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RESEARCH PAPER

An Experimental Study to Identify the Effect of Assistive Technology on Academic Achievement of Visually Impaired Students

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PAPER INFO	ABSTRACT
	Assistive technology includes the devices which are designed specifically for persons with disabilities. Present study experimental research, conducted for visually impaired students who are enrolled in Department of Education of University of Karachi. The purpose of the study was to compare the results of two semesters of visually impaired students with and without using assistive technology. In first semester, visually impaired students studied with traditional teaching method while in second semester researcher provided them the course content in audio files, while the whole process was supervised by researchers. Data was analyzed by Paired sample t-test in pre and post Performa of visually impaired students with and without using Assistive technology. The results showed significant difference in the achievement of both semester with and without using assistive technology. It is recommended to facilitate visually impaired students in classrooms by using Assistive technology in order to improve their learning skills and academic performance.

Introduction

The traditional view about disability set apart the individual with defects or different from "normal" people but more recently a "social model" of disability views persons with disabilities as full-fledged members of society, who are not to be marginalized or stigmatized (Wolanin & Steele, 2004). The advancement of science and technology not only influences the life of a common person but also brings a tremendous change in the life of physically impaired students. Many developed countries have passed the laws such equality act 2010 in UK and disability act 2008 in America to eliminate discrimination between physically impaired students and students who are not physically impaired. The development of institutions for physically impaired students brings tremendous change in the teaching-learning process due to which the teachers are adapting new methodologies aligning with technologies to enhance the learning of physically impaired students.

Academic culture and environment are the major barriers for the successful accommodation of students with disabilities in educational institution. Faculty

members are often untrained about how to deal with these students (Walnen & Steele, 2004). At present the majority of children with disabilities in developing countries are out of school, while many of those enrolled are not attending school like other students in the result no learning occured (UNESCO, 2014). In higher education, the student is protected against discrimination and provided an equal opportunity, but there is no process aimed at achieving success (Wolanin & Steele, 2004). However, higher education is not compulsory rather optional.

Literature Review

Difficulties of Visual Impairment

Kaur in (2018) stated the difficulties of visually impaired students at University level are:

(i) Books in braille or in the audio form are not available in market for all faculties and if available the content of the book is very old and outdated, which caused problems for the visually impaired students.

(ii) If any visually impaired student or teacher requests for any book in braille or audio form, then it took over one month by which the semester is getting over.

(iii) The equipment such as scanner, printer or software or any digital device are not in the access of every student in every University and in some cases if these facilities are available then it almost impossible for visually impaired students had to scan or print by themselves. (iv)The facilities of volunteers are not easily available for visually impaired students, if they want to convert any hard copy format book into audio file than they have to face so much difficulty to find any person who provide them services to record the content into audio files voluntarily. Therefore they have to hire volunteers from outside which is not affordable for everyone.

(v) Visual Impaired students have no facility to get writer services from campus to write in their examinations.

(vi)Absence of audiovisual room and no recording or listening facility for visually impaired students availble in campus.

(vii) The software used by visually impaired persons to listen the content is not free of cost; Thus University has to pay for licensing of this software which is very expensive.

(viii) Disabled students who belong to the low socio-economical background don't know how to operate latest technology which creates hurdles in their learning.

(ix)Limited funds and untrained or insufficient staff are also an important factor to provide sufficient facilities for visually impaired students.

While the other difficulties of education are finding books in the library may be impossible without assistance, unable to read examination questions and handouts in standard print or read their own handwriting when answering examination questions, It may take longer for students to write down lecture notes

and they may be unable to see PowerPoint slides or board work, and pictorial descriptions, presentations and new vocabulary can be problematic unless an oral description or additional clarification is given.

Assistive Technology

The term assistive technology means *"any object, equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability."* Lewis (1998) described assistive technology as any technology that can enhance the performance of visually impaired person by enhancing the individual's strengths or providing an alternative platform for completing their task. Assistive technology devices help persons with disabilities can be technological (vibrating pager, Palmtop PC) or non-technological (picture prompts, activity schedules) (Bryant, Bryant, & Raskind, 1998). These devices can be designed specifically for persons with disabilities. Assistive technology has improved the visual impaired person's life and facilitate them in participating in daily society. Assistive technology, itself is a self-management tool, which was evaluated as a strategy for controlling antecedents used by visually impaired persons to improve their own behavior.

Mechling in 2007 stated that assistive technology devices help people with disabilities to participate in society as active members. These devices also help individuals with disabilities to achieve optimal functional ability and independence. Furthermore, assistive technology is known as a means for individuals with disabilities to access society as an equal capable person with and without disabilities (Riemer-Reiss & Wacker, 2000)

Assistive technology was a special tool designed to improve educational results, achievements and life expectancy of all individual not just students with special care in general classrooms. Individuals with Disabilities Education Act Amendments of (IDEA) specified that assistive technology is any element, equipment or product system that helped to develop, uphold or enhance functional skills of individuals with primary need. It allows all students to perform well in the general classroom. IDEA (2004) defined assistive technology as an element or unit of equipment or product system either achieved commercially, off the shelf, reformed or customized and help to raise, sustain or enhance personal's functional skills for a person with disability or disorder. The law enforced assistive technology development and its implementation to enhance the special needs of disabled students in the classroom (Akpan & Beard, 2013). The U.S. Congress supported the effective and efficient use of assistive technology in the classrooms in two ways. First assistive technology can help teachers to reduce the impact of instructional barriers to help students as better as a teacher can. Second ways in assistive technology, that support students with disabilities that law mentioned. Educationist must consider assistive technology while developing instructional plans for all students in public school premises so that can improve standards and better facilitate students with special disabilities. Assistive technology tool uses to develop creative, critical, insights in students with special needs.

Use of assistive technologies in inclusive education, educational technology have, however, been established in other institutions for some time. In some universities, in particular, this attitude was different.

The gap between instructional and assessment practice is especially salient in reading content. In 2007, Turlow, Johnstone, Timmons, and Altman found that students used a wide variety of magnifying, screen reading, refreshable braille, and other devices to assist with reading assignments. Yet, the authors' follow-up study in 2008 found that such devices are often not allowed on statewide assessments(Johnstone, Altman, Timmons, & Turlow, 2009).

Effect of Assistive Technology

The effect of assistive technology went far beyond the benefits of health and well-being to individual users and their families. It also had socioeconomic benefits, by reducing direct health and welfare costs (such as hospital admissions or state benefits), enabling more productive employment, and stimulating economic growth. Some examples are shown below.

- Appropriate use of hearing aids by children improved language skills, without which a person with hearing loss had limited opportunities for education and employment.

- Appropriate wheelchairs increase access to education and employment, and their use eases health care costs owing to a reduction in the risk of pressure sores and contractures.

- The risk of falls in older people can be lowered by managing declines in intrinsic capacity, including reduced vision, hearing and mobility.

- Assistive technology can enable older people to continue to live at home and can delay or prevent the need for long-term care(Chan, 2017)

Assistive technology for the visually impaired and blind people is a research field that is gaining increasing prominence owing to an explosion of new interest in it from disparate disciplines. The field had a very relevant social impact on our ever-increasing aging and blind populations. While many excellent state-of-the-art accounts had been written to date, all of them are subjective in nature. Assistive Technology turns a person with visual impairments life upside down from nothing to everything (Bhowmick & Hazarika, 2017). In American schools, students have provided access to educational opportunities that are changing their futures with the use of assistive technology in the classroom. Assistive technology has broken through the barriers of academic success and future employment opportunities(Team, 2013).

Hypothesis

There will be a significant difference in the academic achievement of visually impaired students with and without using assistive technology at graduate level.

Material and Methods

In a broader sense, the present study is applied and descriptive strategy was used to conduct the research. The researcher has adopted experimental research approach to carry out the research. The population comprised of the visually impaired students of department of Education University of Karachi. Since the population was small in number, the whole population was being considered as

sample of the present study. Since the study was experimental in nature the researcher has designed five Performa as follows:

- Participants demography Performa (PDP)
- Course material information (CMI)
- Voice over volunteer Performa (VVP)
- Writing Volunteer Performa (WVP)
- Student feedback Performa (SFP)
- Pre and post assessment Performa.

The reliability and validity of research instrument were ensured through a committee of three experts. The data was collected as per progress of day to day teaching.

Data Analysis Procedure

The demographic information was analyzed by using descriptive strategies. The feedback Performa was analyzed by using frequency tables and t-test for independence. While the pre and post Performa was analyzed by using a Paired sample t-test.

Results and Discussion

Table 1
Cross-tabulation with Department and smartphone

		Do you use a smartphone?	Total
		Yes	
Department	Education	40.0%	40.0%
	Islamic Learning	40.0%	40.0%
	Islamic History	20.0%	20.0%
Total		100.0%	100.0%

Table 2 showed, in the present experimental study all participants from the Department of Education, Department of Islamic Learning and Department of Islamic History have a smart phone.

Table 2
Cross-tabulation with Department Are you suffering from visual impairment?

		Are you suffering from visual impairment?	Total
		Yes	
Department	Education	40.0%	40.0%
	Islamic Learning	40.0%	40.0%
	Islamic History	20.0%	20.0%
Total		100.0%	100.0%

Table 4 showed, in the present experimental study all participants from the Department of Education, Department of Islamic Learning and Department of Islamic History are suffering from visual impairment.

Table 3
Cross-tabulation with Department and type of visual impairment

		What type of visual impairment you have	Total
		Blindness	
Department	Education	40.0%	40.0%
	Islamic Learning	40.0%	40.0%
	Islamic History	20.0%	20.0%
	Total	100.0%	100.0%

Table 5 showed, in the present experimental study all participants from the Department of Education, Department of Islamic Learning and Department of Islamic History suffered from complete blindness.

Table 4
Cross-tabulation with Department and Since when you are having visual impairment?

		Since when you are having visual impairment?	Total
		Since birth	
Department	Education	40.0%	40.0%
	Islamic Learning	40.0%	40.0%
	Islamic History	20.0%	20.0%
	Total	100.0%	100.0%

Table 6 showed, in the present experimental study all participants from the Department of Education, Department of Islamic Learning and Department of Islamic History have blindness since birth.

Hypothesis Testing
Null Hypotheses: There is no significant difference in mean scores of academic achievement with and without using assistive technology.
Alternate Hypotheses: There is a significant difference in mean scores of academic achievement with and without using assistive technology.
Or   **Ho**: $\mu_d = 0$ **Ha**: $\mu_d \neq 0$ $\alpha = 0.05$

Test Statistic
Table 5
Paired Samples Statistics

		M	N	SD	SEM
Pair 1	First semester result without using Assistive Technology	65.20	5	11.167	4.994

Second semester result with using Assistive Technology	75.20	5	5.541	2.478

Using an alpha level of .05, a paired-samples t-test was used to evaluate whether the first semester without using Assistive Technology and second semester with using Assistive Technology result differed significantly on using of assistive technology. Table 7 showed for the First semester result M = 65.20, SD = 11.167, SEM = 4.994 for the Second semester result M = 75.20, SD = 5.541, SEM = 2.478. It may be concluded that there is significant difference in M (65.20; 75.20) and SD (11.167; 5.541) of visually impaired students with using Assistive Technology.

Table 6
Paired Samples T-Test

		Paired Differences					t	df	p
		M	SD	SEM	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	First semester result without using Assistive Technology - Second semester result with using Assistive Technology	-10.00	9.301	4.159	-21.548	1.548	-2.404	4	.074

Table 8 showed that there is significant difference between First semester result without using Assistive Technology & Second semester result with using Assistive Technology with t (5) = -2.404, where M = -10.0, SD = 9.301, SEM = 4.159.
Decision: p = .074 > .05.
Conclusion: Hence, we accept H_0 and it revealed that there is no significant difference in academic achievement of visually impaired students with and without using Assistive Technology.

Feedback Performa Analysis

Table 7
Descriptive Statistics for Feedback Performa

		How did you find the difference in examination preparation using assistive technology?	Would you like to continue this program for the upcoming academic year?	How was the quality of the voice?	How was the quality of fluency?	How was the clarity of voice?	How was the quality of pronunciation?	How was the quality of the accent?	How was the quality of length and breadth of content?
N	Valid	5	5	5	5	5	5	5	5
	Missing	0	0	0	0	0	0	0	0
	M	1.40	1.00	1.00	1.00	2.80	1.00	1.00	1.00
	Md	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00

Mo	1	1	1	1	3	1	1	1
SD	.548	.000	.000	.000	.447	.000	.000	.000
σ²	.300	.000	.000	.000	.200	.000	.000	.000
R	1	0	0	0	1	0	0	0

The descriptive statistics for feedback Performa on variables; difference in examination preparation using assistive technology, continue this program for upcoming academic year, quality of voice, quality of fluency, clarity of voice, quality of pronunciation, quality of accent and quality of length and breadth of content. Table 9 showed for variable difference in examination preparation using assistive technology M= 1.40, Md = 1.00, Mo = 1, SD = .548, σ² = .300, and R = 1. For variables, would you like to continue this program for upcoming academic year, quality of voice, quality of fluency, quality of pronunciation, quality of length and breadth of content M = 1.00, Md = 1.00, Mo = 1, SD = .000, σ² = .000, and R = 1. For variables quality of clarity M = 2.80, Md = 3.00, Mo = 3, SD = .447, σ² = .200, and R = 1.

Table 8
How did you find the difference in examination preparation using assistive technology?

	Frequency	Percent	Valid Percent	Cumulative Percent
It was outstanding	3	60.0	60.0	60.0
It was good	2	40.0	40.0	100.0
Total	5	100.0	100.0	

For variable using assistive technology for examination preparation, Table 10 showed 60% of participants stated it was outstanding while 40% stated it was good.

Table 9
Would you like to continue this program for the upcoming academic year?

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes, I would like too.	5	100.0	100.0	100.0

Table 11 showed for the variable that would you like to continue this program for the upcoming academic year, for which 100% participants stated yes they would like to continue the program for the upcoming academic year.

Table 10
How was the quality of the voice, fluency and accent?

	Frequency	Percent	Valid Percent	Cumulative Percent
Excellent	5	100.0	100.0	100.0

For the variable how was the quality of voice, table 12 displayed100% of participants stated it was excellent.

Table 11
How was the quality of length and breadth of content?

	Frequency	Percent	Valid Percent	Cumulative Percent

| Valid | Excellent | 5 | 100.0 | 100.0 | 100.0 |

For the variable how was the quality of length and breadth of content, table 17 revealed 100% participants stated it was excellent.

Advancement in technology has been catering to students with visual impairment to provide new opportunities to be work independently at school, college and workplace for the last two decades(Abner & Lahm, 2002). The need for assistive technology for these students (partially blind or completely blind) is essential for active participation in technological society (Kapperman, Sticken, & Heinze, 2002).

Assistive technology devices not only provide the benefit but it also supports them to compete with peers more independently. It should be considerably noticed that, what and which type of tools, gadgets, and technology will be most suitable to fulfill these students' unique learning needs. To facilitate the visually impaired students of the department of education in university of Karachi researchers took an initiative by voice recording of course content and provide the audio files to the students enrolled in B.A (Hons) First year.

It has been observed that a number of visually impaired students have enrolled in different departments of social sciences as well as in the Department of Education at the University of Karachi. They have been attended classes and took lectures with mainstream students without any extra support or facility. The traditional lecture method is more challenging to keep the visually impaired students more attentive and engaged in learning activities. These students need hands-on engagement.

It has also been noticed that books, notes, handouts, and other study materials are available for mainstream students but there are no such arrangements which can facilitate visually impaired students to pursue their education i.e. in Braille, enlarge print or in audio form or any access to software such as JAWS. These visually impaired students just listen or sometimes record the lecture in their cell phone with the permission of their teachers and listen to it later at home, which is not sufficient for visually impaired students to achieve their academic goals.

A considerable need has been felt to facilitate these students by providing them course content and study material in audio files. Therefore, for this purpose researchers made a detailed content course material collected from various authentic books in both languages i.e. Urdu and English, according to their course outline provided by the University of Karachi for First year, second semester. The next step was too gathered student-volunteers from the University of Karachi for the voice recording of course material. The volunteering was free of cost, due to which researchers faced some issues regarding voice recording. Some student-volunteers showed great interest at the start of the project, but later, volunteers also got busy in their studies as they were also students atthe University of Karachi and couldn't manage time. This issue caused hurdles and delayed voice-recording.

The unit-wise voice recording of course material provided to participants while the researcher also supervised their learning with time to time by asking questions regarding course material. Hence, at the time of examination, the writing-volunteers from various Departments of social science except from the Department

of Education were helped out the participants for writing in the examination. The participants' final results of semester showed the admirable difference in their marks between with and without using assistive technology for study. While hypothesis testing in the present experimental study, we failed to reject a false null hypothesis which is actually type-2 error. This error could be eliminated by increasing sample size, but due to the available visually impaired student of education only, the researchers was bound to depend on small sample size available.

The academic achievement was higher with using assistive technology in contrast with and without assistive technology as the marks showed large differences in first and second-semester results. Participants were very much happy and satisfied with their results. They showed great interest and expressed that these audio files are very much helpful for them to get prepared for their examinations. When it was asked to them that, what difference did they find to get prepared for exams by using assistive technology? They responded positively and stated that by using assistive technology they are now more confident and enthusiastic about learning. Most of them stated that previously they had taken help by YouTube videos which were not according to their course outline and content available on YouTube was not sufficient for their academic needs. Sometimes they had to request their friends, classmates and family members to read aloud so that they can memorize it for their examinations but after getting these audio files they can study independently without the help of any person. One of the participants stated that "*In previous semester I used to search videos on YouTube, sometimes I was successful to find relevant material but most of the time feeling disappointed to get the right material*". These audios files are recorded according to my course outline and fulfill all my academic needs for the preparation of examination." The quality of voice is clear and the accent is very much appropriate and understandable. It was suggested by one of the participants that while recording in English, difficult words should be spelled separately so that it will be better and easy to understand. It is recommended by all the respondents that this project should be continued for future semesters and for other courses too so that they can get benefits for their studies till Master's Program without any difficulty and dependency.

Conclusion

Learning can be complicated for numerous reasons not for only a normal student but for also a disabled student in a common teaching-learning process. To minimize the difficulty level of learning in their academics for visually impaired students Assistive technology has been introduced which can be considered as one of the remarkable innovations of this century. Assistive technology enables the impaired students to live, learn and work independently without the assistance of anyone. It also minimized the dependency rate of visually impaired students on other people. The prior studies have revealed that only an inclusive, integrative and demanding quality educational system can ensure a balanced opportunity for all students.

In the above-mentioned statement, it has been clear that the role of Assistive technology is much more important and significant for visually impaired students. It not only provides the benefits to visually impaired students but also encourage them to compete with their fellow learners. Thus, to facilitate the visually impaired students, this experimental study was conducted on students enrolled in B.A. (Hons.)

program and studying in Department of Education choosing Education subject as major or subsidiary subject at the University of Karachi. The main focus of this experiment was to compare the results of visually impaired students of two semesters with and without using assistive technology. The course material of the study was provided to the student in audio files, while the whole process of learning was supervised by researchers. The results showed significantly difference from the previous semester. The participants showed an impressive improvement in their academics scores in the second semester i.e. when participants study course materials with the help of assistive technology.

Recommendations

Based on our experimental study, the following recommendations are proposed:

1. It is recommended to facilitate visually impaired students in classrooms by using Assistive technology.

2. University/ Teachers should provide voice recorded lessons of course content.

3. Software access to visually impaired students such as JAWS should be provided by University.

4. University should develop policies regarding visually impaired students which help them in learning.

5. Books and notes of course materials should be provided in Braille to visually impaired students.

6. Audio-Visual rooms should be set which facilitates visually impaired students only.

7. For voice recording, paid volunteers should be hired outside or inside the University.

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