UNIVERSITATEA BABEȘ-BOLYAI CLUJ-NAPOCA

Facultatea de Psihologie și Științe ale Educației

Școala doctorală „Educație, Reflecție, Dezvoltare”

- DOCTORAL THESIS-

PROGRAM TO ACCELERATE COGNITIVE DEVELOPMENT IN PRACTICE. APPLICATIONS TO EXPERIENCIAL SCIENCES

-SUMMARY -

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INTRODUCTION

In a changing society, for which it is necessary to reconsider the dimensions of educational theory and practice, it is natural that the focus of the education specialists is to identify learning and development needs as well as optimal strategies for the implementation of educational and training actions.

In the PhD Thesis Program for accelerating cognitive development in preschools. Applications in the Experimental Field Sciences are directly and indirectly circumscribed the following key words: program, cognitive acceleration, preschool, investigative learning method, experimental method, experiential domain Sciences. These key concepts develop a series of issues in stimulating intelligence, language, creativity, metacognition, and experimenting with the system of cognitive acceleration methods (observation, didactic play, investigation based learning, discovery, laboratory experiment, problem-based learning) their pre-school children.

By "cognitive acceleration," we mean the acceleration of "natural" development processes at the pre-formal stage of development. The first cognitive acceleration program was developed by Piaget and Inhelder (1958) to stimulate different levels of pre-school thinking. The difficulties of framing the concept into a unitary definition and practical value were raised in the 1990s by M. Shayer and P. Adey. They have developed a curricular curriculum in the field of Science entitled "Thinking Science: The Curriculum Materials of the Cognitive Acceleration Program". In the first phase, the program promised exceptional results for students at national exams, if they went through certain lessons specifically designed for the progressive learning of the Sciences. Later on, cognitive acceleration programs have been developed in preschools across Europe. The research results show that children's intelligence or age-related cognitive development is flexible and is willing to change cognitive bills by stimulating teachers to implement them in the day-to-day educational-educational activities .

Starting from the experimental and practical findings on the cognitive acceleration program described in the theoretical part, we consider it indispensable to adopt an epistemological position that clarifies the learner's relation to the subject of knowledge and answers the question: How can we stimulate the interest of preschools for science and

technology at the youngest age ?. Of course, the answers to such a question are multiple, but we admit that there are positive correlations between the world of science and the high interest of children in this field. That is why educators should facilitate this link. Only a few studies in the Anglo-Saxon literature have been able to assess the cognitive impact of educational practices in the field of Sciences in pre-school activities. Most were addressed as the initial, only for primary education.

In the context of specialized scientific research conducted in other countries, we propose to develop a continuous training program for educators entitled "ABC Science", developed in a formal education framework, on the organization, planning and development of learning, in a continuous and intensive flow, adapted to the needs of pre-school children.

The curriculum for early childhood education promotes the flexibility of the instructive-educational program in order to increase the quality of education at this age. What the Acceleration Program proposes - ABC Science - is accelerating cognitive development in preschoolers through the system of cognitive acceleration methods: observation, conversation, gaming learning, discovery, research-based learning, and problem-based learning. These methods are accompanied by the description of the stages of activities carried out by preschoolers and are accompanied by specific tools for environmental investigation. In order to test the general hypothesis we organize the research below:

1. Evaluation of the Lifelong Learning Program - "ABC SCIENCE" (Research 1)

2. Experimenting Cognitive Acceleration Methods and Identifying Their Effects on Pre-School Students (Research 2)

Because cognitive acceleration program was implemented in the teaching-learning and assessment, it has enabled us to develop a set of experiments applicative and available to any teacher. Experiments for preschoolers were tailored to age specificity. In total, 22 experiments were used for preschoolers: 1) Hot and cold air; 2) What keeps burning ?; 3) Effect of brine; 4) Why do some bodies float and others do not ?; 5) Drops in the snow; 6) Water and colors; 7) Mini ocean; 8) How does steam form ?; 9) Moving Shadows; 10) Solar clock; 11) How do you make a candle yourself ?; 12) Magic Balloon; 13) How do magnets work ?; 14) Why do yeast inflate bread ?; 15) Salt crystals; 16) Huge soap bubbles; 17) Toothpaste for Elephants; 18) colored foam; 19) Volcanic rocks; 20) Lava in the kitchen; 21) The tricky volcano; 22) Effects of earthquakes on buildings.

We used the old curriculum to build the sample of subjects. Research has faded between 2012 and 2014. For this reason, pre-school children from older age groups of 6½ years old were included in the experiments. However, additions have been made in line with

the new curriculum (eg, subchapter - Reflections on current trends addressed in early education studies).

The results of this research demonstrate that approaching learning through scientific research provides important levers in accelerating cognitive development in preschools. The systematic use of these methods contributes to the development of effective group cooperation and effective communication, with pre-schooling gaining intellectual benefits in these activities. In this respect, in the third chapter we analyzed the concepts developed by the Science Teaching paradigm through the US scientific investigation.

The Cognitive Acceleration Program aims to develop pre-school thinking in preschools and seeks to identify multiple answers / solutions to the questions, situations, problems and challenges needed to prepare for active life outside the group room. Experiments are focused on particular scientific skills and conduct. The preliminary results obtained by us, following the implementation of the program, show significant gains in the post-test on the capacity to preserve the number, classification, series, volume, height and surface of preschoolers in the experimental group compared to those in the control group.

Conceptual findings contribute to the development of curricular development knowledge for a curriculum based on teaching Science through pre-school education.

The results of our research provide essential contributions to the validity of the Discovery Box and how it can be applied in the educational activities of the kindergarten.

I. Psycho-pedagogical problem of accelerating cognitive development

I.1. The cognitive system and the psycho-pedagogical problem of knowledge

Building an overview of how scientific psychology can contribute to accelerating intellectual psychogeny in preschools takes place in the context of interventions through genuine teacher activities.

Although there are differences in opinion on the cognitive definition of researchers, we unanimously agree that Salovey and Mayer (1990) have the most appropriate definition of "adaptive and productive action." (Mayer et al. 511).

Regarding knowledge of children's psychophysical development profiles, methods, evidence and strategies to stimulate intelligence in children, neurophysiological studies on the connection between intelligence and brain mechanisms prove that there is a relationship of interdependence (G. Dumitru, 2004). There is a general agreement in the literature that brain adaptation and learning take place throughout life. However, there are confident assertions about the child's ability to learn at the entrance to school that they would be heavily influenced by neural wiring that takes place in the first years of life (Shanker, apud McCain net al, 2007, p. 13).

Many initiators of acceleration programs (Casey, B.J. et al., 2000, Dowsett and Livesey, 2000, Diamond, A., 2000) consider that the dynamics of intelligence is an inalienable aptitude throughout life and demonstrates the usefulness of intervention during childhood.

I.2. Cognitive Education and Knowledge of the World.

First of all, the writings of some theorists, cognitive education is related to the concepts of: 1) intellectual development and the proximity of development; 2) neuroplasticity and the ability of the brain to adapt; 3) mediation and modifiability (Roth et al, 2004). Thus, the cognitive development of higher processes is based on verbal interaction mediated collaboration. Starting from these concepts, M. Roth (2000) formulated the following definition: "cognitive education is a deliberate facilitating intervention from the learning environment, intervention that leads to the intellectual development of the child." (page 8). Along with this definition, the author added: "Cognitive education is driven by an educator interested in improving aspects of cognitive functioning in a systematic manner, based on a methodology based on the psychology of learning." (M. Roth et al, 2004, pp. 8-9).

I.3. Theory of psychogenesis of knowledge and intellectual operations

Much of Piaget's work focused on how the child gets to understand the physical, spatial and temporal world. For Piaget, the activity of the cognitive development is placed -

that is, the child's own constructive efforts to understand and represent the causal processes in the environment.

The Pigeon model of the development of human intelligence is known throughout the world. He considers that there are four major stages from birth to maturity, each representing a qualitatively different way of knowing (Figure 9.I., p. 51). The stages follow in a fixed order. In each new stage, certain mental strategies become accessible and each is an increasingly complex way of giving meaning to the environment. The child passes through each of these stages successively and at different speeds.

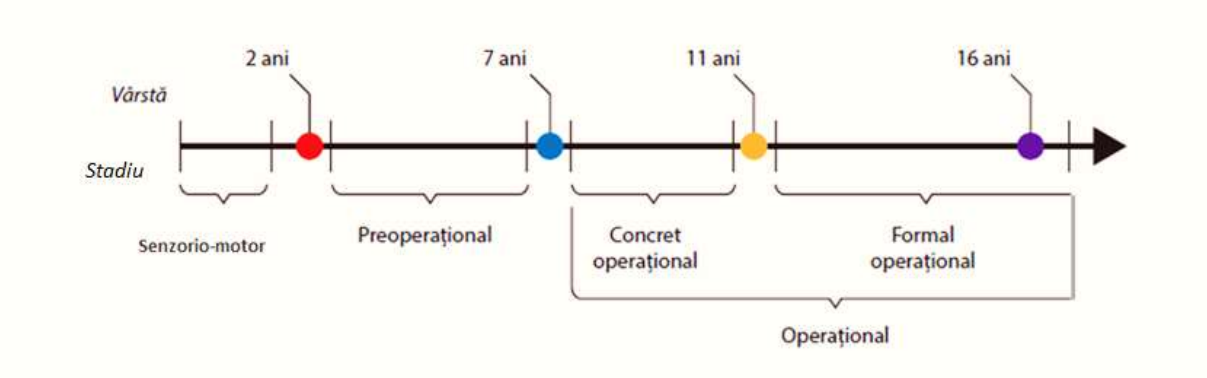

Figure no. 1.I. The model of cognitive development (model adapted by L. Oakley, 2004, p. 16, in Cognitive Development, Routledge Modular Psychology Series).

I.6. Neurobiological model of cognitive development

In order to get some answers on how to "build" a child's brain and the factors that influence his development, Casey et al. (2005) conducted a study using Magnetic Resonance Imaging (MRI) imaging to monitor the cognitive development of cognitive functioning of children. The "in vivo" images during the trial indicated the existence of activities in the parietal and frontal cortex known to be involved in the development of memory and thought processes in pre-school children. The study showed that the poor results of pre-school children in the Stroop and Go / Not Go tests, compared to adults, are not due solely to the tasks of the test, but due to the differences that exist when activating regions that are still maturing.

II. Cognitive Acceleration Program (Adey and Shayer): Objectives, Concept, Structure and Effects

The Cognitive Acceleration in Education Sciences Program (Adey, Shayer and Yates, 2001) was developed at the Kings University of the United States. The program was developed to promote the different levels of child thought described by Inhelder and Piaget (1958) as "formal operations" (analysis, synthesis, abstraction, generalization).

The main purpose of the program was to develop an intervention project addressed to science teachers to accelerate the cognitive development of students within the scientific disciplines. The first form of this program was presented to primary school teachers in 1980. After the implementation of the initial research phase (1984-1987), the co-founders of the project carried out a continuous training course for teachers, followed by the design of the twenty-one lessons of cognitive acceleration. The project has a clear and well-founded theory (McGuiness, 1999, Leat, 1999, Higgins, 2001), proving to be useful for educational practice and student training for national exams (Adey and Shayer, 1993).

III. Pre-school education level analysis of contemporary educational systems in Romania and the US

The onset of experiential approaches to science was introduced in the US in the early 1990s. This was followed by the publication of more than 300 written communications highlighting the desirability of reforming science education by upgrading scientific and technological skills and by concretely realizing modern theories and strategies on teaching and learning sciences from the youngest ages.

The US is concerned about the constant orientation of social and educational policies in favor of early education. The extent of these concerns relates to:

- global policies on education development;
- educational practices and new attitudes regarding the pre-school child;
- substantiating new models and approaches to teaching science in pre-school education.

The interface of the two systems consisted of a profound analysis of papers and articles published in the US, Romania and other countries, focusing on the analysis of those published in the US. The positive experience of the American system validates the importance of using Inquiry Based Science Education (IBSE), the Experimental Method and the Problem Based Learning (PBL) method.

III.2.1. Inquiry-Based Science Education - Founded in Pre-school Curriculum for Sciences in the U.S.

Starting from the general presentation of the proposed stages and sub-stages for the IBSE method, Pedaste et al. (2015) have built an Inquiry based learning model. Following the analysis of 13 articles reviewed in the 32 studies drafted by the authors, they proposed three possible cycles of investigation that can be identified when guiding us by arrows (figure 13 III., P. 89), namely: a) Guidance-Question-Exploration-Data Interpretation (the possibility of following a Return to Question) -Conclusion; (b) Orientation-Generation of the hypothesis-Experimentation-Data computation (the possibility of following a return path towards Generating the hypothesis) -Conclusion; and (c) Guidance-Question-The Generation of the Hypothesis-Experimentation-Interpretation of the Data (the possibility of following a Return to Question or Generating the Hypothesis) -Conclusion.

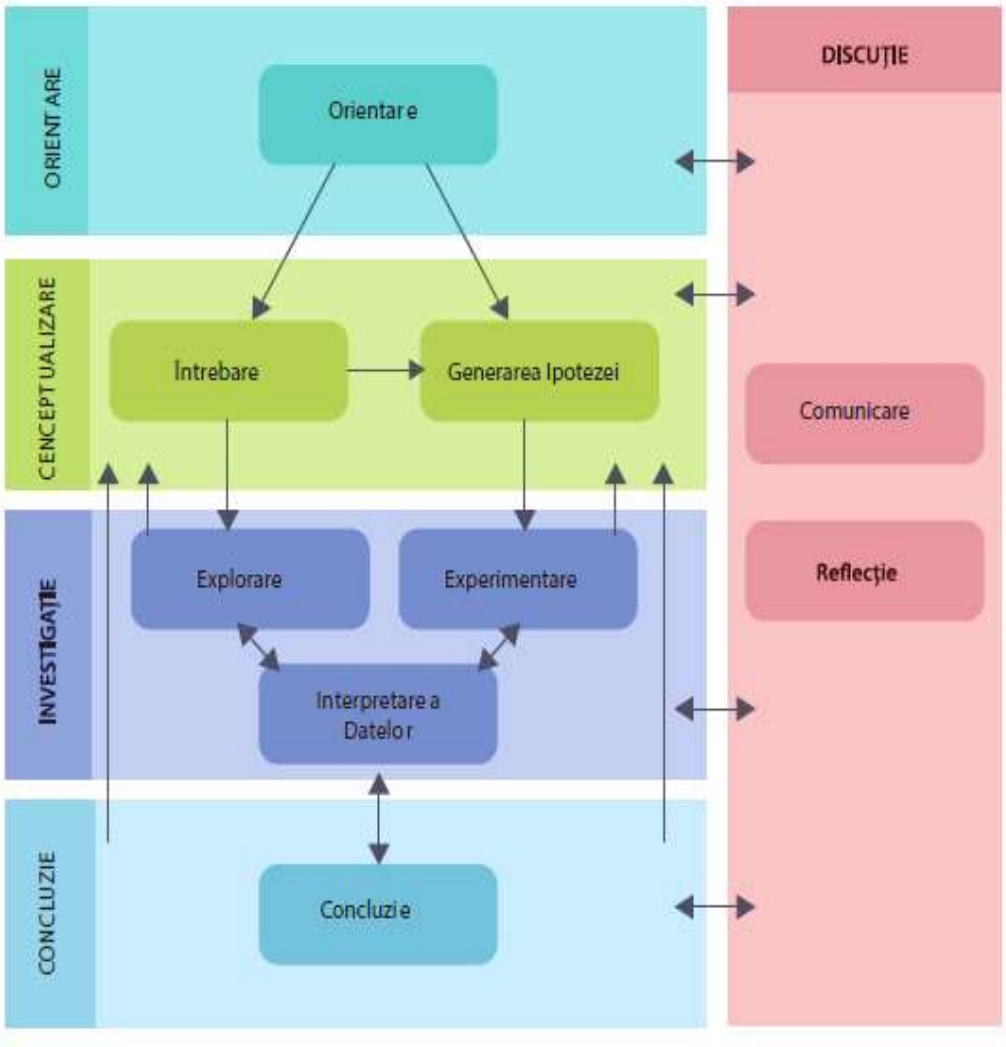

Figure no. 13.III. The conceptual framework for Inquiry-based learning (Pedaste et al., 2015)

III.2.3.Particularities of the curriculum for Romanian sciences

Under the new curriculum, Sciences - includes acquisitions of mathematics and natural sciences; aims to form representations of concepts, such as: volume, mass, number; it is recommended: to carry out activities of discrimination, classification or quantitative description; the development of reasoning capacities, including abstract reasoning; making observations, investigative and experimental steps; the use of different sources of information, the selection of significant elements, the formulation of hypotheses, the search for solutions, the problem solving, the communication of results (Curriculum for Early Childhood Education from the age of 6) implemented since 2018.

The analysis and interpretation of the content of the activities of Sciences on the basis of the principles of general biology, as well as of the didactic principles, ensures the instructive-educational value of the activities carried out in the preschool education sciences. The reintroduction of notions, concepts, ideas into a coherent knowledge system meets the requirements of an integrated education, ensuring a unitary framework of understanding and interpretation of biological, physical, chemical processes.

IV. Evaluation of the Lifelong Learning Program - "ABC SCIENCE" (Research 1)

IV.3. Design of research

IV 3.1. Purpose and objectives of the "ABC SCIENCE" training program

The "ABC SCIENCE" training program aims at capitalizing on examples of good practice on the use of the experimental topic "Teaching Sciences through Investigation".

The participation of teachers in the training program will aim to improve the teaching activity in pre-school education. In turn, educators will develop pre-school thinking and will stimulate the child's curiosity about explaining and understanding the surrounding world.

This program aims at developing the professional-teaching teaching skills that are useful in the field of experiential sciences by methods of cognitive acceleration, valorisation of pre-school attitudes and competences, integrated approach of the related themes and realization of an educational approach according to the principles of the science teaching paradigm through the scientific investigation (Inquiry - Based Science Education).

In order to implement the training program, the following objectives were pursued:

 Developing the professional competencies of the educators by selecting and adapting the educational-educational content in the field of Sciences in order to be compatible with the interests, knowledge, experiences, abilities and cognitive processes in preschools;

 Exercise the steps involved in planning, designing and organizing the educational-learning process of science learning through observation, exploration, investigation and problem-solving activities;

Using a system of didactic methods to accelerate cognitive development in preschools;

 Conducting experiments in Science through a combination of methods of teaching Science through IBSE-type research;

 Adaptation, conceiving, identifying materials, educational kits and means of education necessary for the development of activities in Sciences.

IV.3.2. Hypothesis and research variables

By operating the general hypothesis we derived the following specific research assumptions to be tested in the research no. 1. - Evaluation of the "ABC Science" teacher training program.

1. Following the application of the Cognitive Acceleration Program ABC SCIENCE, we will see in the posttest a significant development of the methodological and didactic design experiments of the cognitive acceleration experiments, group management and evaluation of the pre-school activity of the educators in the experimental group compared to those in the control group.

2. Following the application of the cognitive accelerator program ABC SCIENCE we will find in the posttest a significant increase of the level of instrumental-applicative skills necessary for carrying out the experiments using the educational kit "Discovery box" to the educators in the experimental group, compared to those in the group Control.

From the formulation of the general hypothesis, we can deduce that the independent variable V.I. In our experiment is:

Starting from the formulation of the general hypothesis, in the case of our experiment we determine the following variables:

 Independent research variables:

V.I .: Implementation of the "ABC SCIENCE" cognitive accelerator program that valorizes the science of science research (IBSE) paradigm;

 Dependent variable of research:

V.D .: Structure and content of the continuous training course "ABC SCIENCE".

V.D.1 - methodological and didactic design skills;

V.D.2-group management skills;

V.D.3-competences for evaluating the activity of preschoolers;

V.D.4-instrumental-applicative skills for the use of experimental kits

"Discovery Box".

IV.4. The research procedure

IV.4.1. Presentation of the target group

The target group consists of 260 educators from Cluj-Napoca city involved in collecting relevant data on the impact of the in-service training program among preschoolers.

The sample of teachers directly involved in the experiment was selected in accordance with the representativeness and the criteria for:

 Participation of educators who carry out their educational and instructive activities in state and private kindergartens, close to number.

 Knowledge and systematic use of modern and interactive teaching-learning-evaluation strategies in the development of activities in the field of Experimental Sciences.

 Availability of teachers to complete the survey questionnaire.

 Issuance of the "Discovery Box" (Siemens Stiftung, Germany) through the Teaching Staff House of the Cluj County, 2-3 November 2011, from the Bambi Kindergarten, structure 4. Cluj-Napoca.

A. Characteristics of teachers according to their place of origin

As can be seen in table no. 31.IV, the body of the teaching staff involved in the study is made up of 260 educators, of which 80 came from urban and 180 from rural areas.

Table no. IV.31. Statistical Distribution of Teachers by Place of Origin:

Mediul	**Frecvenţă (N)**	**Procent (%)**
rural	80	40.8%
urban	180	59.2%
Total	260	100.0

In terms of the environment of origin, the participants were distributed on two intervals: the highest share is held by urban educators 171 (59, 2%), followed by rural 109 (40.8%) (Figure 19 IV. , p. 138).

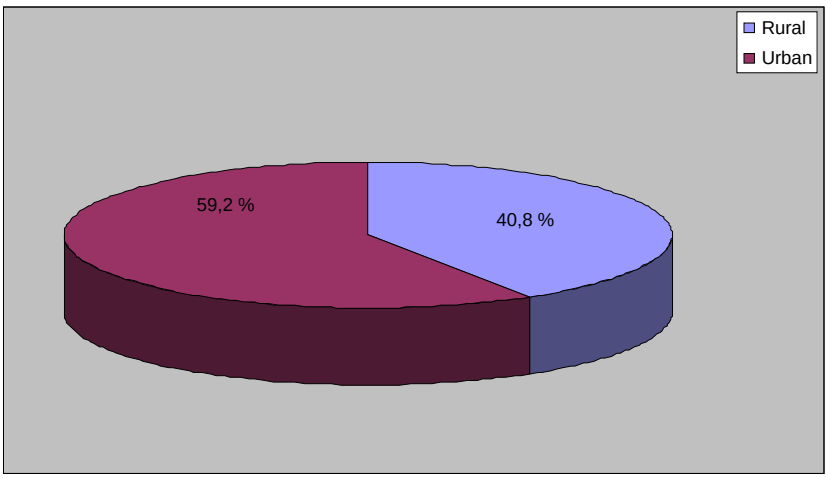

Figure no. 19.IV. Teachers distribution by place of origin

B. Characteristics of subjects in terms of age

We consider the age distribution to be representative, each age category being represented as below: 25-25%, 25-29-15-15%, 30-39 years- 25%, 40-49 years - 20% and over 50 years - 15%. Representative distribution allows us to formulate some preliminary conclusions regarding the onset of teachers from state and private kindergartens, as well as on the nature of professional experience (Figure No. 20.IV, p. 139).

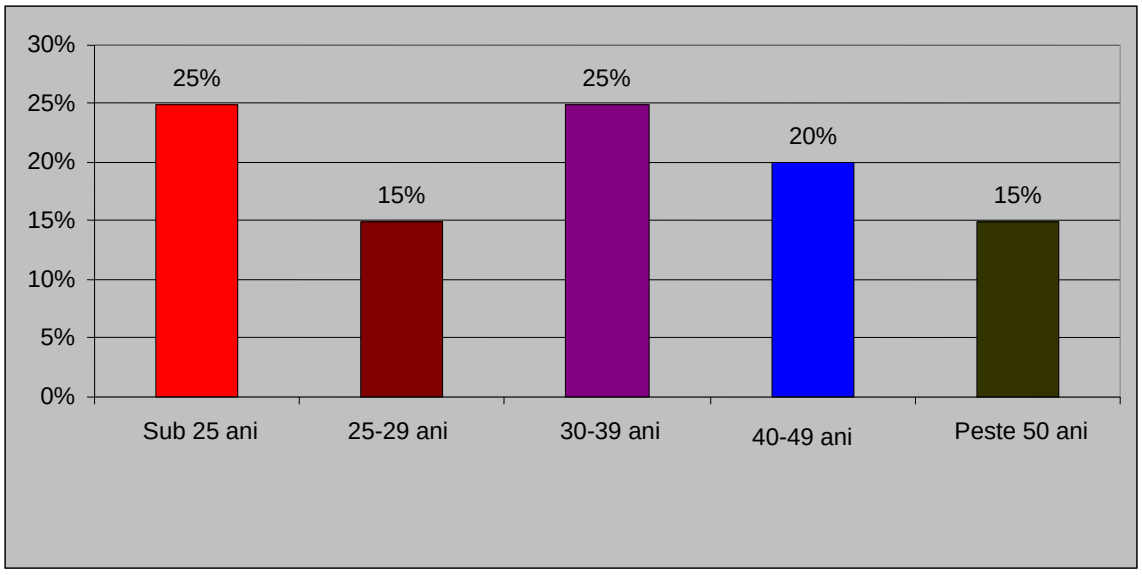

Figure no. 20.IV. Teacher distribution according to professional experience

IV.4.4. Experimental milestones for teacher activity (selective)

1. THEME: AIR

Objectives of learning 1:

• to explain phenomena through the correct use of specialized terminology;

• use investigated and experimented experimentation to highlight and explain the interaction of air with other bodies in the environment;

• record and analyze the results of the experiments.

Where is the air?

The air surrounds us, occupying any free space. It exists in water, in objects and in plants, also in the human body and in the animals. The air is light and invisible, but there are ways to weigh it and see it.

EXPERIMENT 1. "COLD AND COLD AIR"

Materials required:

• a balloon

• Empty glass

• a hot water tank (note: hot water should be handled with care!)

How does it work?

1. Insert the balloon on the neck of the bottle.

2. Hold for a minute the bottle in warm water.

What happens?

Fig. no. 36.IV. Exp. "Hot and cold air"

The balloon swells.

Why...

... the air, like the other substances,

is made up of small moving particles, called molecules, which, due to heat, move away from one another. Glass air expands and therefore needs a larger space; so he enters the ball and so the ball swells.

3. Put the bottle under a cold water jet.

What happens? The balloon is deflated.

Why...

... because of the cold water, the air is contracting (that is, its molecules approach each other and occupy only the original space of the glass).

EXPERIMENT 11: "HOW TO CONFESS YOU ONLY A LOVE?"

Materials:

• Wax scraps from candles already in use
• candle arrays
• a bunch of lace or cotton
• a starter from an old candle base Utensils:
• an old saucepan
• a stick larger than the diameter of the container
• a small patent
• scissors

How does it work?

Step 1:

• Candle cubes of different colors are prepared aside
• Draw the string through the die
• then tighten using the patent

Step 2:

• Place the saucepan warm
• Add wax to the saucepan
• Wait until all is melted

Step 3:

• Attach the sticker cord
• Position on the edge of the container
• add melted wax ...

Figure no. 47.IV. Stages of making a candle

V. Experimenting methods of cognitive acceleration and identification of their effects on preschoolers (Research 2)

V.2. Design of research

V.2.1. Sample of subjects

In the study, we tested pre-school children from three kindergartens, belonging to the middle socio-economic status. The total number of participants was 208 preschoolers. Their ages varied between 4.92 and 6 years ½ with an average of 5.45 years and a standard deviation of 0.29. Of the total sample, 100 participants were girls and their age ranged from 4.92 to 5.92 years (M = 5.44; AS = .29). The total number of male participants was 108 and their age varied from 4.92 to 6 years (M = 5.46; AS = .30). Increased attention has been paid to mothers education because most studies show that academic education influences the development of intelligence in children. Similarly, in our case, we note that 35.4% of mothers have university education with a doctoral degree, master studies (29.5%) and undergraduate (23%).

V.2.3. Purpose and objectives of the cognitive acceleration program

The overall aim of the research is to determine the level of pre-school intelligence development by applying a system of cognitive acceleration methods: observation, didactic play, investigative learning (IBL), discovery, laboratory experimentation, problem-based learning PBL).

The entire research program will be carried out as follows:

1. Applying methods of cognitive acceleration on selected groups of preschool children from three kindergartens - "Babeş-Bolyai University", "Albinuţa" and "The Story of Stories" from Cluj-Napoca.

2. Conducting experiments of cognitive acceleration within a partnership between the Babeş-Bolyai University Kindergarten and the Alexandru Borza Botanical Garden, the Paleontological Museum, the USMV Botanical Museum, the Astronomy Observatory and the Ethnographic Museum of Transylvania.

3. The use of the Discovery Box educational kit in the didactic activities of preschoolers to train their cognitive development.

4. Formulation for pre-school teachers of investigative work tasks to promote experiential learning activities and stimulate their creativity.

V.3. Hypothesis and research variables

By operating the general hypothesis we derived the following specific research assumptions to be tested in the research no. 2. Experimenting the system of methods of

cognitive cognitive acceleration (observation, didactic play, investigation based learning, discovery, laboratory experiment, problem-based learning) and identifying their effects on preschoolers.

1. Following the application of cognitive acceleration methods, it is assumed that there are significant differences between the level of memory development, motricity, language and intelligence between experimental and control groups, in favor of the experimental group;

2. Following the application of cognitive acceleration methods, it is assumed that there are significant differences in the degree of development of metacognitive strategies between the experimental and control groups in favor of the experimental group;

3. Following the application of the cognitive acceleration methods, we will see in the posttest a significant increase of the classification capacity between the experimental and the control group in favor of the experimental group;

4. Following the application of the cognitive acceleration methods, we will see in the posttest a significant increase in the number conservation capacity between the experimental and the control group in favor of the experimental group

5. As a result of applying the cognitive acceleration methods, we will notice in the posttest a significant increase of serum capacity between the experimental and the control group, in favor of the experimental group;

6. Following the application of the cognitive acceleration methods, we will notice in the posttest a significant increase of the volume conservation capacity between the experimental and control groups, in favor of the experimental group;

7. Following the application of cognitive acceleration methods, there are significant differences in the posttest on the level of height and surface conservation capacity between experimental and control groups in favor of the experimental group;

8. Following the application of the cognitive acceleration methods, there are significant differences in the post-test regarding the level of scientific creativity of the surfaces between the experimental and the control groups, in favor of the experimental group.

From the formulation of the general hypothesis, we deduce that the independent variable V.I. In our experiment is:

V.I. Applying methods of cognitive acceleration by educators to preschools

V.D. level of cognitive development on operational dimensions, variable represented by:

V.D.1. - the level of development of memory, motricity, language and intelligence;

V.D.2. - the degree of use of metacognitive strategies;

V.D.3.- ability to preserve classification

V.D.4.- the ability to preserve the number;

V.D.5.- the ability to preserve the series;

V.D.6.- Capacity for conserving the volume;

V.D.7.- Capacity for preserving the height and surfaces:

V.D.8 - the level of development of scientific creativity.

V.4. The system of methods used

In this research we used two categories of research: quantitative, obtained through a sociological and qualitative survey.

A.Protocol of observation - In our study we have developed several observational indicators in the investigational experimental group containing the following elements:

- behaviors pursued within the intervention;
- the place where the experiment took place,
- the length of time we take the observation and the duration of the observation;
- how observations are made.

B. The psycho-pedagogical experiment - the psycho-pedagogical experiment was the main experimental method used in this study. Testing the overall hypothesis involved organizing and conducting the research-action experiment. The research was based on the use of two experimentally and controllable samples corresponding to intersubject design (Bocoş, M., 2007).

C. Analysis of curriculum documents and other school documents - The use of this method allowed the collection of data related to the activity of teachers and preschools, outlining an overview of the organization and carrying out of the instructive-educational activity in the field of Preschool Education Sciences.

D. Methods of qualitative measurement of research data: the method of the focus group and the survey - in the research approach, we develop a tool for sounding the opinion of the teaching staff starting from the operationalization of the proposed concepts and research objectives.

1. The method of investigation aimed at exploring the level of competence of the teachers, used for the construction of the Questionnaire for the measurement of the level of development of the competence of educators regarding the methods of cognitive acceleration in Annex no. 12.

2. During the focus group sessions, personal discussions and reflections were raised on their knowledge of the science teaching model through investigation and, at the same time, to

find out whether the contents of the accelerating program - "ABC SCIENCE" were walk to the group without difficulty. Phases of focus group research and basic guidance during the assessment, available in Annex no. 13.

E.Methods of organization, presentation and mathematical-statistical processing of research data - after obtaining full questionnaires, data interpretation was performed using SPSS version 13.0. In the statistical processing of data, descriptive statistics were used: the t test, the ANOVA techniques (eg professional competence and the use of cognitive acceleration methods) and MNOVA to determine significant differences in the coefficient $\alpha = 0.05$.

Methods of Laboratory Experiment - Preschoolers have the ability to discover processes and phenomena specific to the living world.

G.Method test - Test no. 1 was aimed at evaluating the knowledge of the educators about the methods of cognitive acceleration, processes and capacities used in a scientific investigation: observation, communication, classification, prediction, hypothesis, variable, inference (Annex no.14). The second test was built to verify teachers' knowledge of physical and chemical phenomena (Annex no. 15).

V.5. Research Tools

The main research tools used in our study consisted of: Pigeonian Quantitative Evaluation and Preservation Tests, McCarthy Scale Assessment (MST) and WISC-III Child Scale Assessment Scale.

V. 6. Teaching Tools

The "Discovery Box" kit was designed by Siemens Stiftung in Germany for educational purposes and serves as a means or teaching tool. The premises behind the founders of the educational kit were the constructivist approach to learning based on Jean Piaget's work, which considered pre-school children to interact with the world to actively build their knowledge. The 26 experiments in the field of Science are structured in 4 major themes, namely: energy, electricity, health and the environment. Experiments target both 3-7 year olds and older students.

The kit consists of the following analogues: bulbs, dynamos, batteries, thermometers, electric motors, funnels, human body graphics, tubes and glasses for mixing solids.

In order to provide an overview of this pedagogical tool, we will give a classification of the experimental activities to each field:

• ENERGY EXPERIMENTS: How Do You Use a Battery ?, Power Generation, Electric Circuit, Electron Olympiad, Moriška.

• ELECTRICITY EXPERIMENTS: Electrical circuit, Insulating conductors, Switch, "Do not touch", Brilliant thread, Multi-element circuits, Serial and parallel connections.

• EXPERIMENTS ABOUT THE ENVIRONMENT: How Do I Drink Water Flowers ?, Adopt a Liquid, The Office Clip, Solid Dissolution, Solvent Recovery, Water Cleaning, Smog, Global Warming, Carbon Dioxide Journal.

• HEALTH EXPERIMENTS: The parts of the human body, How to see your beating heart, Listen to your beating heart, Fun digestion, Blood circulation system, Catch and "arrest" the bad infection, play the Human Body.

Chapter VI. Presentation of the results

The psycho-pedagogical experiment of the type of action occupies a central role in the development of pedagogical research, a stage dedicated to the experimental intervention, according to the cognitive acceleration program. The processing and interpretation of experiment data, based on the hypothesis formulated, draws the following conclusions:

The involvement of educators in the ABC Science program leads to a significant development of the didactic skills involved in using the Discovery Box, as well as to the significant influence of the cognitive development of preschoolers.

1. Conclusions on the influence of the "ABC SCIENCE" cognitive accelerator program on the instructional-educational activities

Following the interpretation of the post-test questionnaire, educators have demonstrated a positive attitude toward the efficiency of acceleration methods (observation method, conversation method, role play, discovery, investigative learning, experiment and problem-based learning), in the practice of science teaching in pre-school education. The participants agreed that experiments applied in the field of Sciences increased the level of competence in using cognitive acceleration methods when working as a team and that this would be a good indicator for the cognitive development of preschoolers.

The systematic use of the Scientific Investigation Method (IBSE) has played an important role in cognitive acceleration compared to other pre-vocational training sources in various national and international environments and organizations. The participants indicated their personal belief in the efficiency of the cognitive accelerator program and at the same time increasing the quality of the manifestation of science teaching competence. Teachers considered that the IBSE method would develop positive attitudes of preschoolers towards science (51.9% out of a total of 206 respondents). Moreover, they argued that in order to improve teaching practices, curricular optimization is needed through educational projects

designed to stimulate the curiosity and interest of preschoolers to investigate the sciences. Statistical results have indicated that there is a strong agreement among educators on the effects of cognitive acceleration methods and their use in designing experiments from the field of Experimental Sciences.

2. Conclusions on the influence of the "ABC SCIENCE" cognitive accelerator program on the competences of instructive-educational activity management

Following the interpretation of data from the ANOVA Factor test on the effects of the implementation of the cognitive acceleration program on managerial skills, the results showed that there is a significant difference between the group averages, exceeding the level of 0.05.

Calculation of partial correlations between identified predictors and dimensional management of instructive-educational activity in the experimental field. Science correlates positively with the use of cognitive acceleration methods ($r = 0.236$, $p = 0.002$).

3. Conclusions on the influence of the "ABC SCIENCE" cognitive acceleration program on learning outcomes assessment competencies

Based on the data from the ANOVA factorial test on the effects of the cognitive acceleration program implementation on learning outcomes assessment competencies, it was found that the magnitude assessment of learning outcomes correlated negatively with the results of pre-school teachers in experiments ($r = - 0.223$, $p = 0.003$). The poor correlation coefficient between the evaluation and the didactic performance can be explained by the fact that it represents an insignificant percentage of the didactic performance variance ($R2 = 0.0365$), compared to the other competencies dimensions.

4. Conclusions on the influence of the "ABC SCIENCE" cognitive accelerator program on the instrumental-applicative skills for the experimental Discovery Box

The results of this experiment highlight the fact that the "ABC Science" cognitive accelerator program is an essential component of the continuous training system for educators and has a decisive role in improving the teaching skills of scientists. The effects of these methods are tested in research no. 2 and used as premises for accelerating cognitive development in preschools. The results from the ANOVA Factor test for the effects of independent variables on scientific competences, managerial skills, age, professional experience and background. Thus, the average of the variables of the study was calculated and the value of Chi2 =, 355. The results showed that there is a significant difference between

group averages, exceeding the level of 0.05. Therefore, there are statistical results that confirm the specific hypothesis 2 - Various practices and tools used by educators facilitate the teaching of Sciences. This was important to highlight in a first phase of the research to successfully implement the cognitive acceleration program, observing a positive improvement in designing skills in the field of Sciences for the Experimental Group (M = 36.07, AS = 3.85), compared to the control group (M = 34.83, AS = 4.05), t (260) = 3.43, p≤.05.

5. Conclusions on the influence of cognitive acceleration methods on the level of memory development, motricity, language and intelligence in pre-school children

The implementation of a cognitive accelerator program "ABC SCIENCE" on the development of memory, motricity, language, scientific creativity and metacognition helps to increase the intelligence of preschoolers. The third specific hypothesis concerns the study of the effects of applying experiments that have strong links with the preoccupations and interests of preschoolers. This hypothesis of research forms the starting point for the development of experimental activities that can be addressed by the investigation method. Through such activities, the scientific creativity of preschoolers develops, cognitive efficacy is favored, and metacognition is stimulated longer. Preschoolers will solve tasks that pursue their intellectual development by enriching language, practicing motricity, and stimulating artistic creativity.

Experimenting the effectiveness of the cognitive accelerator program "ABC Science" was conducted to test the effects of the proposed experiments on the cognitive development of preschoolers. If in the first study we were interested in the effectiveness of the program on teachers' competences in science teaching, in the second part of the research we identified several variables responsible for accelerating cognitive processes in preschools. These variables were reported to those responsible for learning a few preoperative schemes identified by Piaget and Inhelder.

Preschools were trained in cognitive task-solving activities that called for the relationship of the acquaintance with the unknown. The formation of the language specific to Sciences, the gradual complication of the degree of difficulty of experiments and investigations, through the discovery assisted by educators, through the understanding of probabilistic reasoning are different facets of the development of metacognition and creativity.

With the help of research literature and from the lessons of accelerating the groupings by Adey and Shayer, we aim to demonstrate through our experiments that preschoolers who go through the selected activities within the intervention will accelerate thinking from the

preoperative stage to the stage of concrete operations early. Preschoolers will learn to conserve quantity, weight and volume more quickly through cognitive workout and scoring system development curves.

After median calculation (median = 60.9) of total cognitive function score, two groups were obtained: pre-school with high IQ level and pre-school with low IQ. Statistical data reveal the existence of positive, moderate correlations (in the range of .30 to .70) and low (under .30) in the verbal MST scale ($r = .65$, $p < .001$) correlated positively with the verbal scale from WISC R ($r = .42$, $p < .001$), WISC-R perceptive performance performance ($r = .63$, $p < .001$). Similarly, we can see that the MST perceptual-performance scale correlated significantly with the scales from the WISC-R ($p > .05$). The perceptual-performance scale ($r = .28$, $p > .05$) correlates positively with the Global IIS Coefficient WISC-R ($r = .43$, $p > .05$).

The MST quantitative scale also correlates significantly with the WISC-IV scales. The MST quantitative scale ($r = .61$, $p < .001$) correlates positively with the WISC-IV verbal scale with the WISC-R Performance Scale ($r = .36$, $p < .001$) and the WISC-IV ($r = .56$, $p < .001$). The MST general knowledge scale correlates positively with the WISC-R scales. The MST general rally ($r = .73$, $p < .001$) with the WISC verbal scale -IV ($r = .62$, $p < .001$), the Scale Scale of WISC-IV performance ($r = .62$, $p < .001$) and WISC-IV Global IQ coefficient ($r = .72$, $p < .001$).

Significant correlations have been found between IQ and the participants' age on memory, motoric and language measurements through WISC-IV: verbal scale ($r = .71$, $p < .01$) and global IQ index scale ($r = .40$, $p < .05$).

These correlations confirmed the hypothesis of our study, and preschoolers showed significant increases in measured IQ scores on memory, motricity and language.

Thus, IQ variables and age correlated significantly with MST-M memory measurements ($r = .49$, $p < .01$), general knowledge scale - MST-SG ($r = .59$, $p < .01$) MST-MT ($r = .70$, $p < .01$) and verbal scale ($r = .39$, $p < .05$).

Significant correlations have been found between IQ and the participants' age on memory, motoric and language measurements through WISC-IV: verbal scale ($r = .71$, $p < .01$) and global IQ index scale ($r = .40$, $p < .05$).

These correlations confirmed the hypothesis of our study, and preschoolers showed significant increases in measured IQ scores on memory, motor and language levels.

The MSTM memory performance scale ($r = .46$, $p < .001$) correlated positively with the Piaget Sample number ($r = .47$, $p < .001$), with preservation from DB ($r = .54$, $p < .001$) and the scientific creativity DB ($r = .50$, $p < .001$). This means that the progress between

intellectual progress in pre-school and cognitive abilities in Science is a positive correlation. Investigation experiments in the DB kit ($r = .34$, $p < .001$) correlated positively with role play ($r = .63$, $p < .001$) and with the Memory Performance Scale -MSTM ($r = .31$, $p < .001$).

In post-hoc comparisons, all groups have significantly differentiated in measurements of: intelligence, memory, motricity, language, creativity and metacognition ($p < .05$). However, in the short-term memory measurements and the Simon inhibition load, no significant differences in mathematical performance were found between intermediate and low-level groups. Finally, as regards the burden of change, the differences were significant ($p < .05$) only between the medium and high level performance groups, favoring the high performance group.

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Therefore, 43.5% of the variance of the scientific knowledge measurement can be explained by the cognitive variables introduced in the model: memory, motricity, language and global IQ of the WISC-IV test load.

6. Conclusions on the influence of cognitive acceleration methods on the use of metacognition

To test the general hypothesis we analyzed the link between the independent variable - the implementation of the cognitive accelerator program "Science ABC" and the variable dependent on the level of development of the metacognition. Thus, 119 preschoolers were selected and a factorial design (2x2) was applied to independent groups to introduce new tasks through which pre-school children would develop metacognitive strategies. Preschoolers were divided into two groups: low-performance preschool (PS) and high-performance preschool (PR).

The results are divided into different categories of cognitive acquisitions, identified following accelerating and cognitive training interventions, namely:

- The degree of adoption of strategies in the evaluation sheets for GC and GE, where Results showed that there is a significant principal effect for time $F(1,117) = 186.44$; $p < 0.001$, which indicates a significant difference in the averages obtained in pretest and

posttest stages of pre-school results; b) a major significant effect for intervention, where F (1,117) = 37,56; p <0.001, indicating the effect of metacognitive abilities intervention;

- the degree of adoption of strategies in experimental differences between the low-performance group of preschoolers and the high-performance group (PR). Preschoolers from the PScog group have made no progress. The score is higher in PRexp pre-school posttest test (M = 2.91; AS = 0.35) than the post-test score of pre-school PRcog (M = 1.92; AS = 1.03). However, the data showed a higher lag in post-test scores of preschoolers PSexp (M = 2.79, S = 0.54) and PScog (M = 0.14, SD = 0.36) .

- the degree of adoption of metacognitive strategies. In the post-test phase, preschoolers from the three sub-groups (PRexp, MGexp and PScog) made considerable progress, compared to their pretest scores. Preschoolers from PScog have made no progress. The PRexp preschooler score in the posttest test (M = 5.67, AS = 0.87) is higher than the post-test score of pre-school PRcog (M = 3.91, AS = 1.86). However, a large gap between the PSexp posttest score (M = 5.23, AS = 1.42) and PScog (M = 0.87, AS = 0.69) was found.

- the degree of delay in metacognitive strategies: differences between the low-performance group of preschoolers (PS) and the group of high-performance preschool (PR). The Chi-square test showed that the differences between the four subgroups (x2) .2 (3) = 79.51; p <0) were statistically significant. An additional set of tests to locate significant differences between the different groups showed: (a) a significant difference (x2). (1) = 27.78; p <0) between PRexp and PRcog; (b) a significant difference (χ2). (1) = 18.37; p <0.000) between PSexp and PRcon; (c) a significant difference (χ2) (1) = 48,11; p <0.000).

7. Conclusions on the influence of cognitive acceleration methods on quantity conservation capacity, classification and serial operator groups

In order to test the general hypothesis we analyzed the link between the independent variable - the implementation of the cognitive accelerating program "ABC Sciences" and the dependent variable, the level of acceleration of the classification groups and the number conservation by using smaller age groups than in the previous experiment . Sixty preschoolers have been selected and their activities consisted in the use of age-appropriate educational kits to demonstrate that most preschoolers in the experimental group anticipate early-grading schemes and preservation schemes. Thus, three levels were found to predict classification in the first samples by the sign test, where p <0.01. Although the number of subjects in the experimental and control group, whose ability to anticipate classification schemes has progressively improved during the intervention or remained unchanged. In the last session of the posttest there are no significant differences between the two groups (χ2 = 0.01, df = 1, p>

0.05). It can be concluded that AC intervention did not have any significant influence on the ability to predict classification schemes. Instead, by comparing the numbers prediction and performance patterns, during the first and second probes for each group, an improvement for the control group (Signal Assay, $p < 0.05$) can be observed.

Comparing the number of subjects in the experimental and control group, whose ability to predict the quantity preservation schemes and classification groupings have progressed over the three months of study. Analyzing the interaction between the variables, an improvement in preschool science, class grading, numbering and numbering schemes was observed due to the experiments used in the Discovery box. The charts show us visible results regarding the learning of these groupings during the intervention phases. Preschoolers from the experimental group achieved better performances than those in the control group in the Pigetian preservation samples of the number [$t(60) = 0.45$, $p < 0.05$], classification [$t(60) = 0.39$, $p < 0.05$] $(60) = 4.52$, $p < .05$).

In conclusion, the hypothesis is asserted that the use of cognitive acceleration methods by educators positively influences the capacity of preserving the quantity and classification and grouping operator groups in preschoolers in the experimental group ($\chi 2 = 4{,}43$, $df = 1$, $p < 0{,}05$) .

8. Conclusions on the influence of cognitive acceleration methods on volume conservation capacity

To test the general hypothesis we analyzed the link between the independent variable applying the cognitive acceleration methods (eg the method of investigation based on investigation and problem-based learning) and the dependent variable the level of preservation capacity of the preschoolers in the experimental group.

They participated in an educational partnership project with the University of Agricultural Sciences and Veterinary Medicine and the Botanical Garden in Cluj-Napoca. These activities aimed at acquiring knowledge specific to Sciences and ecology, and pre-school children managed to answer some causal questions: "How do I live and how do trees grow?", "Plant care", "Meteorological phenomena", "Medicinal plants", etc. All these themes are debated within the program activities.

The experiment in the partnership, entitled "How do we explain the coloring of the petals of a flower?", Was conducted to demonstrate that preschool children performing cognitive accelerating volume experiments perform better in Sciences, compared to those who teaches such topics by classical methods. Among the methods responsible for accelerating the

knowledge of preschoolers in the three groups of participants was the method of learning based on investigation (group 2) and the problem-based learning method (group 3). The results showed a percentage increase in pre-school post-test scores as a result of the methods used (correlation value is 0.77).

9. Conclusions on the influence of cognitive acceleration methods on the height and surface conservation capacity

To test the general hypothesis we analyzed the link between the independent variable and the application of the cognitive acceleration and the dependent variable - the acceleration of the height and surface conservation capacity. The participants reported the earthquake losses that would be due - the distance from an earthquake to the site [χ 2 (1) = 7.2, p <.01] and because of the height of the buildings [χ (1) = 12, 8, p <.01].

10. General Conclusions on the Effects of Implementing the Cognitive Acceleration Program on Preschoolers

The results obtained by pre-school children have been reported in terms of increasing intelligence and advancing them from the preoperative stage to the actual stage. Based on the results, it was observed that the level of intelligence growth was influenced by the results of pre-school students in the WISC-IV, MST, Probe Piaget, Discovery Box tests and cognitive acceleration response record sheets. The statistical data show the existence of positive, moderate correlations (in the range of .30 to .70) and lower (under .30) of intelligence level measurement. The verbal MST scale (r = .65, p <.001) correlated positively with the verbal scale from WISC-R (r = .42, p <.001), the WISC-R perceptive performance performance scale (r = .63, p <.001). Similarly, it was observed that the Perceptive-Performance Scale from MST correlated significantly with the WISC-R scales (p> .05). The perceptive-performance scale (r = .28, p> .05) correlated positively with the Global IQ Coefficient WISC-R (r = .43, p .05). Thus, a strong effect in time [F (3, 36) = 3.87, p = .02, η2 = .24] on the increase of intelligence levels in pre-school children was observed following the implementation of ABC- the Science ".

Regarding the advancement of preschool students from the preoperative stage to the concrete stage, it was due to the experiments carried out during the cognitive training sessions. Throughout the three training sessions through cognitive acceleration methods, it was noted that preschoolers who participated in the intervention solved problems of quantity, classification and serial conservation early on.

The last problem identified in our research was the link between the level of creativity, intelligence and experimental skills of using the Discovery Box kit to preschoolers. In order to test the experimental skills of preschoolers, the Alpha Cronbach Index was calculated for the 26 items. The calculation procedures were based on three psychometric conditions: (1) assessment of the item's difficulty index, (2) assessment of the capacity for discrimination, (3) assessment of internal consistency. The DVD presentation of the kit indicated that experiments are addressed to preschoolers between 3 and 6 years of age. The index was calculated on the basis of gender criteria (boys vs. girls) with a global index of .86

After analyzing the evidence of creativity and intelligence, we have concluded that acquiring knowledge specific to the field of Science depends to a large extent on the formation of the skills of intelligence and of creativity. Therefore, the link between the three variables, in which the mediator (level of knowledge in the field of Sciences) is the variable criterion, and the predictor is the intelligence, b = 0.024 - the non-standardized regression coefficient of the mediator variable, sb = 0.011- the prediction equation in which intelligence is the variable criterion, and the predictor is considered the mediator variable.

The results from the cognitive acceleration program confirmed our hypothesis. The program influenced the significant development of didactic skills involved in using the Discovery Box, as well as significantly influencing the cognitive development of preschoolers. The task of Pigetian reasoning indicates that pre-school children have gained considerable cognitive gains during training sessions.

Leadership management has been instrumental in implementing the cognitive acceleration program. Kindergarten directors have supported and encouraged teachers' participation in workshops to contribute to a common goal.

Like other research, our study has taken into account several ethical criteria for carrying out an "accelerated" research on cognitive development in pre-school children. It took into account the age of preschoolers, their desire to learn new things, their innate curiosity for the study of science, and their educational path to learning scientific phenomena within the kindergarten activities. Therefore, it was necessary to consider the mother's education in the first phase. This was necessary to underline, as previous studies have demonstrated that there are positive correlations between mother's education and children's performance in intelligence tests. Thus, the level of education proved to be a strong predictor for the success of preschools in experiments, as 35.4% of mothers had a doctoral degree, master study (29.5%) and undergraduate (23%). Secondary education has a fairly low

percentage of around 10%, so most of the pre-school performance will be reported to those from higher-performing families.

As regards our efforts to demonstrate a link between cognitive acceleration and the performance of preschoolers in science, on the one hand, it was necessary to select and adapt cognitive measurement tools such as WISC and MST, but also innovative teaching tools Discovery box.

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