ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 03 No. 02. Apr-Jun 2025.Page#.2387-2402
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems

Augmenting Tertiary-Level Scholastic Outcomes for Visually Impaired Learners via Advanced ICT Modalities

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Abstract
The study focuses on the role of the Information and Communication Technology (ICT) in increasing accessibility of education and facilitating student-to-student learning and supports among VI students in the university. A quantitative research approach was utilized in obtaining data regarding the knowledge of visual impaired students regarding their utilization of assistive tools such as screen reading software, voice to text applications and electronic braille books. Findings showed that 88% of the participants utilized ICT facilities regularly, and over 80% of them reported improved academic performance, confidence, and autonomous learning. There were no statistical variations in attitude by gender or visual impairment category, but notable heterogeneity by study discipline and level of education. The primary issues were reported to be little infrastructure, lack of training, and affordability. The students with longer exposure to assistive technology showed greater level satisfaction, indicating that universal and long-term access is essential. ICT training incorporation in syllabuses of courses and policy implementation in institutions is suggested by the study for inclusive education. In conclusion, the results affirm the significance of institutional intervention to guarantee ICT seizes its potential in providing equal opportunities for blind students to learn.

Keywords: *Information and Communication Technology (ICT), Visual Impairment, Assistive Technology, Higher Education, Academic Performance.*

Introduction

ICT is one of the significant aspects that has been researched towards enhancing academic performances that are peculiar to visually impaired persons in higher education. In most came up with, a number of them carried a burden that hindered the achievement of higher education by the visually impaired students: these are the conditional access to the academic learning and relevant activities and, in fact, the essential independence in order to get the chance to learn. Screen

readers, speech recognition applications, and Braille e-books help convert obstacles into opportunities, fostering an environment conducive to learning. Gaining acknowledgment through recent study work conducted in Pakistan, the chances and the worst were discussed concerning the applicability of such technologies for the visually impaired students in (Mazhar et al., 2024).

Some of them are screen readers and other magnifying software like the JAWS and NVDA, the latest significant aids which enable blind students facilitate their access thematically to their online course materials and internet sites. For example, it provided a training program to visually impaired persons from Pakistan's Directorate General of Special Education, which aimed at training the participants to effectively use JAWS and NVDA for document creation, communication, and web-based browsing. Participants indicated improvement in their proficiency and increased outcomes regarding confidence in using these tools, requiring less dependency from others with concern to academic-related tasks (Hussain et al. 2022).

Khan et al (2023) said that Silicone Braille e-books are equally important because they are accessible formats to ensure that all students have equal access to academic content. However, research reveals that a large number of students still encounter challenges because of the non-provision of accessible formats for PDFs and scanned texts. Like the National Book Foundation, which has an initiative for offering Braille materials free of cost, such as textbooks and advanced mathematics charts, universities also lack such resources.

As well, due to the pandemic, online learning options were brought to the limelight. introducing the ICT aids to the blind. In Punjab most students have experienced increased reliance on the usage of such technologies as screen readers and speech-to-text applications. holding online classes. Some platforms had accessibility issues; limited Braille-compatible content was available; and high internet expenses obstructed full participation. Additionally, assistive mobile technologies such as Seeing AI are gaining popularity among visually impaired students to interpret visual information through auditory means to aid in tasks like reading textbooks or recognizing objects in classrooms (Mushtaq et al., 2023; Alnajashi et al., 2023).

However, notwithstanding the advances, effective implementation of ICT solutions continues to face a myriad of challenges. Most importantly, financial and technical constraints have come to be one of the most serious deterrents to the most attainment of the schools; universities could not, however, have been in a position to provide the assistive technologies or afford adequate training programs for students and often for such faculty. The design aspect of curriculum also creates problems; highly visually presentational subjects such as geometry or science tend to be considered especially hard to adapt without tactile diagrams or audio descriptions. Also, the lack of physical infrastructure makes it worse - as just about more than 12 percent of Pakistani universities have been reported as equipped with dedicated assistive technology labs such as screen readers and Braille displays (Shekianoka & Arthur, 2024; Rehman et al., 2024).

Siddiqua et al (2022) examined that some institutions have been taking some encouraging steps to cope with the problems posed by inaccessible digital content. The University of Karachi, for example, has set up Assistive Technology Labs that provide special software and training for visually impaired students, thereby becoming a model for other institutions across the country. Spurred on by the research is a plethora of policy reforms that nationalize standards-policies on accessible digital content and require ICT tools training for teachers. Alongside this, there is an exploration of various public-private partnerships like the university-NGO collaboration that would subsidize internet access and provide assistive devices such as talking pens.

Summarily, ICT is a boon to bridge the gap amongst the visually impaired pupils in higher Pakistan education. Systemically, there are barriers like insufficient funding, inflexible course curricula, and infrastructural inadequacy; the solutions must come from the institutional and policy side. Funding for assistive technologies, changing or modularizing traditional curricula to include tactile

and auditory resources, training faculty on issues of inclusion, and making higher education an accessible learning environment would give the best chance for inclusion in higher education. There is some recent evidence for growing demand for ICTs in upgrading the national education system to a more universal definition of inclusion and accessibility.

Hopefully, this research should assess how ICT tools assist in enhancing the academic capabilities of blinded population in higher learning on Pakistan. Present study shall analyze the role of ICT tools, such as screen reader software, speech recognition software, Braille e-books, etc., in enhancing academic accessibility and success. Furthermore, the study shall attempt to identify problems associated with visually impaired students use of these technologies as a financial, technical, and infrastructural barrier while also seeking to develop strategies to counteract this challenge.

Research Objectives

- To evaluate the effects of Information and Communication Technology (ICT) tools in increasing the accessibility, independence and performance of visually impaired students at the tertiary education level and to propose barriers and recommend solutions to ensure an inclusive use of the ICT tools

Research Questions

1. How do ICT tools impact academic success for visually impaired students?
2. What are these students face challenges in accessing and effectively utilizing ICT tools, and how can barriers be eased to make learning more inclusive?

Literature Review

The literature on the use of Information and Communication Technologies (ICTs) in improving academic performance of the visually impaired students in the tertiary level of education portrays quite a complex situation, in terms of the potential benefits and the persistent challenges, in particular in Pakistan. Research has pointed out the various other obstacles that visually impaired students are subjected to in conventional settings, where the accessibility of materials with opportunities for participation in academic endeavors is compromised.

To bridge this gap, ICT tools, including screen readers and Braille e-books, become the two major preparations in ensuring the independence of the students. Studies indicate that the special technologies support a great deal of improvement in academics through independent access to information and a more inviting educational environment. However, the effective integration of ICT is dependent on tackling several core challenges. Awareness about the importance of assistive technologies is lacking among the educators and administrators, and there is also a lack of funding and training opportunities in Pakistan (Khan & Mahmood, 2022; Siddiqua et al., 2022).

ICT refers to the infrastructure that support contemporary computing, such as the internet, mobile networks, and new technologies such as artificial intelligence (AI) and quantum computing. It combines telecommunications, computers, and software to enable data sharing and global connectivity, revolutionizing how people interact and solve problems (Pratt, 2019). ICT has transformed learning from conventional practice to digital and blended methods. It improves learning, teaching, and assessment processes through the abundance of resources available and promoting creative pedagogies (Zafar, 2019). Among some of its significant advantages are better concentration, flexibility, and analytical thinking of learners, with communication and collaboration becoming easy with instructors (Talebian et al., 2014).

History of Information and Communication Technology (ICT) is captured researched properly and where it began theoretically and progressed thus far in the world. The flash points between theory and practice were RAND networking ideas and the ARPANET creativity in the 1960s that unlocked the

barrier to the current ICT. Standardization of the TCP/IP protocol suite in 1982 and development in 1983 of the Domain Name System (DNS) motivated the development of a modern internet as a transparent worldwide network supported by multiple independent networks. The 1990s also saw the commercialization of the internet through actions like the conception of the World Wide Web (WWW) in the year 1991 and development of first web browsers like Mosaic in 1993. The ten-year period marked the introduction of commercial ISPs, coupled with the decommission of NSFNET in 1995, and the start of privatized infrastructure of the internet (Webb & Cox, 2004).

The literature that shows the role of ICT in education points to the role of ICT is altering learning and teaching, in this case, expanding access to individuals with disabilities i.e., visual impairment. Literature focuses on the use of assistive technology and digital content to leverage learning outcomes (Schneider, 2004). The ICT for Development (ICT4D) advocates have been present since the 1980s as they addressed the social aspects of ICT in the developing world. Mass events like the 1988 New Delhi conference have shaped the agenda of the debate around the contribution of ICT towards socio-economic development. These arguments create a general context of ICT history and its application in different domains from development to education (Walsham, 2017).

ICT is very essential and a really revolutionary one in processes of learning of visually impaired children. What it entails is more assistive technologies and more digital resources that make it considerably easier to access information as well as having independent and inclusive learning environments. Screen readers, text-to-speech software, magnification software and Braille displays allow the effective instruction of the visually impaired students. The study reveals that learning among such type of people turns more participatory and creative as a result of the availability of the e-books, digital libraries and the internet via ICT. They are involved with collaborative learning on the whole, where the student learns with their peers and educators easily. For example, Evernote and Read & Write applications allow audio recording and playback for easy listening and following directions for achievement of tasks. (Eligi & Mwantimwa, 2017: Pacheco et al., 2017: Bocconi et al., 2007).

Poor infrastructure, costliness of assistive technologies, and non-training of teachers are some of the barriers to the full realization of ICT for visually impaired children. Conventionally, literatures suggest in-house solutions with continued professional development to address the evaluation challenges. Still, ICT has been found to have an important role in improving academic performance as well as literacy and social integration into the mainstream of the visually impaired child (Montenegro-Rueda et al., 2023).For instance, teaching strategies regarding ICT for students of visual disabilities may include modifying screen brightness and, by using mobile devices, accessibility can be enhanced by means of zoom facilities (Cursiefen et al., 2019). Eligi and Mwantimwa (2017) evaluate the usability and accessibility of ICT in Tanzania, found to be supportive of independent and collaborative learning for visually impaired students. Pacheco et al. (2017) elaborated the need for using ICT to facilitate functionally substituting for visual impairment, communicating, and the academic smooth transition.

Many applications such as JAWS and NVDA are considered as screen readers which convert digital text to accessible formats enabling students to work with it independently. Thus, blindness assistive software made provision for Braille e-book features. The improvements include personal strategies to meet the specific needs of blind students. But research shows that the choice of the right assistive technologies and the implementation process within higher institutions often bring about obstacles for which proper consideration needs to be given to the individual student's needs and resources. The research study carried out at the University of Dar es Salaam, Tanzania, raised concerns with respect to accessibility and usability of ICT for students with blindness, indicating that while ICT facilities are provided, it is access based on availability and functionality (Senjam et al. 2020; Sutar & Hande, 2021).

Similarly, the evidence in New Zealand portray digital technologies such as social media and mobile computing devices as the facilitators that can help students with vision impairments to address various obstacles during transition into university life. These technologies not only help with coping due to impairments, communicating, and a variety of information and learning skills but also really assist in organizing, collaboration, social connections, and participation. It underscores the need for a holistic one-window approach to ICT integration, whereby assistive and mainstream digital technologies can truly create an environment for learning that is inclusive and supportive for visually impaired students. (Pacheco et al., 2021; Haleem et al., 2022).

Types of ICT for Visual Impairment, reviews the diverse range of Information and Communication Technology (ICT) aids developed to assist visually impaired persons. The aids are divided into the overall categories of software and hardware solutions, both set to address different needs. Computer software such as screen readers, for example, JAWS (Job Access with Speech for Windows) and NVDA, verbalize on-screen data, and thus allow an individual to independently read digital materials (JOLSELT, 2019: Amponsah & Bekele, 2023). Screen enlargement software such as SuperNova and ZoomText support the low vision by enlarging text and pictures (Amponsah & Bekele, 2023: Patel & Parmar, 2022). Speech-to-text software also promotes communication through writing down spoken words, allowing the visually impaired to access digital media more easily (Hwang et al., 2020).

Hardware products include adaptive products such as high-contrast keyboards, Braille embossers, and desktop video magnification, which enlarge printed text and diagrams for easier reading (Amponsah & Bekele, 2023: Patel & Parmar, 2022). Braille displays are tactile interfaces that enable users to read computer content in the form of Braille characters, while mobile devices such as iPads and Android gadgets facilitate pinch-to-zoom capability, improving access for people with low vision. Also, devices such as talking pens and programmable note-takers support access the visually impaired learners to learning materials to a greater extent Amponsah & Bekele, 2023: Bhowmick & Hazarika, 2017).

These hitches include the lack of ICT literacy skills and limited access to reliable support systems, which have hindered the effective use of such tools by visually impaired students. As a consequence, such universities are unable to adopt the assistive technologies that, until now, force students to resort to human assistance, thereby reducing their autonomy and academic independence. It is important to note that the literacy has provided largely an impetus to systemic alterations such as creation of greater awareness, appropriate allocation of funds, and broad training initiatives, to enable the integration of the visually impaired students in tertiary academic institutions on an equal footing. It's time for further research to see the subtler ways that ICTs impact academic success and evidence-based practices to overcome the stubborn obstacles this student population faces (Karim, 2023; Iqbal & Ashraf, 2023).

The rising use of Information and Communication Technologies (ICT) in learning has been recognized to play a major role in ensuring that education becomes inclusive and favors students with visual disability to enhance their learning outcomes. According to the empirical literature, there are several spheres in which students with visual impairments experience significant challenges in a typical learning scenario, once they have their hands on practically any kind of guide or other documents that usually accessed via the printed and visualized media. Thus, technology stands as a bridge linking these different methods of information access and participatory academic activities. According to researchers, "ICT tools act more than as compensatory mechanisms but facilitate new ways of learning, enable special arrangements, and promote collaboration and participation" (Upadhyaya, 2023; Bharti et al., 2024).

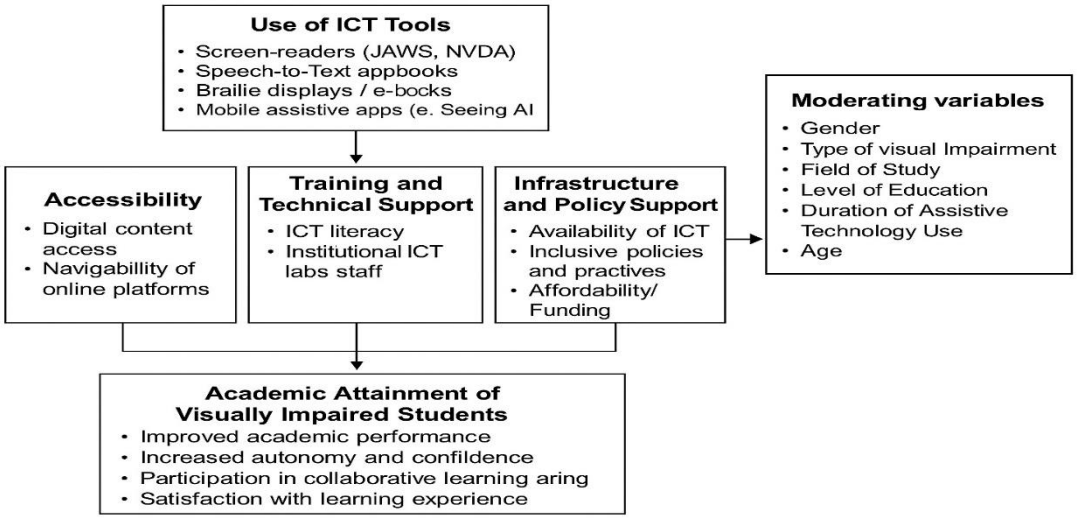
This means that the academic performance of visually impaired students is influenced positively by ICT applications, even though large gaps continue to exist in the degrees of accessibility and

implementation. The evidence indicates that ICT also enhances academic performances by It facilitates the availability of learning resources and materials, increases independence as well as supports communication and cooperation. They observe in a study that adoption of the online and distance learning programs enables visually impaired students to perform better by provision of assistive technologies, i.e., use of screen reading technology with speakers or Braille displays. In another example, a study conducted in Lagos State, Nigeria, revealed a significant relationship between ICT use and academic performances among visually impaired students, thus suggesting that technology can be used to improve curriculum access (Montenegro-Rueda et al., 2023; Eguavoen, 2016; Arslantas & Gul, 2022; Msambwa et al., 2024).

Digital technologies help students in many critical ways: aside from compensating for visual impairments, they support organization, collaboration and importantly socialization for the transition to university. Unprecedentedly, these benefits come under heavy subordination through long-standing barriers that restrict the integration of these digital technologies, including exorbitant costs, inadequate training, and platforms that are inaccessible. Lack of suitable assistive technology laboratories and trained human resource to serve the visually impaired students is usually the case in most universities. Without these necessary facilities and services, the students are bound to be limited from access to essential tools and resources (Lisboa et al., 2020).

In addition, it worsens the challenges by making the course materials and online platforms inaccessible and incomplete for participation in studies. The research impact on the use of ICT by the visually impaired students is aimed at presenting a wide picture of the literature on the use of ICT as an aid to low vision or blind students in the university. Hence, while there is a clear demonstration of positive impact being made on students' academic performance by ICT, it becomes very pertinent to remove the barriers to ensure that all students have equitable access and that technology can be uploaded maximally for the benefit of students with visual impairment in higher education (Bilyalova et al., 2021; Zhu et al., 2025).

Conceptual Framework



The conceptual framework explains how the application of ICT tools improves academic achievement of the visually impaired students. Such factors as accessibility, training and technical support, infrastructure and policy support mediate this relationship. Also, there are some moderating factors like gender, age, extent of education, nature of visual disability, and study course as well as time span of the usage of assistive technology that delivers to the effectiveness of ICT. The

framework discusses that with these elements in cooperation, the contribution to the academic performance, feeling of independence, and satisfaction of the learning experience are enhanced.

Methodology

Research Design:

The study applies the descriptive study design in its research on the use of information and communication technology (ICT) aids, such as screen readers, speech-to-text programs and Braille books to increase academic accessibility and independence among the students who are blind and have poor vision within the institutions of higher learning. The paper also examines the challenges that deprive the students of using ICT devices and it provides recommendations in maximizing their use and effectiveness. A quantitative study design is employed using the employment of survey data collection in the bid to access data from participants.

Population:

The target users here are the visually impaired students in higher learning institutions who are keen on the incorporation of assistive ICT devices in smoothing out learning processes.

Sampling & Sample:

The purposive sampling technique is utilized in selecting participants who are provided with the criteria and are specific to the purpose of the study. They are visually impaired students utilizing ICT devices for learning on a daily basis. The sample is visually impaired students at the university level. The final number of participants resorts to their availability and willingness. Every effort is made to achieve diversity in age, gender, educational level (undergraduate, graduate, or Ph.D.), and category of visual impairment (total blindness or low vision).

Research Tool Development:

The most common type of data collection instrument used in the current study was a guided survey where Google Forms were used in an attempt to allow convenient and accessible web data collection. The survey was divided into five sections: demographic information, collecting information on the age, sex, level of education, field of study, type of visual impairment, and previous experience with assistive technology; impact of ICT equipment, assessing the influence of ICT devices on learning independence; accessibility issues encountered, exploring topics such as technical problems, affordability, insufficient training, and an absence of institutional support; models of inclusion, where the opinions of participants on the possible solution to the better use of ICT and its performance will be solicited; and comments, where the general opinions on the utilization of ICT in the situation of learning will be sought. The majority of questions used the No-Likert type of scale (strongly disagree, strongly agree) as a method of accurately capturing the strength of difference in the responses among the participants. Hard copy (paper-based) surveys were also used so as to provide the participants with limited access to the digital platforms with an equal opportunity and access to the data collection. This mixed-mode approach allowed greater participation and catered to potential biases toward internet access and digital literacy. Online and hard copies of data were merged to enable comprehensive analysis.

Research Instrument Validity and Reliability:

Content validity was ensured through a thorough literature review of extensive published literature on inclusive education and assistive technology. The questionnaire items were precisely mapped according to the research goals based on extant studies to match maximum relevance, clarity,

and congruence with the research goals. Cronbach alpha was also used to infer the consistency of the instrument.

Cronbach's Alpha	No of frequency	No. of Item
0.828	100	37

Data Analysis & Interpretation

The SPSS (Statistical Package for Social Sciences) was used in the analysis of the collected data.

Table 1: Frequency of the Demographic Information

Category	Respondents	Frequency (f)	Percentage (%)
Age Group			
	18-22 years	42	42%
	23-27 years	39	39%
	28-32 years	11	11%
	33 years and above	8	8%
Gender			
	Male	65	65%
	Female	35	35%
Level of Education			
	Undergraduate	70	70%
	Graduate	28	28%
	Doctoral	2	2%
Field of Study			
	Special Education	85	85%
	Other	15	15%
Type of Visual Impairment			
	Blindness	73	73%
	Low Vision	27	27%
Use of Assistive Technology			
	Yes	88	88%
	No	12	12%
Duration			
	0-1 Year	3	3%
	2-3 Years	16	16%
	4-5 Years	33	33%
	5 Years +	47	47%
	Never	1	1%

Table 2: Impact of ICT Tools on Academic Accessibility and Independence

Statement	SA	A	N	D	SD	Mean	S.D.
Using ICT tools such as screen readers enhances my ability to access	40	48	10	1	1	4.25	0.757

diverse course materials effectively.							
I find speech-to-text software beneficial for completing assignments and participating in class discussions.	51	34	12	2	1	4.32	0.839
Braille displays or e-books enable me to engage more independently with academic content.	27	50	4	18	1	3.84	1.051
ICT tools have improved my overall academic performance.	32	52	13	0	3	4.10	0.847
I feel more confident managing my studies and meeting deadlines because of ICT tools.	41	36	21	0	2	4.16	0.825
I can navigate online learning platforms with ease using assistive technology.	41	27	27	0	5	4.04	0.942
Assistive technology and ICT tools have expanded my access to research materials and scholarly articles.	24	44	4	22	6	3.99	0.847
I actively participate in online discussions and collaborative projects thanks to assistive ICT tools.	28	47	25	0	0	4.03	0.731

Section 3: Challenges Faced in Utilizing ICT Tools

Statement	**SA**	**A**	**N**	**D**	**SD**	**Mean**	**S.D.**
Find existing ICT infrastructure in my institutions accessible.	6	50	27	13	3	3.43	0.905
Technical glitches or compatibility issues with assistive technology often disrupt my learning process.	20	53	22	4	1	3.87	0.812
Assistive tools and software are a prohibitive element to an individual accessing the much scorned tools.	40	15	35	6	4	3.81	1.152
I lack confidence in my ability to troubleshoot technical problems with ICT tools.	6	54	25	8	7	3.44	0.978
The digital materials provided by instructors are not always accessible to visually impaired students.	10	45	22	22	1	3.41	0.975
I am not fully aware about existing ICT resources.	8	39	15	32	6	3.11	1.127
Lack of training sessions is a barrier to developing ICT literacy skills.	51	33	11	4	1	4.29	0.891
There are compatibility issues when using ICT tools and software.	21	47	28	2	2	3.83	0.853

Section 4: Strategies to Overcome Barriers and Enhance Inclusion

Statement	SA	A	N	D	SD	Mean	S.D.
Institution effectively solves ICT-related problems for students with visual impairment.	10	28	41	6	15	3.12	1.157
I believe that providing more training sessions is essential for improving ICT literacy skills.	48	41	7	2	2	4.31	0.849
Increased funding for assistive technology and accessible materials is essential for my success.	52	37	6	2	3	4.33	0.911
I believe that greater collaboration between institutions and technology developers is necessary.	51	39	8	2	0	4.39	0.723
My institution creates effective policies for ICT tools usage.	11	30	37	5	17	3.13	1.212
Public-private partnerships boost the availability of assistive technology and materials.	25	41	19	13	2	3.74	1.041
There is effective support staff regarding ICT issues.	10	11	55	9	15	2.92	1.098
My institution ensures the accessibility and usability of the online learning platform.	7	40	17	15	21	2.97	1.298

Section 5: General Feedback on ICT Usage

Statement	SA	A	N	D	SD	Mean	S.D.
The ICT skills I've gained have enhanced my employability after graduation.	18	56	19	4	3	4.25	0.757
I can recommend an ICT-based training program for visually impaired students.	62	22	13	1	2	4.32	0.839
I believe that my institution cares and encourages the use of ICT to improve my learning.	16	42	12	11	19	3.23	1.369
I would recommend ICT-based assistive technology to other students.	56	31	10	1	2	4.38	0.862
It is necessary for assistive technology to be part of the curriculum.	53	33	12	1	1	4.36	0.811
Overall, my academic experience has been positively transformed by ICT tools.	55	14	28	1	2	4.21	0.993

Table 6: Comparison of Opinion of Respondents Based on Gender (Independent Sample t-test).

Gender	N	Mean	S.D	df	t	Sig
Male	64	117.2500	11.21082	95	2.011	0.230
Female	33	111.9091	14.43599			

*P > .05 Level of Significance

Table specifies that the empirical information for male respondents (N=64, M=117.25, SD=11.21) and female respondents (N=33, M=111.91, SD=14.44) with t-statistics (t (95) = 2.011, P > .05) shows that there is no significant difference in the opinions of male and female respondents regarding the role of ICT in facilitating academic achievement of visually impaired students.

Table 7: Comparison of Opinion Based on Field of Study (Independent Sample t-test).

Field of study	N	Mean	S.D	df	t	Sig
Special Education	84	115.7976	11.43950	95	.723	.010
Other	13	113.0769	18.84791			

*P < .05 Level of Significance

Table specifies that the empirical information for respondents from Special Education field (N=84, M=115.80, SD=11.44) and other fields (N=13, M=113.08, SD=18.85) with t-statistics (t (95) = 0.723, P < .05) shows that there is a significant difference in the opinions of respondents based on their field of study concerning the role of ICT in academic achievement of visually impaired students.

Table 8: Comparison of Opinion Based on Type of Visual Impairment (Independent Sample t-test).

Type of Visual Impairment	N	Mean	S.D	df	t	Sig
Blindness	70	114.4857	13.52480	95	-1.196	0.503
Low Vision	27	117.8889	9.52863			

*P > .05 Level of Significance

Table specifies that the empirical information for blind respondents (N=70, M=114.49, SD=13.52) and low vision respondents (N=27, M=117.89, SD=9.53) with t-statistics (t (95) = -1.196, P > .05) shows that there is no significant difference in the opinions of blind and low vision respondents on the role of ICT in academic achievement.

Table 9: Comparison of Opinion Based on Use of Assistive Technology (Independent Sample t-test).

Use of Assistive Technology	N	Mean	SD	df	t	Sig.
Yes	86	116.3140	12.81292	95	1.956	.204
No	11	108.5455	8.15308			

*P > .05 Level of Significance

Table specifies that the empirical information for assistive technology users (N=86, M=116.31, SD=12.81) and non-users (N=11, M=108.55, SD=8.15) with t-statistics (t (95) = 1.956, P > .05) shows that there is no significant difference in the opinions of respondents regarding the role of ICT in academic achievement on the basis of assistive technology usage.

Table 10: Age based comparison of opinion (One-way ANOVA Test).

Age	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	938.373	3	312.791	2.039	.114
Within Groups	14269.441	93	153.435		
Total	15207.814				

*P > .05 Level of Significance

Table indicates that whose empirical data on respondents of the various age groups (F = 2.039, P = .114 > .05) shows that there is no significant variation in the opinion of the respondents concerning the role of ICT in academic achievement.

Table 11: Comparison of Opinion Due to Educational Level (One-Way ANOVA Test).

Level of Education	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1433.253	2	716.627	4.890	.010
Within Groups	13774.561	94	146.538		
Total	15207.814				

*P < .05 Level of Significance

Table stipulates that the empirical data of the respondents from different levels of education (F = 4.890, P = 0.010 < 0.05) shows that there exists a significant correlation between the different views of the respondents in regards to the issue of level of ICT and academic achievement.

Table 12: Comparison of Opinion with the Duration of Using Assistive Technology (one-way ANOVA Test).

Use of Assistive Technology (In years)	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1498.116	3	499.372	3.354	.022
Within Groups	13697.790	92	148.889		
Total	15195.906				

*P < .05 Level of Significance

Table indicates that empirical data of respondents according to the number of years of employing assistive technology (F = 3.354, P = .022 < .05) have shown significant difference on their views on the role of ICT in academic achievement.

Findings

The results indicated that 88 percent of the visually impaired students regularly utilize assistive technologies e.g. screen readers, speech-to-text applications, and Braille e-books, and these actually facilitated the access of their studies. Most of the responses had a consensus; above 80% agreed that ICT tools enhanced their performance in academic activities, raised their confidence level and promoting autonomous learning (Mean scores between 3.84 and 4.32).

The statistical results showed no significant differences in ICT perceptions concerning gender (p = 0.230) or type of visual impairment (p = 0.503), indicating that the experience of either group under both factors was almost similar. But there is a significant difference regarding the opinion between fields of study (p = 0.010) and education level (p = 0.010) in which the students in Special Education and upper academic programs portrayed more positive perceptions.

Barriers to effective ICTs became a glaring issue. Technical glitches or lack of adequate infrastructure were reported frequently by 81% of respondents while 75% agreed that the training gap does not augur well for ICT literacy (Mean = 4.29). Price was yet another hindrance and 55% claimed that it was an affordability challenge.

Students employing assistive technology for longer periods of time reported significantly greater satisfaction (p = 0.022), indicating the value of prolonged exposure. Institutional actions were

perceived as inadequate; just 38% concurred their institutions had effective policies or support systems.

Discussion

The current research deals with ICT in revolutionizing scholarly accessibility and autonomy among visually impaired higher-learners. The regular employment of assistive technology, as affirmed by 88% of the participants, proves their efficiency in independent learning and ensuring educational justice. The observations concur with existing research stating that the adoption of technologies including screen readers and Braille e-books enhances access to learning experiences and supports learner autonomy (Hussain et al., 2022; Eligi & Mwantimwa, 2017).

Students' attitudes were not substantially different by gender or visual impairment group, suggesting an equivalent impact of ICT across these groups (Montenegro-Rueda et al., 2021). There was, however, considerable heterogeneity both by field of studies and level of studies, with improved attitudes being observed among students in Special Education as well as those who had pursued higher levels of studies. This would be interpreted as showing greater exposure to inclusive practice and access devices present, as was found in the observations of (Siddiqua et al.,2022; Khan & Mahmood, 2022).

Even though the findings were positive, there are still significant barriers. The majority of the participants had identified infrastructural and technical limitations, lack of proper training, and limited resources. These results were consistent with research results that institutional preparedness is the biggest barrier to successful ICT integration in special education. (Rehman et al., 2024; Amponsah & Bekele, 2023). Additionally, students who had been exposed to assistive devices for a longer duration were happier, further attesting to the success of early intervention and universal access (Sutar & Hande, 2021).

Institutional support was presented as an overarching concern, with most not holding the opinion that there was existing infrastructure or well-designed policies. Although specialized labs like the assistive technology lab at the University of Karachi are useful in providing prototypes (Siddiqua et al., 2022), there has to be collective action at the system level. Inclusive education, as per literature, requires aggregate planning, policy continuity, and multi-actor discourse in providing access to learning resources equally (Walsham, 2017; Bharti et al., 2024).

In short, while the potential of ICT to enable visually impaired students to be more capable is promising, technical capacity development, institutional support, and policy environments open and accessibility-oriented to the tertiary level are required.

Conclusions

ICT has a major role to play in advancing participation and independence of the visually impaired student in institutions of higher learning. According to empirical findings, it is apparent that assistive technologies proved to have positive influences on learning outcome irrespective of both gender and disability type. There still exists inequality based on academic background, education level and the period in which technology is used.

In order to use ICT most effectively, improvement must be made at the systemic level specifically, training, infrastructure, cost affordability, and institutional support. Encouragement of inclusivity in the form of accessibility policies, collaboration between partners, and curriculum integration of ICT can provide the visually impaired students with equal learning opportunities.

Recommendations

Recommendations made for the future research are listed below:

- Provide formal ICT training to visually impaired students to develop digital competences and independent learning engagement.
- Practice inclusive policies and mechanisms for providing inclusive access to assistive technologies and institutional support.

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