

Interaction during operational tests: building products for child evaluation

A interação durante as provas operatórias: considerações para a avaliação infantil

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ABSTRACT: The Jean Piaget's theory classifies child development in stages, according to the cognitive structures established by age and prepares the system of child evaluation – operational tests, known and used in many occasions by occupational therapists. We'll present relevant results of a critical-reflexive research aimed to analyze the variables during the application of operational conservation tests; seriation; classification and symbolic function in children in pre-operational, formal operational and concrete operational stages. The applied methodologies and materials used were intentionally modified in three stages for each test: traditional material and methodology; diversified material and active manipulation; and personalized material and active methodology. After three months of applications, image recording, completion of research instruments and analyses performed, the main results showed that the active manipulation and the relationship with the diversified materials contributed to answers of higher intellectual maturity of the child, in a considerable number of sessions.

KEYWORDS: Child development; Occupational therapy; Evaluation/methods.

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RESUMO: A teoria de Jean Piaget classifica o desenvolvimento infantil em estágios, de acordo com as estruturas cognitivas delineadas por idade e elabora o sistema de avaliação infantil - provas operatórias, conhecido e muitas vezes utilizado pelo terapeuta ocupacional. Serão apresentados os resultados relevantes de uma pesquisa que objetivou a análise crítica-reflexiva de variáveis durante a aplicação de provas operatórias de conservação; seriação; classificação e função simbólica em crianças nas fases pré-operatória, operatória e operatória concreta. As metodologias aplicadas e os materiais utilizados foram intencionalmente modificados em três etapas para cada prova: material e metodologia tradicionais, material diversificado e manuseio ativo e material personalizado e metodologia ativa. Após três meses de aplicações, registros imagéticos, instrumentos de pesquisa preenchidos e análises realizadas, temos como principais resultados que o manuseio ativo e a relação com os materiais diversificados contribuíram para respostas de maior maturidade intelectual da criança, em um número considerável de sessões.

DESCRITORES: Desenvolvimento infantil; Terapia ocupacional; Avaliação/métodos

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INTRODUCTION

Occupational therapy, in its broad spectrum of intervention possibilities, plays an important role in the field of child development, which considers aspects related to the individual and their interaction with the environment, be it from family, social, emotional, cultural, relational environments, among others.

We define development in terms of the changes that occur over time in an orderly and relatively lasting manner, affecting the physical and neurological structures, the thought processes, the emotions, the forms of social interaction and many other behaviors¹ (p.25).

Many theorists, over time, made numerous research and studies, contributing to the human understanding of child development. An important classic in the field is the biologist, epistemologist and French psychologist, Jean Piaget William Fritz (1896-1980). Piaget³ believes the interaction of the subject with the environment is the source of the formation of knowledge. Studying the riches of child's thoughts, Piaget began to understand that the development of knowledge results from child's activities, whose main occupation is the play and, consequently, the exploitation of objects⁴.

Occupational therapy often uses the Piaget's constructivist theory as a base to their practices, to support interventions with children to understand the evolution of the acquisition of knowledge and the constant connection between cognitive aspects and learning².

Piaget's constructivism states that children learn, not by absorbing outside values, nor do they have them within themselves already, but they build it from their interaction with the environment⁵. Thus, to understand child development, it is necessary to understand three constants: the universal standards, individual differences and contextual influences¹.

Using schemes which are mental structures by which we adapt and organize ourselves when faced with environmental stimuli, we can initially feel the world and then, over time, we begin to create more complex schemes for each action developed.

Scheme is a cognitive structure that refers to a class of sequences of a similar action, sequences that are potent totalities and are well-defined, in which the behavior elements that constitute them are closely inter-related⁶ (p.52).

With this premise, Piaget developed the concepts of assimilation, accommodation and equilibration, the latter being a general state of efficacy between the environment and the intellect as a child explores the world⁷.

Piaget classifies child development in stages according to the cognitive structures limited by age. However, he considers this classification an ongoing process of steps through which every child begins to acquire new knowledge schemes and greater cognitive complexity. Piaget defined four stages of child development: sensorimotor, preoperational, concrete operational and formal operational.

The operational tests developed by Piaget can cover all kinds of knowledge to reach a wide parameter of child's assessment. By applying the tests, it is possible to investigate whether there is a lag in the child's knowledge and if his chronological age is in line with the child's cognitive aspects⁸. Based on the application of tests, involving the logical and infra logical operations, Piaget could, through the answers and the dialogue, analyze the child; in the process, the error is an important and revealing part.

The evaluation tests methods are usually limiting to the expression and opinion of the child and eventually standardize children rather than understand their processes, depending on how they are built and systematized⁹. Dialogue, flexibility and depth of the analysis to be performed, expand the possibilities of the child putting on and grasping its reality, in its essence.

Piaget waives, thus, any kind of rigid questionnaire that does not allow question variations or use other suggestions. In this sense, the term "clinical" puts in particular relief the peculiar characteristic inherent in its method of "talking" at ease with the subject about a determined task, without it being limited to standardized questions, making it possible to consider as many numbers and the implications of dialogue¹⁰ (p.8).

Regarding evaluation tests, we also "cannot assume the constancy of behavior, nor in different situations, nor over time" ¹⁰ (p.19).

Interrogations that are made with each test are intended not only to get to know the child's judgments, which vary according to age and development, but particularly on the arguments that accompany them. For example, we are not only interested in whether the child accepts or denies the quantitative invariance of fluid racking test, but above all, what arguments it uses to justify its judgment of conservation or non-conservation¹¹ (p.7).

As proposed by Assis and Assis¹², the following characteristic and notions can be stimulated in the tests, according to each knowledge, such as: *physical knowledge* (object properties): color, shape, texture, consistency, temperature, sound, weight, smell and taste; *logical-mathematical knowledge*: notion of conservation, classification, grading, concept of space and time, causal relationships; and *social knowledge*: knowledge of the physical environment (where home, school and community are located), concepts of family, functions and community.

For Piaget, there are no wrong or right answers, they should be interpreted for the process to be understood, and thus capturing the essence of the child's thinking, only to then classify the child according to a certain stage of cognitive development¹³. This way, we have the structure of evidence: with the ultimate goal of discovering something about the reasoning that hid behind the right answers, but with interest in the processes that were inherent to the wrong answers³.

When performing an operational test, one must analyze and formulate critical insights about the involvement and affection in the application and analysis. These aspects should be relevant, because they can significantly alter the results and should be considered and evaluated so a realistic conclusion can be reached.

Piaget¹⁶ points as context, the influence on cognitive acquisition when he says that the child, from an early age, already has the knowledge of a specific operation and if is not stimulated to perform it through the extension of actions over things, the child won't be able to understand the operation, the concepts, the whys. Active learning stimulates creation in the subject.

The occupational therapist should also realize if the language, the communication, the words and phrases and even the materials used in its assessment cause no different reaction or are known to the child, as this can influence the results. The vocabulary used should be the subject who is conducting the tests. Caution should be great to not transpose the child's spontaneity by something suggested by the one applying the test and thus changing the course of the responses and the analysis¹⁰.

Silva and Lima¹⁷ point out that, among the publications made by occupational therapists, from literature reviews (2010-2014), in two relevant Brazilian journals, 75 articles focused on topics that cover the child population were identified, of those a small number (12%) referred to studies on the identification of evaluation factors in child development, since such studies "contribute little to the consensus formulation in the profession, because they do not allow conclusions about the effectiveness of the methods and strategies" (p.348).

After all considerations, we present the most relevant research results, "Interaction during operational tests: building products for child evaluation", seeking to analyze variables, materials and application methods during assessments of child development, prioritizing conservation, classification, grading and symbolic function, focusing on the preoperational and concrete operational stages.

METHODOLOGY

The methodological procedures consists of detailed, longitudinal investigation of some important variables in the child assessment process: relationship with materials, active forms of manipulation, proximity and connection with the one applying the test, which could interfere with the outcome of the final and classification in stages.

The behaviors are the result of the interaction between momentary situation and individual differences. This means that, with different levels of situational specificity, the study of variables depends on the objectives to be pursued which can be summarized into the following question: the behavior keeps up with the particular situation or not? In the perspective we came to refer to the ideal would be to define the conditions that influence the onset of certain behavior or condition its non appearance³ (p.19).

The methodological procedures were divided into phases, for better performance and exposure of all the processes necessary for the concretion of the research.

Phase 1 – Development and creation

Materials and methods were developed to support the implementation of operational tests. The focus of analysis was guided by the following categories: type of material used for the application of the tests, physical characteristics, production and development of products, attractive and stimulating potential, active manipulation by the child, prior knowledge of the material and its functions, considering even the familiarity of the child with the materials as an important aspect.

After all, we have research that shows that children of more popular classes accomplished better results when performing operational tests related to their daily routine than when the tests were performed through the classic procedures, which exemplifies the sociocultural influence on the evaluations¹⁸.

Phase 2 – Field research

Population and sample

The target population was composed of nine children (three five-year-olds, three seven-year-olds and three nine-year-olds) in the preoperational and concrete operational stages of development, all attending public kindergarten, with seven girls and two boys (the five-year-olds were all female, the seven-year-olds were two girls and one boy and two girls and one boy were nine years old).

The participation criteria for the children in this study was the specific age (according to the stages proposed by Piaget), for it would be possible to analyze the skills acquired or not, but the appointment of teachers, pedagogic coordination and/or school directors was also performed.

All ethical procedures, security and privacy issues are contained in the Free and Informed Consent Term, signed by the children's responsible parties after a meeting in which all the stages of the research and its procedures were explained. The research was approved by the Secretary of Education of São Carlos-SP, all ethical procedures were respected, including the approval by the Human Research Ethics Committee, Process no. 143.360.

Instruments

Initial introduction scripts were filled out for each child who fit the criteria: family and behavioral context of the children in the classroom, known by the teachers and that directly affect some cognitive aspects and the learning process.

Detailed description scripts were also used for each application of each operational test. At the end of the applications, the scripts of each child were filled out. We, therefore, have 12 scripts a child, adding to 108 scripts, which can be accessed at Silvestrini and Silva (2013)¹⁹. All sessions were filmed for later data analysis, seeking higher reliability in the results.

Place of research

Twelve sessions were held with each child over three months, with one session per week at a Municipal Educational Center for Children's Education (CEMEI) and a Municipal School for Basic Education (EMEB) in the city of São Carlos, Brazil.

Materials used

The materials used for the research were diverse and can be divided into traditional, alternative, made and from daily life or with personal interaction with the child. The traditional ones are represented by a classical Piaget operational briefcase containing: blue and red EVA chips, a 15 cm chain, a 10 cm chain, four small glasses of equal size, a medium glass, a wide, low glass, a narrow, tall glass, 11 different sized wooden sticks (standard measure in the tests), a box of modeling play dough, a scale with two plates and linear flowers figures (roses and daisies).

The alternative materials are those that replace the classics, because they are more interesting to the child's universe and have richer exploratory features: plastic mug (replacing the glass cups), the colorful strings (replacing the chains), weights (pellets as proof for mass conservation), the plastic flowers with real dimensions and fragrance (replacing the figures of linear flowers, traditional in the kit).

The made material was the modeling play dough, created with the child, who was stimulated to discover its properties and textures. Personal objects from the participating children were also used, in some steps that verified the power of recognition and familiarity: school supplies (colored pencils, erasers, sharpeners and rulers), the drawings made by the children of the flowers and personal toys for the symbolic function tests.

Phase 3 – Operational tests application

There was a first meeting to get know the child and make him or her more comfortable in the presence of the researcher when testing began. Thus, a school employee introduced the researcher to the children and accompanied her to a room, where they were offered the materials, so the children may produce a drawing. We sought to maintain a pleasant environment, maintaining conversation with the children about their tastes, their families, and the presentation of materials that were going to be used in the next few steps.

In the following sections, the following Operational Tests were applied: Mass Conservation; Liquid Conservation; Length Conservation, Discontinuous Quantity Conservation; Weight Conservation; Serialization; Classification – Class Inclusion; Symbolic function I (drawing); Symbolic function II (symbolic play) and two final evaluation sessions to the reapplication of the tests with traditional materials and methods.

The order shown in the literature points that the tests of classification, serialization and liquid and mass conservation

and small groups begin to be implemented at the age of six or seven, while the tests of length, surface and weight conservation occur between the ages of eight and nine and the volume conservation tests come later, at the age of ten to twelve¹⁴.

For each session, procedures were built, ranging from the traditional methodology proposed by Piaget^{3,15} and Sampaio⁸ and then a traditional methodology plus the child's interaction with materials and objects and, also, a third stage in which the child was the protagonist of the manipulation and/or manufacturing of the materials and objects, so that the steps could be analyzed regarding the material and/or object offered and according to the methodology adopted.

The interventions consisted of weekly sessions of approximately thirty minutes with each child individually. The sessions had a longitudinal, three-month duration and

occurred indoors, with only the presence of the child and the researcher, to avoid other stimuli than those already offered. After each intervention, the children returned to their school routine.

The tests' application occurred through small intellectual logical-mathematical exercises, which were adapted for each age, taking into consideration materials and the contexts of the children, methodological strategies and the attachment time of each child. Children's behaviors were analyzed as they answered the questions regarding the materials and obstacles to be overcome. The justifications and explanations were also carefully analyzed regarding how they came to the solutions, as well as the absence of any argument or logical explanation (Chart 1).

Chart 1 - Individual session script for the operational test application: liquid conservation

Liquid conservation script
<p>Script at the end of each session: Name: R. Age: 9 years Grade: 4^o year Date: 16/04/13 Step 1: Liquid conservation => traditional methodology and material</p> <p>Materials: Set of glasses and colored liquid Step description: I put a certain amount of liquid in the narrow, tall glass and I transferred this liquid to the wide, low glass. I asked what had happened to the liquid. R. said that there was more liquid in the low glass, what afterwards stated that the liquid amount hadn't changed. I questioned her and she argued that the change in the shape of the glass made it seem that the liquid changed. I transferred the liquid to two smaller glasses and asked about the liquid. She said that the amount hadn't changed, that now was simply divided into two glasses. () Accomplished the test with ease (X) Had difficulties but accomplished () Didn't accomplish</p> <p>Step 2: Liquid conservation => methodology: traditional, but active/ material: colorless</p> <p>Materials: Set of glasses and colorless liquid Step description: R. was the one to manipulate the liquid into the glasses. She put a certain amount of liquid in the narrow, tall glass and transferred this liquid to the wide, short glass. I asked what had happened to the liquid. She transferred the liquid to the two smaller glasses and I asked about the liquid. R. said that the amount of liquid would keep the same. She also said that the shapes of the glasses are what makes the liquid seem different: "both little glasses are fuller, in the wide one, the liquid seems to decrease". (X) Accomplished the test with ease () Had difficulties but accomplished () Didn't accomplish</p> <p>Step 3: Mass conservation => methodology: interactive/ everyday material.</p> <p>Materials: Set of glasses and a school mug Step description: We talked about the mug that was used during snack time, I put a certain amount of liquid in the mug. Afterwards, I distributed this liquid into the set of glasses and asked about the amount of liquid. R. said that the amount wasn't going to change, conserved the liquid and still argued that only the distribution of the liquids in the different glasses changed. (X) Accomplished the test with ease () Had difficulties but accomplished () Didn't accomplish</p> <p>Relationship of the child with the offered materials: There was no estrangement. Therapist participation during test application: The least response influence as possible. Relevant commentary: R. was very observant, understanding the new test and the objects, explored the situation and managed to rapidly absorb and execute the operations. Very attentive this week.</p>

The evidence and procedures were presented to the child in an appropriate language and the child was encouraged to carry out the proposed activities. The researcher's behavior during the test applications sought to be exempted from any induction, regarding the child's decision-making. At the end of this process, a final report was produced for each child, with all the processes carried out in all the sessions, indicating the main points of each session and the performance's final conclusions, which describes the variables that interfered in processes³.

All sessions were documented by recorded imagery, consented by the responsible parties, the footage was used as analysis material and for the systematic tests application.

The research also involved the participation of teachers, parents and guardians that allowed for greater knowledge of the children, and also expanding the observations on them. After finishing the field research, activities were held to present the results obtained to the coordinators, teachers, parents and guardians, through school meetings and with the delivery of the final consultation report.

RESULTS AND DISCUSSION

From the detailed analysis of each child through the filmed descriptive scripts, important considerations that

must be made in the assessment processes stand out. After all, a punctual child's evaluation process may not represent the unique essence of each child, because it may overlook possible complications and influences that modify the course of a response or a behavior.

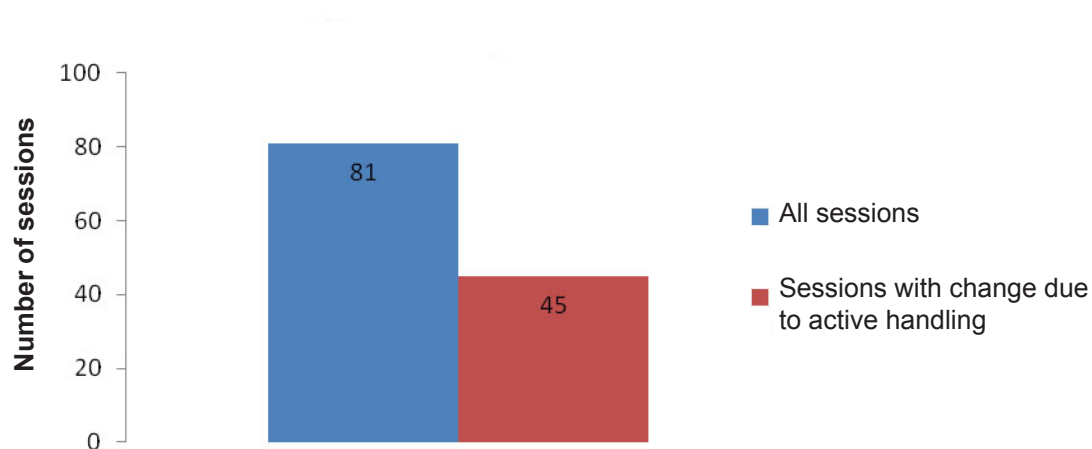
Despite the particularities of these processes, the categories analyzed were investigated to make certain whether they interfered in children's responses to the operational tests.

Category use of use of diversified materials

All 81 sessions were compared from all the children, to whom we offered traditional materials, alternative, made and everyday life objects or from the child's personal living; the number of indicated sessions refers to those in which different materials and procedures were used, this way, the first and last sessions were excluded.

Generally, we have over that, for 45 sessions (55%), different responses were obtained from the operational tests, when offered diversified materials. In all children and in 45 of the sessions, the responses were expressed to demonstrate a better adequacy and exploratory ability of the children, compared to the instances the traditional materials were used (Graph 1).

Graph 1 - Number of sessions x positive evaluative changes related to the diversified materials (non-traditional)



The various resources, represented in the research by the diversified materials, appear to be facilitators of the intellectual discoveries made by the children. All the children, at one session (of some step) changed their exploratory behavior and evaluative response by changing the type of material offered; this difference was observed in the case of everyday materials, both from school, better known by the children, as well as the personal objects (used for the symbolic function test).

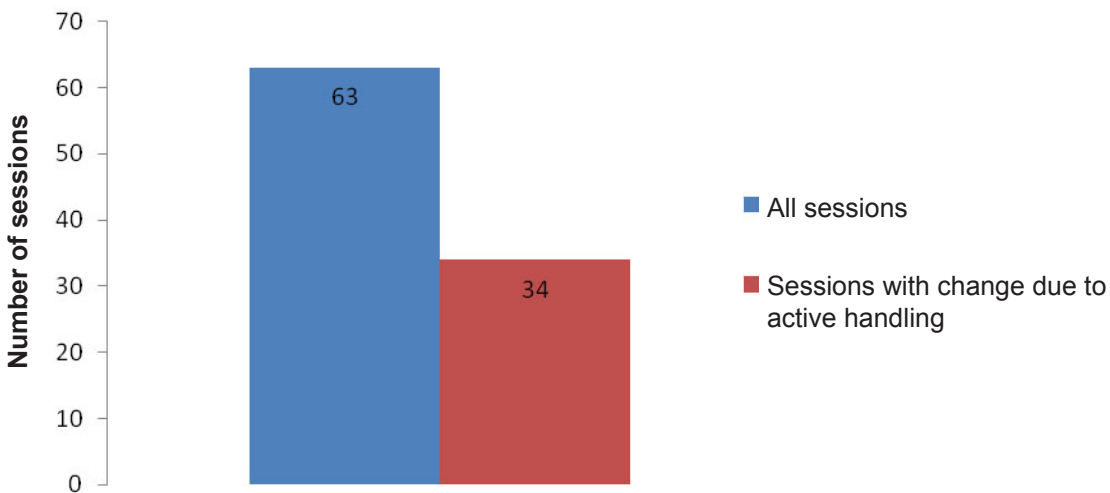
When analyzing the immediate responses of the children who suffered no impact by the shift in the supply of traditional materials, it was possible to verify that, regardless, the diversified materials eased the interaction process with the researcher, and it was possible to observe a safer and more expressive behavior by the child in the final evaluations.

Category active handling

The active handling refers to the more autonomous and explorative activity by the child, by the manipulation of objects, structured with a leadership role situations with which they had to relate to and respond to the small logical-mathematical tests, under the guidance of the researcher.

Regarding the active handling of children with materials and objects, we have that, in 34 sessions (54%) (excluding sessions related to the evaluation of the symbolic function, the first and last sessions) it was possible to perform the registration of greater intellectual maturity in the children's answers (Graph 2), in other others, responses that achieved the operations in a correct manner and using more elaborate arguments.

Graph 2 - Number of sessions x positive evaluative changes related to the active handling by the child



Also, when analyzed, the children who responded negatively to the early stages of the operational tests in the traditional way, on some operation (conservation, serialization, classification and symbolic function), but

during the second stage, with active handling, gave correct answers, in 70% of the time, the return was accompanied by a logical argument, in other words, not only did they change the course of the child's response, e.g., a non-

conservative response to a conservative one, the child produced an explanatory concrete elaboration of the concept of conservation, while in the step they were just spectators they failed to identify, but with active handling could produce and elaborate.

We have, therefore, similar percentages with regards to the changes of positive responses, be it with the use of another material or with the invitation for the child to manipulate. We highlight that the change in the responses was noted within the same session, during the same test application, just with modifying the procedures adopted, in other words, first with the application of traditional tests and then with the active handling.

The active handling and the use of diversified materials constituted resources that allowed or facilitated the development of a concrete experience and matured in internal concepts.

This finding expresses the importance of interaction with the object and the environment for the acquisition of knowledge, cited by Piaget³ and other authors^{5,20,15}. Through handling, the child becomes aware of the possibilities of that object, realizes how to act on real experience and from that contact that the conceptualization of the various operations forms in the child.

Therefore, such a significant change when the evidence is manipulated and directed by the researcher (the traditional way of most evaluations), may result in a child that is distant, does not understand the magnitude of the exploration of that situation. However, acting on the object/situation, can activate mechanisms of decentration, enabling the ability of relaxing and spontaneously abstracting a centration. "Such relaxation is processed so as to multiply the number of centrations and establish relationships between them. The visual field or the consciousness horizon widens" (p.95)²¹.

According to Piaget³, especially at the end of the preoperational stage, the passage from a strong egocentrism to a more relative decentration occurs, but this relativity still depends on what is offered to the child. Preoperational children can understand the operations only in the concrete visual level, the resources in this sense are very important in facilitating this process²¹.

"The schemes are, therefore, flexible and capable of transformation, with a scheme apt to be used in various situations and in different ways" (p.81)²¹. The activation of a schema always accompanies a sense or feeling: frustration, joy, stress, satisfaction or displeasure, therefore, the complications bring feelings to certain moments of a child's life, collide directly in acquisition and intellectual representation processes³.

The children, as they come to understand the dynamic of the evaluation, in which their questions and their responses fail to produce punitive behavior or judgement, allowed for a deeper participation, each week, exploring independently, having more confidence in expressing themselves and testing their theories.

In the symbolic function tests, we were able to perceive how the proximity of the researcher and the understanding of the uniqueness of each child made a difference in relation to the behavior and the possibilities, the symbolic dealing helps the children develop their verbal behavior regarding social conventions. We know that this repertoire of symbols and signs must be constructed by the child in the exploration and the actions in the world and represented by it, spontaneously, safe and very specific in every form of expression.

In the occupational therapy, such analysis about the child's repertory and the possible strategies and instrumentalizations are as necessary as they are specific. The scripts, tools, analysis procedures of concrete doing, mediated by resources or diversified materials is part of the set of approaches theorized and referenced in the occupational therapist's education.

Researches that intend to investigate the practice of occupational therapists in child development using experiments with structured analysis of activities and with the creation of evaluation scripts, are badly needed and promote the possibilities of thinking about occupational therapy in classic children's activities²². The Piaget Institute²³ considers that the occupational therapy training permeates several subject areas and that child development is a field for practice and for fundamental and specific evidence. In the pedagogical institute headquarters also teases that the occupational therapist must take ownership of the instruments and evaluation and decision-making strategies to discuss the practices and issues of the developing subject.

CONCLUSION

We conclude that different situations, materials and forms of interaction produce different effects on the behavior of a child and resulting relationships with the objects, which are usually constituents of a child's evaluation processes, as well as the known and traditional operational tests.

No reality of the human mind is absolute and fails to receive interference from the external system in the course of development. Piaget reflected on these interferences: if the cognitive development paralleled or allowed itself to change due to the various cultural and contextual systems

in existence. Piaget²⁰ managed to prove that differences occur in the pace of the development, though not always in this direction, however this rhythm is expressed and can be stimulated in different ways/resources with each child and this essentially critical and experimental stance to produce relationships, doings and evaluations should be standard practice with every scientific contact for content elaboration in the developmental area.

In this study, it was noticeable that the nine children participating in the research presented, at some stage of the test application sessions, influences of the analyzed categories in their responses. In most cases, the use of diversified materials (alternatives, made and everyday objects or from the child's personal living) and the stimulated active handling produced even more elaborate responses, revealing more maturity in the children as they performed the test themselves.

The instrumental and the field of research have been shown valid for the analysis of variables – materials and application methods – during the evaluations of child development, prioritizing operational tests of conservation, classification, serialization and symbolic function, focusing on preoperative and concrete operational periods. Thus, the scripts and the systematic application of the tests and the filming constituted an essential part of the research data produced, evaluated and analyzed.

Finally, the need to further study other variables and their interactions and correlations in the operational tests stands out, as well as in other infant evaluations. They corroborate with the deepening in the field of occupational

therapy and its professional contribution in the evaluations field, coming from the demands of our users, their realities and contemporary aspects. Since the study and the practice of occupational therapy in the analytical and evaluative universe of human development are made relevant.

After all, occupational therapy is dedicated to contributing to a better understanding of the factors involved with childhood, “especially in relation to occupational areas, as well as in providing solutions for facing situations that are directly related to damages to the development of the child”¹⁷ (p.346).

Thus, it confirms that the procedures that were closest to the conducts related to the occupational therapist – participatory methodologies, use of everyday material belonging to the children and interactive strategies, seem to provide beneficial effects on child development.

If grasping the everyday life implies understanding how the subject-everyday life-history-society relationship happens, the most appropriate methodologies are qualitative ones, that allow for the subjective understanding of social reality and allow the subject to realize himself as a result of multiple determinations²⁴ (p.108).

In order to foster discussion about the variability that constitutes human life and the possibilities to comprehend an evaluative process in a wider and unique way. Kesselring²⁵ cites that logical knowledge is formed not only from inventions, but also from discoveries. So, let's create and invent for us to be facilitators in new discoveries.

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