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An Investigation of Learning Difficulties for Visually Impaired Students: Ethiopian Public Universities in Focus

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Abstract

This study was aimed at investigating the learning difficulties of visually impaired students (VISs). The target population of this study was obtained from three Ethiopian universities using stratified random sampling, snowball sampling, and purposively selected instructors, VISs, and visual students enrolled in the 2019, 2020, 2021, and 22 academic years. A sample size of 270 (90 VISs, 90 visual students, and 90 instructors) was involved in the study. There were also 57 FGD participants involved in the study. Questionnaires and FGD were used to gather the data. The quantitative and qualitative data were analyzed using descriptive statistics with the help of SPSS version 27 and thematic analysis. The findings revealed that VISs receive financial remuneration, meals, accommodations, health services, and computer lab services from their universities. However, VISs confirmed that the challenges related to learning resources inadequacy, inability to write using Braille, time constraints during examinations, less accessibility of service provision, instructors' lack of training to handle VISs, barriers to the course of learning and the acquisition of education, and inability to move in campus due to lack of safe routes to dormitory, library and laboratory, and contact friends for different social affairs. These were due to carelessly erected poles, uncovered ditches, and heaps of stone left over during the previous constructions; these became the main obstacles not only to studying with their counterparts but also to participating in social events outside the classrooms. Based on these findings, some recommendations were directed to educationalists, higher education institutions, policymakers, and future researchers.

Keywords: /Inclusive education/Public Universities/Students with visual challenges/Visual impairment/

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1. Introduction

Education is the key to opportunity, and it is for everyone, including students with disabilities. Education is also one of the vital factors in broadening their employment prospects and promoting their social adaptation skills to improve their quality of life (Fletcher, 2010; UNESCO, 2012; Lövi, 2014). Hence, no matter what type of disability a student may face, as we experience UNESCO's motto, all students deserve the right to a full education. Similar to the sighted students, the VISs have the opportunity to broaden their future career paths.

Visual impairment, in the above sense, is one of the disabilities that affect many people, especially, students at different academic levels (Buarattana & Pragasit, 2021). In this regard, different civic societies played significant roles in educating visually challenged students.

Religious sectors also have made Paramount contributions to educating the blind for spiritual services in the world. The industry of inclusion of visually impaired students in the academic sector was highly played by Christian and Muslim religions. Especially, the history of the education of the blind in Ethiopia has been profoundly anchored into the past Christianity (Sergew, Haile, and Tadesse, 1970; Zelalem, 2014). They aimed to prepare the children for the service of the church. Since the mode of instruction/ presentation was oral, it helped the blind children a lot. Students with visual impairment do not only attend residential schools but also regular schools together with their sighted peers in the elementary, secondary, and tertiary levels. However, it is not fully supported with specially trained itinerant teachers and adapted materials and facilities (Ababayehu, 2002).

On this issue, there is an increasing number of VISs in public Ethiopian universities. These students attend conventional lectures and are examined on the same subject content as their visual peers. The inclusion of VISs in mainstream education is also beneficial not only to them but also to all sighted students in schools; because it enhances social integration so that both parties can motivate each other (Wandera, 2017; Sandra, 2018).

As research findings entail, in modern education, the inclusion of VISs with visual students in regular classrooms has a great advantage in the academic environment. It assists in making changes. Blind and low-vision students interact with other students in regular school settings, playing and sharing things and ideas. Moreover, inclusion will promote healthy competition among VISs and visual students. When blind or low-vision students perform well in class, this will influence the sighted students to strive to work harder, for they will think that the blind or low-vision students can do well (Schwartz, 2008; Musasizi, 2009; Boorse, 2011).

On the other hand, many studies have discussed the difficulties that the handicapped face in the educational environment. Hull (2005), for example, conducted a study aimed at recognizing the extent to which students perceive the process of inclusion of VISs in the university. The results indicated that there were many problems that VISs faced, especially in the area of transport and developing social relationships with their peers.

According to estimates by the WHO, 10% of the world's population is made up of people with physical disabilities. However, this number is contentious, because it surpasses more than this. For example, other research findings entail that an estimated 1.3 billion people, or 16% of the global population, experience a significant disability today. This number is even growing because of an increase in noncommunicable diseases and people living longer (Amini *et al.*, 2007; Boorse, 2011; Agesa, 2014; Leong & Ahmadi, 2017).

On this issue, currently, there is an increasing number of VISs in public Ethiopian universities. These students attend conventional lectures and are examined on the same subject content as their visual peers. The inclusion of VISs in mainstream education is also beneficial not only to them but also to all sighted students in schools to enhance social integration so that both parties can ignite each other (Gezahegne & Yalew, 2011).

Similarly, evidence indicates sizable numbers of people with physical disabilities are found in Ethiopia. According to the 2007 census, out of 73.7 million people, 805,492 people with physical disabilities are found in Ethiopia (CSA, 2007). Notwithstanding this, many agree that the number of people with physical disabilities in the country constitutes 10 % of the total population, while still, others suggest their number goes beyond 10 % given the country's long-lasting civil war and poverty (Institution of the Ombudsman, 2010).

Even though inclusive education means the enclosure of all students regardless of their physical, intellectual, social, emotional, linguistic, or other conditions, the mainstream classrooms, school curriculum, teaching methods, organization, and resources need to be adapted to ensure that all learners, irrespective of their ability, can successfully participate in the classrooms (UNESCO, 1994; Hull, 2005; Fletcher, 2010; Lövi, 2014). In this study, inclusive education referred only to the inclusion of VISs in academic higher institutions.

Some teachers, on the other hand, have questions about whether VISs can cope with the required academic challenges or question their doubts about their abilities and how effectively they can teach students with disabilities (Hogde & Keller, 1999; McKenzie & Schweitzer, 2001). These negative attitudes acted as barriers to students' study choices now and then. Regarding undermining attitudes in the Ethiopian context, Tirussew (2005, *p.* 3) indicated that in Ethiopia, persons with disabilities are perceived as "weak", "hopeless", "dependent" "unable to learn" and "subjects of charity", however, the ideas are contentious.

At the national level, the Ethiopian Government has also ratified several conventions to ensure the education of all VISs. The key policies include Education Policy 487/94, 388/87, and Persons with Disability Welfare Act 8531/90. The Education Policy articulated that to establish equity in education for all learners, facilities need to be provided for all learners including VISs (MOE, 2010).

This policy emphasizes quality education with equal opportunity for all Students, regardless of sex, age, nationalities, and the like. The policy further accentuates providing training for instructors to teach learners with different types of disabilities in different academic programs. However, as the research findings show, the Ministry of Education in Ethiopia has made little progress in providing education to students with disabilities despite having such policy initiatives (Etenesh, 2000; Abebe, 2001; Alemayehu, 2003; Gezahegne & Yalew, 2011).

One factor that might cause very few research findings in the area of VISs is the lack of special attention from the concerned bodies to evaluate the status of the inclusion of VISs by investigating teacher attitudes. For example, certain problematic aspects that inhibit inclusion could be identified (*e.g.*, lack of teaching skills, need for funds, materials, support services, negative teacher or student attitudes, *etc.*), and interventions (teacher training programs, visual student awareness of VISs, *etc.*) could be developed (Bavelier, & Neville, 2002; Avaramidis & Norwich, 2010; Human, 2010; Mwakyeja, 2013).

VISs are unable to access higher education, as expected, due to various barriers they encounter within and outside the institutions of higher learning. The traditional barriers, especially to the inaccessibility of higher education for those VISs might arise from a variety of circumstances, particularly from two false premises: the first is that their demands are assumed to be 'luxurious to cover', and the second is that persons with disabilities are underrated because they cannot perform the required 'minimum qualification criteria for higher education. Some also argue that university faculties are not free from traditional stereotypes of inabilities regarding students with disabilities (Bishop, 1996; Norwich & Tony, 2002; Willet, 2002; Adams, 2010; Knouwds, 2010; Sahasrabudhe, & Palvia, 2013; Aryanti, 2014; Mathews, 2019).

Moreover, very few contributions to the literature have been made that illustrate the challenges encountered by VISs. Methods utilized by VISs to acquire information in a classroom environment differ significantly from methods used by students who are fully sighted (Cohen, Sahasrabudhe, & Palvia, 2013).

Besides, the cause of disability is wrongly perceived, according to Tirussew, (2004), as (a) a curse; (b) a consequence of sin or wrongdoing or evil deeds by parents, ancestors, and persons with disabilities themselves, or a supernatural presence. These false impressions of causal attribution added to the misunderstandings of the capabilities of persons with visual disabilities have contributed to the low social and economic status of individuals with eyesight disabilities.

A multitude of research works have been done on language learning in different settings so far, but relatively few research works have been conducted about VISs in Ethiopian higher academic institutions. For example, Zelalem (2014) conducted research on School Challenges of Students with Visual Disabilities in the primary schools of Weldeya town in Ethiopia. The findings show that the challenges VISs encountered were, environmental inaccessibility, inflexibility of financial guidelines in schools, and lack of training among teachers for their academic success. Kahsay (2022) also conducted a study on the academic barriers that prevent the inclusion of learners with visual impairment in mainstream schools. The findings reveal a lack of books in braille, a shortage of computers with “Job Access with Speech” (JAWS) software, few audio-recorded materials, and minimal curriculum adaptation to suit learners with visual impairments.

On the other hand, Cowan, & Oliver, (2016) conducted his study on the Right to Education of Children with Visual Impairment (CWVI). The thesis accordingly found out that the level of access to a school of CWVI in Addis Ababa is very low due to lack of awareness, inadequate expert supply and training, low economic status, and low level of government attention towards the realization of the right to education of the said group. Gezahegne and Yalew (2011) also carried out their study on the Inclusion of the Visually Impaired in the Educational, Social, and Economic Systems in the Oromyia region, focusing on the employment/labor market of visually impaired graduates. The finding disclosed that lack of awareness and wrong attitudes are identified as the root causes of the problems related to accessibility in terms of physical environment and orientation and mobility services as well as less attention of the system towards the visually impaired scholars.

Thus, this study was intended to fill the gaps that the earlier studies could not identify to measure the challenges visually impaired students encounter in current Ethiopian universities. In other expressions, the overall intention of this study was to identify the challenges VISs experience and the provisions made to support their studies at Ethiopian public universities. The findings of the study would also be used to initiate dialogue and networking among universities, as well as serve as input in the preparation of the Basic Manual for the Service of VISs in higher education institutions in the country. In addition, the results of this study can help educators address the challenges and narratives identified to better serve VISs. The study and its results might also suggest better ways of supporting special needs students, for example, through training and equipping instructors with strategies, techniques, and approaches that address mainstreaming or inclusive education.

Thus, the general objective of this study was to explore the challenges of VISs encountered in some selected Ethiopian public higher academic institutions. The research questions of this study are:

- What are the challenges VISs face in their public universities?
- What are the attitudes of VISs toward their universities, faculties, and service provisions?
- What are some special treatments the universities provide for VISs to alleviate the challenges they face?
- What sorts of approaches are employed to improve the academic challenges of VISs in the Universities?

2. Methods

2.1 Setting

Three universities were purposefully selected from the first-generation universities of the country, where the researchers can easily get VISs. Accordingly, Wolaita Soddo, Hawassa, and Addis Ababa universities were selected for their proximity and accessibility compared with other first-generation universities.

2.2 Research Design

The study employed a descriptive survey research design involving quantitative and qualitative data. The design was employed to survey and describe the general trends of universities in participating and serving VISs and to quantify the availability of services in the participant universities.

2.3 Participants of the Study

The target population of this study was obtained from purposively selected universities where we could access VISs and their proximity. Respondents were obtained through a stratified random sampling method to get the target population. The regular program students who were enrolled in 2019, 2020, 2021, and 22 academic years at three universities were participants in this study. The three public universities' sample consisted of 270 members, especially, instructors, VISs, and VSs were participants in this study. In other expressions, the sampling scheme that the researchers used to recruit was also proportional quota sampling. Hence, 270 participants from three universities were assemblage (Nyman, *et al.*, 2010; Wald, *et al.*, 2014; Brookfield, & Preskill, 2012).

2.4 Sample size

There were three target groups in the study; namely VSs, VISs, and instructors in the sample universities. The sampling comprised 90 instructors, 90 VISs, and 90 VSs, WSU, HwU, and AAU respectively. Put it another way, 30 VISs, 30 VSs, and 30 instructors were selected from each university (Table 1). Two hundred seventy (270) participants were proportionally selected from each selected department of the colleges of Social Science & Humanities and College of Education.

Table 1

<i>Sample Size</i>									
Participants	Universities						Total		Total No.
	WSU		HwU		AAU		M	F	
	Sex		Sex		Sex				
	M	F	M	F	M	F	M	F	
VISs	13	17	16	14	15	15	44	46	90
VSs	14	16	17	13	20	10	51	39	90
Instructors	25	5	16	14	18	12	59	31	90
Total	52	38	49	41	53	37	154	116	270

2.5 Samples and Sampling Techniques

The participants were snowball sampled VISs, purposively selected instructors, and stratified randomly sampled visual students enrolled in 2019, 2020, 2021, and 22 academic years. The sample size of students and instructors was determined depending on the population proportion of the college, department, or batch at each selected university. The stratifying variables were college, department, and batch (1st, 2nd, 3rd, and 4th years). In Ethiopian universities, as experiences show, VISs are assigned in education and social science colleges. Thus, the selection of the above sample size was guided by (Cottrell & McKenzie, 2011; Brandt, 2011; Özer, 2018).

2.6 Research Instruments

Questionnaire. A questionnaire contained closed and open-ended, twenty-one questions (ten and eleven) were developed for VISs VSs, and instructors, respectively. The VISs' questionnaires were read by their peer visual students, who gave responses to the questionnaires. The questionnaires which were adapted slightly solicit information from VSs and VISs about their demographic data, attitudes, educational challenges during their university studies, and service provisions and modifications at their respective universities. For the measurement of their attitudes, five-point Likert scales were used, ranging from Strongly Disagree (SD) to strongly agree (SA), containing the weights 1–5.

Table 2

Focus Group Discussions (FGD)

Participants	Universities						Total	Total No.	
	WSU		HwU		AAU				
	Sex		Sex		Sex				
	M	F	M	F	M	F	M	F	
Instructors	4	1	3	2	4	1	11	4	15
VISs	3	4	5	2	4	3	12	9	21
VSs	5	2	6	1	5	2	16	5	21
Total	12	7	1	5	1	6	39	18	57
			4		3				

Focus group discussions. FGDs were held among purposefully selected instructors and VSs and VISs on accommodations and other logistics rendered at their universities. The FGD was used to collect data from 7 VISs from each university, 7 VSs from each university, and 5 instructors from each university 57 FGD members participated in 9 discussion groups.

The discussion points focused on the challenges they experienced during their stay at their universities and the measures being taken by their respective universities. Besides, instructors and VSs also gave their opinions. This was happened deliberately to encourage the participants to speak freely. Subsequently, during the FGD, field notes were taken by two assistants of the researchers to ensure triangulation as researchers noted (Ndurumo, 1993; Cavanaugh, 2002; Creswell, 2003).

2.7 Validity and Reliability of Research Instruments

The reliability of the questionnaire was computed using SPSS, 27 to determine Cronbach's reliability coefficient. So, it was found to be reliable, with an alpha for perception of 0.79 for 21 items. To establish the validity of the questionnaire, utmost care was taken in adapting appropriate items. It was also given a high emphasis on readability, consistency of style, and clarity of language for the face and content validity of the questionnaire. Further, the aim of the study was explained clearly to the participants before questionnaire administration.

2.8 Procedures for Data Collection

A supporting letter was obtained from the researchers' department to have access to data collection. Then, the researchers and their delegates collected the necessary data from each selected university at nearly the same time of the semester according to the research plan.

At each sample university, deans of the selected colleges were communicated to the selected department heads so that they could coordinate the distribution, administration, and collection of student and instructor questionnaires after completion. Researchers monitored this process and conducted FGD with instructors as well as students, VISs, and Sighted students.

During the FGD, the groups were divided into two parts, the VISs and VSs made an FGD on the first day, and the instructors' group made their FGD on the second day in each university. The participants shared insights and experiences about the following topics: challenges VISs encountered within themselves, from visual friends, instructors related to pedagogical aspects and assessment, institutional infrastructure, and factors influencing the use of learning materials. In the same token, the FGD of instructors was facilitated by the researchers and conducted in the English language, and the VISs' and Visual students' discussions were conducted in Amharic, the National language. After the qualitative data was transcribed in Amharic and translated into English by the researchers, the precision of the translation was checked by two English instructors, and some amendments were made.

2.9 Coding of the FGD Participants

Wolaita Soddo University was coded as, WSU (VISs1-7), (VSs8-14), and (Inst.15-19). Hawassa University was coded as HwU (VISs20-26), (VSs27-33), and (Inst34-38). Addis Ababa University was also coded as, AAU (VISs39-45), (VSs46-52), and (Inst.53-57).

The FGD discussants, as it has been indicated in Table 2, were 57, and they were apportioned as follows: the VISs, VSs, and Instructors were 7, 7, and 5, respectively in three universities, WSU, HwU, and AAU. The first day FGD discussions were carried out with VISs and VSs in three universities. The discussions were given 1:45 hours in each university for VISs and VSs, and then, the sessions took 9:10 hours for 42 VISs and VSs. The second day morning sessions were given to make the FGD of Instructors in all universities. The time allotted for each discussion was 1:45 hours and a total of 9:10 hours were spent as it has happened in VISs and VSs groups'.

2.10 Analysis of the Questionnaire Data

Descriptive statistics were used to analyze the quantitative data. Frequencies and percentages were also computed to describe the teaching methods using the availability of learning resources.

2.11 Analysis of the FGD Data

The following steps were applied to analyze the results of the FGD: Before the discussion, participants were informed that they were being recorded. Then, FGDs were audio recorded and transcribed using a digital audio recorder; after that, video-recorded data were transcribed and edited. In the fourth step, similar responses to a question were categorized together. After the discussions had been carefully typed, the keywords and phrases were categorized into certain groups. The coding was aimed at two reasons: (1) a central theme and (2) general sentiments (positive, negative, neutral, and suggestion). Selected quotations needed to be put into direct expression; besides, analyses of repeated themes were also summarized. The two-day discussions' transcript data were analyzed through categorization. This allowed the researchers to discover “patterns, themes, and categories” within the data gathered on the experiences of VISs, VSs, and instructors (Cohen, Manion, & Morrison, 2007; Marshall, 2016, p. 222).

2.12 Ethical Clearance

Permission to have access to colleges, departments, and classrooms were obtained from the university authorities based on connecting and supporting letters from the researchers' department. Then, the researchers collected the necessary data from each selected university nearly during the same time of the semester according to the research plan. At each sample university, deans of the selected colleges were communicated to the selected department heads so that they coordinated the distribution, administration, and collection of data from instructors, VISs, and VSs. Researchers monitored these processes and also conducted FGD with the participants. They were also informed about the purpose of the recording so that the discussion could be referred in the time of report writing. For the discussions, the researchers used an FGD protocols, pre designed forms having few open-ended questions and ample space among the questions. The spaces allowed the researcher to record some responses of the participants. To minimize losing eye-contact with the discussants, the researchers memorized the questions carefully (Mugenda, 1999; Hodge, 1999; Hatton, 2014).

3 Result

3.1 Demographic Information

This part presents demographic data collected from 90 lectures, 90 VISs, and 90 visual students. The demographic data were analyzed alongside variables, such as age, gender, and teaching experience, area of specialization, level, and area of study for VISs.

Table 3

Gender and Age of Lecturers

		Age	30-35	36-40	41-45	46-50	51-55	Total
Sex	Female	Frequency	13	10	3	3	1	30
		Percentage	11.7%	9%	2.7%	2.7%	0.9	27%
	Male	Frequency	20	18	15	5	2	60
		Percentage	18%	16.2%	13.5%	4.5%	1.8%	54%
Total			33	28	18	8	3	90
Percentage			29.7%	25.2%	16.2%	7.2%	2.7%	100%

Table 3 shows that 13 (11.7%) of female lecturers were between 30 and 35 years of age, and 10 (9%) of female lecturers were between 36 and 40 years old. Furthermore, 3 (2.7%) female lecturers were between 41 and 45 years old, 3 (2.7%) female lecturers were between 46 and 50 years old, and 1 (0.9%) instructor was between 51–55 years of age. On the other hand, 20 (18%) of male lecturers were between 30 and 35 years old, 18 (16.2%) of them were between 36 and 40 years of age. While 15 (13.5 %) of male lecturers were between 41 and 45 years old, only 5 (4.5%) were between 46 and 50 years of age, and 2 (1.8%) were between 51 and 55.

Table 4*Teaching Experience of Instructors*

Experiences	1-5	6-10	11-15	16-20	20-30	+31	Total
Frequencies N=90	6	15	18	24	22	5	90
Percentage	5.4%	13.5%	16.2%	21.6%	19.8%	4.5%	100%

Table 4 shows the findings on lecturers' teaching experience. Accordingly, 6 (5.4%) of lecturers had 1 to 5 years of working experience, 15 (13.5%) of them had 6–10 years of experience, 24 (21, 6%) of lecturers had 16–20 years, and 22 (19.8%) had 20–30 years of working experience. Furthermore, five (4.5%) lecturers had 31 or more years of work experience. The above results show that the majority of lecturers had teaching experience ranging from 16 to 20 years. This indicated that lecturers teaching at the three universities had long experiences in teaching.

Table 5*Lecturers' Areas of Specialization*

Specialization	Education	English Language	Special Needs	Humanities	Law	Total
Frequency=90	35	16	6	14	19	90
Percentage	31.5%	14.4%	5.4%	12.6%	17.1%	100%

Table 5 shows that 35 (31.5%) of lecturers are specialized in education, 16 (14.4%) in English language, 6 (5.4%) in special needs, 14 (12.6%) in humanities, and 19 (17.1%) in law. The findings show that the majority of instructors have some education training, while a few are trained in special needs. Among the registered specializations, however, there are a very small percentage of lectures that are specialized in special needs education.

3.2 Data for VISs

Table 6

Gender and Age of VISs

Frequency=90	Sex	Age	18-21	22-26	27-30	31-35	Total
	Female	Frequency	11	12	17	6	46
		Percentage	9.9%	10.8%	15.3%	5.4%	41.4%
	Male	Frequency	9	20	10	5	44
		Percentage	8.1%	18%	9%	4.5%	39.6%
Total			18.9%	28.8%	30%	11%	100%
Percentage							

Table 6 shows that 11 (9.9%) of female learners with visual impairment were between 18 and 21 years old; those between 22 and 26 years old were 12 (10.8%); those between 27 and 30 years old were 17 (15.3%), and those between 31 and 35 years old were only 6 (5.4%). This implies that the majority of female and male learners with visual impairments in the sampled three universities were between the ages of 27 to 30. A good number of them have passed the age of being in university, pursuing their first degree.

Table 6 also indicates that 9 (8.1%) of the male students were between 18 and 21 years old, while 22 and 26 years old were 20 (18%). Further, 10 (9%) of male students with visual impairment were between 27 and 30 years old, and only 5 (4.5%) of them were between 31 and 35 years of age.

Table 7

Gender and Age of VSs

Age	Frequency=90	18-21	22-26	27-30	31-35	Total
Female	Frequency	21	8	-	-	29
	percentage	18.9%	7.2%	-	-	26.1%
Male	Frequency	22	20	15	1	61
	percentage	19.8%	18%	13.5%	0.9%	54.9%
Total		27%	25.2%	13.5	0.9%	100%

Table 7 indicates that 21(18.9%) of female students with visual are between 18-21 years old; but those between 22-26 years old are 8(7.2). Those between 18-21 years old are male visual students, 22 (19.8), and those found in the age of 22-26 were 20(18%), besides, 15 (13.5%) of them are between 27 and 30 years of age. Moreover, 1 (0.9%) of male students with visual were between 31 and 35 years old. The data shows that most male and female students are at a young age that they are active enough to help their classmates, male and female visually impaired students.

Table 8*Challenges VISs Encounter in their Public Universities*

Statement	Frequency (N=90)	Percentage Agreed
1 This university does not have adequate facilities for VIS	72	64.8%
2 The college does not have specially trained instructors to handle VIS	85	76.5%
3 VISs have problems moving from place to place.	88	79.2%
4 Instructors usually disregard or ignore the needs of VIS in class.	61	54.9%
5 VISs usually feel lonely and less recognized by others	89	80.1%
6 VISs are always caught up with time while doing the assignment in class.	87	78.3
7 Some VIS students have dropped out of university classes due to difficulties they encountered.	87	78.3
8 I do not have appropriate Braille skills to write & read using the material	12	10.8
9 Poor physical environments do not promote easy mobility for VIS	88	79.2%
10 Getting experts to educate me on modern methods of teaching the VIS is a challenge.	90	81%

Table 8 shows a summary of the responses to various items asked by the investigators and the corresponding frequencies and percentages at which they were scored as "Agree." Accordingly, (Q1) 72 (64.8%) of the respondents agreed that the universities do not have adequate facilities for VIS.

The VISs, like any other students in a regular program, are being taught and experiencing society's modes of living. Therefore, the study aimed to disclose how often the VISs confront problems in their daily walks in the academic domain on campus. As shown in Table 8, (Q.4), 61 (54.9%) of the respondents said that instructors sometimes ignore the needs of visually impaired students in class.

Further, (Q5), 89 (80.1%) of the respondents said that VISs were left behind or less accepted by their counterparts in class. On the other hand, (Q 6), 87 (78.3%) of visual fellows understood that VISs are allotted very short time to work on their tests and examinations and that they need extra time to accomplish class work to write using Braille, which takes time and sitting for examinations. When the respondents were asked to reflect on a (Q7), whether the institute has well-trained instructors to treat visually challenged students, 85 (76.5%) agreed that the institutes do not have specially trained instructors to handle students with visual impairment.

On the other hand, in response to the statement (Q.9) "poor physical environment does not promote easy mobility for VISs in the regular classroom", almost all VISs, 88 (79.2%), agreed that the institutions do not permit VISs to move from place to place. In the same token, in response to the statement (Q10), "Getting experts to educate me on modern methods of teaching the VIS is a challenge", a great deal number of VISs, 90 (81%) agreed that VISs were not taught in a way they had to be taught. This means that VISs' instructors were not trained to teach VISs and they were likely to lack instructional efficiency skills, which is an essential component of their education process. Therefore, the findings in this particular research provide clear evidence of a lack of instructors with special training for VISs.

3.3 Challenges experienced by instructors in the integrated classrooms

Table 9

Challenges Instructors Experienced

Statement of challenges	F N=90	Percent Agreed
1 This institute does not have adequate instructional facilities for VISs	75	67.5%
2 This institute does not have specially trained instructors to handle VISs	68	61.2%
3 VISs have additional problems that influence their performance	88	79.2%
4 Instructors usually neglect the needs of VISs	12	10.8%
5 VISs are always caught up with time and so need more time	80	72%
6 The academic institute does not have adequate funds.	78	70.2%
7 Some VISs have dropped out of attending the classes due to frustration	84	75.6%
8 I do not have the appropriate Braille skills to support VISs	88	79.2%
9 Poor physical environment does not promote VISs	76	68.4%
10 I find it difficult to get parents to discuss vital information about VISs	85	76.5%
11 Getting experts to educate me on modern methods of teaching the VISs is a challenge.	59	53.1%

Table 9 depicts, (Q.1), that 75 (67.5%) of instructors responded that the institutes do not have adequate resources to aid the education of VISs. When instructors were asked, (Q2) whether the respective universities have specialized instructors to handle VIS or not, the majority of the respondents, 68 (61.2%), confirmed that except for very few instructors, most of them were not trained to teach visually impaired students.

When instructors were asked to respond to the question (Q.3) of whether the VISs have additional problems that influence their performance, 88 (79.2%) agreed that the VISs have additional challenges. Instructors, as FGD2 VSs and instructors, noted that students with visual impairments have additional problems that they cannot solve, even though it influences their class performances. When the respondents were asked if instructors usually ignore or neglect the VISs, (Q4), 12 (10.8%) of them noted that whenever there is a new teacher, instructors may not treat VISs due to their newness to the situation.

When instructors were asked to respond to "VISs are always caught up with time and so need more time", accordingly, (Q5), 80 (72%) respondents said that students with visual impairments have problems in class during instruction time.

The study found that instructors responded to the questionnaire on the issues concerning the university's financing of the program. (Q6) Out of 90, 78 (70.2%) agreed that the respective universities are not in a position to spend lots of money on purchasing expensive gadgets that would serve a third of the population of the student body. Responding to the statement (Q7) "Some VISs have dropped out of attending the classes due to frustration" 84 (75.6) instructors agreed to the statement that VISs drop their education due to various internal and external problems.

When instructors were asked to respond to the statement (Q8) "I do not have the appropriate Braille skills to support pupils with visual impairment in the regular classroom", 88 (79.2%) instructors said that they had no Braille skills to assist students with visual impairment. Again, for the inquiry of (Q9) "Poor physical environment does not promote easy mobility for VISs regular classroom", many instructors, 76

(68.4%), agreed with the statement that the physical environment in most inclusive settings does not promote easy mobility.

Again, in Table 8, (Q10) respondents expressed the statement, "I find it difficult getting parents to discuss vital information about VISs in the regular classroom." The majority of the instructors, 85 (76.5), agreed with the statement. They were not considered reliable sources of information and were not consulted about their child's development. Therefore, involving parents as equal partners in a professionally dominated culture was difficult. Again, in responding to the statement, (Q11) "Getting experts to educate me on modern methods of teaching the VISs is a challenge", 59 (53.1%) of the teachers agreed that they couldn't get the experts who could train them to retrain the visually impaired students.

3.4 Focus Group Discussions

Analysis of the FGD discussions was held for validation purposes with VISs, VSs, and Instructors from three universities, Wolaita Soddo University (WSU), Hawassa University (HwU), and Addis Ababa University (AAU). The three FGDs were coded as follows:

- I. WSU (VISs1-7), (VSs8-14) and (Inst.15-19);
- II. HwU, (VISs20-26), (VSs27-33) and (Inst34-38);
- III. AAU (VISs39-45),(VSs46-52) and (Inst.53-57);

In May and June 2022 (within two months), the researchers conducted FGDs. During these sessions, some potential problems that could hamper visually impaired students' academic performances in their present education were identified. Six main themes emerged from the FGD analysis: (Theme1) Difficulties in infrastructure-related challenges; (Theme2) Difficulties in the instructor's specialization in teaching VISs; (Theme3) Difficulties in learning material accessibility for VISs in libraries; (Theme 4) Difficulties related with attitudes of VISs toward their universities, faculties, etc. and (Theme 5) Difficulties related with service provisions.

Theme 1: Difficulties in infrastructure- related challenges

The first FGD questions raised to VISs about the difficulties they face are related to infrastructure. The VISs FGD participants, S1, S2, S7 and S11, S22, and 31 complained that the existing infrastructures at their universities were inadequate and insecure for the VISs to freely move from place to place to practice their education comfortably. Moreover, S4, S8, S20, and S26 stated that when they move to classrooms, dormitories, and the library, the erected poles on their way, leftover stones, and, uncovered holes become serious challenges for locomotion even for their social contacts.

In line with them1, the teachers FGD discussants, Inst.16,19, 35,56 and 57 also pinpointed that the presence of environmental barriers to moving safely from classroom to classroom, as well as from playgrounds to buildings is atrocious not only for VISs but also for the sighted community in the campus. In the same concern, according to the discussant, Inst.54 uttered:

Carelessly installed poles and uncovered ditches are the main obstacles for visually challenged students to study with their counterparts and participate in social events outside the classroom. Moreover, heaps of stone and sand that were left over from previous constructions were some of the barriers they were experiencing on their campus.

Inst.53 added, "A poor physical environment does not promote easy mobility for sightless students in the classroom".

Them2: Difficulties in the instructor's specialization related challenges

The FGD discussants reported challenges related to the instructors' specialization. On the same issue, the S5, S6, S8, S18& S19 specified the following points regarding classroom instruction: instructors used to write notes on the blackboards silently. As they have noticed, the process consumed much of the class time. Hence, to ensure the equal benefit of the class, the group recommended that instructors had better narrate or verbalize while they write on the blackboard or whiteboard. By the same token, the instructors responded to the extent to which VISs face professional-related challenges. Especially, Inst. and Inst. 35 replied: "Some of us are unable to read materials written in Braille to support students with visual impairments in the regular classroom." On the same theme, 2, Inst. 16, 17, 18, and 34, mentioned that instructors need training to enable them to meet the needs of VISs. To take Braille as a specific example, instructors require not only a detailed knowledge of the Braille codes but also a clear understanding of techniques for the development of literacy. This issue highlights an important concern relating to the skills that instructors require to successfully supporting VISs in inclusive settings. Another FGD discussant from the instructor group, Inst.55 narrated:

As far as my experiences are concerned, more experienced professional instructors in special needs education are required for the actual implementation of inclusive education. I think it is better to train more instructors to create a conducive learning environment for all learners in college; they can treat learners with impairments and make them feel loved since these students are left behind.

On top of this, a female instructor who was visually disabled, Inst.36 expressed "Although unsighted pupils face challenges in an integrated education program, many of their challenges are academic. They can be integrated well into the system. However, they have suffered more by being brought into an integrated system." This shows that VISs have not been given special attention in the system to be successful in their academic and social life affairs.

Theme 3: Difficulties in learning material related challenges

On the other hand, the FGD participants were inquired if they were provided with learning materials or not. Accordingly, S2, S7, S20, S22, S43, 44, and S45 forwarded their points on difficulties they face in learning material accessibility in their respective libraries. However, they stated that students with special needs have no special curriculum designed for their pedagogic process. These students face a lot of challenges in their studies that affect their academic achievement. The discussants expelled that there are shortage of a slate and stylus, Braille paper, and an abacus. A female instructor, Inst.37 asserted: 'I couldn't access brailed textbooks for visually challenged learners in the campus library.' Also, other sighted students,

S10, S11, S12&46 in FGD explained that the lack of Brailled textbooks is considered one of the major barriers to inclusive education for VISs.

Moreover, as inst.16 participated in FGD, stated: “To assist blind students, the section has to arrange computer laboratory and the library centers. Besides, they should help the disabled learners to efficiently use computer technology.” To the contrary, another female instructor, Inst.36 uttered her ideas saying: “In our campus library, there are braille books in braille form. These books include Communicative English I&II, History, Geography, Economics, Civics, and Ethical Education. The university has tried to help non-visual students by giving braille papers and arranging computer rooms, however, it was not adequate”.

Regarding resource accessibility, a male visually impaired instructor, Inst.19 pinpointed: “Un sighted students face a lack of accessibility of information. Also, they have difficulty accessing information as well as reference materials, online systems, and even university infrastructure. This challenge results in their limited access to good and quality facilities.” The majority of instructors who participated in FGD, Inst. 16, Inst.17, Inst.18, Inst.34, Inst.35, Inst. 55 and Inst.56 narrated that the challenge of obtaining information is in the problems faced when the information they want is in book form and digital form. The majority of informants have problems accessing information through both methods. Besides, an instructor who participated in FGD, Inst.57 pointed out: “Visually impaired students suffer due to a shortage of time during their test and examinations; the examination time was not enough; it was needed more time for instruction and doing assignments compared to their sighted counterparts.”

All VISs, VSs, and instructors from all sampled universities, in FGDs, suggested that there should be provisions for more furnished faculties at the university level where inclusive education can be designed in such a way that curricula and syllabi are designed for particular forms of disability. There should be also adequate training for special instructors and in-service training for current teachers in the mainstream schools to cater to the educational development of persons with disability. There should be structural and other adaptations of all educational institutions to the needs of persons with disabilities and the promotion of specialized institutions that facilitate research and development of their education. The FGD discussant from the instructors group, Inst.57 disclosed that

We assess learners with visual impairment similar to other learners, such as sighted learners. However, it was noticed that students with visual impairments would take longer hours while writing tests in an examination class. I think it has to be revitalized that the non-sighted students should be given a little more time than their counterpart students to get their knowledge which was hidden due to a shortage of time provided during the examination time.

These challenges, according to, Abma (2010), assessments should consider learners’ conditions because this can affect the assessment of their skills and abilities.

Theme4: Difficulties related with attitudes related challenges

Next to the above elaborations, FGD participants were inquired about VIS's attitudes towards Universities, faculties, and service provisions. The sighted learners, S9, S11, S12, S29, S30, and S48 and S49 described that the interactions between sighted students and the VISs were very good. VISs asked sighted learners to read for them, and the sighted learners were very cooperative. So, VSs had good interaction with their counterpart learners. In addition, the sighted learners stated that the VISs' presence in their classrooms gave them psychological strength. The visual learner discussants impressively expressed

when they see VISs with them; they understand how much they have psychological strength, and they also try to do better. This shows that they had positive attitudes toward visually impaired learners.

VISs from other groups, S1, S3, S5, S20, S21, S22, S39, S40, and S41, nonetheless, described that though the visual students were cooperative in assisting them in reading materials from the blackboard and whiteboard, and guided them in campus to the places where they move and out of the campus to different social issues due to good interaction, other sighted students disfavored them on their ways and left them in vain. Additionally, a lady discussant of FGD3, from AAU, expressed that many students with visual impairment did not always get their sighted colleagues to guide them willingly on campus. Four female discussants, S43, S44 and S45 added regarding the attitude of sighted learners as follows: whenever they (VISs) faced difficulties in writing and reading using Brail, they sought support from their instructors; however, the help they got from their instructors was so meager; as VISs understood that instructors had a negative attitude towards their learning approaches, they had a negative attitude towards some of their sighted instructors.

Most of the students with disability in FGD, S2, S4, S6, S23, S24, S25, S26, S42, S43, S44, and 45 participants, emotionally explained that the conjoining of students with disability into regular classes would be very frustrating due to the existing communication barrier between the VISs and instructors, including sighted students. Additionally, mistreatment and provocation of sighted students against the VISs and lack of willingness, according to the view of VISs, on the part of regular class, instructors to accept VISs in their classrooms were also mentioned as main obstacles towards the integration of VISs.

Theme 5: Difficulties in service provisions related challenges

Another inquiry the FGD discussants probed was on service provisions from academic institutions where they attend their academic processes. As far as the FGD discussants, S4, S5, S21, S22, S40, and 42, revealed that VISs receive financial remuneration, meals, accommodations, health services, and computer lab services from their universities. However, S11 and 12 mentioned that though there are some supports offered from their university, especially, financial support, the amount that they pay per month is not adequate to equate to the living inflation of the market price.

In the case of service provisions, the FGD participants (VISs) from all universities narrated that the inaccessibility and support provisions were found uncomfortable and insufficient. Three of the female FGD discussants from VISs groups(S5, S6 and 7) asserted that VISs had been deprived experiences concerning the physical structure and support services, and felt that the university did not consider meeting their special needs and that they were poorly supported. This opinion was also supported by the instructor group and one of the female instructors, Inst.54, witnessed:

There were a lot of barriers on the way to their dormitories, library, cafeteria, and classrooms. The routes were full of the leftover of sand, stones, and obstacles. To travel to different buildings, to different offices, they couldn't do unless someone accompanied them; for instance, vehicles were parked here and there. The roads were also overcrowded with a multitude of students

In addition, other female VISs, S24, S25 and S26, mentioned that nobody gave them orientations on how VISs could behave on campus at all. They had asked their senior most students and other sighted students if there was a resource room with VISs-specific equipment and materials. They could have received support and services from experts if a resource center had existed and had those professionals who could support them. Other male VISs from FGD discussants, S5 and S6, added their ideas that the university had

no adequate resource rooms staffed with professionals who provided support services for VISs. Many of the FGD participants in all sampled universities were highly concerned regarding the inaccessibility of support provisions, as exemplified by the earlier speaker. The participants had repeatedly asked the university to provide appropriate support to VISs.

In the end, the researcher asked each and individual team in each university about something they want to perform in the future and things to be done. Accordingly, many of them suggested that they, VISs, need some more apparatus and materials which make life easier for them; their needs were not fully addressed as every visual student. They need financial and moral support, so if they get these, they promise that they will do better in their academic work and they will perform more than what they had been performing.

4. Discussions

The main purpose of this research was to obtain information about the challenges visually impaired students experience in education. One of the advantages and primary goals of inclusive education is increasing social interaction between students with sight and their peers without sight to exchange their backgrounds in their academic settings, accept differences, and respect individuals' disabilities (Fletcher, 2010; Ghafri, 2015; Prih *et al.*, 2021). On the contrary, regarding the concept of inclusion, Bateman and Bateman (2020) argued that "full inclusion is not the best placement for all students" because "the general education classroom is typically not individualized" (p. 3). These students, VISs, have several challenges in the university environments that they face during lectures: accessibility, movement, daily living skills, and social challenges that eventually affect their academic achievements, such as a lack of Braille machines, and textbooks in Braille form and slates.

Most of the instructors were not formally trained in teaching and handling VISs. When the instructors were asked to reflect on the question of whether the institute has well-trained instructors to treat VISs, most of them agreed that the institutes do not have specially trained instructors to handle VISs adequately. Most of the instructors responded that they were not trained to instruct VISs. In the FGDs, the instructors mentioned that they suffer when they instruct VISs due to a lack of adequate training. Research findings also show that before teaching students with visual impairments, it is important for the instructors to acquire information about how the loss of vision influences the teaching and learning processes (Ibrahim, 2001; Fuller, 2004; Fuller, 2004; Fletcher, 2010).

Instructors, in other expressions, were in problems with using the appropriate teaching methods. When teaching methods are not properly used and teachers lack the skills and abilities to deal with VISs, then, the students would experience challenges in education. Our finding is in line with other studies which explain that teachers were not educated enough in sign language, the use of Braille materials, the preparation of teaching aids, tactile diagrams and maps, and so forth (Hamour, 2013; Savaiano, *et al.*, 2014; Radhika, 2017; Bateman & Bateman, 2020).

Among the registered specializations, however, there is a very small percentage of lectures specialized in special needs education. This implies that the above findings may seriously contribute to the poor academic performance of learners with visual impairment in the university. Most of the VISs reacted that their instructors were not trained to instruct them. The discussants also further explained that when the program was introduced in their respective institutions, the government planned to give each university a trained and experienced instructor to handle VISs. However, this has not been done. Therefore, the teachers were forced to teach the students just like the normal class without giving them extra coaching after class lessons. The research findings

also show that trained teachers play a critical role in creating a positive classroom environment in addressing individual learning needs and providing appropriate educational services (Smith et al., 2001; Whitburn, 2014; Kahsay, 2022).

This implies that the above findings may seriously contribute to the poor academic performance of learners with visual impairments at the university. VISs need instructors who know and have enough training in the area of special needs to be able to adapt teaching and learning resources and meet their individual academic needs in inclusive classes. In line with this, the research findings assure that the Braille language that is used by VIS involves writing on straight lines. The teachers, who are experienced and have practice of writing on straight lines, usually do not experience problems, but those who are novices in this area, and do not have experience, would have difficulties in writing on straight lines, as a result of which, they would not be able to provide adequate knowledge and information to the students. Support for our finding comes from Dea and Negassa (2019), who identified that teachers encountered several challenges while teaching VISs in Ethiopia. Therefore, the teachers need to master the skills necessary in teaching, training, instruct, and guiding students with disabilities (Yalo *et al.*, 2010; Sahasrabudhe & Palvia, 2013; Korir, 2015).

The analysis further revealed that the institutes do not have adequate resources to aid the teaching and learning of VISs. They also pointed out that the resources available so far are not sufficient to treat all VISs. Instructors exclaimed that the printer for the Braille paper is not adequate and needs maintenance, and it is very expensive even to repair. The lack of Brailled textbooks is considered one major barrier to inclusive education for VISs. Besides, the VISs have faced enormous obstacles in proceeding with their education competently, as have other non-disabled classmates. Lecturers teaching in these universities were experienced and had taught for a long period. This does not mean that these instructors were well-experienced and trained in teaching VISs. The research findings, also assured that due to instructors' inability to read Braille and the absence of related materials, students are not expected to complete homework and take notes in class, unlike their sighted peers. Similar findings are documented by studies somewhere else (Tibebu, 1995; Schwartz, 2000; Ellis, 2003; Schwartz, 2008; Louis, 2009; Rae, 2010).

On the other hand, the universities where this study was conducted tried their level best to give special treatment to VISs in their universities. For example, as the analysis shows, the FGD1&2 discussants, according to the findings, confirmed that the VISs were receiving monthly financial support from their universities. They had received a stipend of 500 ETB from their respective universities. Nevertheless, the provision was not as adequate as expected, as it had to be for VISs. Lecturers also witnessed that the VISs depend on their sighted peers to dictate their notes, and others got their notes from the resource room after having been written in Braille. Sighted students confirmed that they assist VISs when they come to the notation of notes that they have not been given in Braille (Fuller, 2004; Julie, 2006; Manisah & Zaleha, 2012).

However, in certain circumstances, several innovations can be observed to increase academic success, especially for disabled students. The support made by sighted peers to read for VISs when they lack braille, guiding them when they miss routes to the classroom and to their dormitory, and other human-related support have the potential power to initiate VISs to follow their education to the extent which they could withstand problems they encounter. Our finding is incongruent with other research findings that show that VISs sometimes obtain multi-faceted support from the social environment, and academic society; for example, to reduce troubles, "peer work" has been created, which includes two different help styles, "physical help" and "academic help," which are beneficial for students to share academic knowledge. From the findings, it can be seen that the physical environment in most inclusive settings does not promote easy mobility (Crooked, G., & Schmidt, 1989; Nurbanu, 2017; Friend, 2008; Özer & Cabaroğlu, 2018).

During the FGD, the discussants confirmed that carelessly erected poles and uncovered ditches are the main obstacles not to studying with their counterparts and participating in social events outside the classrooms. Moreover, heaps of stone and others that were left over during the previous constructions were some of the barriers they were experiencing on their campus. This use of a cane is to protect themselves from different obstacles and to direct them where they want to go safely. When they walk, as some VISs expressed, without a cane in the compound, they face difficulties like falling and being harmed, going to unsafe areas, facing difficulties in going where they want to go, and so on. So it is possible to say students walking in the compound without a cane can be a challenge they are experiencing (Trent & Truan, 1997; Landsberg, 2005; Abma, 2010).

Moreover, VSs in FGD repeatedly assert that VISs did not always get their visual colleagues to guide them happily on campus. Furthermore, the study also underlined that routes to the halls across the universities had not been disability friendly making them life-threatening as well as security was unsafe for the mobility. Research findings about challenges related to service provision, students have to get awareness of mobility and orientation to use different services like libraries, toilets, and harmless roads/routes on campus to avoid physical harm. Some students on campus sometimes face different problems like arms and legs broken and wounded on their heads and different parts of their body. Support to this analysis the findings come from previous studies show that, next to the attitudinal barrier, the most obvious impeding factor for people with disabilities is environmental inaccessibility (Sherrill, 1998; Johnson, 2001; Mathewos, 2019).

5. Conclusions and Recommendations

5.1 Conclusions

In this chapter, a summary of the study, objectives, and implications of the findings, and general conclusions are pointed out.

Based on the findings, the following conclusions were drawn:

Challenges Related to Teaching Materials: This, use of a cane, is to protect themselves from different obstacles;

- a) Challenges Related to Students: The inability to write in Braille is one of the challenges VISs are facing;
- b) Challenges Related to Service Provision: VISs have to get awareness of mobility and orientation to use different services like libraries, sports fields, toilets, and harmless roads/routes on campus to avoid physical harm;
- c) Challenges Related to instructors: It is a challenge students are facing. The majority of the instructors, as the FGD result shows, there are no adequate instructors who were well trained in Special Needs Education on the campuses. Moreover, heaps of stone and others that were left over during the previous construction were some of the barriers they were experiencing on their campus.
- d) Challenges Related to attitudes: In some instances, the developments of labeling and negative attitudes prove to be barriers to the course of learning and the acquisition of education. VISs do experience problems with listening (if not spoken loudly and clearly), reading, and writing, understanding concepts, and even communicating with others.

5.2 Recommendations

The following recommendations were directed for the betterment of VISs in Ethiopian institutions:

1. The MOE of Ethiopia should come up with strategies with improved policymaking that could help to sensitize issues of disability to instructors, students, university administrators, and stakeholders so that they can contribute to the successful inclusion of VISs.
2. Teacher training institutions should provide practically oriented courses of inclusive education for preservers' instructors to raise their awareness towards VISs issues and equip them with basic skills of Braille as well as orientation and mobility. Moreover, providing adequate training to instructors on how to handle and treat VISs can boost their competencies in instructional processes.
3. The content, method, teaching material, and other related activities that are provided for VISs should be accessible and flexible. The curriculum must take into consideration the different abilities and needs of all students. It must be capable of being adapted and modified to meet the needs of VISs.
4. Within learning institutions, the academic environment should be pleasant and friendly for the students in general and VISs in particular. The learning rooms should be well furnished, with seating arrangements, tables, and teaching and learning materials.
5. Financial and other university guidelines should be designed flexibly to address the special needs of students with disabilities. Especially, the education department should endeavor to allocate a portion of its budget to inclusive education. Donors and non-governmental organizations can also contribute by providing appropriate resources for facilitating successful inclusion.
6. The regional education bureau, in collaboration with non-governmental organizations, should come up with strategies that could help sensitize the community about issues of VISs.
7. Finally, further studies should be carried out on the same issue to reach a common consensus to fill the gaps where this research lacks.

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Authors' Contributions

1. Collected the data, read the manuscript, commented the manuscript for finalization
2. Collected the data, analyzed, interpreted the data, and produced the manuscript

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