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RESEARCH ARTICLE

INSTRUMENT DEVELOPMENT AND VALIDATION OF A QUALITY SCALE: ICT ENABLED DEVICES FOR DIFFERENTLY ABLED STUDENTS

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ABSTRACT

The present study is focused on instrument development and validation of a quality scale. There are limited measures to assess PWD's ICT needs, purpose of using ICT devices and problems in the usage of various devices. Hence the study aimed to validate and standardize the schedule to assess ICT enabled devices used by differently abled. Market survey was conducted to check the availability of various ICT and assistive devices for differently abled students. With the help of relevant literature and market survey a questionnaire was developed for pilot study. The pilot study was conducted in disabled institutes using 30 respondents (10 respondent's form each category of disability i.e. visually impaired, hearing impaired & locomotor impaired). With the help of pilot study the tool was developed and many parameters were added to the questionnaire. In the last phase, a group of 30 experts were consulted in the related and allied fields to validate the questionnaire. The experts were asked to evaluate the instrument in terms of clarity of items, linguistic accuracy and appropriateness of the instrument to achieve the purpose of the study. In this phase the items for relevance with the help of experts using 3 point likert scale was evaluated. Each item was scored as 3, 2, 1 i.e. highly relevant, moderately relevant and irrelevant. Revisions and suggestions made by experts were taken into account. After validation of the instrument, some parameters were added and some were deleted for its relevance and appropriateness. Thus, the tool was finalized and the finding of this study indicates good reliability and validity of the schedule.

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INTRODUCTION

Information and communication technology (ICT) has the potential to enhance participation in educational activities for students with physical disabilities. Even though incorporating ICTs into teaching and learning in education has become an important issue but it is not clear what evidences research has provided. (Lidstrom *et al.,* 2014) In today's society, where information plays an important role, being able to use Information and Communication Technologies opens up opportunities for holding more responsible social positions. It is also more convenient for governments, institutions, public and private enterprises to use the Internet to provide information services. Moreover, ICT offers great opportunities of social inclusion. Technological development can enable people with disabilities to improve their quality of life. They can accomplish tasks that would be impossible to do without the computer, such as: writing a letter, communicating, drawing a picture, etc. Moreover, the digitalization of many public services such as education (school, university), shopping, banking, library, or even sending a letter allows people with disabilities to live in much the same way as those who are not disabled. They can acquire an "independent life" and achieve social integration. However, the prospective promised with the digital era often has not become the reality for most people with disabilities. (Arrigo, 2005) In a country like India where the disabled population is 2.21 percentages (as per census 2011) of the total population, access to ICT remains neglected for many disabled. In such cases, creating self sufficiency and independence through the fruits of technology would play a pivotal role towards ensuring their basic rights and dignity. It is imperative that people with disabilities are entitled equal access to education and employment, equal rights to parenthood, property ownership, political rights, and legal representation. Computers, adaptive technology and the internet can help disabled people take advantage of education and employment opportunities leading to sustainable long term empowerment opportunities. (Hossain, 2010) In present scenario, the society where we live in is called a Global Society and the gradual development of Information and Communication Technologies (ICT) contributes to its change

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and development. Disability is inevitably associated with several limitations with regard to electronic accessibility and individuals with various forms of disability cannot be excluded from technological evolution. Therefore, it is imperative that they benefit from such technologies, should fulfill the need of the disabled and should promote their digital inclusion, communication and autonomy.

The benefits of the ICT tools for resource discovery should reach the disabled users without any barrier. They should also be able to handle the tools without any difficulty. Their hidden talents should also be expressed through the modern ICTs for the welfare of the society. The disability should not be a hurdle for exposure of their talents. The ICT tools should be modified or new accessories may be invented, to attach with the existing tools, to rectify the defect (Nagarajan *et al*., 2001). The information and communication technology will be helpful to reduce the discrimination of the differently abled and will make a suitable environment for them to work along with the other ICT tool users. Employment opportunities should be created for persons with disability to expose their talents and make them independent. Therefore, the usage of ICT tools for resource discovery should be made available to all the citizens including the physically disabled so that the full- fledged global access can be achieved. Assistive technology for disabled is defined as any equipment or system that assists people who have difficulties, due to age or disability, in carrying out everyday activities. The Foundation for Assistive Technology (FAST) 19 uses a similar definition: "a product or service that enables independence for older or disabled people". Assistive technology is coming to be the preferred term for all such devices rather than "disability equipment" or "technical aids". It covers simple items such as walking sticks, bath seats and grab rails, as well as electro-mechanical equipment (e.g. powered wheelchairs), electronic aids (e.g. digital hearing aids and environmental controls), or equipment used by care takers such as lifting aids. (Curry *et al*., 2002)

Technology can reduce the effects of impairment by improved activity and greater participation, to promote inclusion of students with disabilities. Access to ICT for students with disabilities may require more (and more costly) resources than are provided for other students. Different technologies are adopted or adapted for use for students with hearing, vision, communication, physical and intellectual disabilities. Technology issues arise in two ways for students with disability. First, the emphasis has been on the costs of providing services to people with disability in the form of assistive technologies. Second, with the introduction of ICT as a new mode of pedagogy, access to computers enables students with disabilities to participate more fully in learning activities. (Nanda *et al*., 2012) Fichten *et al*. (2009) developed the POSITIVES Scale (Postsecondary Information Technology Initiative Scale), a brief, bilingual, reliable, and valid measure to allow staff at postsecondary and rehabilitation institutions a means to assess the extent to which the information and communication technology (ICT)-related needs of students with various disabilities are met. The researcher found that students participants were relatively old (mean age was 28) and about half of the sample reported a learning disability, about a third reported a psychological/psychiatric disability, and over a third reported more than one disability. This implies that different adaptive computer technologies meant to support people with different disabilities need to be able to operate together. Akbulut *et al*. (2007) has conducted a study to analyze psychometric features of a scale which was developed to measure indicators of Information and Communication Technologies (ICTs) at an undergraduate institution in Turkey. Questionnaire items for each factor were prepared and verified through expert panels. The questionnaire was administered to 359 education college students at a Turkish state university. Exploratory factor analysis eliminated 13 of 54 questions in the scale, identified 10 factors accounting for 51.557 % of the variance. The internal consistency was also high (α=.888). Al-Natour *et al*. studied the status quo of using ICT among special education teachers in Amman- Jordan schools. This study focused to the extent to which ICT has been made available to teachers and students, and obstacles that hinder their use. The researcher developed a questionnaire and 137 teachers were participants in the study. 97 questionnaires were returned, representing 70% of the total population. Results of this study indicated that availability of tools and devices was limited. The output of this research shows that educational programs available in resource rooms were Word Processor, PowerPoint, graphic related programs, and educational games. Difficulty in accessing the internet, lack of educational programs for students with special needs, and lack of educational devices were the obstacles encountered by special education teachers. Results of this study showed significant differences among special education teachers based on their educational qualifications.

Objective

Validate and standardize the schedule to assess ICT enabled devices used by differently abled students.

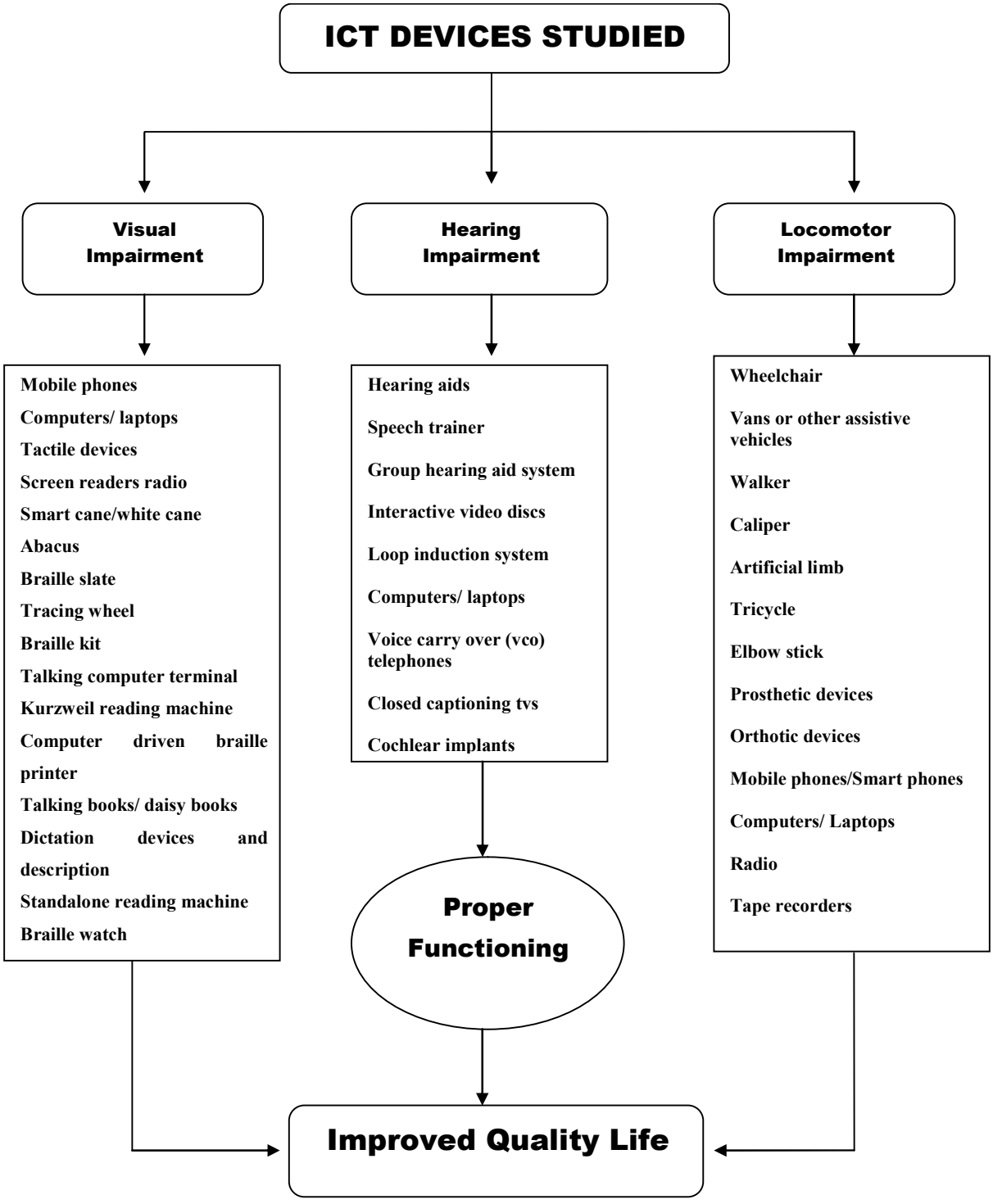
Rationale

The objective behind developing a schedule for differently abled students is to study the ICT enabled devices available in various institutes of higher education. The study also aims to assess the extent to which the ICT enabled devices are being used by differently abled students and what kind of barriers they are facing while using various ICT and assistive devices. Thus, the goal was to ensure that a scale may be developed that can be completed by the students with three kinds of impairment i.e. visual impairment, hearing impairment and loco-motor impairment that would be able to evaluate how students are using various assistive and communication technologies to improve their quality of life and to make barrier free environment for them. With the help of developed tool, the influence of modern and traditional ICTs on persons with disabilities and the extent ICTs are helpful in making their life barrier free and improving their quality of life can be assessed. Moreover, the use of ICT will enhance students' autonomy, self-esteem, self-confidence, and spirit of cooperation, particularly among those with special needs. For instance, using different programs by such students can motivate them to participate effectively in their learning and throughout their life. If they use supportive technology, it can reduce the dependence of differently abled persons on others

and engages them in their societal activities especially when they find themselves in a position where they can directly get into contact and interact with those around them. To ensure that the ICT-related needs of students with visual impairment, hearing impairment and loco-motor impairment are well met, using the tool; A study on customization of ICT enabled devices for differently abled students, needs to become an institutional priority for colleges, universities, tutoring centers, and rehabilitation facilities. The outcome of this tool will result in majority of the ICT- related needs of the students being met; contribute to remove the barriers face by students while using ICT devices, and equip students with some challenges with the skills needed to succeed in the increasingly ICT-driven world of daily living, college work, community, and leisure.

MATERIALS AND METHODS

The process of developing a scale and testing its validity was being carried out in four phases. In the first phase, a market survey was conducted to check the availability of various assistive and ICT devices for differently abled. Checklist was prepared for market survey. With the help of market survey and relevant literature, an open ended questionnaire was designed for pilot study. The purpose of designing open ended question was to determine the appropriate parameters for the study. As the study aims to explore various ICT enabled devices for persons with visual impairment, persons with hearing impairment and persons with loco-motor impairment, so the questionnaire consisted of 3 sections as A, B and C.



Section A deals with the kind of ICT devices used by the respondents, section B deals with the purpose of using various devices and section C deals with the problems faced by the respondents in the usage of ICT devices. In the second phase, a pilot study was conducted in the disabled institutes by selecting a sample of 10 from each disability to make a total of 30. With the help of pilot study many new parameters were identifies to construct the tool.

In the third phase, the tool was developed incorporating all the parameters. Many parameters were added to the questionnaire. Open ended questions were made into closed ended questions. So the items were generated for content evaluation with the help of pilot study. The questionnaire consists of 3 sections as A, B and C. In the section A, focus was to assess the knowledge regarding ICT enabled services. Respondents had to answer in Yes or No. In the section B respondents were asked to respond about the purpose of using various ICT related devices. Multiple choice questions were asked in this section. In the section C, questions were designed to know the problems faced by the respondents while using ICT related devices. Thus, the instrument was developed based on extensive review of literature, market survey and pilot study. In the fourth phase, a group 30 experts were consulted in the related and allied fields to validate the questionnaire. The experts were asked to evaluate the instrument in terms of clarity of items, linguistic accuracy and appropriateness of the instrument to achieve the purpose of the study. In this phase the items for relevance with the help of experts using 3 point likert scale was evaluated. Each item was scored as 3,2,1 i.e. highly relevant, moderately relevant and irrelevant. Revisions and suggestions made by experts were taken into account. After validation of the instrument, some parameters were added and some were deleted for its relevance and appropriateness. Thus, the tool was finalized. The questionnaire consists of 5 sections as A,B,C,D&E. Section A consists of uses of various ICT devices, Respondents have to answer in Yes, No and Sometimes, section B consists of purpose of using various ICT devices; respondents were asked to choose one option as questions in this section were multiple choice questions. Section C consists of problems faced by the differently abled students in the usage of ICT devices. Section D and E deals with the open ended questions as what features they feel to be incorporated in any of the ICT devices and what other devices they feel to have to improve their quality of life. Thus, the scale was developed and validated.

DATA ANALYSIS

Principal component factor analysis was used to assess construct validity (Elsaadani, 2012). Data presented in the table 1, clearly revealed that instrument provides a great deal of information about the respondents. Majority of the items in instruments scored 'r' value 0.75 or >0.75 means items are relevant to collect information. Seven items in the table shows perfect positive correlation as 'r' value is +1. In the line of above, five items scored 'r' value +0.9, these items shows very high degree of positive co-relation. Seven items from the table scored 'r' value +0.75 or > 0.75 indicates items framed in the instrument are positively correlated. Only three items in the table shows negative correlation as 'r' value is – 0.375 and -0.49, means items are relevant to collect information. Individual with visual impairment rely on JAWS software, computers/laptops and Braille language in writing and reading which can only be used by special machine for paper dotting. Therefore, feeling or touching is the main sense by which Braille enables them to learn and teach (Al-Natour *et al*., 2008).

Table 1. Use of ICT devices by persons with Visual Impairment

S.No.	Items	R value
1.	Use of mobile phones.	1
2.	Use of JAWS software.	1
3.	Use of computers.	1
4.	Use of laptops.	0.965
5.	Use of tactile devices	- 0.375
6.	Use of screen readers	0.750
7.	Use of radio	0.750
8.	Use of tape recorder	.075
9.	Use of smart cane	0.750
10.	Use of ABACUS	.871
11.	Use of Braille slate	.849
12.	Use of tracing wheel	-.375
13.	Use of Braille kit	.965
14.	Use of German slate	.963
15.	Use of compressor	.965
16.	Use of talking computer terminal	.367
17.	Use of kurzweil machine	.965
18.	Use of optacon	.375
19.	Use of computer driven Braille printer	.750
20.	Use of paperless Braille machine	1
21.	Use of talking book	.491
22.	Use of dictation devices	.750
23.	Use of standalone reading machine	.521
24.	Use of Braille translation software	-.491
25.	Use of text to speech software	1
26.	Use of book scanner	.736
27.	Use of Braille watch	1
28.	Use of white cane	1.00

Table 2. Use of ICT devices by persons with Hearing Impairment

S.No.	Items	R value
1.	Use of hearing aids.	.404
2.	Use of speech trainer.	1
3.	Use of group system.	1
4.	Use of interactive video discs.	.937
5.	Use of loop induction system	-.761
6.	Use of computers/laptops	.404
7.	Use of videophones	.937
8.	Use of captel	.474
9.	Use of voice carry over telephones	.474
10.	Use of closed captioning	.529

Table 2 indicates the ICT and assistive devices used by persons with hearing impairment and its relevance was tested by using Pearson correlation. In the above table, four items scored 'r' value +1 or 0.9 or > 0.9, it means questions are relevant to collect information. Speech trainer and group system is more common assistive device among hearing impaired persons while ICT related technologies are also preferred as interactive video discs, video phones, computers and laptops. Some of the devices as hearing aids, loop induction system, captel and closed captioning shows positive correlation. Many studies in this field suggested that use of assistive technologies may vest in psychological benefit by enhancing the potential of persons with hearing impairment to make possibility about how they carry out their daily activities and the degree to which they

participate in daily activities (Agree and Freedman, 2011). Thus, above table shows that some questions are highly relevant and some questions moderately relevant to collect information from hearing impaired respondents.

Table 3. Use of ICT devices by persons with Loco-motor Impairment

S.No.	Items	R value
1.	Use of wheelchair.	**1**
2.	Use of vans or other assistive vehicles.	**1**
3.	Use of walker.	**1**
4.	Use of caliper.	**1**
5.	Use of artificial limb	**1**
6.	Use of tricycle	**1**
7.	Use of elbow stick	**1**
8.	Use of prosthetic devices	**1**
9.	Use of orthotic devices	**1**
10.	Use of cochlear implant	**1**
11.	Use of mobile phone	**1**
12.	Use of computers/laptops	**1**
13.	Use of radio	**1**
14.	Use of tape recorder	**1**

Table 3 describes use of assistive and ICT devices by locomotors. Pearson Correlation was used to check the relevance of items constructed in instrument for persons with physical disability. As far as 'r' value of the items is concerned, all the items scored 'r' value +1 and it shows perfect positive correlation. From the above table it can be interpreted that ICT related and assistive technologies as computers, laptops, radio, television, mobile phone, calipers, tricycle and elbow stick are more common devices used by persons with physical disabilities. These measures appeared to perform substantially better than questions about the role of assistive technology in reducing pain, the extent to which activities were tiring, the amount of time needed to carry out activities, and reliance on other people **(**Agree and Freedman, 2011).

Table 4. Purpose of Using ICT devices by persons with Visual Impairment

Snow.	Items	R value
1.	Purpose of using mobile phones	**1**
2.	Purpose of using computers	**1**
3.	Purpose of using laptops	**1**
4.	Purpose of using radio	**.500**
5.	Purpose of using screen readers	**.500**
6.	Purpose of using tape recorders	**.500**
7.	Purpose of using Braille translation software	**.655**
8.	Purpose of using Braille embosser	**.655**
9.	Purpose of using Braille E books	**.655**
10.	Purpose of using audio text books	**1**
11.	Purpose of using handheld magnifiers	**1**
12.	Purpose of using stand magnifiers	**1**
13.	Purpose of using spectacle magnifiers	**1**
14.	Purpose of using tactile materials	**1**
15.	Purpose of using optacon	**1**

It was anticipated that questions on the assessment instrument would address three categories of the theoretical framework (highly relevant, moderately relevant, and irrelevant) used to construct the assessment instrument (Fitzallen, 2006). As the study aims to validate and standardized the schedule to assess ICT enabled devices used by differently abled**,** Table 3 shows the purpose of using various ICT devices. Nine items in the table shows perfect positive correlation as scored 'r' value +1. These items are highly relevant for the purpose of collecting information from blind or partially blind. Remaining items in the table shows 'r' value 0.5, 0.6, these items are also relevant for data collection. In the light of above result, it can be concluded that information technologies as mobile, computer, laptop, Braille e books, audio text books handheld magnifiers, tactile material and optacon are more common devices used by persons with visual impairment.

Table 5. Purpose of Using ICT devices by persons with Hearing Impairment

S.No.	Items	R value
1.	Purpose of using closed captioning television	**-.500**
2.	Purpose of using real time captioning	**1**
3.	Purpose of using loop induction system	**1**
4.	Purpose of using video remote interpreting	**.500**
5.	Purpose of using computer	**1**
6.	Purpose of using laptop	**1**
7.	Purpose of using video phones	**1.00**
8.	Purpose of using cap tel	**1.00**

Table 5 is concerned with purpose of using ICT devices by hearing impaired and the table indicates that majority of the items are highly relevant. Only one item in the table shows negative correlation as 'r' value is – 0.5. Rest of the items shows positive correlation in the items. Devices that are reducing the barriers and improving the quality of life of the respondents are laptop, computer, video phones, loop induction system and real time captioning. Moreover, such items can increase their efficiency of work and create barrier free environment for them. This implies that different assistive and ICT technologies meant to support persons with differently abled need to be able to operate together (Fichten *et al*., 2009).

Table 6. Purpose of Using ICT devices by persons with Loco-motor Impairment

S.No.	Items	R value
1.	Purpose of using wheelchair	**1**
2.	Purpose of using tricycle	**1**
3.	Purpose of using mobile phones	**.309**
4.	Purpose of using laptop	**.271**
5.	Purpose of using radio	**.527**
6.	Purpose of using television	**.790**

In order to investigate the use of ICT by physically disabled, an exploratory factor analysis was conducted through PAS for windows (Akbulut, *et al*., 2007). Factor analysis is used as a data reduction technique, which takes a large set of variables, and reduces or summarizes the data using a smaller set of components (Pallant, 2001). The table shows that two items out of six are highly relevant (r= +1) and one item is relevant as 'r' value + 0.79. Wheel chair and tricycle are the assistive vehicles mostly used by the respondents. These vehicles are mainly used for going to institute and market. ICT related devices as mobiles are used for the purpose of communication. Radio and television are used for the purpose of information gathering. Laptop and computers are used basically for academic purpose.

Conclusion

As a pivotal step in greeting the assessment of ICT enabled devices used by differently abled, this developed scale fills the

gap. The assessment instrument can be used in variety of ways to assess the ICT services used, purpose of using various ICT services and problems faced while using these services by disabled. The instrument will also provide an avenue to customize need based assistive devices to overcome the barriers faced by them. With the help of validated and standardized the schedule, it will be easier to measure the ICT enabled services for differently abled independently.

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