Stimulation program for selective and sustained attention in preschool based on ICT

T L Paternina¹, D A Rodríguez¹, D Sibaja¹ and A D Morales¹

¹University Corporation Antonio José de Sucre – CORPOSUCRE, Sincelejo, Colombia.

alex_morales@corposucre.edu.co

Abstract. Attention is the key cognitive system of mental activity, which influences the development of higher processes and executive functions. Indeed, the need to design an innovative training program for preschoolers arose. Because here the most important evolutionary development of individuals is determined. Because of this, record potentiates the program and improves attentional levels in children, emphasizing two respective types of attention which are sustained and selective, and focusing in two modes, which are visual and auditory, but based on software of ICT implementation. The research type is quasi-experimental and descriptive, through which a documentary review of psychological theories and apps were made with relevance for this purpose. As a result, a specialized program to stimulate attention, with a complete file containing the theoretical directives of the program and its respective protocol program was obtained. It is concluded that the use of ICT to stimulate selective and sustained attention in children of this age, can generate many benefits for being interactive and innovative, contributing to the motivation of preschool, while it enhances mental abilities and improves their attentional levels.

1. Introduction

The XXI century is known as the digital era, the major role of new information and communications technology in several daily activities that people do; which implies that at an early age, children be encouraged to use these tools, guided by professionals for proper development in computer literacy in the infant.

According to Jean Piaget, children pass through specific stages as it matures his intellect and ability to perceive relationships of all kinds, developing cognitive processes; attention is a fundamental cognitive process of human beings because it is the access mechanism for the implementation of any mental activity [1]. According to Portellano and Garcia attention is a functional complex information filtering system, which focuses on hierarchy and organization, addressed to the selection and coding of stimuli to develop a response process in the human body. Similarly, basic cognitive processes are foregoing higher processes and executive functions of the preschool.

For Rothbar and Posner, during childhood, fixing attention on an object is in competition with multiple distractors; the development of that attentional process in this period is characterized by a significant increase in the time span in which are sustained attentional resources on a stimulus, it means that it increases the number of elements that can be retained in a time specific and also improves the skills to ignore and inhibit irrelevant stimuli to a task [2].

Attention turns to modify the structure of psychological processes determining these to appear as activities that are aimed at certain objects, which occurs as the content of the activities proposed and guide the development of all the psychic processes passing attention to be a fundamental facet of
psychological processes. That is why, it is necessary to stimulate this basic cognitive process through interactive, fun and innovative tools, features containing ICT tools.

2. Attention

Attention is the access mechanism to perform any mental activity, the anteroom of cognition, and functions as a filter system able to select, prioritize, process and monitor information.

Attention is an inclusive process when learning, that is why preschoolers need stimulation during the learning process because they are in a developmental stage where they begin to develop their cognitive, physical and social skills. Because of this, and maturational changes in the central nervous system begin to act under a sphere of pre-operational thoughts, not leaving out the need to socialize and interact with their peers.

In this sense, attention is a process that allows input of information with the aim of facilitating integrated learning, which helps the individual to recognize his surroundings; Apart from that, Reategui proposes that attention is responsible for the leak of information for internal adaptation of the organism in relation to external demands process [3].

Attention is considered an independent function, however there are factors that influence it, such as perception, emotion, intelligence, memory and motivation, primarily talking about the existing fusion between motivation and voluntariness including the alert level that the individual possesses, which happens to contribute to the performance of tasks, because the more you are motivated the more will be the effort needs to be applied, in the same way, the more will a subject is to concentrate the better, because with this, he can eliminate all distractions and the more this heightened his alert levels are, his attention levels will be better [4].

2.1 Sub-categories of attention

2.1.1 Selective attention. Selective attention is the one that includes the ability to select and integrate specific stimuli and mental images, also targeting skills and alternation of these stimuli as adequate information processing [5]. In addition, it is considered as the type of care that allows people to perceive the important stimuli, put aside that which is irrelevant, that means it focuses the individual to attend a specific stimulus even though this contains simultaneously, additional and irrelevant information, generating the capacity of processing a section of information as whole.

2.1.2 Sustained Attention. Sustained attention or vigilance does not refer to cognitive functions but motivational aspects, including complex interactions of functions, where the attentional focus is maintained with effort and resistance to increased fatigue and conditions of distractibility that can occur. That is how sustained attention happens to include warning and component contributions in terms of motivation. It is important to highlight that sustained attention acts on an attentional focus, and therefore within the hierarchy of the system it happens to be linked directly with selective attention.

Posner, defines sustained attention as the ability to retain the attentional focus, either on an activity or on a stimulation which occurs during a period which allows attention in an activity to concentrate for the required time so that it can happen. Also it is divided into surveillance and concentration despite the distractions that can occur. So all the activities that require sustained attention, are influenced by various factors that may come to favour their performance, among which we highlight physical characteristics of stimuli and in the same way the number of stimuli presented, the rhythm required by the presentation of these stimuli [6].

2.2 The physiology of attention.

Physiology of attention is explained from two specific models, highlighting areas of the brain involved, the functions of each and intersections made:
Meshullam model, it states that attention consists of two brain subsystems; attentional matrix (state function) which regulates the overall processing capacity information, the detection efficiency of stimuli, the potential targeting capacity, the level of vigilance, the resistance to interference and signal to noise ratio; these processes are directly related to what is known as the alert level. While attentional channel (vector function), regulates the management of attention in all dimensions: Personal extra, mnésica, semantics, visceral, among other dimensions.

Furthermore, the Mesulam Model understands selective or targeted attention as a neural network distributed attention. In the network, cortical regions participate: the dorsolateral posterior parietal cortex, prefrontal cortex, and the cingulate gyrus, which are associated with perceptual components, motor and limbic; each of these components form a local network [7].

Moreover, Posner and Petersen Model, proposed the existence of certain anatomical and functionally independent neural networks responsible for attentional processes. Despite its anatomical and functional independence, these networks may also interact during responses to stimuli, so it is considered to maintain a functional relationship; two of these networks could be found anatomically distributed by the anterior cerebral cortex. The third of these networks, which is the orientation of attention network, would be distributed by the posterior regions of the cerebral cortex. In first instance, the network would be compromised in the guidance of the selection of sensory information and it would justify the visuospatial attention. Tasks that are used for the functional evaluation of this network involve preferentially either finding a particular stimulus in a scene with distractors (visual search tasks), brain areas of this network would be; parietal cortex, the precentral gyrus, the front oculomotor cortex, and thalamus upper calículos [7].

2.3 Evolutionary development of attention up to 5 years.
According to Lopez and García, the evolutionary process of care is as follows:

At the age of 0 to 18 months attention is determined by the characteristics possessed by the stimulus, that is, the striking color, larger or more novel depending directly from the position where it was or intensity that is desired from the stimulus. Approximately at the age of two, no differences in the processes of eye fixation, the complexity of the stimulus or task increases, other differences among children aged 3 to 11 years were observed, the younger ones tend to give up, because in the new stimulus early age becomes a very considerable force and can easily and efficiently serve for a period of seven minutes. In contrast, children less than 5 years serving the salient aspects of objects, then they begin to attend to visual cues that determine them. Within this novelty is no longer the central and attractive part of the stimulus. It should be noted that since the early ages they maintain the ability to focus more intensely on stimuli that are irrelevant provided by the environment, but which are demanding an interest and are thus able to maintain a strong attention up to fourteen minutes so they recognize the existence of variables which determine the attention, and there are some objects that hinder the process. Also at this age they are fully capable of recognizing certain situations or stimuli that are easier to deal with and that in other circumstances can educate strategies to draw attention to relevant stimuli.

3. Information technology and communication (ICT)
The information and communications technology are technological devices (hardware and software) that manage digital information through several processing techniques and data transmission.

3.1 ICT in education
ICT in the education sector has had positive results being used to create major changes in intra- and intermental processes involved in teaching and learning; taking into account the characteristics and properties of symbolic environments that allow to create and design some particular process.

These technologies have features that contribute to and influence the teaching and learning processes described below:

- **Immateriality.** Creating ICT is generated in some cases without real references, but through simulation processes emulating a behaviour or specific process.
• **Interactivity.** In Education is a fundamental characteristic, because it obtains an exchange of information between the user and the computer, to adapt the resources used to the needs and characteristics of users, depending on the specific interaction of the person with the device.

• **Interconnection.** It refers to the creation of new technological possibilities from the connection between two technologies, creating new opportunities strategies in teaching and learning.

• **Instantaneity.** A feature that allows interaction between different users quickly without limitation of distance.

• **Digitization.** Transforming information into a single format that allows the transmission and processing of it by the different electronic devices.

• **Innovation.** ICT are subject to constant changes allowing inroads into new forms of applications of these tools to achieve the desired results in the field of education goals.

Therefore the use of ICT in ages 4 to 5 years old is motivating; because children are fascinated with interactive elements that a computer teaches them. It is not the same teaching English with a blackboard or headphones, to create an English class through specialized software, including games, music, and colors, children thus learn more and in the same way are entertained, without doubt that the motivation and fun play a conclusive role in the desire to study and learn.

4. **Methodology**

The research is documentary because the study is based on the search, retrieval, analysis, criticism, and interpretation of secondary data, that is to say, obtained and recorded by other researchers in documentary sources: print, audio-visual or electronic, as in any research, the purpose of this design is the contribution of new knowledge. But at the same time, it is not experimental because it is not seeking to manipulate the variables of this research, but it is empirically directed to observe and study the original context and/or the evolution of the subject matter until the present time. The research focuses on exploring the basis of relevant data for the study, for the construction of such a program; and also the results of this research according to Arias, are set in intermediate terms for the acquisition of new knowledge.

In turn, it is descriptive and, according to Hernández, Ferandez & Baptista, this type of study seeks to characterize phenomena, people, things or communities that may be subject to a process of analysis, without manipulating variables. This research aims to design a program to stimulate two sub-categories of attention, sustained attention and selective attention through ICT tools, thus a characterization of psychological models and existing theories that support the development of research is done, ICT tools that serve as support in the process of encouraging attention are also characterized.

Literature and sources were selected based on a search criterion, where the main subject is the stimulation of attention in preschool, also keywords such as ICT, selective, sustained attention were used. The research was conducted in the databases of academic google, redalyc, scielo, dialnety, pshicothema, among others; a review of different university articles, undergraduate and graduate research focused on the subject under study was also made; where keywords such as TIC, selective, sustained attention were used; meanwhile, the subtopics as ICT in education, attention physiology, evolutionary development of attention, information technology and communication (ICT), types of attention more influence in the results and concept of attention, with an antiquity of 5 years old or less.

5. **Result**

After an arduous review of documents in several scientific journals Redalyc, scielo, dialnety, pshicothema, among others, and undergraduate and graduate research related to the topic of study. Thus, a filter was performed to select the literature and application software relevant to the design of the training program that acts as a stimulus that reinforces sustained and selective attention specifically on preschool.

For his part, finding applications that simulate the behaviour of these activities took place, so a complete design record of the program was made, which contains and classifies the type of attention
that needs to be worked on initially, the protocol of functionality, time determined for each session, duration of overall program, also activities for each type were specified. What is evident in Table 1.

**Table 1. Tab stimulation program execution for attentional stimulation.**

| **App name**          | **Type of activity** | **Type of Attention** | **N° session** | **Time** | **Application mode** |
|-----------------------|----------------------|-----------------------|----------------|----------|----------------------|
| child coloring book   | color                | sustained             | 6              | 20 minutes | Individual           |
| Coloring pages for kids | color              | sustained             | 6              | 20 minutes | Individual           |
| Kid Mazes            | labyrinth            | sustained             | 6              | 20 minutes | Individual           |
| Finger Paint         | drawing              | selective             | 6              | 20 minutes | Individual           |
| Color for kids       | Find the color       | selective             | 6              | 20 minutes | Individual           |
| Intruder             | Find the intruder    | selective             | 6              | 20 minutes | Individual           |

In addition, a record format for monitoring was generated to write down the behaviour of each preschooler during the session (see table 2).

**Table 2. Format for observations by session.** Facilitate the monitoring process during and after implementation of the intervention program, since it contains the specific punctualities to be recorded to observe the progress and benefits.

| Date | Observations |
|------|--------------|
|      | **Start Time:** | **Ending time:** |
|      | **Name of patient** | Age |
|      | **Sex** | Session number |
|      | **Type of care that works** |

Finally, it generated a record of characterization of ICT resources that will be selected for program implementation, as shown in the following example. (See Table 3).
**Table 3.** Tab characterization of ICT application software. It describes the functionality of the app and pertinence of this to be used to train sustained attention.

| Software name          | Coloring Pages for Kids                     |
|------------------------|---------------------------------------------|
| **Company that produces** | Sunny Kid Games                              |
| **Version**            | 1.45                                         |
| **link**               | [https://play.google.com/store/apps/details?id=com.sunny.coloring.book.kids.paint](https://play.google.com/store/apps/details?id=com.sunny.coloring.book.kids.paint) |
| **Attention**          | Sustained                                    |
| **Recommended age**    | 2 or more years.                             |
| **Topic**              | Educational                                  |
| **Language**           | Spanish                                      |
| **Platform**           | Android                                      |
| **Format**             | APK                                          |
| **Equipment requirements** | 60M space                                    |
| **Navigation and how to use** | It requires 4.0.3 and later                   |
|                        | - For the use of this educational software, it is important to have a counselor to strengthen and secure the child in the use of video games and technology. |
|                        | - Navigation is aimed at children in a simple way, where interaction is important, since the sounds are present and visibly indicated the steps. |
|                        | - Because the software is designed for children, there is no pressure and all errors are represented as learning. |
| **A brief description of the content** | Over 130 fun coloring, doodling and painting with educational content, simulating the use of paint, tempera and oil paintings with your own fingers drawings. |
| **Educational aspects:** | The application allows children to display their creativity by coloring, drawing, painting and decorating their works with multiple seals. |
| - **Goals**            | It is an educational game that encourages and helps the child to learn, develop and grow intelligently and creatively. In addition to amuse, enhance their creativity and entertain them, it contributes positively to growth and development. |
| - **Materials**         | **Pedagogical projections** | Coloring will grant the child a great satisfaction to realize the beautiful things he can do alone. It develops his ability to detect, investigate and memorize. He will create drawings that will be valued by their loved ones encouraging their self-esteem. This entertainment gives them the opportunity to express their inner world and to channel their mood and feelings and giving us, parents another way to understand them. |
| - **Activities**        | **Personal opinion**                         | |
| - **Evaluation**        |                                              |
5.1 Pilotage

As a pilot test, a sample of twelve children was chosen, which was divided into two groups, one of control and the other to intervene.

Initially it applies to both groups the preschool neuropsychology battery - BANPE that allows to measure the level of sustained and selective attention in children from 3 to 5 years old through the items digits in progression, cubes in progression, visual cancellation, detection of digits and visual search.

Subsequently, the program was applied for a period of 3 months with a periodicity of twice a week to the group to intervene.

Finally the BANPE instrument was applied again to both groups to perform a correlation and to know the real benefit of the program, the results obtained were.

When making a comparison between the previous test and the subsequent test of the control group, it is observed that there are minimal changes in the oscillation of the values, from which it can be argued that the daily activities of children aged 3 to 5 years in a lapse of time at 3 months varies little in the parameters referring to sustained attention and selective attention (see graphic 1 and 2).

Graphic 1. Pre-test – Control Group

Graphic 2. Post-test – Control Group

When reviewing the comparison between the previous test and the subsequent test of the intervention group, it is observed that there are significant changes in the aspects of digits in progression, cubes in progression, visual cancellation, detection of digits and visual search, of the previous ones (see graphic 3 and 4). The program proposed in this research can contribute positively to the stimulation of sustained and selective attention, so in a subsequent investigation it is recommended to perform the intervention with a larger group of children between the ages of 3 to 5 years.
6. Conclusion
With the results presented in this research, it can be seen that stimulation of attention through a specialized innovative program in the use of these transversal tools such as ICT specifically at early ages, with proper guidance and support, promote improvements in attentional levels, mental ability and promote social relations. Also, in contrast with the results obtained by July and Pimentel, it was evidenced that attentional factor interventions enhance skills and competencies in subjects. Therefore, to make use of ICT for preschoolers, gives positive results in cognition, because these tools currently act as positive stimuli, fostering in children that intrinsic motivation that leads them to engage in academic or daily activities, which are difficult to perform or are boring for them if traditional methods are used. This is due to the characteristics and properties of ICTs that transform something boring and mechanic into something dynamic and playful.

For its part, during the course of the research, it appears that there are several free applications on the market that simulate the behavior of intervention activities created by experts for attentional stimulation. Most of them are available for the Android platform. In addition, when selecting the application it is recommended that they be offline applications because Internet connectivity can be a distracting agent.

Finally it should be mentioned that the stimulation program focused on selective and sustained attention through the use of ICT, according to other authors as Martinez, Olivo, and Herrera, Deck, and Callejas and Romero, is a viable study result to help preschoolers to increase and improve their
attentional levels and influence the rapid acquisition of higher cognitive processes and in turn, facilitate the arrival of executive functions they should have for life.

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