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Enhancing Cognition of Students with Visual Impairments via Human Computer Interface Blueprint for SDG 4

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Abstract

The urgent need for sustainable development led to the adoption of the 17 sustainable development goals (SDGs) by United Nations Member States in 2015, aiming to achieve them by 2030. However, ensuring quality education, especially for vulnerable groups like persons with disabilities, remains challenging. Goal 4, focused on inclusive and equitable education for all, lacks attention. The current paper explores the use of computer assistive technology (CAT) to enhance the cognition of visually impaired students (SWVI) in vocational training colleges, providing a blueprint for sustainable developing countries by emphasising inclusive higher education (HE), access, and inclusivity challenges. While the findings highlight the importance of meeting the needs of marginalised groups for a more equitable and sustainable future, the recommendations include prioritising inclusive education policies, investing in training, support services, and ensuring equal access to quality higher education for visually impaired students to foster sustainable development and achieve SDG 4.

Keywords: *Cognition, Human Computer Interface, SDG 4, inclusivity, quality education, persons with disabilities*

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1. Introduction

Over the past decade, South Africa has undergone a significant change in relation to the expansion of access to higher education. As a consequence, more educationally underprivileged rural settlers are now pursuing STEM degrees. However, these learners come from diverse backgrounds and possess varying levels of socio-cultural, educational, and academic preparation [40]. The cognitive and understanding skills that these learners possess upon admission to universities and higher institutions ultimately have an impact on their learning outcomes. For example, their prior numerical cognition of STEM subjects, such as mathematics, serves as a crucial foundation upon which new knowledge is built. Thus, this study aims to address SDG 4 by investigating learners' prior numerical cognition as a predictor of educational performance.

Despite the continuous evolution of higher education, there have been several reasons why the use of Job Access with Speech (JAWS) for students with visual impairments (SWVI) in

Technical and Vocational Education and Training (TVET) colleges has become a concern and requires further analysis from various local and international sources and perspectives, particularly with regards to SDG 4 [13, 17, 33, 34, 52, 53]. One general observation from SDG 4 is that inequalities in educational access [53] and inadequate implementation of inclusive teaching approaches [17] are the main drivers for the emergence of assistive computer application systems (CAS) such as JAWS. The assessments of Engelbrecht [17] and Zongozzi et al. [53] have the potential to enhance educators' instructional delivery and SWVIs' educational experiences due to its audio system, which uses text-to-speech screen content reading. Consequently, the availability of JAWS has motivated the mainstreaming of SWVI, even in rural-based TVET colleges [21]. It has brought hope and comfort to those who have been and are still disadvantaged in educational access. The inclusion of SWVI has also been recognised nationally and internationally (see, e.g. [13, 18, 19, 21, 22] and South African TVET colleges are no exception. However, several concerns remain rife for research. For instance, TVET colleges in South Africa are still finding their footing with the inclusion of SWVI education in their classrooms [17]. Furthermore, the inclusion of SWVI in the classroom requires the integration of assistive computer application systems such as JAWS, which may interrupt TVET educators' traditional methods of instruction.

Nonetheless, as much as JAWS empowers students' interaction with computing applications through computer skills acquisition, Computer Practice (CP), for instance, has not been given the attention it deserves. Although, for instance, CP is an essential subject in the TVET curriculum for both National Technical Education Diploma (NATED) and National Certificate and Vocational (NCV) courses, as it arms students with fundamental computing concepts and applications (Department of Higher Education and Training, 2021), lines are still blurry about JAWS skills acquisition and CP literacy in the TVET curriculum. In other words, it is unknown how and when SWVI receives training on using JAWS after enrolling in TVET colleges. More concerning is the question of TVET educators' proficiencies in being able to transfer JAWS skills to their students. This concern emanates from Delubom et al. [11], who revealed that in South Africa, TVET educators lack the knowledge and skills to teach SWVI confidently. As with international concerns, for instance, research on TVET educators' professional development in South Africa remains in the grey literature [17]. For instance, Seale et al. [45] presented alarming evidence of college educators' limited understanding and skills to use ACAS, even in countries like the US, the UK, Germany, Israel, and Canada. Alarmingly too, the study of educators' practices on the inclusion of learners with visual impairment in computing education programmes in Brazil discovered that out of 56 computing educators, 79% of them never received any training to teach visually impaired learners, such that the 84% of computer educators confessed to not changing their lecturing styles to accommodate SWVI in their computer lessons [26, 27].

We articulate several implications. For example, there is an urgent need for teachers' training to successfully implement the inclusion of students with visual impairments across the South African education sectors. The implication is built upon Engelbrecht's [13] view that regardless of the gradual transformations in training teachers on inclusive practices in South Africa, institutes continue to be a significant contributing factor toward inclusive education implementation. As such, lamentations of van Wyk and Hodgkinson-Williams [52], Govender and Dhurumraj [17] about shortages of teachers' professional qualifications among TVET educators arguably exacerbate the need for inclusive TVET teachers to acquire proficiencies in specialised computer applications for students with visual impairments. Van Wyk and Hodgkinson-Williams [52] lament because the assumption is that generally, teachers should dismiss barriers to inclusive approaches in their teaching yet find themselves overwhelmed with the ever-developing trends of educational computer applications [50]. Based on such conjecture, the current study proposes that educators' technological fluency and confidence impact students' JAWS skills. It is for this reason that the reflections of Engelbrecht [13] and Hooijer et al. [20] on the journey of inclusive education in South Africa encourage the South African education system to provide continued adequate human and technical support to support educators' inclusive practices, thus the need for the current research.

2. Methodology for Literature Review

It is essential to evaluate the TVET inclusive education system's capacity to use accommodative ACAS to cater to the educational needs of SWVI. To achieve this goal, the current research employs an integrated systematic review of the literature on the use of JAWS as an ACAS in the education of SWVI in TVET colleges. The study begins by examining the role of JAWS in SWVIs' computer practice literacy, drawing from various sources such as Alabi and Mutula [1], Carter and Pritchard [8], Lund and Cmar [26], McDonnall [32], and Pritchard et al. [42]. It positions JAWS usage in TVET education as an asset-based approach to SWVI's educational access and educators' innovative pedagogy.

The next task draws from other perspectives, including Amoor and Magaji [2], Papuda-Dolińska [41], Fichten et al. [14], He [18], Kizilaslan [21], Muzata [37], Papuda-Spinczyk et al. [41], and Singleton and Neuber [48] to assess the impact of JAWS usage on the learning processes of SWVI. The study also references Baker et al. [4], Kretzmann and McKnight [24], Makhasane and Khanare [30], Mourad and Ways [33], Myende and Chikoko [39], Myende and Hlalele [38], Ramatea and Khanare [43], and van Wyk and Hodgkinson-Williams [52] to analyse the alignment and transformation of TVET's inclusive education and digital training reforms.

Based on the themes in Table 1 and guided by the research objectives, the following section discusses three critical factors: the role of JAWS in SWVIs' computer practice literacy, the impact of JAWS on SWVIs' learning processes, and the alignment of the TVET sector with inclusive education and digital training reforms.

Table 1: Methodology of Literature Review (Authors' Table)

Themes	Sources	Research Objectives
The role of JAWS in SWVIs' computer practice literacy	1, 8, 26, 32, 42	Understanding the role of JAWS in SWVIs' computer practice literacy
Impact of JAWS on SWVIs' learning processes	2, 15, 18, 23, 37, 41, 49, 48	To examine the need to understand the impact of JAWS usage in the learning processes of SWVI
Aligning the TVET sector with inclusive education and digital training reforms	4, 24, 30, 33, 39, 38, 43, 52	To analyse the alignment and transformation of TVETs inclusive education and digital training reforms

3. Literature Review

3.1 Bridging the Gap: Enhancing Cognition and Sustainable Development through Inclusive Higher Education in Africa

The need for sustainable development in Africa arises from the pressing challenges faced by the continent, including poverty, inequality, quality education, environmental degradation, and social instability [29]. Sustainable development refers to a holistic approach that balances economic growth, social progress, and environmental protection, ensuring the well-being of current and future generations.

In the context of the current chapter, quality higher education plays a crucial role in achieving sustainable development in Africa. It equips individuals with the knowledge, skills, and critical thinking abilities necessary to address complex challenges and contribute to sustainable development efforts [5]. However, there are several issues and problems that need to be addressed to ensure quality higher education and promote sustainable development in the context of enhancing cognition of students with visual impairments via a human-computer interface [29].

One key issue is limited access and inclusivity for students with visual impairments. Many students with visual impairments face barriers to accessing higher education due to a lack of appropriate infrastructure, support services, and inclusive teaching methodologies. The current education system in Africa often lacks adequate provisions and resources to cater to the needs of visually impaired students. This results in exclusion, unequal opportunities, and limited educational outcomes for these individuals. To address these challenges, a comprehensive blueprint for SDG 4 (quality education) in Africa is required. This blueprint should focus on the following aspects:

1. Inclusive infrastructure and technology: Enhancing physical infrastructure and providing assistive technologies like human-computer interfaces can facilitate access to quality education for visually impaired students. Accessible campuses, classrooms, and digital learning platforms should be developed.
2. Specialised teacher training: Providing specialised training programs for teachers to equip them with knowledge and skills in inclusive education and assistive technologies. This will enable them to create an inclusive learning environment and deliver effective instruction to visually impaired students.
3. Curriculum adaptation: Developing accessible and adaptable curriculum materials that incorporate universal design principles. This will ensure that visually impaired students can actively participate in various academic disciplines and have equal opportunities for learning.
4. Support services: Establishing comprehensive support services, such as disability offices and counseling services, to address the unique needs of visually impaired students. This includes providing academic support, assistive devices, and accommodations to facilitate their learning process.
5. Collaboration and partnerships: Promoting collaboration among educational institutions, government agencies, non-governmental organisations, and other stakeholders to create a network of support for visually impaired students. This collaboration can help in sharing resources, and best practices, and advocating for policy changes to ensure inclusivity and quality education.

By implementing this blueprint, African countries can enhance the cognition of students with visual impairments via human-computer interfaces and promote sustainable development. It will contribute to the achievement of SDG 4 (quality education) while fostering inclusivity, equity, and empowerment for visually impaired individuals, ultimately leading to a more sustainable and inclusive society [29, 44].

3.2 Understanding the Role of JAWS in SWVIs' Learning Processes – Means to address SDG 4

There are arguably several reasons to consider the role of JAWS in SWVI's learning processes. For instance, McDonnall [32] and Lund and Cmar [26] suggest that the use of JAWS alongside TVET's vocational skills is critical in transforming and upskilling SWVI to align with the 21st-century labour market. McDonnall's [32] assertion is that the current workforce demands technological skills, and education departments, especially government institutions, must produce students with such skills, including SWVI, who equally contribute to the economy.

However, a significant concern noted by Sefotho (2018) that currently threatens the economic participation of people with visual impairments is persistent inequalities in educational access and noticeable unemployment. Therefore, there is an urgent need to equip current and future youth, including people with visual impairments, with vocational skills and digital literacy to increase opportunities for innovation, creativity, and employment [51]. The question is how the TVET education system can be aligned to meet this challenge.

The current study calls for action in the mainstream TVET curriculum to respond to the current technological demands in response to the question. The authors believe that the current prescribed TVET Business NATED and NCV curriculum, which considers computer practice literacy as the gateway to advanced technology comprehension and application skills, is indeed a move in the right direction. However, the consideration of SWVI's learning processes in partaking in the TVET technology curriculum, particularly computer literacy, is unclear. Moreover, acquiring computer skills for SWVI involves integrating JAWS as an assistive tool mainly used by people with visual impairments [1]. Thus, understanding the role of JAWS in SWVI's learning processes has one key implication: understanding JAWS as extended cognition.

3.3 Global context

The Sustainable Development Goals (SDGs) are a crucial aspect of the United Nations (UN) 2030 Agenda and were universally adopted in 2015 by all Member Nations of the UN as a blueprint for action towards people, the planet, and prosperity [5]. However, the significance of SDGs in education policies and implementation has been questioned, and changes to classroom practices have been limited [44]. This study explores the notion of learners' prior numerical cognition as a predictor of educational performance. In this study, learners are regarded as active participants in their learning, with their interests and prior knowledge influencing their education. The revised Bloom's taxonomy was used as a theoretical framework in the mathematical context of the study.

3.4 African context

The primary concern of the SDGs is the promotion of sustainable growth by ensuring well-being, economic and academic progress, and environmental legislation [5]. Among the most significant projected goals of the SDGs is the provision of high-quality education to learners. Despite sufficient evidence of application failure, the SDGs have been accepted in African countries such as Rwanda. Most research [9] has examined the implementation of SDGs at the primary and secondary levels in Rwanda. The findings from the Rwandan study indicate that, for instance, by 2030, most African countries will require over 10 million additional secondary teachers due to the need for the expansion of learners' enrolment [9]. Countries in Africa face further challenges impacting the quality of mathematics teaching in the context of fast growth in learners' enrolment. Therefore, it is essential that this study was conducted in South Africa to encourage and raise awareness for the realization of the SDG4 goals in the mathematics classroom of the African context.

3.5 Specific Lessons for African Countries

There is an urgent need to conduct research on SDG-related goals with a wider scope that focuses on the role of learners in achieving an effective learning process to ensure quality education. Educational institutions in Africa should encourage experts in international education, particularly in mathematics classrooms. The authors of this chapter have provided additional literature that can serve as a reference for achieving one of the SDG goals in schools. The study investigated whether learners' prior mathematical cognition could predict their performance at current educational levels. The findings from this study provide a direction for further research on SDG goals. Future investigations could focus on the challenges of implementing SDG goals in teacher education institutions, proposing several actionable approaches with concrete steps for key players in teacher education development in Africa.

3.6 JAWS as an extended cognition

Several studies have indicated that the integration of ACAS such as JAWS and other related technologies in the learning processes of SWVI goes beyond the mere use of an assistive device or application, and involves a form of biological, cognitive relationship between the student and the assistive device or application [9]. For example, cognition researchers such as Pritchard et al. [42] carried out a pilot study on integrating assistive technology in the education of SWVI in the United Kingdom. The study engaged with specialists in assistive technology for SWVI, a qualified educator of SWVI, and a mobility and habitation specialist based on their long-term expertise and experience in working with SWVI. The results of the in-depth semi-structured focus group discussions revealed that an assistive device becomes an extended cognition of a student. This implies that any cognitive success presented by a SWVI due to the integration of an assistive device or application in their learning process demonstrates their cognitive urgency. Thus, Pritchard et al. [42] concluded that visual impairments should not be equated with cognitive or intellectual impairments of SWVI.

The implication is that there is a need for technological fluency in using such assistive applications or devices by SWVI. However, there are several practical challenges. For SWVI to be fluent in their extended cognitive process, that is, the integration of JAWS and other related ACAS and devices in their learning, their educators must boost their confidence in such skills transfer. This requires understanding the impact of JAWS on computer practice literacy.

3.7 Understanding the Impact of JAWS on Computer Practice Literacy

As Muzata [36] proposed a Computer Practice Course solely for SWSV in higher institutions of learning in Zambia, Manis et al. [31 recommended a computer course focused on the use of assistive computer applications as a compulsory module in the development of a postgraduate qualification in visual impairment studies in South Africa. Similarly, Seale et al. [45] reported that in technical schools and colleges for SWVI in the US, the UK, Germany, Israel, and Canada, the main challenge with the successful inclusion of SWVI is the lack of computer skills among both SWVI and their educators. This problem is also prevalent in TVET colleges in South Africa educators in integrating computer applications in STEM subjects. Some have identified a severe lack of technological knowledge among educators, resulting in a lack of technologically supported teaching approaches for accommodating SWVI [45].

In response to this issue, this research argues that the TVET education system should address the current lack of JAWS skills among TVET Computer Practice educators. By doing so, TVET computer practice educators can incorporate JAWS as an innovative pedagogical and technological teaching approach in transferring both JAWS skills and Computer Practice skills to their students, improving computer practice instruction for SWVI and emphasising the need for computer practice as a lifelong learning tool [49, 50].

3.8 Computer practice as a lifelong learning tool

Many reasons account for the need for computer practice as a lifelong learning tool. For example, Muzata [37] noted that computer practice is now the primary tool in higher learning institutions, given the recent accelerated integration of educational technologies due to the COVID-19 outbreak. Additionally, besides its educational benefits, being skilled in computer software operations brings convenience and efficiency to people's daily lives. It is therefore crucial to provide computer skills to SWVI through the subject of computer practice to enhance their learning experiences, support the relevance of current educational technology, and stimulate their independence.

However, teaching computer practice to SWVI can be challenging due to the nature of their learning. Computer practice teaching is application-oriented and requires adequate time for real-time hands-on practice. Educators tend to resort to a traditional one-way communication approach due to time constraints, which leads to students being passive receivers. This approach can be disadvantageous, especially as teaching SWVI takes longer. The problem is exacerbated if educators lack a basic understanding of the SWVI cognition process, have no technology pedagogical skills for accommodating SWVI, and cannot operate an assistive tool presented for teaching and learning SWVI.

Thus, being skilled in the operations of assistive applications such as JAWS and understanding the role of such applications as educators' instructional tools and SWVIs' extended cognition can be beneficial. Such understanding is essential for the efficient and appropriate application of JAWS, enabling and enhancing computer practice educators' teaching and SWVI's learning experiences to avoid cognitive overload.

3.9 JAWS and cognition overload

As JAWS enables interaction between the user and computer, it can be considered a powerful tool for SWVI, whose learning relies on sound and touch cues [3]. However, lack of operational skills and understanding of students' learning process in JAWS usage can lead to inefficient utilisation. Inefficiencies in JAWS usage may result in SWVI experiencing cognitive overload, impeding cognitive processes [25 28]. However, visual and auditory perception, attention, and retaining information form part of the learning processes of sighted students. SWVI heavily relies on compensating their visual indicators with more auditory modalities to access and process information during their learning processes [3]. Auditory perception replaces the missing visual perception [16].

JAWS's auditory feedback responds to the user's inputs as they interact with their computers, but it can have irritating effects on the user's ear, contributing immensely to cognitive load [47]. In the context of computer practice literacy, using screen readers requires simultaneous listening to the auditory feedback and the educator while recalling a series of unseen keyboard commands in navigating their learning content. SWVI may also have to pay attention to their human support systems, commonly called scribes or readers [10]. These processes can be tedious, cognitively tiring to students, and frustrating to educators. McLaughlin and Kamei-Hannan [32] cautioned professionals to be cognizant of the extra cognitive energy and effort SWVI exert to pay attention to their instructors and assistants while decoding instructions during auditory reading and responding to auditory feedback.

One may wonder how the earlier mentioned implications of SWVI's extended cognition and technological fluency are related to the impact of JAWS on their learning processes. The idea is that when educators have a good understanding of SWVI's learning processes and the role of JAWS in their education, the two become interdependent and form an asset that educators can use as a basis for more formal training on inclusive practices. On the other hand, if educators lack knowledge of these concepts, especially in computer instruction, they miss the opportunity to apply practical computer application professional practice, leaving students to rely on their own coping strategies in computer application literacy. As a result, there is a need to align the TVET sector with inclusive education and digital training reforms.

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4. Discussion

The current study investigated the use of JAWS for teaching and learning computer practice in TVET colleges. Based on an examination of the role of JAWS in SWVIs' computer practice literacy, the impact of JAWS on SWVIs' learning processes, and the alignment of the TVET sector with inclusive education and digital training reforms, several discussions and lessons were learned.

For example, drawing from Myende and Hlalele's [38] and Myende and Chikoko's [39] work, as well as Mourad and Ways' (1998) research, it is suggested that the TVET sector has the resources to address their technological skills shortages if they can learn to mobilise and connect to these resources. According to Myende and Chikoko [39] and Mourad and Ways [33], these resources are found within primary, secondary, and outside tiers (see Fig. 1). The authors suggest that each tier has specific responsibilities that the TVET sector can utilise to improve the inclusion of SWVIs in computer practice literacy.

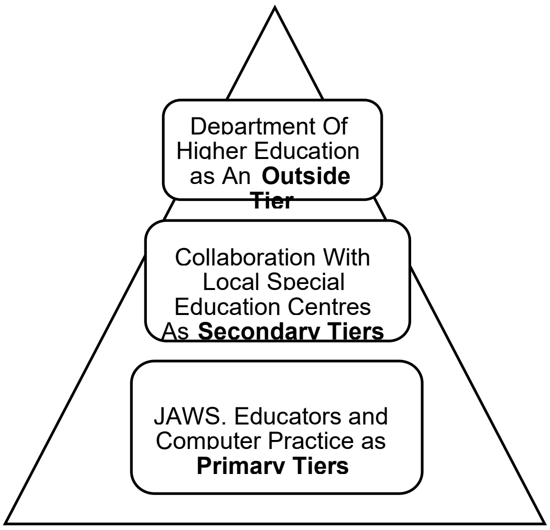

Figure 1: TVET Colleges' Assets Mapping for JAWS Usage in Computer Practice Literacy (Primary, Secondary, and Outside Tiers in TVET Colleges) [39]

Based on Mourad's and Ways' [33] framework for asset building, primary tier assets are the most immediate pool of assets that are easily accessible or available within the TVET college community. For instance, Myende and Chikoko [33], in investigating possibilities for school-university partnerships in South Africa using an ABA, concluded that educators could be considered assets within school settings.

Furthermore, van Wyk and Hodgkinson-Williams [52] identified electronic devices preloaded with JAWS and other related screen-reading software as assets for students. Therefore, the mere provision of the subject of computer practice using the institution's computer labs is also an asset approach, as stated by the Department of Higher Education. JAWS, educators, and the subject of computer practice are primary assets that are already available within the TVET.

On the other hand, secondary tiers are less immediate, situated in the neighborhoods of TVET colleges, and are not under the administration of the TVET sector. One of the findings from Makhasane and Khanare's [30] research is the importance of forming positive relationships and collaborations with other stakeholders who could contribute to enhancing SWVI educational livelihoods. Based on this finding, mapping and mobilising resource centres through collaborations with the nearest surrounding special schools, education, and societies for the blind could be an asset to the TVET.

The least accessible assets or resources would be the outside tiers, which, according to Kretzmann and McKnight [24], have the potential to develop new possibilities for new capacities that the TVET community could utilise to enhance the already existing assets. In this case, the existence of the Department of Higher Education [12] is undoubtedly an asset to the TVET sector with hope for the development and enhancement of computer educators' already existing assets. However, acknowledging and mobilising the primary assets certainly does not reject and embrace external resources from the secondary and outside tiers, thus adopting an inside-out approach to strengthen the existing assets by aligning the TVET Sector with SDG 4.

Local literature, such as Zulu and Mutereko [54], notes that due to high unemployment and illiteracy rates in developing countries, such as South Africa, the government has identified the TVET sector as a critical asset in closing the twenty-first-century vocational skills gap. To achieve this, TVETs must be transformed and remain relevant to industry needs. Consequently, some TVETs have responded to education and training reforms that drive transformation in societies and industries. However, despite TVETs' efforts to include students with impairments (SWVI) as per the call made by the Department of Higher Education, the colleges are still in the early stages of integrating digital technologies into their learning technologies.

TVETs' continuous effort to include SWVI demands that educators have unique pedagogical and technological capacities to enhance students' vocational and computer skills in preparation for the real world. The computer practice subject offered in TVET colleges is defined as "the study of the integrated components of a computer system (hardware and software), practical techniques for efficient use and application to solve everyday problems" [12: 3]. Thus, CP aims to empower students to use computing applications to achieve their digital relevance in the current digital age. Besides educational benefits such as creating software-based artifacts, the CP subject equips SWVI's with lifelong skills necessary for the world of work.

However, developing these skills in SWVI requires educators to have confidence in their operational skills with assistive computer applications, such as JAWS, to transfer them to their students. Therefore, TVET computer practice educators must be adequately equipped with JAWS skills and understand their application to computer practice literacy. They should also comprehend how technology acts as an enabler to SWVI's enhanced learning experiences. In this way, educators can build and enhance students' capacities in vocational and computer skills, preparing them for the real world.

According to Ramatea and Khanare [43], one recommended approach to enhancing the educational livelihoods of SWVI is to recognise their full potential in achieving academic goals by applying positive psychology. To demonstrate the relevance of positive psychology approaches in supporting educators' usage of JAWS as an assistive computer application to enable computer practice literacy among SWVI, we locate our arguments within an Asset-Based Approach (ABA). As described by Kretzmann and McKnight [24], an ABA operates under the premise that all communities have human and non-human resources to address their challenges. Therefore, Ramatea and Khanare [43] conducted an asset-based approach study that investigated the use of resources in improving the well-being of SWVI in Lesotho, discovering constraints such as a shortage of qualified teachers and inadequate teaching resources, while also strongly recommending the importance of adequately managing existing assets.

The ABA focuses on identifying, mobilising, and managing assets such as skills, resources, and human capital in and around learning institutions in resolving challenges. Given the challenges experienced in the TVET sector, as the study mentioned earlier, the ABA challenges the needs-based mentality that views the TVET sector as incapable of resolving its shortcomings. This approach also dismisses the notion of scribes-acceptance, which undermines the capabilities and strengths of SWVI, perceiving them as incapable of independently navigating their learning and resolving their computer navigation challenges. Instead, educators should develop students' JAWS and computer application capacities to enhance their independence in their computer literacy journey.

Therefore, it is imminent to apply the ABA in viewing the urgent need for TVET educators' capacity development on accommodative computer application inclusive practices. Arguably, seeking external support or embracing external support may not be a weakness or needs-based but instead be viewed as the TVETs' strength to identify and recognise their limited potentials, thus seeking support to close identified gaps. The argument is based on the notion that the ABA is a glass-half-full approach that may require external partners to fill up the rest of the glass in terms of available assets for teaching and learning computer practice through JAWS in TVET Colleges [6. 7].

5. Implications and Conclusions

Drawing from the discussions based on the research objectives, several implications emerge. Firstly, it is essential to address the issue of attracting SWVI to mainstream TVET colleges to acquire vocational skills and the new technological and inclusive pedagogical skills required for successful and efficient integration of JAWS in computer practice literacy. Secondly, TVET computer practice educators can only acquire these skills through capacity development. Thirdly, this study revealed that TVET educators lack the necessary skills to teach SWVI. The first conclusion is that providing TVET college educators with these skills can be viewed as an asset-based approach to enhance their existing teaching strategies and students' learning experiences. As a second conclusion and in response to the first objective, TVET educators must have a basic understanding of the learning processes of SWVI to better incorporate JAWS as an asset, which is an extension of SWVIs' cognitive processes. In response to the second objective, the conclusion is that providing assistive applications or devices to SWVI without fully understanding their impacts might disadvantage SWVI due to inefficiencies in usage, leading to cognitive destruction and forfeiting the benefits of the system's usage.

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