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The effectiveness of an intervention program for the development of cognitive capacities of children with a hearing impairment

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Abstract ;

The goal of the study was to determine the extent to which a psycho-educational intervention program, based on a variety of Arabic and math activities, was effective in enhancing the cognitive abilities of a sample of 18 children with auditory impairment. The sample was purposefully divided into two groups, one experimental and the other control. The experimental group's members participated in the program's activities, which were spread out across (36) sessions over twelve weeks, to improve their ability to pay attention, perceive, and remember. Both groups' members took part in auditory and visual attention tests, visual perception tests, and visual memory tests before and after the program was put into place, with the control group receiving no exposure to any activities. The activities in the intervention program were effective at enhancing the cognitive abilities of kids with hearing loss, according to statistical findings.

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1. *Introduction*

Caregiving for those with special needs is a crucial responsibility that is fraught with many challenges and necessitates, first and foremost, an understanding of the value of the human being, then the conviction and the desire to alter how society, in all its facets, views its owners in order to integrate them as contributing members based on their the abilities, their level of education and training in educational institutions. In a different report, up to 5% of schoolchildren are thought to have hearing impairment, hearing issues, and require special educational programs. Hearing impairment limits a person's capacity to acquire language and speech, to learn different capacities or to engage in normal life activities. Therefore, losing this sense means losing a source of knowledge. Hearing impairment makes the child suffer from loss of attention and concentration, he becomes unable to listen for long periods of time, unable to interact in communicative situations with others in addition to not remembering spoken sentences easily, and it also affects cognitive development and mental capacities, as the results of a study to compare reading comprehension abilities in hearing impaired and normal students in sixth and third grade of elementary school showed that the level of reading comprehension was low in a large percentage of hearing impaired students (Northern & Downs, 2002). Particularly given that those who have hearing loss are just as intelligent as those who do not, and that they are capable of learning and reflecting unless they have brain damage connected to their handicap (Moores, 2001). Diversifying educational settings, adjusting curricula, and looking for appropriate and adjusted teaching strategies that match the unique educational requirements of students are some ways to advance the idea of equal educational opportunity for all people (Smith, 2004).

The study was chosen as research topics as a way to determine how well an intervention program can help children with hearing loss enhance their cognitive abilities, based on the psycho-educational method in the study of mathematics and Arabic. Following is the primary query that constitutes the research issue:

How well does an intervention program work to improve the cognitive abilities of hearing-impaired children? The following sub-questions are included in it:

- 1. Does the use of the intervention program help children with hearing impairments enhance their attention capacity?
- 2. Does the use of the intervention program aid in the improvement of the perceptual capacities of children with hearing impairment?
- 3. Does the use of the intervention program help children with hearing impairment increase their memory capacity?

2. *Theoretical framework*

2.*1 Hearing impairment*

According to this division, the OMS (2021) definition is based: Deafness and a decreased ability to hear:

Hearing loss occurs when a person's threshold for sound is 20 dB or above in both ears, which indicates they are unable to hear as well as someone with normal hearing. Mild, moderate, severe, or profound hearing loss are all possible. Affected ears may have trouble hearing loud noises or following conversations. Hearing loss can range from mild to severe in those who suffer from it. The use of captions, cochlear implants, hearing aids, or other assistive listening devices, however, may be beneficial as they typically communicate verbally. The majority of deaf people have substantial hearing loss, which leaves them with little to no hearing. In most cases, they use sign language to communicate.

Deafness is a functional handicap that interferes with a person's ability to carry out their everyday tasks and fulfill their social obligations. This illness ruins a person's daily life and joy (Grandmont & Ndayisaba, 1999, p.120).

2.2 *Cognitive capacities*

The term cognitive capacities was born at the beginning of the 20th century with the research on intelligence and its measurement by Binet and then Spearman, who replaced the term intelligence and spoke of the general mental capacity that controls all the different mental processes and activities (Lochner & Aïd, 2016). The concept of primary mental capacities is that intelligence consists of a set of primary capacities, namely numerical capacity, spatial capacity, verbal comprehension, linguistic fluency, memory capacity, perceptual speed, and inferential thinking, where the cognitive system is characterized by flexibility and the capacity to direct attention and focus on the most important information to address a particular situation or focus on certain aspects and characteristics of that situation. Cognitive capacity develops with age, especially in early childhood, and is multidimensional in terms of dependence on a set of overlapping processes in the area of attention, storage and retrieval of information (Naceur, 2010, 2013).

- *Attention, perception and memory troubles and hearing impairment:*

Since hearing impairment affects perception, it also affects cognitive functions because the development of the different functions depends on each other. Early sensory deficits have an impact on how particular brain functions and neurocognitive abilities develop (Kronenberger & al, 2018). We note that several abilities are affected, such as auditory attention or executive functions (Conway & Kronenberger, 2009). Working memory functions are also affected to a very significant degree, which is interesting because they are closely related to language capacities, which may partially explain the lack of working memory in children with hearing impairment at the level of language impairment.

"When a child is deaf or hard of hearing, everyone expects them to develop or overdevelop their visual abilities in all

areas of cognition: perception, action, memorization, representations, etc. This expectation is often not even explicit, as it seems "obvious" that the deficit of a sensoriality will "spontaneously" and automatically lead the child to use compensations in the other perceptive sector deemed to be intact, namely vision." (Mazeau, 2005). Therefore, it is necessary to integrate intervention programs based on visual stimuli into the educational pathway of the hearing impaired.

Visual attention is considered among the factors most associated with hearing impairment, the results of a study conducted by Quittner & al (2010) confirms a strong correlation between attention and behavioral disorders in children with hearing loss, according to what parents and teachers reported about this category of children.

Attention deficit in hearing impaired children is not limited to experimental situations in which artificial stimuli have been presented that may not represent what happens in real life, but the external validity of what has been achieved in the laboratory is supported by studies in which children have been observed in both normal and near-normal situations. In the study by Quittner & al (2010), the researchers reported that 'parents and teachers' observations of the behavioral problems of children with hearing impairment in everyday situations at home and at school correlate strongly with attention tests conducted for them in experimental situations. As well as what was mentioned before the note referred to "joint attention", which is defined as the ability to pay attention to both ears, and it naturally appears during the first year of a child's life (Quittner & al, 2010). For children with hearing impairment the development of joint attention begins normally and continues until about 18 months of age, when the child begins to experience difficulties with joint attention due to language and communication disorders. Deficits in joint attention occur in children with hearing impairment in situations of free play between the child and mother or between the child and other children.

The differences found between hearing impaired and normals are not only limited to attention, perception and cognitive processing strategies as mentioned in previous studies, but they go beyond differences in cognitive brain functions. Where the two halves of the brain exchange roles in processing cognitive inputs depending on the nature of the task: the left half of the brain processes verbal information such as words or numbers, while the right half of the brain has the task of perceiving images and cadastral information (Wilson & Power, 1987). But Szelag (2008) found that for the hearing impaired this is different. A study was conducted on eighteen congenitally hearing impaired children in which their performance was compared to that of the same number of hearing children. The task asked the subject to perform in this study was to identify visual stimuli, which are a three-

syllable word or a picture of a face. It was shown that the stimuli appeared in either the right or left field of vision, after the nature of errors made by the subjects was analyzed to determine which of the two brain hemispheres was dominant in the stimulus recognition process. The results of the study indicated that there was a difference between the two groups, since the analysis of the results of the hearing impaired showed that the right hemisphere of the brain dominated the process of perception of words, while in the process of perception of faces, the two hemispheres of the brain shared the task almost to the same degree. As for the hearing impaired, text processing was performed in the left hemisphere, while image processing was performed in the right hemisphere of the brain. The researchers attributed this difference in the cognitive brain functions of the hearing impaired to the fact that the hearing impaired are forced to use visual - spatial information in the communication process through the use of sign language, and this is the reason why the right hemisphere dominates in the linguistic tasks of the brain. The brain functions to classify, organize, and configure sensory information and make sense of it, and a child with hearing impairment can be helped to organize and develop focused reactions and responses by exposing them to sensory stimuli. It is known to improve cognitive capacities and information processing systems including attention, perception, memory comprehension, and motor capacities (Brady & al, 2013). The environmental enrichment method is one of the methods used to improve cognitive capacities because it leads to an increase in neural branches, which leads to a change in neural connections and thus improves cognitive processes (Wilson & Power, 1987). For the individual to reach the maximum benefit of their latent cognitive capacities must be an appropriate intervention, as cognitive processes depend on previous experiences that form a frame of reference to which the individual refers in their awareness and distinction of the things they interact with, without which it is difficult to perceive and distinguish things (Naceur, 2013). The cognitive capacities of children with hearing impairment can be developed through educational activities and stereoscopic sensory play (Marschark & al, 2007). As well as Kuku & Adeniy (2020) indicate that the use of appropriate educational methods with people with hearing impairment helps to strengthen and develop the ability to think well and helps to reduce the effects of their language deficits, which are reflected in their thinking processes.

Visual memories in people with hearing impairment are important because they are the primary channel of knowledge. They rely on visual coding, so information is recognized and stored in visual images, of letters, numbers, words, or shapes (Quittner & al, 2010). In addition, Macdoughall (1979) conducted a study on the role of visual and auditory factor in hearing

impaired and normal children in shortterm memory. It was found that young hearing-impaired children are almost dependent on the visual factor, while older hearing-impaired children are dependent on both the visual and auditory factor to remember. Thus, if visual development is not as important or does not parallel auditory development, it can negatively affect the reading and writing of children with hearing impairment.

Many studies with students with hearing impairment have confirmed their learning process, especially learning sign language, which relies heavily on visual and visuospatial memory. The results of some experiments conducted on hearing impaired people showed that their visual and spatial memory was better than that of their normal peers. This includes the visual-spatial processing map, which is concerned with maintaining visual-spatial information in working memory, as well as visualization and visual-spatial search processes (Gibson, 2003). It stores visual-spatial information, and this map also has a limited capacity, such as the verbal or phonetic memory barrier, and the capacity of this barrier and the vocal memory barrier are independent of each other.

The capacity of visual-spatial visualization plays an important role in the learning process, because this capacity includes the understanding and perception of spatial relations, the circulation of mental images and the visualization of different form situations. This capacity appears in any mental activity characterized by visualization (Badeley, 2002).

3. The intervention program

3.1 Basis of the intervention program's content from a theoretical perspective

Intervention rooted in psychology: educator can benefit from this method, so that he can establish a personality and a sense of self-acceptance that will enable him to adapt to his environment, and take advantage of his abilities to develop psychologically and become more mature in the future, using psychological techniques to address his issues (Gendreau,1978).

The game-based intervention: it offers various benefits for instructing, identifying, and treating a child's behavioral issues and is employed in the field of child support. Given that play is a child's job and a psychological and social need that needs to be met, it is based on a variety of theories of play. Play serves as a means of guiding, correcting, and controlling a kid's behavior as well as fostering growth, meeting needs, and giving a youngster a chance to express themselves and let off steam (Lenoir, 2009).

Intervention in education: within a particular educational program, it is reflected in the intervention services offered throughout the educational procedures. Given that education is a process by which a person learns about life via various activities and under the leadership and direction of the educator,

there must be compatibility between the goals of the intervention strategy and the goals of the educational strategy. In this case, the goals, roles, plans, and methods of the instructional and guiding processes are comparable (Lenoir,2018).

Children's play-based psychoeducational intervention: an art-based representation of play was used by the psychoeducational intervention program to create a behavioral therapy support model, play-based learning techniques like theater. The following will clarify this:

- Drawing is used to provide psychoeducational support: the youngster has a genuine desire to pursue the many skills, even if its core is simulating and approximating, instead, it is a need that results from his persistence on establishing himself through a variety of emotional releases that he uses to let go of his worries and suppressed feelings. In order for children to understand the meanings of each element in their paintings and to be able to express their thoughts, feelings, and emotions during the diagnostic and therapeutic processes, it is crucial to analyze the paintings they create. This analysis also helps to advance the level of sensory perception development in children, which in turn helps to shape their personalities (Labrèche, & Poirier-Magassouba, 2003).

- Theater as a vehicle for psychoeducational assistance: A technique used to accomplish certain educational objectives is educational theater, which consists of a series of tasks that students carry out while being guided by their instructor. Drama may be employed in behavioral treatment for kids since it's a motor activity that kids perform to play. Consequently, children with behavioral and psychological issues have a chance to emotionally retreat and regain emotional equilibrium (Lenoir,2014).

- Theater's role in the psycho-educational therapeutic process: Theater may be employed in the educational process as a way of teaching and learning, as well as in the intervention process as a psychological support tool for the treatment of numerous disorders.

- The value of art in the education of children: the goal of art and artistic education as a whole is to develop the whole child's personality free from often restrained emotional impulses since art therapy tends to help children feel good about themselves and be able to interact with others in a stable way. In fact, the young kid enjoys using his artistic talents in a variety of activities that combine motion and sensory stimulation, such as singing, dancing, kinetic rhythm, sketching, poetry, and storytelling (Labrèche & Poirier-Magassouba, 2003). As a result, it is thought that arts education reflects their function in the development and evolution of many behavioral, intellectual, sensory, emotional, cultural, and social components (Lenoir, 2014).

3.2 The theoretical underpinnings of the intervention program's creation and execution

The psycho-educational intervention is a component of a methodical and customized view of the student that considers his or her unique abilities, the environment in which they were raised, and their ability to participate in everyday life events. The surroundings of the kid informs the direction of the teacher's psychoeducational intervention. Renou (2005) has demonstrated that this type of intervention is defined by:

- Create a connection based on education that is constructive, safe, respectful, trusting in approved procedures, professional and self-assured, consistent in attitudes, empathic, and charitable.

- Treat all of the circumstances in a person's life as limitless opportunities to embrace learning new habits and acquiring new skills.

- For actors to adopt a more adaptive pathway, the individual and his or her environment must be assessed and supported in a progressive manner.

The main founder of the psycho-educational model of intervention by activities is Gendreau, the model affects mainly children and adolescents with disabilities and specific difficulties, Gendreau (1978) present it in the form of moments of comfort and pleasure in which various activities touch the weak points of people in difficulty to make them stronger by preparing a well equipped and adapted environment.

Preparation, application, and assessment are the three steps that these activities go through, according to Renou (2005), which are all carried out by the educator. Additionally, the connection between the overall frameworks of the educational activity's 10 components with (Gendreau, 1978) has expanded to fourteen components with (Gendreau, 2001; Gendreau, Prince & Lévesque, 2006a; Gendreau & Prince, 2006b; Gendreau, Prince & Bernier, 2006c).

Following are descriptions of the performers who participated in the instructional activity; as well as **Figure 1**

- The participant: is the core of the accompaniment, he usually suffers from several problems that affect various dimensions of his life.

- The teacher, educator or guide: whose competence is required to ensure solid support.

- The group: collaborates and uses its collective knowledge to assist youngsters who are having difficulties.

- Peers: they usually have commonalities in the intervention and cooperate with each other.

- Parents: their major work is at home, they try to achieve the right interaction on all levels.

- Other experts: they step in when aid is needed, and they have a variety of skills.

- The objective: is the center of the intervention that puts together all the other components, it is very important

to prepare the necessary means and identify all the standards to have good results.

The instructional activity's structural elements are:

- Time: this is the period of time required for the intervention and differs according to the needs of the children and the specific objectives.

- Space: it is the environment where the intervention takes place and must be well studied, enriched, comfortable and relaxing.

- Programming : this component consists of a number of ongoing or evolving procedures whose purpose is to guide, assist, inform, and inspire participants to keep working toward the activity's objectives.

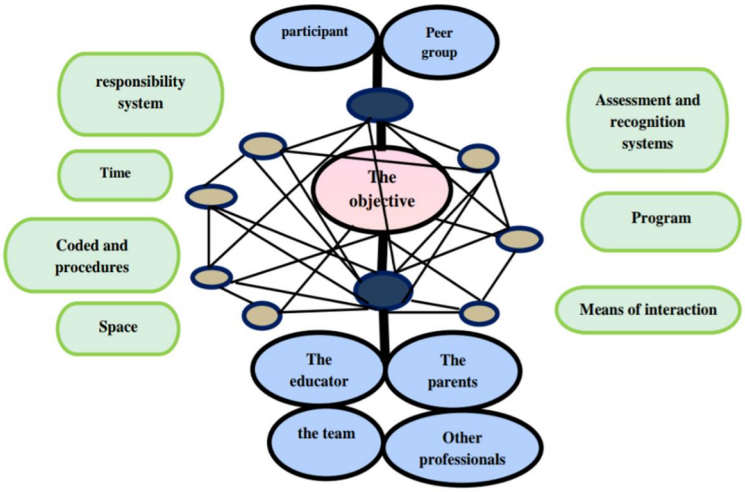
- The means of interaction : with the use of these approaches for animating the direction of ideas, emotions, and actions to achieve the objectives, the facilitator intends to have the participants interact with the activity's content.

- Responsibility structure : depending on their level of self-management and the complexity of the task, the children were given these skills and knowledge.

- The code and the procedures: the code is a collection of guidelines established to update the expectations of how people should interact with one another and with tools used to implement program interaction. The methods of realization are called procedures, and they vary depending on the situation and the qualities of the people involved.

- The assessment system is represented by standards that have been set as benchmarks to assess the activity and the participants' development (Le Blanc, 2014).

Fig.1. Interactive elements to help organize the teaching activity



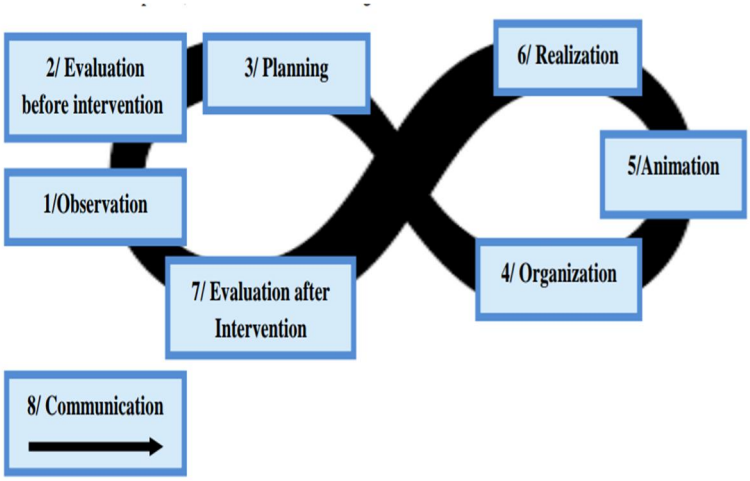
(Le Blanc, 2014, p.128)

A form with the infinity sign (∞) was used by was used by (Gendreau & al,2006a) to highlight the professional procedures' efficacy and efficiency. This exhibition demonstrates how these processes are ongoing and interrelated, as well as the internal connections that bring them together. The first procedure that gives the information required to create a precise assessment of the individual in need is observation. The planning for the intervention, which comes before the evaluation, is done right away. This planning then

decides how the many elements of the intervention scenario will be organized. The intervention scenario is animated, creating structural and relational

connections that give the intervention purpose and value. Analyzing the intervention's state is made feasible by the post-intervention evaluation. This assessment shows the intervention's efficacy and draws attention to some aspects that may be the focus of a future intervention. Between the many players participating in this intervention, there are ongoing communications stages that run concurrently to these various processes (Caouette & Pronovost, 2013). It is demonstrated in **Figure 2**

Fig.2. Operations for psychoeducational intervention.



(Gendreau, 2001, p.129)

According to (Gendreau, 1995; Dionne, 1996), these procedures and strategies were initially developed to aid children and adolescents who were experiencing social and emotional delinquency, but they are now utilized to support a variety of circumstances, notably those including disability and special needs. All specialists in special education use this paradigm of psycho-educational intervention as their main resource (Gendreau, 2001; Renou 2005).

Thus Grégoire (2004) analyzes the situations that distinguish a good achievement according to the psycho-educational approach:

- These interventions are well-constructed with well-developed and well-organized information about the difficulties and disabilities encountered by the patients.

- It takes into consideration the moments of strength and weakness as well as a total diagnosis of all the social, cognitive, relational, emotional and intellectual aspects of the patients.

- This diagnosis helps to set the general and specific objectives and to control them.

- Choose the necessary tools to achieve and evaluate the objectives perfectly.

- Evaluate the extent to which the outlined objectives are achieved (Renou,2005).

Thus, the psycho-educational approach is based on three main poles: the pedagogical pole, which allows communication about the difficulty, its symptoms and remediation; the psycho-emotional pole, which aims to reduce fear, anxiety, depression and anger; and the behavioral pole, which targets learning and invests in behavioral change strategies to improve the various dimensions that affect the patient's well-being (Duhamel, 2014).

4. Methodological approach

4.1 Hypotheses

General hypothesis: the intervention program contributed to improving the cognitive capacities of children with hearing impairment.

First sub- hypothesis: the intervention program help children with hearing impairments enhance their attention capacity

Second sub-hypothesis: the intervention program aid in the improvement of the perceptual capacities of children with hearing impairment.

Third sub-hypothesis: the intervention program help children with hearing impairment increase their memory capacity.

4.2 Approach to research

This is a quasi-experimental approach in which the participants in the experimental and control groups were not randomly chosen, were equal, and had passed pre-tests. The experimental group was then subjected to activities while the control group was excluded from the activities, and post-tests were given to both groups to assess how effective the intervention program was for the development of cognitive abilities (attention, perception, and memory).

4.3 Sample of research

We chose two samples, each consisting of nine kids with the same characteristics, to compare the effects of the psycho-educational approach and the conventional pedagogical approach (math, Arabic language) on the cognitive abilities of kids with hearing impairments (hearing impairment, intelligence and biological age between 9 and 11 years, with a cochlear implant or a hearing aid). The kids are members of "ATAS" of Nabeul, a Tunisian organization that helps the deaf.

4.4 Research tools

- *Auditory and visual attention test "Number matching and letter erasure"* (Mitchell Quittner, 1996):

- Number matching test: is one of the tests that measure the attention capacity, which indicates the individual's ability to pay attention to more than one stimulus at the same time. In this test, the examinee is asked to respond to the following dual numbers (3-7), (5-5), (0-1). These numbers are audio and are recorded on cassettes. Then, the number of remaining stimuli and the number of errors, in the indicated time is calculated, the correlation coefficients between the children's scores over a period of three minutes were (0.806), moreover a strong correlation was found between the children's scores on the intelligence test and the correct response to this test, which indicates its reliability. The correlation coefficients of the test were (0.479), and this value is statistically significant at the (0.01) level.
- Letter Scratch Test: this test requires the test taker to be both fast and accurate, which means that this type of test requires the test taker to focus his or her attention within the specified time period to determine the required response. The test is a paper with a set of letters on it. In the test instructions, there are four letters "L, Y, M, H", which are the letters that the test taker is asked to cross out within a specific time period. Once the candidate's performance is completed, the errors are calculated, that’s to say the stimuli that the candidate failed to estimate, and the stimuli remaining in the specified time period, and the number of errors is also calculated. Its legalization and the calculation of fidelity and reliability occurred, as it happened in the number matching test, and the value of the reliability coefficient was (0.715) and the correlation coefficient was (0.667).
- *Visual perception test* (Doehring & Rosenstein, 1969): The test consists of four

axes, each axis consists of items and each item contains questions, which are as follows.

- Visual Distinction: it contains two items, and each item contains exercises that the child does, also for:
- Visual recall: contains 3 items
- Visual analysis: contains one item
- Visual recognition: contains two items.

Test Validity: Through the results presented, it was found that the Pearson correlation coefficient before adjustment (R = 0.99) after adjustment with the Spearman-Brown equation is estimated to be (RS = 0.99) and compared to the table (R) which has a value of (0.76) at the degree of freedom (08). We find that (Rs). The calculated value is greater than the tabulated value (t), which is a statistically significant value at the significance level (0.01). And that the differences between the means of the two samples (T=10.71) at the degree of freedom (08) and that the calculated value (t) is greater than the tabulated value (t) at the significance level (0.01). Therefore, the questionnaire has a high degree of validity.

- *Visual Memory Scale* (Hollingworth & Henderson,2002) *:* and was applied to study the differences between students with hearing impairment and normal students at the basic instructional level on the variable of visual memory, where each item response takes a score (0 or 1) and the scale consists of three subscales.

-The first scale: (visual-spatial memory) which includes a set of numbered images presented in front of the candidate in two or three rows over a period of time ranging from 5 to 20 seconds.

- The second scale: (visual memory of shapes/numbers) which includes a set of cards, each containing a picture in its upper row, symbols and geometric shapes (line, shape, symbol, circle, square, star, triangle, etc...) corresponding to the numbers in the lower row corresponding to these symbols. It was exposed to the subject for a period of time ranging from 10 to 30 seconds.

- The third scale: (Visual memory of shapes/letters) which includes a set of cards, each containing a table in its upper row, symbols and geometric shapes (line, shape, symbol, circle, square, star, triangle, etc…) corresponding to the letters in the lower row corresponding to these symbols. It was exposed to the subject for a period of time ranging from 10 to 30 seconds. It can be applied to both normal and hearing-impaired people, and the scale has good standards of validity, reliability and scientific measurements.

Validity of the scale: The results of the structural validity of the scale and its included subscales were as follows: all internal correlations between the three subscales were positive, as the correlation coefficients ranged from (0.65 to 0.9) and all internal correlations for each subscale with the total score were positive, where the correlation coefficients ranged from (0.67 to 0.885) The results of the structural validity of the scale and its subscales indicate the consistency of its items in each subdomain and for the overall degree, which confirms the validity of the scale.

The reliability indicators of the reapplication of the subscales included in

the scale and the total score were high and significant at the default significance level (0.05), the reliability coefficients for the sample of normal students ranged between (0.84 and 0.91). Regarding the sample of hearing-impaired students, it ranged from (0.79 to 0.87). These results indicate the reliability of both the subscale and total degrees, which supports the indicators of subscale reliability.

- *Program of psychoeducational intervention:*

- Program's main idea: employing different teaching methods based on games and arts in order to improve and develop the cognitive abilities of children with hearing disabilities. Planning exercises with well-defined objectives in accordance with the official curriculum of the Ministry of Education.

- The execution stage: The intervention started in October and ended in December 2021, this period was divided into 36 sessions at an average of 4 sessions per week, each session lasting 30 minutes.

- The program's overarching objective: improvement and reinforcement of the cognitive abilities of children with a hearing impairment. (Attention, perception and memory).

- The program's methods: tablets, smartphones, dictionaries, stories, paintings, books, notebooks, watercolors, dolls, video Sequences, music, drama, dance, colored papers, drawing papers, scissors...

- Program credibility: first, the program was corrected by teachers in the field. After the correction and verification it was implemented with the target group.

- Program assessment: using the same tests from the first stage to measure the effect rate of the intervention program on children

4.5 Analysis of statistics

Standard deviation is added to the mean to represent values. The Shapiro-Wilk W test was used to determine the acceptability of normality prior to adopting parametric testing. A two-factor analysis of variance was done to determine the impact of the program. Time and the group factor are both important. A Bonferroni post-hoc test was used to determine important pairwise differences when the groups x time interactions were significant. All ANOVAs also included partial eta-squared calculations for effect sizes. Using a paired-samples t-test, the within-group comparison was conducted. The significance threshold for all statistical analyses was set at $p < 0.05$ and was carried out using the SPSS program.

5. Analysis of the results

Result analysis of the hypothesis: A two-factor analysis of variance was carried out to determine the program's effect on cognitive capacities in order to verify the correctness of the hypotheses (attention, perception, and memory). Furthermore, within-group comparisons are performed using a paired sample t-test and impact sizes were computed for all ANOVAs using partial eta-squared.

- **Results of the first sub-hypothesis:** As stated in the first sub-hypothesis, "The intervention program help children with hearing impairments enhance their attention capacity" This is shown in **Table1**

Table 1. The effect of the intervention program on attention

the test	the group	pre-test	Post- test	Change %	Analysis of variance test: interaction time × group	group effect	effect of time
visual attention	Experimental	75.50±7.04	16.10± 8.65**	-78.7	F=258.55 P < 0.001 η^2= 0.93	F=97.19 P=0.001 η^2= 0.84	F = 251.68 P = 0.001 η^2= 0.93
	Control	6.50±6.87	76.9± 9.70	0.5			
auditory attention	Experimental	53.00±9.83	16.5± 5.15**	- 68.9	F=232.35 P=0.001 η^2= 0.93	F=27.91 P = 0.001 η^2= 0.61	F = 362.13 P = 0.001 η^2= 0.93
	Control	53.00±8.55	51.9± 7.31	-2.1			

**at the 0.01 significance level; * at the significance level of 0.05

The analysis of variance reveals that the time factor has a statistically significant impact on visual attention (F = 251.68; P = 0.001; η^2 = 0.93) and time × group interaction (F = 258.55; P < 0.001; η^2=0.93), the effect of the group was likewise statistically significant, and there were statistically significant differences between the experimental group and the control group. (F = 97.19; P = 0.001; η^2 =0.84) and this was reflected in the experimental group's performance developed significantly after being tested (t = 19.30; P = 0.001) and -78.7% difference between pre- and post-tests in comparison to the control group, which achieved just 0.5 percent where no statistically significant differences were seen between pre- and post-tests.

For auditory attention, According to the analysis of variance, the time factor has a statistically significant impact (F = 362.13; P = 0.001; η^2= 0.93) and time × group interaction (F = 232.35; P = 0.001; η^2=0.93). The group effect was statistically significant, and there were also statistically significant differences between the experimental and control groups (F = 27.91; P = 0.001; η^2=0.61) and this was demonstrated by the experimental group's performance, which significantly improved (t = 17.39; P = 0.001) contrasted to the control group, where there were no statistically significant variations between the pre and post-tests, with a percentage of -68.9% change between the pre and post-tests, as opposed to the control group, which reached -2.1%. This reflects that the experimental group reduced the number of their errors and developed their attention and concentration by a significant percentage compared to the control group in visual and auditory attention as well, the first sub-hypothesis is confirmed.

- **Results of the second sub-hypothesis:** As stated in the second sub-hypothesis, "The intervention program aid in the improvement of the perceptual capacities of children with hearing impairment". Which is shown in **Table 2**

Table 2. The effect of the intervention program on visual perception

the test	the group	pre-test	post test	Change %	Analysis of variance test: interaction time × group	group effect	effect of time
Visual distinction	Experimental	0.53 ± 7.5	7.70±1.49**	2.7	F=117.28 P=0.001 η^2= 0.87	F=66.07 P=0.001 η^2= 0.79	F=181.46 P=0.001 η^2= 0.91
	Control	1.55 ± 7.5	8.50±1.55	13.3			
visual reminder	Experimental	5.2±1.75	9.60±0.97**	84.6	F=41.09 P=0.001 η^2= 0.69	F=7.63 P=0.001 η^2= 0.30	F=41.09 P=0.001 η^2= 0.69
	Control	6.4±0.70	6.40± 0.70	0.0			
Visual analysis	Experimental	1.6±0.52	2.70±0.48 **	68.8	F= 7.28 P=0.02 η^2= 0.29	F=5.43 P=0.03 η^2= 0.23	F=5.06 P=0.04 η^2= 0.22
	Control	1.8±0.63	1.70±0.82	-5.6			
Recognition visual	Experimental	4.2±0.79	8.70±0.95**	107.1	F=54.88 P=0.001 η^2= 0.75	F=179.87 P=0.001 η^2= 0.91	F=35.12 P=0.001 η^2= 0.66
	Control	3.0±0.94	2.50± 1.18	-16.7			

**at the 0.01 significance level; * at the significance level of 0.05

Analysis of variance revealed that the time factor had a statistically significant impact on visual distinction (F = 181.46; P = 0.001; η^2= 0.91) and time × group interaction (F =117.28; P =0.001; η^2=0.87). The group effect was statistically significant, and there were statistically significant differences between the experimental and control groups. (F=66.07; P=0.001; η^2=0.79). This was demonstrated by the experimental group's performance noticeably improving (t = 23.66; P = 0.001). Having a rate of 2.7 percent change between the pre- and post-tests, whereas the control group saw a shift of 13.3 percent in the various items assessed between the pre- and post-tests.

- The analysis of variance shows that the time factor has a statistically significant impact on visual reminder (F = 41.09; P = 0.001; η^2= 0.69) and time × group interaction (F = 41.09; P = 0.001; η^2=0.69). Additionally, there were statistically significant differences between the experimental and control groups, and the group effect was also statistically significant.

(F = 7.63; P = 0.001; η^2=0.30) and this was demonstrated by the experimental group's performance significantly improving. (t = 7.12; P = 0.001) and by a difference of 84.6 percent between the pre- and post-tests compared to the control group, which reached 0.0 percent. At the level of the various items that were tested, no statistically significant differences were seen between the pre- and post-test.

Regarding the visual analysis, the analysis of variance shows that the time factor has a statistically significant impact (F = 5.06; P = 0.04; η^2= 0.22) and time × group interaction (F = 7.28; P = 0.02; η^2=0.29). Additionally, there were statistically significant differences between the experimental and control groups, and the influence of the group was also statistically significant (F = 5.43; P = 0.03; η^2=0.23) and the experimental group's performance significantly improved as a result, which was demonstrated by (t = 6.13; P = 0.001) with a difference of 68.8% between the pre- and post-tests, compared to the control group, which attained -5.6% and showed no statistically significant changes between the pre- and post-tests at the level of the various items assessed.

According to the analysis of variance, the time factor has a statistically significant impact on visual recognition (F = 35.12; P = 0.001; η^2= 0.66) and time × group interaction (F = 54.88; P = 0.001; η^2 =0.75). The group effect was statistically significant, and there were also statistically significant differences between the experimental and control groups (F = 179.87; P = 0.001; η^2=0.91) and this was demonstrated by the experimental group's performance significantly improving (t = 13.17; P = 0.001) with a difference of 107.1 % between the pre- and post-tests, compared to the control group, which attained -16.7% and showed no statistically significant changes between the pre- and post-tests at the level of the various items assessed.

- This reflects that the experimental group improved their perceptive abilities, understood to establish logical relationships between different situations and reduced the number of their errors by a significant percentage

compared to the control group, the second sub-hypothesis is confirmed.

- **Results of the third sub-hypothesis:** As stated in the third subhypothesis, "The intervention program help children with hearing impairment increase their memory capacity". Which is shown in **Table3**

Table 3. The effect of the intervention program on visual memory

the test	the group	pre-test	post test	Change %	Analysis of variance test: interaction time × group	group effect	effect of time
spatial	Experimental	23.30± 3.06**	10.5±2.80	121.9	F=630.33 P=0.001 η^2= 0.88	F=48.88 P=0.001 η^2=0.73	F=108.03 P=0.001 η^2= 0.86
	Control	10.10±1.66	10.7±2.06	-5.6			
short term (forms and letters)	Experimental	22.60±2.67 **	11.1±2.13	103.6	F=65.17 P=0.001 η^2= 0.78	F=64.01 P=0.001 η^2= 0.78	F=86.12 P=0.001 η^2= 0.83
	Control	11.0±02.40	10.2±1.87	7.8			
short term (shapes and numbers)	Experimental	20.20±1.99**	10.7±1.95	88.8	F=44.55 P=0.001 η^2= 0.71	F=67.36 P=0.001 η^2= 0.79	F=65.16 P=0.001 η^2= 0.78
	Control	10.80±1.75	9.9±2.28	9.1			

**at the 0.01 significance level; * at the significance level of 0.05

According to the analysis of variance, the time factor has a statistically significant impact on visual spatial memory (F = 108.03; P = 0.001; η^2= 0.86) and time × group interaction (F = 630.33; P= 0.001; η^2=0.88).

There were statistically significant differences between the experimental and control groups, and the group effect was also present (F = 48.88; P= 0.001; η^2=0.73) and the experimental group's performance significantly improved as a result, which was demonstrated by (t = 14.15; P = 0.001). with a difference of 121.9% between the pre- and post-tests, compared to the control group, which attained 5.6% and showed no statistically significant changes between the pre- and post-tests at the level of the various items assessed.

The analysis of variance reveals that the time factor has a statistically significant impact on visual short-term memory (shapes and letters) (F = 86.12; P = 0.001; η^2= 0.83) and time × group interaction (F = 65.17; P = 0.001; η^2=0.78). Statistically significant differences were between the experimental and control groups, and the group effect was seen as well (F = 64.01; P=0.001;η^2=0.78), and this was demonstrated by the experimental group's performance significantly improving (t = 12.16; P = 0.001) with 103.6% interval between the pre and post-tests relative to the control group which only reaches 8.7%, where no statistically significant difference was noted between the pre and post-tests at the level of the different items examined.

According to the analysis of variance, the time factor has a statistically significant impact on visual short-term memory (shapes and numbers) (F = 65.16; P = 0.001; η^2= 0.78) and interaction time × group (F = 44.55; P = 0.001; η^2= 0.71). The group effect was also statistically significant, in addition to the experimental and control groups having statistically significant differences from one another (F = 67.36; P = 0.001; η^2=0.79). This was demonstrated by the experimental group's performance becoming much better than control group performance (t = 11.40; P = 0.001) with a calculated percentage change of 88.8% between the pre and post-tests relative to the control group which only reached 9.1% where there were no statistically

significant differences noted between the pre and post-tests at the level of the different items that were examined. This reflects that the experimental group improved their memory capacity and reduced the number of their errors by a significant percentage compared to the control group in visual-spatial, short-term (shapes and letters) and short-term (shapes and numbers) memory, supporting the third sub- hypothesis.

- Results of the general hypothesis: As stated in the general hypothesis, "The intervention program contributed to improving the cognitive capacities of children with hearing impairment". Which is shown in **Table 4**

Table 4. The effect of the intervention program on cognitive capacities

the test	the group	pre-test	post test	Change %	Analysis of variance test: interaction time × group	group effect	effect of time
Cognitive capacities							
Attention	Experimental	128.50±12.36	32.60±10.01**	-74.6	F=424.17 P = 0.001 η^2= 0.96	F=93.04 P=0.001 η^2=0.84	F=436.73 P = 0.001 η^2=0.96
	Control	129.50±12.90	128.80±13.97	-0.5			
Memory	Experimental	32.3±4.99	66.10±4.89**	104.6	F=197.8 P = 0.001 η^2=0.92	F=134.55 P = 0.00 1 η^2=0.8 8	F=225.33 P = 0.001 η^2=0.93
	Control	30.8±4.64	31.90±2.03	3.6			
Perception	Experimental	18.5±2.17	37.7 0± 2.41**	103.8	F = 133.20 P = 0.001 η^2= 0.88	F=138.75 P = 0.001 η^2=0.88	F = 136.00 P = 0.00 1 η^2=0.88
	Control	19± 2.87	19.10± 2.60	0.5			

**at the 0.01 significance level; * at the significance level of 0.05

The analysis of variance shows that the time factor has a statistically significant impact on the overall level of attention (F = 436.73; P = 0.001; η^2= 0.96) and time × group interaction (F= 424.17; P = 0.001; η^2= 0.96). The group effect was also statistically significant, in addition to the experimental and control groups having statistically significant differences from one another (F = 93.04; P = 0.001; η^2=0.84) and the experimental group's performance significantly improved as a result, which was demonstrated by (t = 23.75; P = 0.001) with a calculated percentage change of -74.6% between the pre and post-tests relative to the control group which only reached - 0.5% where there were no statistically significant differences noted between the pre and post-tests at the level of the different items that were examined.

The analysis of variance reveals a statistically significant influence of the time factor on the overall memory score. (F = 225.33; P = 0.001; η^2= 0.93) and time × group interaction (F = 197.81; P = 0.001; η^2=0.92). There were statistically significant differences between the experimental and control groups, and there was also a statistically significant group effect (F = 134.55; P = 0.001; η^2=0.88) and the experimental group's performance significantly improved as a result, increasing (t = 20.38; P = 0.001) with acalculated percentage change of 104.6% between the pre and post-tests relative to the control group which only reached 3.6% where there were no statistically significant differences noted between the pre and post tests at the level of the different items that were examined.

The analysis of variance shows that the time factor has a statistically significant impact on the overall degree of perception (F = 136.00; P = 0.001; η^2= 0.88) and time × group interaction (F =133.20; P = 0.001; η^2=0.88). There were also statistically

significant differences between the experimental and control groups, as well as a statistically significant group effect (F =138.75; P = 0.001; η^2=0.88) and this was demonstrated by the experimental group's performance significantly improving (t = 21.23; P = 0.001) with a calculated percentage change of 103.8% between the pre and post-tests relative to the control group which only reached 0.5% where there were no statistically significant differences noted between the pre and post-tests at the level of the different items that were examined. These results confirm the general research hypothesis, because the planning and carrying out of the intervention program activities led to the improvement of the cognitive abilities of deaf or hearing-impaired children.

6. Discussion

The cognitive capacities of hearing-impaired youngsters are statistically significantly impacted, after the application of the intervention program in favor of the post- measurement, which confirms the effectiveness of the program in improving the level of attention, perception and memory. The level of the children improved in the acquisition of Arabic and mathematical skills in a remarkable way, and through the results of the three hypotheses related to these abilities, it was found that the intervention program with its techniques, tools and sessions helped the children (the experimental group) to develop the level of attention (auditory and visual) and perception (visual recognition - visual recall - visual analysis - visual determination) and visual memory (spatial - shapes and numbers in the short term - shapes and letters in the short term). There was an improvement in the children's capacity to understand certain arithmetic concepts and to realize the connections and relationships between objects, symbols and geometric shapes and their meanings.

The results also showed an improvement in attention capacities during learning and avoiding distractions during and after the sessions, and this helps in good learning, concentration and not being impulsive which leads the child to make mistakes.

The previous results are explained in the light of theories that dealt with cognitive capacities, on the basis of which the current research program was prepared, which was reflected in its results, where it was based on the attractiveness of the activities offered to the child, as it is considered the information received for certain areas of the brain, which it analyzes through its internal and external senses. And this is what the Pass theory indicates to process and store information, which helps to develop cognitive capacities. (Attention - perception - memory).

In preparing the program, consideration was given to certain problems that the child may encounter, such as: visual or auditory perception or recognition problems. The activities in the sessions included a variety of sensory stimuli to include visual and auditory recognition and perception of concepts. The activities were also characterized by flexibility to help the child overcome some of the problems to which he may be confronted. The current research findings are due to the progressive presentation of activities

that address cognitive capacities in the program, and this is what mentioned (Naceur,2010,2013) that the learning process takes place in successive levels that depend on each other, starting with the attention process, then the perception process, then the memory process. The results of the intervention program for the development of cognitive abilities (attention - perception - memory) are consistent with what has been mentioned in the theoretical part and previous studies that emphasize the importance of developing cognitive capacities to avoid some of the problems that children with hearing impairment may encounter.

The activities of the program were based on the stimulation of motivation towards learning, through the diversity of individual and collective concrete activities, and the use of various techniques, thus proposing exercises classified from easy to difficult, proposing also artistic activities, narration, theater by inserting elements of suspense and attraction, as well as the use of material and moral reinforcement methods, which played an important role in attracting children to the activities and following instructions during the program's implementation period. The findings of a research by Smith (2004) that sought to determine the developmental age of attention in groups of hearing children showed that there were statistically significant variations in the levels of attention between the two groups of hearing and non-hearing children, and no difference was found between the hearing impaired who had cochlear implants and those who did not. The best performance was for the hearing group, followed by the cochlear implant group, and the non-cochlear implant group was the worst performer. This supports the claim that one of the primary causes of the reduction in reading ability and accomplishment documented by a number of study is attention deficit in hearing-impaired individuals. This finding includes that treating the problem of attention deficit in people with hearing impairment may be the treatment for the decreased level of reading capacity and achievement they suffer. While the results of the study indicate that attention levels improve with the use of appropriate strategies during learning, build cognitive enrichment intervention programs to train children with hearing impairment to focus their attention during learning and cognitive situations in general. This would reduce the difference between this group of children and normal children in terms of attention, and thus help to improve their level of achievement and cognitive capacities.

Visual attention is one of the factors most associated with hearing impairment. Results from a study conducted by Quittner & al (2010) indicated that there is a strong correlation between attention and behavioral problems in children with hearing impairment, based on what was reported by parents and teachers of this group of children.

Thus Doehring & Rosenstien (1969) compared the speed of visual perception from a "target stimulus" among other similar stimuli between fifty hearing impaired children and fifty hearing children, they found that hearing people

were the fastest to find the target and based on the results of the study, the researchers came to the conclusion that the visual perception disorder in hearing impaired children was not only the result of hearing impairment, but that other factors such as age, learning, language development and reading ability interacted with the hearing impairment and led to the development of a visual perception disorder.

The cognitive capacities of children with hearing impairment can be developed through educational activities and stereoscopic games (Matkin & al, 1999). Also kuku & Adeniy (2020) indicated that the use of appropriate educational methods with people with hearing impairment helps to stimulate and improve the ability to think well and helps to reduce the effects of their language deficits, which reflects on their thinking processes. In addition, Quittner & al (2010) to detect the impact of a sensory integration program on the development of cognitive capacities of people with hearing impairment revealed that the children improved after the sessions in the degree of interaction, perception and motor balance with an increase in the rate of concentration and understanding.

Also, Brady & al (2013) revealed the positive effect of a game-based intervention program for improving visual thinking skills of children with hearing impairment (recognition, analysis, making relationships, perception, meaning extraction). This is also confirmed by Naceur (2013), where he showed that visual perception works in parallel with visual memory, which is characterized by a short duration of information storage since it does not exceed one second despite its large capacity.

Many researchers confirm the existence of an active interaction between visual perception and other cognitive capacities including Kaplan (2010), who showed that there is a close relationship between memory and perception because memory focuses on information acquired from perception, while object recognition and perception requires retrieval from memory. In addition to the findings of Kuku & Adeniy (2020) after several researches on hearing impairment and its relationship with visual memory, it was found that hearing children are able to retain visual stimuli more than hearing impaired children therefore, more attention should be paid to visual stimuli, especially those that attract children's attention while presenting activities in terms of lighting, colors, locations, design, choice of games and means of animation among school and office tools and others, this was confirmed by Quittner & al (2010), where hearing children performed more significantly than hearing children on visual short-term memory and visual long-term memory tasks after two months of visual stimuli presentation, but after the passage of 4 intervention sessions, there was a significant improvement in hearing children and a decrease in the difference between responses to visual stimuli compared to hearing children. Also Mitchell & al (1996) showed that hearing impaired people of all ages were more attentive than hearing people to marginal visual stimuli due to compensatory changes in the visual processing of hearing impaired people due to auditory

deprivation, which resulted in an increase in their visual abilities and thus an increase in their visual perceptual capacities and the same for visual memory, this was confirmed by Parasnis & al (1996) thanks to the remarkable development that occurred in the visual memory of hearing impaired people, where they remember images more easily than words and verbal syllables. Thus, we conclude a close relationship between attention, perception, memory, and especially visual memory. This is because this category relies more on visual stimuli through color, lip reading, and sign language than on auditory stimuli (Wilson & al, 1987). As well as the auditory level also marked a remarkable improvement as it was studied and took into account the degree of hearing of the research sample, the activities were presented in comfortable conditions and away from all auditory distractions, and the work within the group was organized, respecting the etiquette of dialogue and discussion in all stages of oral or written activities, whether in arabic language and mathematics. Therefore Stevens (2006) emphasizes the importance of providing intervention to improve cognitive capacities, including perceptual enhancement activities and developing educational programs for people with hearing impairment, as Kuku & Adeniy (2020) point out that the use of appropriate educational strategies with children with hearing loss helps to stimulate and enhance the capacity to think well and helps to reduce the effects of language deficits that reflect on their thinking processes, which helps to increase motivation and stimulate a number of senses, resulting in an increase in their cognitive development (Gathercole, 1999). Allowing children to play games while learning and giving them complete freedom to do so and placing them in the different stages of the activity according to their abilities and without competition or comparison of their performance with hearing children, which helps to increase their confidence, motivation and develop their cognitive capacities. This result is in agreement with Bond (1987), Kelly& Keasy(1976),. Gibson (2003), Hitch (1989), Lyxell & Holmberg (2000), Santos& al (2005), Hollingworth & Henderson (2002) and kuku & Adény (2020). According to the data previously presented, there are statistically significant variations between the mean pretest and mean posttest scores for the experimental group at all levels of cognitive ability as well as for the overall score. The post-test results were favorable, showing growth in all the abilities that had been the focus of the study. This confirms that the increase in attention levels has a good impact on the levels of perception and memory, all of which automatically affect emotions, cognition and human relations as a whole (Naceur, 2010, 2013). Whether it is paying attention to events and learning or focusing while doing. This strengthens their confidence in themselves and others, and makes them love learning and take ownership of it. When we are aware of the unique characteristics of the hearing impaired, we may seriously consider their advantages and prevent any potential problems, which will draw more attention and improve their ability to perceive information, keep it in memory, and, if

required, aid their recovery. Additionally, it is clear that for hearing-impaired people, attention, perception, and memory interact strongly.

7. *CONCLUSION*

It is very important these days to seriously think about different methods for the education and learning of children with hearing impairment. Although there are several efforts in this area, it takes a serious investment in active pedagogy in each subject based on the arts, games, animation and group work to touch all cognitive, behavioral aspects, relationships of these children. This is why we have tried in this study to plan an educational program that takes into consideration all its dimensions, mainly cognitive abilities. So in preparing and planning the intervention program we took the principles of the psycho-educational approach to establish a foundation to help develop cognitive capacities such as attention, perception and memory, particularly at the visual level, in an attempt to compensate for auditory deprivation, and to engage fully in all moments and stages of animation by taking advantage of the means provided to activate all his sensory organs and his sources of force. It has been demonstrated that using this strategy effectively helps people build these skills and get through the numerous challenges they encounter in their life. This reflects a remarkable improvement in the other aspects of hearing-impaired children, because their motivation and their desire to learn and discover has developed and this thanks to the rich and adapted environment which allows them to better concentrate during the tasks required of them. 'or the assimilation of color, balance, space, depth and volumes, as well as group discussion and role-playing as a technique of implementation during each learning session (Kahn, 2011).

This was confirmed by Naceur (2013), that the internal motivations of the individual realize their motivation to learn. If the research sample is a group with a hearing disability, they have interaction and communication difficulties, it is for this reason that the choice of tools, teaching aids, learning strategies is oriented towards the sensory aspect by minimizing the verbal aspect since we are trying to deeply improve the essentially visual perception but without neglecting the other dimensions, the teacher is required to differentiate activities and diversify teaching aids to meet the needs of people with hearing impairment in order to invest their intelligence and align with their needs (Daneman & al ,1995).So it is very important to put in the first place the primordial role of artistic, playful, motor activities and educational games during each preparation of lessons and each planning of intervention programs, especially since they are oriented towards children with special needs specific, including hearing impairment.

8. *Bibliography List*:

1. Bond (1987), An assessment of cognitive abilities in hearing and hearing impaired preschool children, Journal of Speech and Hearing Disorders, JSHD-JSD Journal PPV, National library of medicine, volume52 number 4;

2. Brady et al (2013), Visual Long-Term Memory Has the Same Limit on Fidelity as Visual Working Memory, Psychological Science , SAGE Journals, volume 24 number 6 ;

3. Baddeley (2002), Is working memory still working?, European psychologist, APA Psy, volume7 number 2;

4. Caouette & Pronovost (2013), L'utilisation psychoéducative : une compétence du psychoéducateur, Revue de psychoéducation, érudit, volume 42 number 2 ;

5. Conway & Kronenberger (2009), The Importance of Sound for Cognitive Sequencing Abilities : The Auditory Scaffolding Hypothesis, Current Directions in Psychological Science, Association for Psychological Science,volume18 number 5;

6. Duhamel (2014), Psychoéducation et TCC. Dans F, Bange TDA/H Trouble Déficit de l'Attention/Hyperactivité 57 notions, DUNOD, France ;

7. Daneman And Others (1995), Working Memory as APredictor of Reading Achievement in Orally Educated Hearing- Impaired Children, Volta Review, ERIC, volume 97 number 4;

8. Doehring & Rosenstein (1969), Speed of visual perception in deaf children. Journal of Speech and Hearing Research, Journal of Speech and Hearing Disorders, SAGE Journals, volume12 number 1;

9. Dionne (1996), L'intervention cognitive-developpementale auprés des adolescents délinquants, Criminologie, érudit, volume 29 numéro 1 ;

10. Gibson (2003), Teaching Strategies used to develop short-term memory in deaf children, A research project funded by the British Association of Teachers of the Deaf, at St John's School for the Deaf, Boston Spa, West Yorkshire;

11. Gendreau (1978), L'intervention psychoéducative : solution ou défi ?, Fleurus, Paris ;

12. Gendreau (1995), Partager ses compétences, un projet à découvrir Tome 1, Éditions science et Culture, Montréal ;

13. Gendreau (2001), Jeunes en difficulté et intervention psychoéducative, Sciences et culture, Montréal ;

14. Gendreau & Le Blanc (2002), Grille d'analyse pour la conception d'un programme d'activité de réadaptation pour adolescents, Sciences et culture, Montréal ;

15. Gendreau, Prince & Lévesque, (2006a), Le modèle psychoéducatif : manuel d'accompagnement, Sciences et culture, Montréal ;

16. Gendreau & Prince (2006b), Le modèle psychoéducatif : manuel d'accompagnement, Sciences et culture, Montréal ;

17. Gendreau, Prince & Bernier (2006c), Le modèle psychoéducatif : manuel d'accompagnement, Sciences et culture, Montréal ;

18. Gilles & Lhuilier (2012), L'activité au cœur de l'intervention psychosociologique, Bulletin de psychologie, CAIRN, volume3 65 numéro 519 ;

19. Gathercole (1999), Cognitive approaches to the development of short-term memory, Trends in cognitive sciences, National library of medicine, volume 3 number 11;

20. Grandmont & Ndayisaba (1999), Les enfants différents : les comprendre pour mieux les aider, Les Editions LOGIQUES, Québec ;
21. Grégoire (2004), L'examen clinique de l'intelligence de l'adulte, Pratique psychologique, Mardaga ;
22. Hollingworth & Henderson (2002), Accurate visual memory for previously attended objects in natural scenes, Journal of Experimental Psychology: Human Perception and Performance, APA PsycNet, volume 28 number 1;
23. Hitch, Woodin & Baker (1989), Visual and Phonological Components of Working Memory in Children, Memory & Cognition, National library of medicine, volume 17 number 2;
24. Kahn (2011), Pédagogie dif érenciée, De Boeck, Bruxelles ;
25. Kuku & Adeniyi (2020), Impact of learning interventions on mathematics achievement among learners with hearing impairment, Contemporary Educational Researches Journal, ResearchGate, Volume 10 number 4;
26. Kelly & Tomlinson-Keasey (1976), Information processing of visually presented picture and word simulation by young hearing-impaired children, Journal of Speech Hearing Resource, National library of medicine, volume 19 number 6;
27. Kluwin (1994), Interpreting Services for Deaf Youngsters Who Are Deaf in Local Public School Programs, Journal of American Deafness and Rehabilitation Association, Scientific Research volume 28 number 2;
28. Kaplan , Relationship Between The Achievment and A visual Memory for Deaf Students, , Walden Universty, USA,2010;
29. Kronenberger, Henning , Ditmars, Roman, & Pisoni (2018), Verbal learning and memory in prelingually deaf children with cochlear implants, International Journal of Audiology, Taylor & Francis Online, volume 57 number 10;
30. Lyxell & Holmberg (2000), Visual speechreading and cognitive performance in hearing-impaired and normal hearing children (11-14 years), British Journal of Educational Psychology, the british psychological society, volume 70 number 4;
31. Le Blanc (2014), La rigueur dans les activités éducatives, l'application de la méthode psychoéducative. À la mémoire de Gilles Gendreau, psychoéducateur, Revue de psychoéducation, érudit, volume 43 numéro1 ;
32. Lenoir (2009), L'intervention éducative, un construit théorique pour analyser les pratiques d'enseignement, Nouveaux cahiers de la recherche en éducation, érudit, volume 12 numéro1 ;
33. Lenoir (2014), Les médiations au cœur des pratiques d'enseignement-apprentissage : une approche dialectique, Groupéditions Éditeurs, Québec ;
34. Lenoir, Y., Alaoui, D., & Pelletier, L. (2018). L'intervention éducative : problématique, enjeux et perspectives, Revue des sciences de l'éducation, érudit, volume 44 numéro 3 ;
35. Lochner & Eid (2016), Successful emotions : how emotions drive cognitive performance, Springer, Wiesbaden;
36. Labrèche & Poirier-Magassouba (2003), Processus de création et art-thérapie, Colloque sur les psychothérapies par les arts, au 70e Congrès de l'Association Canadienne-Française pour l'Avancement des Sciences, Rimouski 23/5/2003, Canada ;
37. MacDougall (1979), The education of the deaf in Canada: An update, Canadian Psychological Review, APA PsycNet, volume 20 number 1;

38. Marschark & al (2007), Effects of Cochlear Implants on Children's Reading and Academic Achievement, Journal of Deaf Studies and Deaf Education, OXFORD Academic, volume 12 number 3;
39. Mitchell & Quittner (1996), Multimethod study of attention and behavior problems in hearing impaired children, Journal of Clinical Child Psychology, APA PsycNet, volume 25 number 1;
40. Moore's (2001), Educating the Deaf: Psychology, principles, and practice, Cengage Learning, Boston;
41. Matkin & Wilcox (1999), Considerations in the Education of Children with Hearing Los, Pediatric Clinics of North America, ELSEVIER, volume 46 number 1;
42. Mazeau (2005), Perception visuelle et mémoire, Connaissances Surdités, Audition-Vision, volume 11 numéro 1 ;
43. Naceur (2010), Quand l'émotion perçoit et decision. In Masmoudi & Naceur Du percept à la decision, De Boek, France;
44. Naceur (2013), Emotion et apprentissage. De la théorie à la pratique, CPU, Tunis;
45. Northen & Downs (2002), Hearing in children, Lippincott Williams and Wilkins, Philadelphia;
46. OMS (2021), Surdité et perte auditive ;
47. Parasnis, Samar, Bettger & Sathe (1996), Does deafness lead to enhancement of visual spatial cognition in children? Negative evidence from deaf nonsigners, The Journal of Deaf Studies and Deaf Education, National Library of Medicine, volume 1 number 2;
48. Quittner, Barkr, snell, Cruz, Grimley, Botteri & Marciel (2010), Parenting stress Among parents of Deaf and Hearing Children: Association With Language Delays and Behavior Problems, Science and Practice, Parenting, volume 10 number2;
49. Renou (2005), Psychoéducation : une conception, une méthode, Sciences et culture, Montréal ;
50. Szelag , wrobel & Szymaszek (2008), Towards electrophysiological correlates auditory perception of temporel order, Neuroscience Letters, ELSEVIER,volume 437 number 2;
51. Santos, Mello, Bueno & Dellatolas (2005), Crosscultural differences for three visual memory tasks in Brazilian children, Perceptual and motor skills, SAGE journals, volume 101 number 2;
52. Smith (2004), Introduction to Special Education: Teaching In An Age of Opportunity, Boston : Mattie Stepanek, USA;
53. Stevens & Neville (2006), Neuroplasticity as a double edged sword: Deaf enhancements and dyslexic deficits in motion processing, Journal of Cognitive Neuroscience, National Library of Medicine, volume 18 number 5;
54. Wilson & Power (1987), Developmental differences in the span of visual memory for pattern, Developmental Psychology, the british psychological society, volume 5 number 3;