Scientific concepts in Early Childhood (Conceptual approach)

Zeghdoudi Sara [1], Medouri Yamina [2]

1 Research and Social Studies Laboratory, University of Skikda (Algeria), sarazeghdoudi.psy@gmail.com
2 University of Skikda (Algeria), aminapsy.ensg@yahoo.fr

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Abstract:

The development and enhancing early childhood to learn about the world as way of knowing could support them develop scientific habit of mind in future. The young child's understanding of science grows from the fundamental concepts they develop during early childhood. This concept is oriented to the process of recognition and mastery process about scientific concepts that is appropriate to the age level. Scientific concepts may be difficult to understand even by adults; however, this does not mean that children cannot think abstractly about scientific concepts. In contrast, the literature shows that children can think about complex concepts. In this article, we will discuss children's acquisition of scientific concepts and present the most important strategies used to teach scientific concepts and what the auxiliary and the influencing factors are.

Keywords: concepts; scientific concepts; acquisition of concepts; teaching strategies; early Childhood.

***Corresponding author**: Medouri Yamina,*

1. INTRODUCTION

Scientific knowledge helps us explain the world around us, Trundle & Saçkes (2015), said that, "science learning in early childhood education provides enormous benefits for various aspects of child development", so researchers emphasize how important science learning begins early. Science learning for early childhood can provide positive experiences for children who help themselves to develop an understanding of a science concept, develop thinking skills, curiosity, instill positive attitudes, influence competence, values, and provide a strong foundation for concept development science in further education (Eshach & Fried, 2005).

During early childhood, children actively engage in acquiring fundamental concepts and in learning fundamental process skills and scientific knowledge. Concepts are the building blocks of knowledge; they allow people to organize and categorize information. As we watch children in their everyday activities at various stages of development, we can observe them constructing and using concepts. (Karen, 1996, p02). (https://files.eric.ed.gov/fulltext/ED418777.pdf).

Childhood is given great attention by the educational staff because of the fundamental developments in the personality aspects of the individual. The rapid growth of learning is linked with the quick growth of the nervous system on the one hand, and with the pace of interaction with the external environment on the other hand. Managing this stage well may determine the future of the child's personality and the nature of his knowledge building.

Kindergarten is one of the most sensitive stages of cognitive development, where the child puts the first building blocks on which the rest of the academic profile is built. The child begins to receive knowledge in a more structured way, and in a rich environment of social interactions that gives him the opportunity to develop his ability to communicate and integrate by matching his gains and features with the requirements of the new environment. (Nisar, 2017)

According to Piaget, Kindergarten is called pre-process thinking. In this period, the child rises from thinking in a sensual way to thinking on the basis of symbolic concepts. The child becomes capable of internal representation of accidents and avoids the total reliance on sensory motor actions in directing behavior. The child at this stage is self-centered, he does not question the validity of his ideas at all, and he thinks that everyone thinks like him. He does not need anyone to guide him. Perhaps integration into kindergarten, receiving knowledge from educators and peer contact can be the best way to alleviate the child to concentrate around himself. (Lerida, 2003)

Kindergarten offers many educational and learning programs in order to enrich the child's balance in various fields. Each area has its own nature, terminology and distinctive concepts. The scientific field is a fundamental element in building the basic knowledge of the child. Thus, neither scientific

nor basic knowledge can be built without acquiring the main concepts. They are the first steps that cannot be overcome in the course of learning. Moreover, the scientific concepts are considered to be of rather a complex nature, which requires measures, and strategies that are consistent with their nature o on the one hand, and the level of abilities and preparations of the child On the other hand. We, therefore, ask the following questions: What are the scientific concepts and what is their nature? How does it grow in a child? What strategies should be followed to teach the scientific concepts to kindergarten children?

2. Definition of scientific concept

The views differed and varied with regard to defining the meaning of "concept", some opinions tended to focus on the nature of the concept and its way of being, similar to "Gallotti", which considered the concept to be the intellectual representation of some phenomena and things that are shared by common qualities (Nisar, 2017), and "Bourne" focused on The function that the concepts play in terms of organizing and classifying information where he said, "the concept is when two or more distinctive things are placed together, with the possibility of separating them from other things based on their distinctive characteristics or features" (Margaret, et al, 1971).In the learning and educational fields, many specialists focused on studying the concept as the most important pillar in building the knowledge of the learner. Hammed Zahran said in this context, "the concepts are fundamental in the process of thinking and the formation of most mental activity. The child's stock of concepts is directly related to his or her mental abilities" (Badawi, Tawfiq, 2009). Also, the concepts vary depending on the field from which they emerge. Therefore, the scientific concepts reflect the most important to be added to the cognitive balance of the child, knowing that they have characteristics that distinguish them from others, and some of these properties include:

-The scientific concept does not refer to a particular individual or part، but to the general class to which individuals or elements belong.

-The scientific concept includes generalization, i.e., it does not apply to something specific or to one situation.

-The scientific concept consists of the name (symbol or term), and the verbal connotation.

-Each scientific concept has a set of distinctive characteristics in which all members of the concept group participate and distinguish it from other scientific concepts.

-scientific concepts are formed and adopted in principle through three processes: discrimination، organization and classification، generalization. (Zaitoun, 2007, p 482)

3. The relationship between scientific and spontaneous concepts

Vygotsky's discussion of the Development of scientific concepts is

primarily in terms of how they differ from everyday or spontaneous concepts (Vygotsky, 1987). Both in their defining characteristics and in their manner of acquisition. Compared with spontaneous concepts, he argues, scientific concepts have four features which the former lack: generality, systemic organization, conscious awareness and voluntary control. Of these four features it is the first two that are criterial in labeling a concept `scientific'; what distinguishes this category of concepts is not so much the fields to which they apply as the way in which - whatever the field - they relate to experienced `reality'. Whereas everyday concepts are related to the world of experience in a direct but relatively ad hoc manner, scientific concepts are both more abstract and more general; their primary relationship is to other concepts within the relevant system and only indirectly to the particular objects and events that they subsume.

While the first two features serve to define the way in which scientific concepts differ from everyday concepts, the second two features, by contrast, are better seen as more general characteristics of a stage of mental development that is associated with, and perhaps dependent on, their acquisition. For this reason, although the two sets of features are different in scope, they are also interdependent. (Vygotsky, 1987)

Scientific concepts also differ from everyday concepts in the manner in which they are acquired. Unlike everyday concepts, which Vygotsky suggests are appropriated spontaneously by the child through the social interaction that occurs in the course of engagement in jointly undertaken activities in his or her immediate community, scientific concepts can only be acquired as a result of deliberate and systematic instruction in an educational setting. "The development of scientific concepts begins with the verbal definition," Vygotsky asserts. Furthermore, since "the development of concepts and the development of word meanings are one and the same process", it is by focusing on the systematic relationships between word meanings that instruction brings the semantic aspect of speech to conscious awareness. And this, in turn, enables the child to make the transition to a higher level of thinking.

Vygotsky's interest in the development of scientific concepts can be seen; therefore, as part of his more general concern to explain the development of what he called the higher mental functions and, in particular, of decontextualized thinking. (Gordon. 1994, p02).

4. The Difference between Conceptual Formation, Conceptual, and Acquisition of Concepts

There are several common terminology related to concepts, often overlapping. These terms are "composition of the concept formation", "growth of concept development",” Acquisition of the concept ". Vygotsky finds that the process of concept formation is a complex activity. All basic

mental functions are recruited, but the individual's exercise of these functions does not mean that he has learned the concept because this activity does not bring the individual to the depth of the concept and may not be able to take note of his or her dimensions. Yet, acquiring the concept is the process of searching for characteristics with a high level of accuracy, and with a circular Home gained in possible situations. The acquisition of the concept leads to a deeper contrast to the composition that can be superficial. A speaker may include the term "plasma" in the context of his speech, but his knowledge of the term does not mean that he is fully aware of it, he may be unable to determine his basic components and precise characteristics. Thus, it is now in the formative stage of conception rather than acquisition. (Sabry & Al, 2016)

As for the growth of concepts, it is a gradual process that grows steadily and becomes more profound as humans are exposed to additional concepts related to the concept, thereby increasing its ability to perceive its characteristics and distinguish it from the rest of the concepts. (Sabry & Al, 2016)

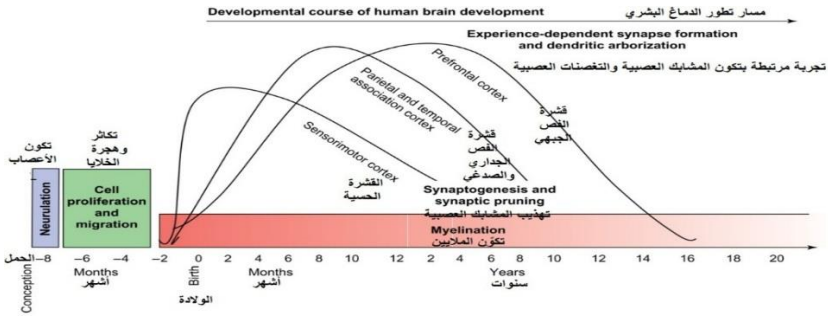
4.1. The Formation Process and Acquisition of Concepts in Early Childhood

In order to provide the child with the appropriate means and conditions to learn and to acquire new concepts, we must first understand the way in which the concept is being formed, as several aspects of this process intervene, including the following:

4.1.1. Physiological aspect (brain)

The human brain is the teaching and learning machine, responsible for complex mental activities and the way in which information is received, organized and processed through the different senses . (Sabry & Al, 2016, p 157). The brain growth begins before birth and continues to adulthood. The Embryonic stage and the first five years are considered as the fastest phase in the growth of the brain, with the production of more than 40,000 synapses per second. Moreover, it acquires new experiences at high speed (Allen & Al, 2015). 90% of the brain grows at this age, and then continues to undergo dynamic changes during Adolescence and until puberty. These changes consist of a process of refinement of neural nerve (Casey & Al 2005). The following chart illustrates the trajectory of human brain growth.

Figure (1) represents the path of human brain development



Source: (Casey & other, 2005, p 105).

Conceptual formation occurs in conjunction with brain growth. As the brain functions and the new neural clamps are formed, the more the child can acquire more concepts. And, as we mentioned earlier, the age of five years (kindergarten stage) is a delicate period of physiological, Nervous and the functional side, where the child lays the foundation stone on which the rest of the knowledge is built.

4.1.2. Cognitive aspect

The most famous to study the cognitive aspect of child development is "John Piaget", he has focused on the process of mental and intellectual development. He has also linked the process of formation of concepts to the stages of growth, and insisted that the child's recognition of the things around him is the starting point in the formation of concepts (Muhammad, 2009). In addition, Piaget has focused on the mental processes that underlie concepts rather than concepts in their own right, as he studies the evolutionary developmental processes and responsible mental organizations. This element is explained more as follows:

-Mental Structures

The concept of mental structures is the essence of the theory of "Piaget". Mental structures are hypothetical structures consisting of the inside of the mind during the development and growth of human from childhood to adulthood, knowing that its basis is hereditary. But, its development is influenced by the environment as a result of dynamic interaction experience. Cognitive growth is only a change in cognitive structures. (Lerida, 2003)

-Cognitive functions

It is a mental process used by humans while dealing with the external environment, since birth the child seeks to identify the surroundings, this is done only by forming concepts around it and this process occurs through two basic functions:

a-The organization

The organization is a complex structure of simpler buildings, and its role is to create a correlation between mental schemes. When the child's thinking grows and while he is forming new concepts, his initial schemes are interlinked and reorganized, resulting in a coherent system of higher mental structures, and the more organized Mental schemes are better. The child has succeeded in adapting in a better way, and the organizing process represents

an integration of the experiences and concepts that he has through his interaction with the environment. For example, when the child tries to connect the consideration and capture of things or between looking and sucking, the organization includes combining experiences. The new concepts are in clusters of systems, based on mutual relations, connotations and solidarity. (Abo Sharfawi, 2012)

b- Adaptation:

All organisms tend to align themselves with their environment and make adjustments as required by the surrounding conditions. This process that regulates the life of organisms from the physiological side is the same as regulating the life of the human being on the mental side (mons, 2008). But, at this level, it includes two processes:

- **Assimilation (representation):**

It is a process to fill in with the new information and integrate it into the pre-existing knowledge structures. This process is aimed at making the new external perceptions and triggers compatible with the old internal perceptions (mons, 2008) For example: When the child acquires the concept of "book". It launches this term on everything that carries similar characteristics in terms of shape or color (copybook, newspaper). The child performs this process to make it easier for himself. Therefore, the elements of the environment are commensurate with what is present in his mental structure.

- **Accommodation**

It is a process of modifying the knowledge structures in order to understand, apply and extract new information. This time, the child changes his old information to suit the external environment, (mons.2008). to clarify this point, we use the same example above, if the child launches the word "book" On A newspaper or something alike, then an adult corrects the label for him, the child will be aware of the differences in the characteristics between the two concepts, the accumulated papers and the rectangular shape, are not necessarily characteristics of a "book". Thus the child begins to alert to the different characteristics of various concepts, and he modifies his Old information to fit the new external one. (Zaitoun, 2007)

• The ideas of "Piaget" have contributed to the building of modern teaching methods, including the teaching of concepts, as the principle of building new knowledge through the existing information is derived from the idea of "representation and harmonization". Piaget believed that new experiences are received through the existing knowledge using these processes (Zaitoun, 2007), where the learner represents the new information and enter it in a way that fits with what is in his mind. So the knowledge of the learner's balance should not be ignored because this balance determines the quality of the subsequent learning. If the student has a good knowledge base, he will continue to progress steadily. However, if he builds incorrect or inaccurate information, this will hinder the learning process as a whole (Archambault et Vent, 2007).

• Piaget also referred to the most efficient role of the person when he

talked about the process of "matchmaking". This role is embodied in the behavior of the teacher who guides the learner to correct his old knowledge and adjust it in accordance with the requirements of the educational situation property. (Archambault et Vent, 2007)

4.1.3. The social aspect

Vygotsky is considered one of the most important participants in studying the impact of the social environment on cognitive development. he considered that the development of the child's abilities, including the process of conceptual formation, is intrinsically linked to the external environmental, since every cognitive development can be in its infancy only in the context of interaction between children and adults or Peers. Vygotsky argues that every high mental process and every concept that emerges during the child's growth path appears twice. Initially shown as a social activity, and then transformed into an individual activity, then a child's internal and personal property (Archambault et Vent, 2007).

Vygotsky studied the relationship between the process of formation and acquisition of concepts and the growth of the child. It was found that cognitive growth depended on what he called the "ZPD" zone of proximal development, where he found two aspects of growth. (Mons, 2008)

-The current level of growth

The child is born with a range of psychological and mental functions that grow and crystallize through maturity. These functions allow him to accomplish some tasks and face different attitudes, and create new concepts through interaction with the environment. (Mons, 2008)

-Potential level of growth: (near ZPD)

This level includes all possible mental functions that have not been reached by maturity. The "Near ZPD growth zone "includes three characteristics:

a. Mental functions grow and evolve:

Every human being is equipped with an underdeveloped capacity but includes the ability to do so. Its completeness takes place in the context of interaction with the social milieu, as well as the implementation of each activity acquired and partially empowered, with the need for guidance and tutoring from a more efficient person. (Mons, 2008)

b. Maturity varies by intellectual fields

The "ZPD near growth zone" does not refer to a number of mental functions accumulated together that characterize each stage of genetic development, but rather reflects intellectual maturity in a specific field, each field having its own characteristics and the quality of the capabilities it requires.

c. Guidance and tutoring create the "ZPD near growth zone"

Potential mental abilities are not an individual's original characteristics,

but when he engages in social interaction he can acquire it, (Mons, 2008) For example, a man is born and is not able to swim but has the ability to acquire this skill, Swimming is not an original feature but a viable trait. (Lewin-Benham, 2011)

The literature researcher, who follows the field of teaching strategies and in particular the teaching of concepts, notes the profound impact of the ideas of Vygotsky in this field. His views were a major starting point for what is known as "Constructivist Theory", which is today the basic theoretical framing of most teaching strategies. It is based on building self-learning in accordance with the student's abilities and aptitudes. Although "Vygotsky" has not defined self-contained teaching strategies, it has set standards and disciplines to effectively govern the learning process. As the idea of the "near-growth zone "that has brought attention of researchers in the educational field to the need to stay alert to the learner's preparations, and the need to take into account the differences between him and his colleagues. Each learner has a field in which he can excel without others. His ideas have contributed to drawing attention to the role of the mentor and teacher in developing and refining the learner's preparations. (Lewin-Benham, 2011)

5. Strategies for acquiring concepts in Early Childhood

Teachers are researchers, designers, relationship orchestrators, listeners, observers, recorders, and documenters of children's work, collaborators, and mediators (Lewin-Benham, 2011). Expert early childhood teachers facilitate children's active involvement in the scientific process by providing materials, encouraging children to observe, predict, describe, and theorize about what they are doing. Teachers raise questions and problems as children play, helping them to grow in their thinking. This is an approach to learning that early childhood educators have set historically, but has not always been recognized formally as promoting learning. It has been supported by many theorists, including Vygotsky (1978), Feuerstein (2011), Malaguzzi (1993), and many others. Learning happens in the relationships and conversations between novice and experienced learners. Experienced learners facilitate learning by asking questions and commenting as children play (investigate). This approach has been used for decades in Reggio Emilia schools in Italy; now world-renowned for their highly purposeful and in-depth approach to young children is learning. (Carol, Gross, 2012)

Lewin-Benham (2011) describes the teacher's role, integrating the Reggio Emilia approach with what she refers to as "other inspired approaches" such as Montessori (1967), the Project Approach (Katz & Chard, 2000), and the Creative Curriculum (Dodge, 2002):

• Create an open-flow schedule with flexible amounts of time for exploration

• Recognize that the environment is a teacher and determines the curriculum

• Engage children in meaningful conversation

- Document children's work and learning
- Assess children's process and progress (Carol, Gross, 2012, p5)

As any scientist knows, the best way to learn science is to do science. This is the only way to get to the real business of asking questions, conducting investigations, collecting data, and looking for answers. With young children, this strategy can best be accomplished by examining natural phenomena that can be studied over time. Children need to have a chance to ask and answer questions, do investigations, and learn to apply problem-solving skills. Active, hands-on, student-centered inquiry is at the core of good science education. (Karen, 1996).

In recent years, educators have focused their attention on active teaching strategies focused on the role and effectiveness of the learner. The most appropriate strategies for teaching kindergarten children with their psychological, mental and physiological characteristics include:

5.1. Project Strategy

The child in kindergarten needs a kind of mental stimulation based on the movement in learning. The child at this age develops his abilities by interacting with his surroundings using movement, senses and language. This is provided by the strategy of the project. This strategy is based on the completion of practical activities by Pupils, whether inside or outside the school. It can be applied individually or in groups, but more appropriately to ensure the integration of the project and achieve interaction between children. The subject is chosen in accordance with their needs and the requirements of the teacher, and the number of pupils participating in the project. It is preferable to have between three and five pupils to ensure the active participation of all individuals (Al-Nashef, 2009).

The strategy of the projects serves the requirements of teaching scientific concepts. It also provides the child with the opportunity to deal with these concepts through the senses by actually embodying them visually and concretely. Thus, the effort of the child in the completion of the project establishes his new concepts easily and deeply. (Atio, 2013)

5.2. Cooperative learning

The child of kindergarten age seeks to contact his peers and form relationships with them to acquire habits, skills and information spontaneously.it is considered a cooperative learning, one of the most prominent strategies that meet the child's needs. it is a teaching model in which students work in heterogeneous groups in abilities and achievement, the difference between them is between 4 and 6 people, assigned by the teacher to a common task, in which each child is responsible for his peers' and learning. The difference is that traditional group learning lies in the participation of all children in the performance of the activity. All of which are responsible for leadership, unlike the traditional way through assign a group leader and complete the task, while the rest are learned by watching. (Atio, 2013)

5.3. Experimentation

It is difficult for the child before the age of six to absorb theoretical information that is not explained concretely. The process of experimentation is an easy way to understand and learn, through which the child acquires direct experience. He performs the work by focusing attention on him, and at the same time, he thinks and absorbs the results. Experimentation gives the learner Self-confidence in the way of self-learning. (Al Samurai, 2013)

5.4. Graphic organizer

The Graphic organizer is one of the common teaching strategies in teaching children in kindergarten. It is done by building a blueprint for the concepts contained in the subject of the lesson. This chart shows the relationships between concepts and their order. As shown in their sequence by placing the most general at the top of the map. The benefit of this strategy for the child lies in its effectiveness in building educational schemes in his mind and linking new concepts to his or her previous knowledge. (Al-Nashef, 2009)

5.5. Strategy of scientific similarities

The strategy of scientific similarities is based on clarifying unfamiliar concepts to the child by comparing them with his existing experiences. Also by providing him with interpretive links that facilitate linking the new concept with the previous information. This comparison is made in several conditions:

- The similarity must be a simple and familiar concept for the child.
- The compared elements should have at least one difference. Because if the qualities match, we are out of the strategy of scientific similarities.
- The possibility of the child realizing the similarities between the almost alike elements is perhaps without much effort .(Atio, 2013)

5.6. Problem Solving Strategy

Friction with the environment in the first years of life creates curiosity and confusion in the child. The strategy of solving problems is saturated with this curiosity, as it gives the learner the opportunity for scientific thinking. When the student challenges a particular problem, he plans to address and search for it. He collects data that help him in this the process. Then, he regulated and drawn from it. Therefore, he has acquired new knowledge while learning how to search for information in an orderly scientific way. (Atio, 2013)

6. Factors that help in the process of acquiring the scientific concepts in Early Childhood:

The nature of the kindergarten child's age group requires several considerations to ensure the success of the acquisition process, including:

6.1.Emphasis on sensory learning activities:

Although the child in kindergarten rose from total dependence on the senses to the direction of symbolic thinking, the role of the senses remains essential at this stage. The child is still unable to strip knowledge in his mind without being represented by Concrete things. Therefore, practices that activate the mind and hands together should be used in the teaching of

scientific concepts (Zaitoun, 2007). such as involving the child in some simple laboratory experiments, and also the use of educational means that facilitate the process of understanding concepts as images, models, models and films Samples ...etc. this ensures that new concepts for the child are removed and made into a well-learned circle.

6.2.The use of examples

Providing a sufficient number of examples applicable to (positive) and (negative) examples helps the child to make comparisons between things in terms of their characteristics and types, making it easier for them to understand, categorize and even use different concepts elsewhere (Mustafa, 2014)

6.3.The use of various teaching activities and models

Diversification in teaching methods and strategies avoids the child's boredom and monotony in learning. Among the tricks that a teacher can use to draw the attention of his students:

- Diversification of teaching methods and tools used.
- Diversification in the use of colors in a single activity.
- Limit the number of activities so that they do not exceed the reasonable limit so that the student does not get tired or distracted. (Al-Demerdash, 1997)

6.4.Structure of educational content

There are two types of organization of conceptual educational content. The first is called "spiral", and the second is called "pyramidal", which are influential in the learning of concepts. It can initially be at easy levels, and then the authors of the curriculum with the principle of precedence take move to higher levels of concepts, it building learning through hierarchy, the (hierarchical) orientation, where some concepts come first and then hierarchically. Regardless of the method used, regulation is a key requirement for the teaching of any concept. (Mustafa, 2014)

6.5.Taking into account individual differences

Although kindergarten-age children are similar in age and circumstances, this does not mean that they have the same characteristics and the same learning abilities. So, the teacher has to treat his students as individuals, not groups, each of them has a certain skill. Each of them has certain means to help learn the most. Thus, all these factors must be taken into account to ensure a better acquisition of scientific concepts. (Al-Demerdash, 1997)

6.6.Feedback

Feedback between teacher and learner provides the opportunity to understand the success of the learning process. Through the students' reactions, the teacher understands the level of grasping of their knowledge. In addition, the teacher's reaction to the performance of the students is a catalyst and encourages them to work more. Therefore, the teacher must ensure that

all activities are constantly evaluated while informing students of the results of their work. (Al-Demerdash, 1997)

7. CONCLUSION

In considering all of the preschool and primary developmental stages described by Piaget, keep in mind that a child's view of the world and of scientific concepts is not the same as yours. Their perception of phenomena is formed from their own perspective and experiences. Misconceptions will arise. So, be ready to explore the world to expand their thinking, and be prepared for the next developmental stage. Teach children to observe with all of their senses and to classify, predict, and communicate, so they can discover other viewpoints.

Early childhood has the same opportunity to get activities that are able to answer their natural curiosity. Through science activities, children can explore many of its developments. The focus on early childhood science education provides a great opportunity to strengthen the curriculum for early childhood by increasing the learning and exploration provided by science. The acquisition of concepts is the main entry point that the child must go through before diving into any scientific field. The child at this stage is still unable to strip the Concepts in his mind and their absorption without examining them with the senses. This requires the adoption of methods and strategies to help, so that it is easier for the learner to acquire concepts with the least effort.

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