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Usability Test for Teachers in Their Training to Care for Children with Hearing Disabilities Mediated by ICT

E. Archundia-Sierra, ORCID: 0000-0001-9686-5305 <etelvina.archundia@correo.buap.mx>

*Benemérita Universidad Autónoma de Puebla, Facultad de Ciencias de la Computación,
Puebla, Pue., Mexico.*

Abstract. The training of teachers in the inclusive classroom in attention to children with hearing disabilities is important for an educational system in equal conditions. The User-Centered Design (UCD) methodology and the System test Usability Scale (SUS) provided perception data to support teacher training in the inclusive classroom, especially for children with hearing impairment. The test (SUS) was applied to 12 teachers, the result of the study indicates that the usability of all the tools is above the standards (72.5), equivalent to a very good rating. The tool fostered acceptance by teachers for inclusive classroom training, in addition to needing a teacher training program where children with disabilities and learning disorders are cared for.

Keywords: Inclusive classroom; educational technology; teacher training; hearing disability.

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Тест на удобство использования для учителей при обучении уходу за детьми с нарушениями слуха на основе информационно-коммуникационных технологий

Э. Арчундия-Сьерра, ORCID: 0000-0001-9686-5305 <etelvina.archundia@correo.buap.mx>

*Бенемеритский автономный университет Пуэбла, факультет информатики,
Пуэбла, Пуе., Мексика.*

Аннотация. Обучение учителей в инклюзивном классе с уделением внимания детям с нарушениями слуха имеет важное значение для достижения равных условий в системе образования. Применение методологии проектирования, ориентированной на пользователя (UCD), и проведение системного тестирования по шкале удобства использования (SUS) предоставили данные о восприятии для поддержки обучения учителей в инклюзивном классе, особенно для детей с нарушениями слуха. Тестированию (SUS) подверглись 12 учителей, результат исследования показывает, что удобство использования всех инструментов выше стандартов (72,5), что эквивалентно очень хорошей оценке. В дополнение к Программе подготовки учителей, в которой заботятся о детях с ограниченными возможностями и нарушениями обучения, выработанный подход способствовал принятию учителями инклюзивного обучения в классе.

Ключевые слова: инклюзивный класс; образовательные технологии; обучение учителей; нарушения слуха.

Для цитирования: Арчундия-Сьерра Э. Тест на удобство использования для учителей при обучении уходу за детьми с нарушениями слуха на основе информационно-коммуникационных технологий. Труды ИСП РАН, том 36, вып. 1, 2024 г., стр. 251–258 (на английском языке). DOI: 10.15514/ISPRAS–2024–36(1)–16.

1. Introduction

ICTs (Information and Communication Technologies) improve access to information, reduce labor costs and increase the interconnection between people with all the advantages of ICTs. However, digitization is not within the reach of all people, affecting the digital divide. Previously, the digital divide was attributed to underdevelopment and it was assumed that it was a temporary trend that would fade as technology became more widely used, but inequality persists today, despite the widespread commercialization of devices with Internet access [1], furthermore, the concept of equity is based on equality and in it the principle of social justice is applied, taking into account the individual needs of each person and attending to diversity, diminishing differences of any kind, therefore, equity is considered a fundamental indicator of educational quality, as some authors affirm, both terms are inseparable and there is no quality without equity, some research with a gender perspective in education considers that promoting equality would be possible to achieve a more just society [2, 3]. Technology in the classroom could create a major impact if it is designed to be accessible for children with disabilities, which could support teaching/learning processes that are usually adapted to the particular children's needs. An example of this process is literacy teaching for deaf children, where strategies must differ from those used with hearing children. One strategy that has been proven to be effective in teaching and learning processes is storytelling [4].

Dudley-Marling and Burns [5] argued that there were two dominant perspectives among educators regarding inclusive education. The first has been described as a deficit position or medical model because students are said to lack the skills and/or ability to succeed in school. The second perspective is a social constructivist perspective that is based on the notion that the responsibility for the disability does not rest with the student and that structural reform should take precedence over remediation. In other words, the social constructivist perspective suggests that there are sociocultural factors that mediate the success of students in school. Further exploration of how teachers, already in the field, are prepared to teach all students, as well as their willingness to implement inclusive education, is warranted, as studies in this area are scarce.

According to Darling Hammond [6] cited by Larios and Zetlin [7], it is to create a stronger and more equitable educational system, presenting seven elements for effective professional development: (a) it focuses on content, (b) incorporates active learning, (c) supports collaboration, (d) uses effective practice models, (e) provides coaching and expert support, (f) offers feedback and reflection, and (g) is sustained in duration.

The Program for Inclusion and Educational Equity is linked to the 2030 Agenda for sustainable development through the objective of guaranteeing inclusive, equitable and quality education and promoting lifelong learning opportunities for all, ensuring technical, professional and higher education [8]. The World Health Organization (WHO) estimates that more than 400 million people, including 34 million children, have hearing loss that affects their health and quality of life, furthermore, it indicates that by 2050, some 2.5 billion people (1 in 4) will have some form of hearing loss, and that almost 700 million (1 in 14) will have moderate or advanced levels of hearing loss in the better-hearing ear [9]. According to Instituto Nacional de Estadística y Geografía (INEGI) data dating from 2010, in Mexico there are 498,640 people with hearing limitations. On the other hand, in the country there are 401,534 people with limitations to speak and communicate in the country [10].

Hearing plays an important role from birth and occurs at three levels: basic, which allows us to be aware of sounds and our body, medium, which controls the sense of distance, and superior, which allows us to communicate and understand spoken language. Hearing is a sensory process that informs us of what happens beyond a visual field, even while we sleep, it allows us to be in contact

with the social context through linguistic codes. Partial or total hearing loss influences the use of language, learning and the relationship in the environment [11].

Ensuring equitable and quality education in the primary stages is one of the educational goals included in the 2030 Agenda, being the core of the Sustainable Development Goal (SDG 4), although the vision of inclusive education (SDG 4) encompasses all children, youth and adults, this education has historically been associated with the education of children with disabilities, and has often been conceptualized as such, therefore, the struggle of people with disabilities has shaped the understanding of inclusion. From the perspective of the teaching profession, this equitable and quality teaching is aimed at developing skills for work and for life of all students without exception, even among the most vulnerable groups of students or groups [12]. One of the challenges that educational policies have faced has been to improve the equity of our educational system.

The research work meets the recommendations of (WHO) and (SDG 4) at the international level and at the national level in Mexico with the Programs for Inclusion and Educational Equity, in the training of teachers in the inclusive classroom for children with hearing disabilities, designing the content structure, interactive learning activities and feedback through evaluation. The implementation was carried out in an open-source tool (open source) facilitating the creation of content trees, multimedia elements and interactive evaluation activities. The usability test System Usability Scale (SUS) was applied to primary school teachers to verify the acceptance and importance of teacher training in the inclusive classroom in attention to children with hearing disabilities mediated by (ICT).

The structure of the research in section 2 indicates the methodology (DCU) focused on teachers to promote inclusive classroom training for children with hearing disabilities, section 3 presents the design and implementation of the tool and Section 4 shows the results of the usability test (SUS).

2. Methodology

Inclusion must imply more than the placement of students with disabilities in regular classes, it must promote teacher training, therefore, the research question of this paper asks: Children with hearing disabilities, what is the perception of teachers in their training in the inclusive classroom? The objective is determined to know the perception of teachers in their training in the inclusive classroom for attention to children with hearing disabilities. The specific objectives are established in the requirements to train teachers in inclusive classroom care for children with hearing disabilities, the (DCU) is contemplated in the development of content and interactive activities implemented in an open source tool and the usability test (SUS) [13] applied to 12 primary school teachers in a study with a quantitative approach and descriptive scope with non-probabilistic sampling.

User-Centered Design (UCD) is a design methodology focused on the needs of users to develop products and services by improving usability, accessibility and user experience, which translates into greater user satisfaction in the use of the product or service. According to Norman and Draper [14], the (DCU) identifies the needs, requirements and limitations of users to design products that meet those needs effectively and efficiently, to achieve this the design process must be iterative and collaborative, with the active participation of users and designers in all stages of the process, for example , conversational agents for informal caregivers , applying a descriptive phenomenological qualitative study to carry out a questionnaire of open questions for the care of people with dementia and piloted with a commercial device [15] and the automatic translate service of the Nahuatl language , on topics of inclusion when Nahuatl spoken in regions where English the dominant language . This leads native people to in some way forget their mother language in favor of Spanish. In this environment, the language slowly disappears or, even worse, the situation leaves the people of these remote communities excluded from the technological advances and vulnerable to laws or services that are not written in Nahuatl [16].

3. Development

The design of the tool to promote teacher training in the inclusive classroom in care for children with hearing disabilities mediated by ICT integrates the characterization of the dimensions of user-centered design, technology and pedagogy. The user-centered dimension corresponds to the development of the (DCU), the Concur method tasks Tree (CTT) and Application Usability Testing (SUS). The technological dimension is addressed by the educational content creation structure which allows the use of multimedia elements, interactive self-assessment activities and games, it also facilitates the export of content in multiple formats, for example: HyperText markup Language (HTML), Shareable Content Object Reference Model (SCORM) and IMS Content Packaging and the pedagogical dimension, where content, interaction and evaluation activities are analyzed. The pedagogical dimension of the teacher training tool is organized by the beginning, introduction and four units. Unit I. Educational inclusion, Unit II. Hearing impairment, Unit III. Educational attention and Unit IV. Strategies for educational inclusion. Each Unit is integrated by theme and interactive activities such as: fill in the gaps, interactive videos, true-false questions and unordered list.

4. Results

The usability method, to measure the software of the inclusive classroom in care for children with hearing disabilities, is carried out through the questionnaire (SUS) with the following ten questions [17] (Table 1).

Table 1. Questionnaire of questions (SUS)

Q	Question statement
Q1	I think I would use this system frequently.
Q2	I find this system unnecessarily complex.
Q3	I think the system was easy to use.
Q4	I think I would need help from a technically savvy person to use this system
Q5	The functions of this system are well integrated.
Q6	I think the system is very inconsistent.
Q7	I imagine that most people would learn to use this system very quickly.
Q8	I find the system very difficult to use.
Q9	I feel confident using this system
Q10	I needed to learn a lot of things before being able to use this system.

The answers to each statement are requested following the Likert Scale:

- 1. Strongly disagree
- 2. Disagree
- 3. Neutral
- 4. Agree
- 5. Totally agree

The demographic characteristics of the participation of a total of 12 teaching participants from the municipalities of the State of Puebla, Mexico, where 33.33% are men and 66.66% are women, with an average age of 45 years, 83.33% have a Bachelor's Degree in Primary Education and 16.66% have a master's degree, who have an average experience of 18 years at the primary level.

Teachers respond to the 10 questions of (SUS) obtaining the following data (Table 2).

The equations to calculate the values of (SUS) result from applying Equation (1) is used to calculate questions 1, 3, 5, 7 and 9. Equation (2) is used to calculate questions 2, 4, 6, 8 and 10.

$$SUS_{impar} = \left(\sum_{i=1}^{10} score - 1 \right) * 2.5 \quad (1)$$

Equation 1: calculation (SUS) for odd question

$$SUS_{par} = \left(\sum_{i=1}^{10} 5 - score \right) * 2.5. \quad (2)$$

Equation 2: calculation (SUS) for even question

Table 2. Results of the questionnaire (SUS)

Teacher	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
D1	4	2	4	2	4	2	4	2	5	1
D2	5	4	4	2	4	2	4	4	4	2
D3	4	3	4	2	3	2	4	2	4	2
D4	4	2	5	2	4	2	5	2	4	2
D5	4	4	4	2	4	2	4	2	4	2
D6	5	5	5	5	5	1	4	5	5	1
D7	5	3	4	2	4	2	4	2	4	2
D8	4	4	5	4	4	2	4	4	4	4
D9	4	3	4	2	4	2	4	2	4	1
D10	4	3	4	5	5	1	4	2	5	1
D11	1	3	4	2	4	2	4	4	4	2
D12	5	2	5	1	5	1	5	1	5	1
Total	49	38	52	31	50	21	50	32	52	21

The applied results of the scoring rules of (SUS) (Table 3), the average scores of (SUS) [18] and the adjective rating scales for the digital application for teacher training in the inclusive classroom for children with hearing disabilities. The general average of the tool for teachers is 72.5, equivalent to a very good rating. The results of the study show that the perceived usability of the tool in general is very good for all participants, given the deficiencies in inclusion issues.

The open question asked to the teachers: What experience have you had in the inclusive classroom with disabled students in your workplace? 83.33% of the teachers surveyed have had or have students with the following disabilities: auditory, visual and intellectual, in addition to identifying students with autism and speech and language disorders. Most of the teachers surveyed mentioned that they have had children with different types of disabilities, but they do not have the knowledge, tools and resources to be able to teach and integrate the group in the inclusive classroom.

5. Conclusions

The application of the (SUS) questionnaire is an important process to involve teachers in the use of technological tools on inclusion issues for children with hearing disabilities. The data has highlighted some of the benefits and challenges faced in inclusive classroom teacher training to address diversity in schools, emphasizes the need for teachers in training to generate strategies and learning activities aimed at inclusive education immersed in a process of attention to the diversity

of needs of all students to reduce exclusion, in addition to addressing a continuous need for a teacher training program in inclusive classrooms.

As future work, it is contemplated to cover more thoroughly other inclusion topics, such as learning disorders, autism and dyslexia.

Table 3. Scale results (SUS)

Teacher number	Addition	Average	Adjective
D1	32	80	Excellent
D2	27	67.5	Well
D3	28	70	Well
D4	32	80	Excellent
D5	28	70	Well
D6	27	67.5	Well
D7	30	75	Very Well
D8	23	57.5	Well
D9	30	75	Very Well
D10	30	75	Very Well
D11	24	60	Well
D12	39	97.5	The best imaginable

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Информация об авторах / Information about authors

Этельвина АРЧУНДИЯ-СЬЕРРА имеет ученую степень PhD в области информационных технологий и анализа решений, с 1997 года – профессор факультета информатики Бенемерийского Автономного университета в городе Пуэбла. Сфера научных интересов: модели рабочих потоков, совместная работа с использованием компьютеров, человеко-машинное взаимодействие.

Etelvina ARCHUNDIA-SIERRA – Doctor in the Information Technology and Decision Analysis, professor of the Facultad de Ciencias de la Computación of the Benemérita Universidad Autónoma de Puebla, since 1997. Research interests: workflow models, computer supported cooperative work and computer human interaction.

