Analysis and Development of a Mobile Application to Improve the Semantic Memory of Children with Down Syndrome

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Abstract. The present research was developed with the purpose of clarifying the impact of the management of the mobile application on the improvement of semantic memory in children with Down's Syndrome. The type of research used is applied, pre-experimental with a quantitative approach, which is why statistical resources have been used for the analysis of the key results in search of approvals of the premises. In order to develop the study, fifteen (15) tutors dedicated to the academic training of children with Down's Syndrome were taken as a sample. Likewise, taking as a reference therapeutic rehabilitation institutes and schools with special abilities with the necessary requirements for a complex evaluation with an accurate percentage for the investigation. Consequently, all goals were fulfilled and all conjectures were accepted, therefore, it could be stated that the management of the mobile application for the reinforcement of the semantic memory of children, could increase motivation, cognitive skills and social skills; where it was possible to specify the correct management of the mobile application aimed at children with Down's Syndrome. Finally, it was stated that the theoretical basis of this study is oriented to the use of ICT tools that show great potential for the training of people with special abilities in the progress of semantic memory supporting the attention of students, increasing their cognitive ability, allowing to improve their ability of perception and linking with the surrounding environment.

Keyword: Mobile application, cognitive skills, semantic memory, Down syndrome.

1. Introduction

The novelty of new ICT is a technological means to guide and dynamize educational interventions for students with special educational needs, which assume a personal and adaptive means of their educational abilities (Cored, Vázquez, Liesa & Baldassarri, 2021). Moreover, ICT has the potential not only to balance and contribute to the various participatory activities that are carried out with children, but also to effectively and objectively study the impact of these activities on the progress and social development of children who are complicated by defects of expression and perception that they present in their feelings (Cored, Vázquez, Liesa and Baldassarri, 2021; Capote, 2022).

Likewise, the innovation of new ICT has brought about significant changes in the way we act and behave both individually and socially (Muñoz, 2020; Elosua, 2022). As a result, it creates a large gap between the subject and knowledge, between institutions and the procedures they apply in the traditional and technological fields; some educational centers use information technologies for various activities (Muñoz, 2020; Elosua, 2022). In the same sense, ICTs have proven to be beneficial for the learning and social inclusion of people with Down's syndrome. The use of ICT is one of the best solutions for people with Down syndrome in improving learning abilities, including increased memory and information processing, improved attention, as well as increased visual and auditory acuity and motor coordination (Vera, 2020; Alderete and Jones, 2019).

In another sense, Pesantez (2022) stated that, through the pandemic the new coronavirus, the main educational difficulties have been highlighted, mainly the transition to a recent regulation by interrupting face-to-face classes and forcing the participation of students in education through telematic training platforms and resources (González, 2019; Molina & López, 2019; Pilevari, Memarian & Shokouhifar, 2021). That is, they need to be constantly aware of the outbreak of this disease, and in this way, it is necessary to apply technologies that are in accordance with the condition of the person with a disability (Teoh Ho, Dollmat, and Tan, 2022). Therefore, children who have physical or cognitive complications need proper intervention, guidance, and stimulation from a variety of professionals for successful educational activities, education, and socialization to be carried out satisfactorily, helping to develop the level of cognitive ability of children with proper awareness and methodical application (Gomez, 2020; Morales et al., 2018; Lai, Lew and Ooi, 2022).

Finally, it is necessary to consider that ICT should be used for expert-based participatory solutions and activities; as has been pointed out, the validity of this analysis is necessary to consider the results achieved in the development and study of novel technologies and procedures to reinforce the semantic memory of children with Down syndrome, with the intention of providing a tool to help parents and educational centers, thus achieving in the future that these children have better visibility in the student and work environment, strengthening their social and cognitive skills (Olguín, 2022; Martínez, 2019; Piñeiro, 2020).

2. Literature Review

The relevant theories shown in the research are presented below, segmenting ideas on semantic memory enhancement or teaching through mobile applications, skills awareness, and ICT management for the benefit of academic training.

2.1. Down's Syndrome

The theory of Down syndrome in the study by Aranda and Samaniego (2017) explains that children with Down syndrome are those who have chromosomal abnormalities, expressed in the presence of 47 chromosomes instead of 46 in normal individuals, which determines the formation of the human body throughout gestation (Spain, 2020; Arizmendi, 2021). In this way, they revealed that subjects with Down syndrome or Trisomy n° 21, mention that every cell in the human body must have 3 separate copies of chromosome n° 21 instead of the 2 that are normal and usual (Barrera and Quiñonez, 2020, p .30; Martini et al., 2019).

2.2. Cognitive Characteristics

In the cognitive characteristics, they present slowness in the procedure and codification of information, as well as difficulty in interpreting, which is why it is difficult for them to develop conceptualization, generalization, and transfer of learning (Caballero and Llave, 2021, p. 24; Hidalgo, 2018). On the other hand, in Lara's study (2020) he stated that children with Down Syndrome show a genetic excess that originates a wide cerebral difference which presents synaptic disunity, generating a decelerated neuronal death (Rebolledo, 2022). Therefore, they point out that people with Trisomy 21 have difficulty remembering information due to limitations in the reception and processing of this information (short-term memory) as well as in the strengthening and retrieval (long-term memory). This is how their greater limitation in memory has a disadvantage in managing and constructing spontaneous strategies to increase their memorization (Ciprés and Tornos, 2021; Peraza et al., 2019).

2.3. Technological Tool

In reference to the technological tools, Heredia et al. (2020) used the specialize tool available for all at the social level, allowing to provide equivalent the opportunity for people with disabilities, since, taking into account the accessible websites or a mobile applications allows to automate of the management processes implemented thus having the active participation in the social and professional fields, therefore considering training in how to access and interact with the information developed (Loya, 2020, Beltrán, 2018).

2.3.1. Mobile Application

Therefore, the purpose of this study in the research methodology was to compare free/paid subscription-type mobile applications for the development of semantic and cognitive memory in children with Down syndrome through integrated functions that may be contained in each mobile application (Díaz et al., 2021; Linares, Vela, & Cano, 2019; Rodríguez et al., 2018). In addition, apps were selected for ages 4 to 7 years, for which mobile applications that have reference to improving cognitive and social skills had to be searched in the Play Store (García and Mesa, 2019; Molina et al., 2021; López and Gonzales, 2021). Table 1 compares integrated app functions to help improve semantic memory in children with Down syndrome using the tools mentioned in the table.

Table 1: Comparison of integrated functions of mobile applications for improving semantic memory in children with Down syndrome.

Applications					
Integrated functions	Otsimo (Tienda Google Play, 2022)	Lectura Visual® (Tienda Google Play, 2022)	MITA (Tienda Google Play, 2022)	Yo Tambien Leo (Tienda Google Play, 2022)	Jade (Tienda Google Play, 2022)
Intuitive interface	x	x	x	x	x
Improvement of motor, cognitive/semantic and social skills	x	x	x	x	x
Development of mathematical skills	x		x		
Development of reading and writing skills	x	x	x	x	

Development of sound and speech skills	x	x	x	x	
Development of identification and selection skills	x		x	x	x
Development of creative drawing skills	x				

On the other hand, Ruiz (2020) stated that ICT has the potential to become an active component in combating isolation, and improving social skills. With ICT innovation, they benefit from personalized educational attention as they benefit the advancement of academic tasks that are adjusted to the educational needs of learners (Deroncele et al., 2021; Allueva and Alejandre, 2019).

2.4. Cognitive Process

In this section of the cognitive process, Ortiz (2021) described the cognitive process as a procedure that allows to retaining, recreating, or updating, these processes are supported by sensory processes, which form the basis of the logical processes to be sustained and developed. Memory consists of short-term memory as well as long-term memory (Llanga, Logacho, and Molina, 2019; Burin et al., 2021). Likewise, in Gavilanes' (2021) study he mentioned that long-term memory stores information for organizational tracking and use, limiting our knowledge of the real world, and social and cultural realities (Manrique, 2020; Jiménez and Diez, 2018). On the other hand, Ruiz (2020) detailed that semantic memory is what stores our knowledge of how the world is and how it works. This is information that normally does not include references to when or where we obtained it (Navarro et al., 2020; García and Mogollón, 2020).

2.5. Android

In Luján's study (2019) he mentioned that Android is an operating system used in Windows, Linux, and others. This is how it allows having full control of the elements of the development device in the application (Qiu et al., 2020; Liu et al., 2020; Sarkar et al., 2020). On the other hand, Gao, Li, Kong, Bissyandé, and Klein (2019) mentioned that the Android Studio development environment is based on IntelliJ, developed and presented by Google I/O in 2013, the company that owns Android. This tool is the official embedded development context for Android applications (Sihag, Vardhan, and Singh, 2021; Koroglu et al., 2018).

2.6. Java

Java development software was used in the programming language in a general way in which any type of program can be implemented or developed (Arroyo, 2019; Yuan and Banzhaf, 2018). Java software is a general way programming language in which any kind of program can be developed. It has become famous for being a platform-independent language, as it has a virtual machine for each system that acts as a connection between its operating system and the Java programming code, allowing it to be read and executed seamlessly (Arroyo, 2019).

2. Materials and Methods

In the present research study, the different indexed scientific articles were visualized. Where they were obtained in different databases such as Redalyc, Scielo, Scopus, and other search engines within the storage. In addition, we have as part of the study of searched for information in Google Scholar that allows extracting all the indexed repositories. In this way, the following filters were used to find the different points of study of high impact as reliable sources, having as 5 years of antiquity for the search of scientific research. In this way, it was possible to develop key points to emphasize the research relevant to the procedures and phases of the application system, which is why, in order to carry out

these important points, keywords were determined for the search of information in Spanish, English, and Portuguese, to find the extraction of data within the repository found. Finally, the amount of data extraction for the research is detailed in table 2.

Table 2: Data collection review

Type of document	Keywords	Quantity
Scientific article	Development of a mobile application for the cognitive development of children with intellectual disabilities	97
Thesis	Children with Down's Syndrome, cognitive ability, ICTs	19
Book	Innovative Inclusive Practices: Challenges and Opportunities	2
Play Store applications	Improvement of motor, cognitive/semantic and social skills.	5

Likewise, the type of applied research was used because it allows solving problems in the development of projects from the constant study and collection of information, in this way it was found in the study of Alan and Cortez (2018) showing the type of research or action where it was characterized by exploration. Therefore, the quantitative research approach was taken, highlighted in the research of Cabezas, Andrade, and Torres (2018), which allows to evaluate and verify the ideas that test hypotheses through the collection, statistical methods, ideas in which a thorough investigation is carried out to obtain the result of the study population. Likewise, they used a pre-experimental research design in which they restored the improvement of semantic memory in children with Down syndrome.

On the other hand, the study considered in the population tutors who are dedicated to teaching children with Down syndrome (Arias and Covino, 2021). Likewise, the sample consisted of 15 specialized tutors dedicated to the academic training of children with Down syndrome (Hernández and Mendoza, 2018). Indeed, non-probabilistic research sampling was considered in the informal choice method for the choice of data in the research specified in the problem statement (Cabezas, Andrade, and Torres, 2018).

The procedure of the research study was to make a matrix of operationalization in which to find the dimensions and indicators that allowed give a fundamental basis to the implemented project, then it took a questionnaire of pre and post-test of motivation to evaluate the performance towards the designed application, also a questionnaire of pre and post for social skills was developed. In addition, an algorithm of use of the mobile application was made allowing it to describe the infrastructure of the project, also a flowchart and a pseudocode of the mobile application were implemented, and so a technological architecture for mobile development was taken. Finally, the Mobile D software development methodology was used, including its main phases for the proper development of the research.

3. Results and Discussion

In general aspects, the mobile application for semantic memory reinforcement of children with Down Syndrome had a satisfactory impact as it proved a severe growth in motivation, cognitive skills, and social skills in the users. The results were as follows: an increase in motivation by 70.04%, an increase in cognitive skills by 60%, and an increase in social skills by 70.62%. Consequently, it was proven that the mobile application is an excellent tool by which children with Down Syndrome can reinforce the growth of their semantic memory and cognitive skills.

Therefore, the constant use of the mobile application increased the motivation to improve semantic memory in children with Down syndrome. For this measure, a questionnaire of five (5) questions was carried out, where the increase in motivation was demonstrated by carrying out the questionnaire before and after using the Huellita mobile application, with an average of 2.47 and 4.20, respectively, therefore a 70.04% increase in motivation was achieved. According to Amores and De Casas (2019), an increase

in motivation of 54.21% was obtained by applying a sample of 120 students in the use of ICT as one of the best motivational solutions for secondary school students, whose case percentage is less, likewise, Cevallos et al. (2019) obtained a percentage of 84%, where they indicate that it is essential to manage digital platforms or applications to strengthen their skills and knowledge of ICT, whose case the percentage was higher, as they consider the use of technological tools to increase motivation in students, who are often in the modern era to use different electronic devices on a daily basis.

In addition, the constant use of the mobile application increased the cognitive abilities to improve the semantic memory of children with Down syndrome. For this measure, a questionnaire of nine (9) questions was used, where the increase in motivation was demonstrated by completing the questionnaire before and after using the Huellita mobile application, showing an average of 2.00 and 3.20 respectively, thus acquiring an increase in cognitive skills of 60%. In this regard, Quishpe and Vinueza (2021) obtained a percentage of 94% as a result, taking as evidence that students favor the use of a mobile application that meets the needs of the degree of knowledge according to the level of intellectual disability, in this regard the percentage was higher, On the other hand, Rodriguez and Martinez (2022) demonstrated that if mobile applications can be considered an essential solution in learning with the STEAM methodology, for which they obtained a degree of growth of cognitive skills of 90%, where they point out that mobile applications facilitate the reinforcement of their knowledge and have greater ease of completing the thematic content aimed at students with intellectual disabilities.

In the same way, Balarezo et al. (2022) conducted a gamification that drives cognitive skills based on the evolutionary progress in children with Down syndrome, for this reason, their acquired results were acceptable showing 80% of students who managed to develop their school skills by managing an innovative software to support social inclusion, these authors achieved these results through questionnaires and software tests that were applied a before and after to find the steady increase in users.

On the other hand, the constant use of the mobile application increased social skills to achieve cognitive skills related to the improvement of semantic memory in children with Down syndrome. For this purpose, a questionnaire of five (5) questions was used, where the increase in motivation was demonstrated by carrying out the questionnaire before and after using the Huellita mobile application, with an average of 1.60 in the pre-test and 2.73 in the post-test, taking into account the number of specialized teachers dedicated to the training of children with special knowledge, indicating an increase in social skills of 70.62%. Likewise, Navarrete et al. (2020) demonstrated how digital transformation supported and benefited in any learning process for people with intellectual disabilities applying with a sample of 15 teachers who help to strengthen their social skills and obtained as a result of growth of 80%, due to the number of tutors who claim that with the implementation of technological innovations can promote the learning of students and at the same time develop the social skills of children adapting through virtual and audiovisual environments, as a consequence the overall development in the educational sector.

To conclude, the constant management of the mobile application increased the improvement of the semantic memory of children with Down syndrome, using the methodology of development of mobile applications Mobile-D for the execution, planning, and development of the mobile application, based on Leyva et al. (2016) indicate that this methodology has a greater effect for the development of mobile and collaborative environments with any mobile device, so the progress of a mobile application for the reinforcement of semantic memory and other capabilities was established following its phases and techniques for proper development.

4. Conclusions

The spread of digital technologies, the increasing use of portable devices in childhood, and their progressive incorporation into classrooms pose challenges for teachers in terms of digital knowledge and skills. Therefore, we conducted this comparative study to analyze and determine integrated functionalities that have been developed by software developers or experts in education to serve as a

digital support tool in the teaching and learning of children with intellectual disabilities, in this case, children with Down's Syndrome.

In addition, it is important to have good learning conditions regardless of the social, cultural, or any other kind of disability the individual may have, educational institutions must have adequate tools and intellectually stimulating teaching methods to make learning conditions fair. and sensitive to needs. Therefore, professionals working in education with students with educational needs need the resources demanded by these special educational frameworks, which benefit their work as educators, but at the same time, it is necessary to create a virtual platform to train teachers prepared for the demands of the 21st century.

In summary, it is necessary to mention that no kind of disability is an obstacle in a person's life, but it is their strength that makes them much stronger, so this scientific article results from a study with an improved vision and mission. The quality of education is expressed inside and outside the classroom, the individual and personal progress of children, bringing the use of mobile applications for learning and teaching aimed at education to a new perspective for parents, teachers, students, educational institutions, families, and the general public.
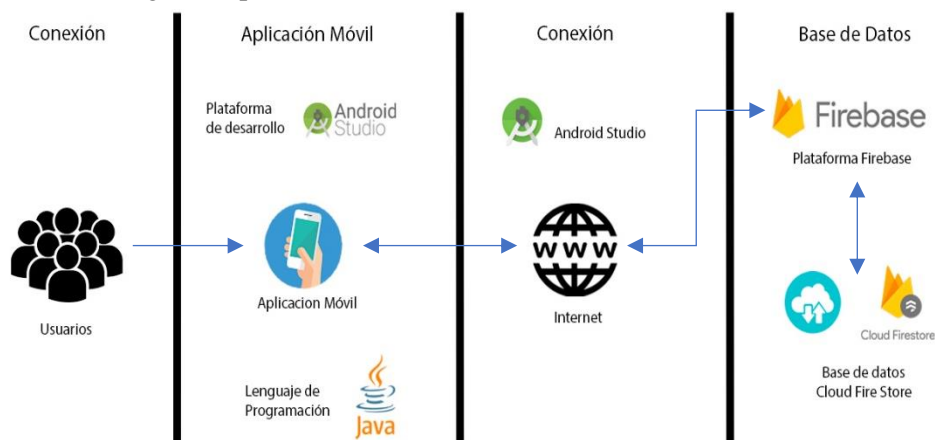

Fig. 1: Technological architecture for the use of the mobile application

Acknowledgements

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