Functional diversity: Needs for technological accessibility for learning

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ABSTRACT

Since the pandemic beginning, the students' problems became visible, particularly those who have a disability when changing their way of working; in the same way, teachers do not know about technological tools to work through the virtual modality. This lived reality has positive and negative results. Among the negatives are: the disengagement from the educational system, the withdrawal of new knowledge and the breakdown of their relationship with classmates and teachers. On the positive side, it can be mentioned that this pandemic has been an opportunity for both teachers and students, it has made it possible to search for learning and teaching strategies and methodologies based mainly on the virtual modality. This article describes an investigation carried out in Ecuador, in which the techno-logical accessibility conditions, the required competencies and the needs from the functional diversity of 212 children and adolescents with disabilities were identified. Subsequently, a Technological Accessibility Plan for Students with Disabilities (TAPSD) was developed, based on person-centered planning (PCP) and universal design for learning (UDL), in which the use of different technological applications is proposed depending on the students' needs and skills).

Keywords: Functional diversity, assistive technologies, intellectual disability, cerebral palsy, PATED.

INTRODUCTION

The health emergency has forced educational institutions at all levels such as initial, basic, high school and higher education, to change rapidly from face-to-face educa-tion to virtual education. The most prepared were supported by technological re-sources, such as videoconferencing software and educational platforms. In other cases, teachers were looking for ways to connect with their students, especially those with limited connectivity, for which they used social networks and even printed mate-rial to be delivered in person (Espinola, 2020). At government level, radio and television programs have been implemented to reach remote locations. In Ecuador in 2020 there were 4,462,460 students in initial, basic and high school education and despite all the ef-forts there were vulnerable groups that faced a number of problems, such as students with disabilities (Educacion, 2020). Children and adolescents with disabilities (CHAWD), have been particularly affected by the deterioration of their life quality, illness, exclusion or limited access to technologies that could make it easier their education, in addition to a worrying increase in the neglect, violence and abuse. In this context, this article describes a study carried out in Ecuador, which takes as a sample 212 CHAWD that are part of regular or special educational institutions who have psychosocial, physical, intellectual, sensory disabilities, infantile cerebral palsy, spectrum disorder autism, Down syndrome and multi-disabilities, in order to identify their condition in the con-text of education in times of pandemic (Cobeñas, 2019).

This study shows the development of the Technological Accessibility Plan for Stu-dents with Disabilities (TAPSD), which prepares a proposal for technical specifica-tions of the equipment, adaptations and software to meet the accessibility needs of technological equipment that facilitates participation, communication and learning of students with functional diversity (Zhang and et al, 2020). The study identified different ways of teaching (Dalimunte and et al, 2020) taking into account their functional learning in order to develop their activities of daily living (Espinola,2020).

As part of the study, the technological equipment in the 212 CHAWD homes was determined, of which 32.54% make use of tablets, 23.58% smart phones and only 16.98% have a personal computer. In addition, 164 CHAWD connect with Wi-Fi service at home, in a lower percentage access to a mobile data plan or with prepaid plans. Due to the high percentages of intellectual CHAWD, very few can turn on the computer alone, raise or lower volume, or increase and decrease the screen brightness. In other words, the TAPSD considers family members, guardians or people who assist CHAWD intervention in the use of electronic equipment.

Facing this statistical data, the TAPSD has been structured taking into account person-centered planning (PCP) and universal design for learning (UDL), which are methodologies that will allow organizing the way of generating support strategies, taking into account the different types of disability, as well as the competences that they must develop through the search for computer applications, especially open access.

TAPSD DESIGNING FUNDAMENTALS PERSON-CENTERED PLANNING

PCP is developed with strategies based on values and on people with disabilities empowerment, to build their own fulfilling life, happiness and rights project. Seeks to achieve the lifestyle they prefer, be more independent, become community active members, establish degrees of connection with people important to them, express their references and wishes, make choices and make decisions (Molany and et al, 2020)

PCP is developed according to the scheme proposed in Figure 1, in which some adaptations have done to identify the technological requirements according to their special educational needs (SEN) and define the TAPSD.

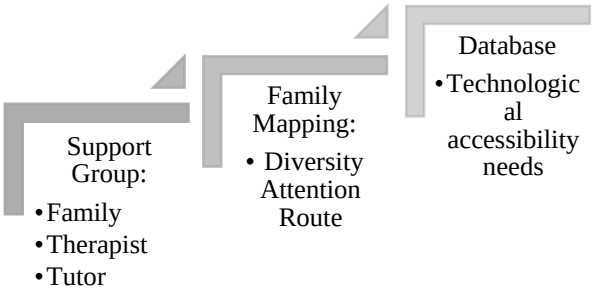

Figure 1. Supports and resources systematization to structure PCP

UNIVERSAL DESIGN FOR FUNCTIONAL LEARNING

The Universal Design for Learning (UDL) arises in the architecture field, whose objective is to personalize the educational journey through the creation and development of a Personal Learning Environment (PLE) and aims to adjust the principles of the curricular design of different educational levels, this approach was developed by the Center for Special Applied Technology CAST, a center that was born in 1984 in order to develop technologies that would support students with some type of disability learning, in such a way that they could access the same curriculum as his companions (Dalimunthe and et al, 2020). It promotes a curriculum easing, so that it is open and inclusive, trying to minimize the necessary and inevitable subsequent adaptations. In this way, equal opportunities in access to education are favored. Many authors understand the UDL as a set of principles focused on an inclusion and accessibility purpose.

The UDL refers to the curriculum elements (aims, objectives, methods, materials, and evaluation (Aguilar,2013), to modify or adapt them effectively and develops guidelines derived from three principles: i) provide multiple forms of representation. ii) Provide multiple forms of action and expression. iii) Provide multiple forms of involvement.

At the same time, the principles and guidelines of the UDL, develop a series of strategies to

be proposed, in order to achieve students' learning. Taking into account the development of the TAPSD, adaptations related to the principles and guidelines related to technological equipment and the use of computer applications are proposed (Delgado-Valdiviezo, 2021).

METHOD

In order to know and intervene according to the accessibility needs for technological equipment according to the functional diversity of students, a qualitative and quantitative research design structured by descriptive objectives was used.

The first objective analyzes the accessibility needs of 212 students with multiple disabilities, severe physical disabilities and other accessibility challenges, to define the technological equipment use that facilitates their participation, communication and learning. The information contents provided according to each student in educational institutions, as proposed by the PCP, with strategies based on values and on the empowerment of people with disabilities, to help them build their own fulfilled life project, were considered as references. The PCP seeks to achieve the lifestyle they prefer, be more independent, become active members of the community, establish degrees of connection with people important to them, express their references and wishes, and make choices. For this objective, the purposes of technological accessibility were taken into account, for which the technological equipment was defined, as well as the computer applications that facilitate functional learning. The main characteristics that allowed its application were: i) carry out a plan for the future based on the use of technologies and ii) focus more on the virtues and positive points than on the limitations and deficiencies of the CHAWD to make use of equipment and computer science applications. The PCP was developed according to identify technological requirements according to special educational needs.

The Inclusive Education Model "Fe y Alegría Ecuador", in which the PCP is referenced, presented in information obtained from the Action Plans or Family Mapping (Reyes and et al, 2019), conducted in CHAWD homes, involves the student, with people who know and are interested in they, evidencing information related to their history, tastes, strengths, dreams, fears, functional assessments, among other aspects (Ramos-Galarza and et al, 2020). All this helps to plan the short, medium and long term person's future. The information obtained analyzed according to its relevance will be a guide for carrying out the TAPSD in which it seeks to incorporate the family and a multidisciplinary team for a joint assessment and planning. The criteria adopted were determined considering the accessibility needs of students with disabilities, for which on-site meetings were held with tutors, educational psychologists, social workers, and parents and/or representatives.

The information collection, to know the technological accessibility needs of the CHAWD, was carried out using a data collection instrument, according to a techno-logical accessibility questionnaire, which was organized into three levels: i) Equipment and connectivity, ii) psychomotor and iii) pedagogical support. This information was complemented with the mappings that have each CHAWD, according to a history within the educational institutions.

The second objective that pursued to develop a Technological Accessibility Plan for Students

with Disabilities (TAPSD), was developed based on the needs of accessibility to technological equipment, according to the functional diversity of 212 CHAWD, the PCP methodology was used, seeks proposals, solutions, hardware adaptations, free access software recommendations or general conditions that facilitate their access and use of technological equipment for learning and communication. For PCP design, the Universal Design for Learning (UDL) methods were considered, taking into account its applicability in functional learning, as well as its methods related to the use of technological equipment and computer applications.

RESULTS AND DISCUSSION

The results related to the first objective Taking into account the first level related to equipment and connectivity: i) Electronic equipment, the data give an idea of the scenario for accessing the educational service during the health emergency with 94.81% of the total population. The quantitative results reflect that the CHAWD mainly make use of tablets, followed by smart phones (without being for exclusive use) and very few have a desktop computer. ii) Equipment and connectivity, it is evidenced that 77.35% equivalent to 164 CHAWD connect with Wi-Fi service at home, a lower percentage has access to a mobile data plan or pre-paid plans. iii) how electronic equipment is being used, most CHAWD indicates that they require help to turn on the equipment, very few report that they can do it alone, as actions can get up and down the volume; while specific situations such as increasing and decreasing the brightness of the screen or connecting and disconnecting to the internet, very few can do it alone.

The main resources used are: tablets, smart phones and computers. The use of desktop computers allows a greater field of work, especially in students with intellectual disabilities and cerebral palsy students since they require additional technological adaptations, such as keyboards, screens, cameras and / or mouse, however, their costs turn out to be higher. Tablets are an alternative of greater accessibility in terms of price, since a tablet according to its capacity could range between $80 and $150, however, its use deserves to be analyzed in terms of factors related to touch. It is worth taking into account the needs of each of the users. For (Acosta-Vargas and et al, 2020) almost no application is 100% accessible for a person with a disability, the greatest accessibility difficulties are constituted by 'touch' and image contrast (visual), although there is also the audio difficulty.

Taking into account the second level related to equipment and connectivity: i) Handling the touch screen (tablet), very few CHAWD have developed the ability to use a touch screen, which merits in a very subtle way, achieving motor skills in order to achieve its use (Acosta-Vargas and et al, 2020). ii) Handling the cursor (pointer, very few children make effective use of the cursor (18.03%). Merging these two numerals shows that touch actions constitute a difficulty for accessibility, which confirms the need to supports iii) Use of the keyboard, in most CHAWD it is not an alternative with respect to the equipment, since its use is not optimal. iv) watch the screen of the equipment you are working with, which can be watched with certain restrictions, but its use is possible. v) Listen to the sounds of the team you work

with, most have some difficulty hearing, which is worth it. vi) Use of alternative and augmentative communication systems, mainly using sign language, which can be natural, however, thematic pictograms could be used according to age, with an organization of themes taking into account a categorization of children and adolescents.

Taking into account the third level related to pedagogical delivery: i) Autonomy for certain functions, such as mobility, food, hygiene and clothing. However, there are those who point out that they only have mobility or food or hygiene or dress autonomously. ii) Demands help from the family, tutor and therapist, who mainly have dependence on the family, although some also require the support of therapists and for learning they have indicated help from their tutors. iii) Learning Development, have described functions such as visual, auditory, kinesthetic, support of music and being in contact with nature.

What is related to functional learning allows us to infer that the CHAWD although they have certain autonomies, but permanently they are people who depend on help such as a family member, to achieve functional learning it is recommended to use applications that promote recreational activities or in artistic areas such as music, dance, theater, plastic arts or literature.

The information from the analyzed family mappings is a very valuable input, since it is possible to deepen into the conditions in which CHAWD families live, especially to know the strengths, likes, dislikes, dreams, fears and special days of the students; that constitute complementary activities to the academic ones and very necessary to generate an atmosphere of harmony in their training process.

The CHAWD must develop motor learning skills, based on technological accessibility. In general, they should grasp objects, use the index finger to point or mark objects, hold the index finger and thumb, have visual coordination with objects and with the hand, focus their gaze, follow objects that have lights and shine, express pleasure or displeasure with visual and auditory stimuli, understand simple com-mands, postural control and develop stimuli to carry out functional learning activities. These competences are complemented with details for certain disabilities such as: multi-disability, language disorder, Down syndrome, Autism Spectrum Disorder, intellectual disability and cerebral palsy.

TECHNOLOGICAL ACCESSIBILITY PLAN FOR STUDENTS WITH DISABILITIES (TAPSD)

The TAPSD aims to identify the different technological applications related to education that facilitate the link between teachers, students and parents, focused on the 212 CHAWD competencies. The table 1 contains applications that could enhance the social, communicational, physical and psychological area of students.

Table 1: Apps recommended to use with CHAWD

Disability	Description	App

Psychosocial	Students need develop skills to interact with others efficiently and consistently. In addition, the students must have the support of a permanent tutor who gives simple guidelines.	Speedstar, Comuicant, Picto Tea, Letra Kid, Iautism
Physical	Students need assistance with mobility, control with mouth or head, speech recognition software, speech generating device.	Pushbutton, Cephalic / Mentonian Pointer, Magnified Mice, Pad Mouse, Joystick Type Mouse
Intellectual	Students need to perform different activities necessary for their independence and daily living. It is necessary a permanent accompaniment with instructions, clear and simple.	Pictosounds, Lim, Bedtime Math, Opposestolandia, Sonigram
Infantile Brain Paralysis	Students need therapies such as physical and language. They need to work on posture depending on neuropsychomotor development	Hipscreen, Baby Moves App, Amialcance Saliva Tracker, Sitplus
Autistic Spectrum	Students need develop behavior patterns and social interaction and communication. They need to know clear work routines and achieve the same order of things.	Process, Piktopop, Appy Autista AutisMIND, Sequences
Down Syndrome	Students need permanent therapeutic support. They need to work through routines, with the use of different applications.	Picca,Skillz, Dibugrama, Soy Cappaz ,Jade
Visual Disability	Students need to carry out their movements autonomously, activities of daily living, or accessing information.	Lazzus, Tie, Tap Tap See, Brailleback, Fingerreader

CONCLUSIONS AND FUTURE DIRECTIONS

This study presented a Technological Accessibility Plan for Students with Disabilities (TAPSD) to provide accessible learning. In relation to the technological equipment, tablets are referenced that due to their characteristics and costs will be easily accessi-ble. The TAPSD provides guidance on the different computer / software / hardware applications that could be used according to the functional diversity of the CHAWD, which may be detailed according to the principles and guidelines described in Table 1.

The study described is a reference at a national and international level, since the technical specifications and proposed applications will allow its use, according to the functional diversity of boys, girls and adolescents with disabilities.

In addition, the authors consider that direct support to educators is a key issue, so that they learn the use of technology and develop skills for functional diversity and are fully aware of the importance and need for specific actions around the issue. theme. On the other hand, providing specific skills and training to parents is a chal-lenge, but nevertheless a necessary measure to improve the impact of functional diversity and accessibility for boys, girls and adolescents with disabilities.

ACKNOWLEDGMENTS

Our deep gratitude to children and adolescents with disabilities; as well as their families and teachers who strive every day to achieve small advances in their personal and educational growth. In a special way we thank the Movement for Popular Education and Social Promotion - Fe y Alegría Ecuador for facilitating direct communication with the people involved and channeling the resources of the project financed by the Inter-American Development Bank (IDB).

REFERENCES

Aguilar, M.A. (2013). Guía de trabajo Adaptaciones Curriculares para Educación Especial e Inclusiva. Obtenido de Ministerio de educación 81, [Online]: Available: https://educacion.gob.ec/wp-

Cobeñas, P. (2019). Exclusión Educativa de Personas con Discapacidad: Un Problema Pedagógico. REICE. Rev. Iberoamericana sobre Calidad, Eficacia y Cambio en Educación 11 , 65-81.

Delgado-Valdiviezo, K. (2021). Diseño universal para el aprendizaje, una práctica para la educación inclusiva. Un estudio de caso. Rev. Int. apoyo a la inclusión, Logop. Soc. y Multicult,, 7(2), 14-25. doi: doi: 10.17561/riai.v7.n2.6280.

Ministerio de Educación, (2020). Acuerdo Ministerial 00036, " Minist. Educ. del Ecuador. Acuerdo Minist. 00036.

Dalimunthe, H.A., Dewi,S.S., and Faadhil. F. Pelatihan (2020). Pelatihan Diseño universal para el aprendizaje untuk Meningkatkan Efikasi Diri Guru Sekolah Menengah Pertama Islam Terpadu dalam Mengajar. Jurnal Diversita, 6(1), 133-142. doi:https://doi.org/10.31289/diversita.v6i1.3784

Espinola, A. (2020). Educación inclusiva e igualdad de las personas con discapacidad en la transformación digital. Revista jurídica valenciana, 1-13.

Ramos-Galarza,C., Cóndor-Herrera O., Arias-Flores,H., Jadán-Guerrero,J., Bolaños-Pasquel M., and Cedillo P.(2020). Cognitive Interventions Based on Technology: A Systematic Literature Review. Advances in Neuroeronomi. doi:https://doi.org/10.1007/978-3-030-80285-1_30

Reyes, M., Villegas, J.C, J. Torres, and Paredes V. (2019). Inclusive Education Model FE Y ALEGRÍA Ecuador.

Molony, S. L., Kolanowski, K.,Haitsma,V and Rooney, K. E. (2018). Person-Centered Assessment and Care Planning. Gerontologist, 18(58), 32-47. doi:10.1093/geront/gnx173

Acosta-Vargas P., Salvador-Acosta B., Salvador-Ullauri L., Villegas-Ch W and Gonzalez M (2020). Accesibilidad dentro de los recursos y prácticas educativos abiertos para estudiantes con discapacidad: una revisión sistemática de la literatura. Aprendizaje inteligente. Reinar. doi:https://doi.org/10.1186/s40561-019-0113-2

Zhang, X., Tlili, A., Nascimbeni, F. et al. Accessibility within open educational resources and practices for disabled learners: a systematic literature review. Smart Learn. Environ. 7, 1 (2020). https://doi.org/10.1186/s40561-019-0113-2.