

Cognitive development in Piaget's theory: from genetic epistemology to pedagogical practice¹

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Abstract

This study aims to analyze children's cognitive development in light of Jean Piaget's Genetic Epistemology, highlighting the processes of assimilation, accommodation, and equilibration, the stages of cognitive development, and their implications for pedagogical practice in the school context. This is a qualitative, bibliographic study based on the analysis of fundamental works by Jean Piaget and recognized authors in Piagetian research, complemented by a search in the *Schème* journal covering publications from the last ten years. The selection, conducted using the keywords: Cognitive Development, Genetic Epistemology, and Constructivism, prioritized studies relevant to children's cognitive development and its educational implications. After the material was selected, the publications were read and organized according to the objectives of the study. The analysis was structured around three thematic axes: a) the mechanisms of assimilation, accommodation, and equilibration in the construction of knowledge; b) the stages of cognitive development and their characteristics; and c) the implications of Piagetian principles for learning and pedagogical practice. Based on these axes, relationships were established between the concepts presented in the selected works and their contributions to understanding children's cognitive development in the educational context. In order to achieve the objective of the study, an introduction to Piagetian thought and the principles underlying children's cognitive development is presented, emphasizing intelligence as a dynamic and progressive process. The process of equilibration is then addressed, explaining the mechanisms of assimilation and accommodation, as well as the role of cognitive disequilibrium in the construction of knowledge. Subsequently, the stages of intellectual development are described and related to school learning. It is concluded that the analyzed principles of Genetic Epistemology provide theoretical foundations for understanding children's cognitive development and for organizing pedagogical practices that value students' active participation, autonomy, and construction of knowledge.

Keywords: Constructivism (education); cognitive development; genetic epistemology.

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O desenvolvimento cognitivo na teoria de Piaget: da epistemologia genética à prática pedagógica

Resumo

A presente pesquisa tem como objetivo analisar o desenvolvimento cognitivo da criança à luz da Epistemologia Genética de Jean Piaget, destacando os processos de assimilação, acomodação e equilíbrio, os estádios do desenvolvimento cognitivo e suas implicações para a prática pedagógica no contexto escolar. Trata-se de uma pesquisa de abordagem qualitativa, de caráter bibliográfico, desenvolvida a partir da análise de obras fundamentais de Jean Piaget e de autores reconhecidos na pesquisa piagetiana, complementadas por uma busca na revista *Schème*, considerando publicações dos últimos dez anos. A seleção, realizada por meio de palavras-chave: Desenvolvimento Cognitivo; Epistemologia Genética; Construtivismo, priorizou estudos pertinentes ao desenvolvimento cognitivo da criança e às suas implicações educacionais. Após a seleção do material, procedeu-se à leitura e à organização das produções de acordo com os objetivos da pesquisa. A análise foi estruturada em três eixos temáticos: a) os mecanismos de assimilação, acomodação e equilíbrio na construção do conhecimento; b) os estádios do desenvolvimento cognitivo e suas características; e c) as implicações dos pressupostos piagetianos para a aprendizagem e para a prática pedagógica. A partir desses eixos, buscou-se estabelecer relações entre os conceitos apresentados nas obras selecionadas e suas contribuições para a compreensão do desenvolvimento cognitivo da criança no contexto educacional. Para atingir ao objetivo da pesquisa, apresenta-se uma introdução ao pensamento piagetiano e aos princípios que sustentam o desenvolvimento cognitivo da criança, destacando a inteligência como um processo dinâmico e progressivo. Desse modo, abordou-se o processo de equilíbrio, explicando os mecanismos de assimilação e acomodação, bem como o papel do desequilíbrio cognitivo na construção do conhecimento. Em seguida, foram descritos os estádios do desenvolvimento da inteligência, relacionando-os à aprendizagem escolar. Conclui-se, portanto, que os pressupostos da Epistemologia Genética analisados oferecem subsídios teóricos para a compreensão do desenvolvimento cognitivo da criança e para a organização de práticas pedagógicas que valorizem a participação ativa, a autonomia e a construção do conhecimento pelo estudante.

Palavras-chave: Construtivismo (educação); desenvolvimento cognitivo; epistemologia genética.



El desarrollo cognitivo en la teoría de Piaget: de la epistemología genética a la práctica pedagógica

Resumen

La presente investigación tiene como objetivo analizar el desarrollo cognitivo del niño a la luz de la Epistemología Genética de Jean Piaget, destacando los procesos de asimilación, acomodación y equilibración, los estadios del desarrollo cognitivo y sus implicaciones para la práctica pedagógica en el contexto escolar. Se trata de una investigación de enfoque cualitativo y carácter bibliográfico, desarrollada a partir del análisis de obras fundamentales de Jean Piaget y de autores reconocidos en la investigación piagetiana, complementada con una búsqueda en la revista *Schème*, considerando las publicaciones de los últimos diez años. La selección, realizada mediante las palabras clave: Desarrollo Cognitivo, Epistemología Genética y Constructivismo, priorizó estudios pertinentes al desarrollo cognitivo del niño y a sus implicaciones educativas. Tras la selección del material, se procedió a la lectura y organización de las producciones de acuerdo con los objetivos de la investigación. El análisis se estructuró en tres ejes temáticos: a) los mecanismos de asimilación, acomodación y equilibración en la construcción del conocimiento; b) los estadios del desarrollo cognitivo y sus características; y c) las implicaciones de los presupuestos piagetianos para el aprendizaje y la práctica pedagógica. A partir de estos ejes, se buscó establecer relaciones entre los conceptos presentados en las obras seleccionadas y sus contribuciones a la comprensión del desarrollo cognitivo del niño en el contexto educativo. Con el fin de alcanzar el objetivo de la investigación, se presenta una introducción al pensamiento piagetiano y a los principios que sustentan el desarrollo cognitivo del niño, destacando la inteligencia como un proceso dinámico y progresivo. De este modo, se abordó el proceso de equilibración, explicando los mecanismos de asimilación y acomodación, así como el papel del desequilibrio cognitivo en la construcción del conocimiento. A continuación, se describieron los estadios del desarrollo de la inteligencia, relacionándolos con el aprendizaje escolar. Se concluye, por tanto, que los presupuestos de la Epistemología Genética analizados ofrecen fundamentos teóricos para la comprensión del desarrollo cognitivo del niño y para la organización de prácticas pedagógicas que valoren la participación activa, la autonomía y la construcción del conocimiento por parte del estudiante.

Palabras clave: Constructivismo (educación); desarrollo cognitivo; epistemología genética.



Introduction

This article is the result of a Course Completion Work (*Trabalho de Conclusão de Curso*) in Pedagogy developed at the State University of Maringá (*Universidade Estadual de Maringá* – UEM). It allowed for an understanding of Jean Piaget's theory, highlighting its relevance to pedagogical practice and the challenges faced in teaching. In this context, the main concepts of Piagetian theory are presented, which are considered fundamental for understanding one of the most studied approaches over time by pedagogues, psychologists, sociologists, and others interested in understanding the process of knowledge construction through the interaction between subject and object.

Regarding the methodological procedures, this study is a qualitative, literature-based research conducted through a review of the literature on Genetic Epistemology and its contributions to education. The bibliographical material comprised foundational works by Jean Piaget (Piaget, 1982; Piaget, 1983a; Piaget, 1983b; Piaget & Inhelder, 2002; Piaget, 2011; Piaget, 2015) alongside productions by recognized authors in the field of Genetic Epistemology and Piagetian research (Becker, 2012; Furth, 1997). In addition, a search was conducted in the journal *Schème: Revista Eletrônica de Psicologia e Epistemologia Genéticas*, a specialized periodical in this theoretical approach, considering publications from the last ten years. For the search, keywords related to the core axes of the research were used, such as Cognitive Development, Genetic Epistemology, Equilibration, Assimilation, Accommodation, Stages of Development, and Pedagogical Practice. The selection of works considered their relevance to the study's objective and to the Piagetian concepts addressed, prioritizing studies that contributed to the understanding of children's cognitive development and its implications for the educational context. Only three works were found, by Borges and Fagundes (2016), Frezza and Marques (2009), and Lepre *et al.* (2012).



Following the selection of the material, the works were read and organized in accordance with the research objectives. The analysis was structured around three thematic axes: a) the mechanisms of assimilation, accommodation, and equilibration in the construction of knowledge; b) the stages of cognitive development and their characteristics; and c) the implications of Piagetian premises for learning and pedagogical practice. Based on these axes, the study sought to establish connections between the concepts presented in the selected works and their contributions to understanding children's cognitive development within the educational context.

The concept of intelligence proposed by Piaget (1982) demonstrates that it develops progressively throughout childhood, evolving from simpler forms, such as sensorimotor intelligence, to reaching more complex levels, such as formal intelligence. This implies understanding that intelligence is neither innate nor something that emerges suddenly at a specific moment in development; rather, it constitutes a continuous process resulting from the integration of reflexes, habits, and experiences constructed through the subject's interactions with the environment and with the people around them.

Piaget and Inhelder (2002) state that, in this process, several aspects are fundamental for achieving comprehensive development: organic (or biological) maturation, active experience, social interactions and transmissions, and equilibration. These aspects are insufficient when considered in isolation, yet each plays a necessary role when operating jointly.

Regarding biological maturation, Piaget (1983a) states that it merely establishes the boundaries of what can or cannot be acquired at a given stage of development, being, in itself, insufficient to drive it forward. For progress to occur, the subject must act upon the environment through what the author terms active experience. It is this direct and continuous interaction with the environment that enables cognitive transformations, furthering the individual's intellectual development.



Among these experiences is social interaction, which is equally important in cognitive development. Social interaction occurs when there is a form of relationship or communication between the individual and the society in which they are embedded. This relationship is necessary because we construct, confirm, and establish concepts, in addition to creating new ones through cognitive conflict. Wadsworth (1997, p. 13) explains that to create new concepts, we necessarily undergo this cognitive conflict, in which “prior knowledge is reconstructed in the face of socially induced disequilibrium.”

In this context, another fundamental element in the development process is the equilibration factor. According to Wadsworth (1997, p. 22), “equilibrium is a state of balance between assimilation and accommodation.” Based on this definition, equilibration can be understood as the regulatory mechanism that coordinates these two processes (assimilation and accommodation), ensuring the continuity of cognitive development. It is through equilibration that, when faced with situations of disequilibrium or cognitive conflict, the individual triggers a process of self-regulation that enables them to restore balance and advance in their structure of thought.

As can be noted, for Piaget, knowledge is not something fixed or finished, but rather in constant transformation, constructed by the subject through their action upon the environment. In this process, the individual develops the necessary knowledge for their adaptation to the environment. Thus, the constructivist teacher is able to understand how the student assimilates and accommodates information, transforming it into knowledge. This understanding enables the educator to provide the student with the opportunity to be an active agent in their own learning process.

Diante dessas reflexões, o objetivo deste texto é analisar o desenvolvimento cognitivo à luz da Epistemologia Genética de Jean Piaget, destacando seus principais conceitos e discutindo suas implicações para a aprendizagem e para a prática pedagógica no contexto escolar. Para tanto, busca-se compreender os conceitos centrais de assimilação, acomodação e



equilíbrio, mostrando como esses mecanismos explicam o modo como o indivíduo se adapta cognitivamente ao meio, reconstruindo seus esquemas mentais diante de novos desafios.

Furthermore, we characterized the four stages of cognitive development proposed by Piaget, explaining the predominant forms of thought in each stage and relating them to school learning. Finally, we discussed the implications of these premises for the organization of pedagogical practice, considering the active role of the student in the construction of knowledge.

The equilibration process

Regarding cognitive development, Jean Piaget highlighted four necessary factors for its process, namely: the maturation of the Central Nervous System (CNS), physical and social interaction, and the equilibration process. For Borges and Fagundes (2016, p. 244), “maturation signifies the ripening of physical structures [...],” providing the foundations for cognitive development as a whole; that is, it serves as the groundwork and possibility for the other developmental factors.

Among the other aspects of development are physical and social interaction. According to Lepre *et al.* (2012, p. 32), “physical interaction is that which is established with physical objects, with material things,” and through this interaction, knowledge can be constructed. On the other hand, social interaction refers to the individual's interaction within the social environment, with other people, and consequently with different values, norms, customs, etc., which are socially transmitted.

The equilibration process, in turn, is considered one of the most important and relevant concepts in Piagetian theory, referring to an active subject who, by triggering internal mechanisms of assimilation and accommodation, is capable of constructing their own knowledge. Thus, it is these mental processes that enable our cognitive schemes/structures to progressively develop, transforming our experiences into knowledge. According to Piaget (2015), this



process represents an essential and inherent characteristic of both organic and mental life; for this reason, understanding it is fundamental to advancing explanations within the fields of biology and psychology.

According to Lepre *et al.* (2012), driven by biological needs, the individual seeks to adapt to the environment to ensure survival. In this process, the individual acts upon the environment with the aim of modifying it, while simultaneously transforming themselves through this interaction. Thus, the individual strives to achieve a balance between their internal demands and new external situations, thereby ensuring adaptation.

It is understood, therefore, that every human being is born with the capacity to adapt to the environment, assimilating and accommodating external elements into their cognitive structure in a constant pursuit of equilibrium, which enables the development of intelligence. Thus, when a child encounters a new situation, they tend to relate it to prior knowledge (assimilation); however, this assimilation often requires adjustments (accommodation) so that the new reality can be fully understood.

Piaget (1983a, p. 6) defines the mechanism of assimilation as “[...] an integration of new elements into pre-existing structures or schemes” and accommodation as “[...] any modification of assimilation schemes under the influence of external situations.” In other words, regarding assimilation, when faced with a new situation, the individual assimilates information into schemes that have already been constructed, bringing the new information into proximity with pre-existing ideas. In this case, schemes are developed without a significant structural change, representing a refinement or an expansion.

Accommodation can be interpreted as occurring when an individual encounters a new situation and, lacking existing schemes that can approximate what is taking place, needs to adapt to that situation by creating new schemes or transforming the concepts they previously held within existing schemes, thereby reorganizing their way of thinking.



Since schemes are constructed and developed from our experiences, they will only be transformed if they undergo situations that lead to the process of accommodation—that is, actions that lead to qualitative modifications in cognitive structures through the alteration or creation of new schemes.

In both assimilation and accommodation, the individual adapts to what has occurred after experiencing moments of cognitive instability regarding the event. In genetic epistemology, these processes are termed equilibrium and disequilibrium, which occur when “[...] the subject assimilates something from the environment, causing their structure to become unbalanced, thereby necessitating an accommodation of the structure to the external element” (Frezza & Marques, 2009, p. 282).

In this sense, disequilibrium is like a cognitive discomfort in the face of situations experienced by the individual when they are unable to find answers to a specific situation; to feel cognitively stable again, the individual undergoes a process of equilibration, wherein they adapt appropriately to the environment through self-regulations. This process of equilibration is understood as the stability of our cognitive system, which organizes and structures our actions after experiencing moments of disequilibrium. Thus,

[...] equilibration is the process by which the whole organism assimilates external reality, organizing it according to its structures and schemes of action and thought, subsequently modifying, through adaptation, the structures and schemes that enabled it to act, thanks to the internal transformations brought about by the actions performed during assimilation and accommodation (Ferreira, 2003, p. 14).

It is worth emphasizing that the aforementioned processes are inseparable and occur daily in any situation we experience throughout our lives. We can exemplify one of these various situations as follows: a young child has their own bicycle, which they ride every day. On a certain occasion, this child decides to ride a friend's bicycle, which differs only in the accessories it possesses, such as a bell, flashlight, basket, etc. Thus, the child finds themselves in a situation where, even though the bicycle follows the same concept of “simply” having to



pedal, all the vehicle's accessories are new to them, given that their own bicycle lacks them, despite the child being familiar with these items. In this manner, the child will experience disequilibrium, as they have never used those accessories while riding a bicycle; once they learn how to use them, they will assimilate them—relying on pre-existing schemes regarding how to use a bell, flashlight, etc.—and restore equilibrium once again.

At another moment, this child will begin to ride a bicycle without training wheels, which are common on children's bicycles. For the child, this occurrence is completely new, since, until then, they had only ridden with the support of training wheels. Thus, when the child encounters this situation, the initial reaction is one of cognitive disequilibrium, as they do not yet possess sufficient schemes to rely upon, given that this experience is unprecedented for them. Consequently, the organism is led to adapt to the new situation, constructing new schemes to comprehend what they are experiencing and thereby expanding their knowledge and intelligence.

This same process can be observed in various daily situations within the school context, particularly during learning. An example to be analyzed occurs in the literacy process. A child has learned that the letter "B" represents a specific sound and is able to identify words starting with this letter, such as "ball" (*bola*) and "candy" (*bala*). At a later point, during classroom activities, the child encounters the letter "D". Initially, they may confuse the two letters due to their similar shapes, attempting to understand the new information based on existing schemes. However, upon realizing that "B" and "D" possess different sounds and spellings, the child experiences a new cognitive disequilibrium. To comprehend this situation, a reorganization of mental schemes becomes necessary, constructing new ways to differentiate the letters and their respective sounds. This process of accommodation can enable the expansion of their knowledge regarding the writing system.

As described in Piaget's theory, intelligence is understood as a dynamic and constantly transforming process. In this context, the mechanisms of



assimilation and accommodation play an essential role, as they allow the child to progress gradually through different stages of cognitive development, which will be explored in the following section. This progressive adaptation to the environment begins with sensorimotor intelligence, which forms the basis for the earliest modes of interaction and understanding of the world, from which the subject starts to organize and reconstruct their experiences into increasingly complex cognitive structures.

Children's Intelligence: the stages² of Development

To explain cognitive development, Jean Piaget divided and classified the process of knowledge structure evolution into four main periods, known as stages. The stages of development are invariant; that is, they always follow the same sequence across individuals. What can be observed is that development through these stages may occur more rapidly or slowly depending on each individual's experience, and the corresponding ages vary across different populations analyzed. Nevertheless, the most relevant aspect is that the sequence of stages always remains unaltered.

However, for Piaget (1982), this criterion does not imply that each stage of development possesses a fixed content of thought, but rather that there is a potentiality that can lead to different outcomes depending on the context in which the child develops. In this manner, "[...] the structures of a whole are integrative and do not replace one another: each derives from the preceding one, integrating it as a subordinate structure, and prepares the next stage, eventually integrating into it sooner or later" (Piaget & Inhelder, 2002, p. 132).

This continuous process of development occurs through the pursuit of a new equilibrium between pre-existing structures and environmental influences. The structures succeed one another in such a way that each new phase offers a more solid equilibrium than the previous one, advancing toward more complex and comprehensive forms.



These stages of development were described by Piaget in several of his works (Piaget, 1983b, 2011) and can be divided into four periods: sensorimotor (from 0 to 2 years); preoperational (from 2 to 7 years); concrete operational (from 7 to 11 years); and formal operational (from 11 years onward). The first stage of cognitive development is the sensorimotor stage, which begins at birth and lasts on average until 2 years of age. It receives this name because, during this period, children explore the world primarily through their senses and motor actions. Furthermore, a characteristic feature of this stage is reflexes, which are spontaneous reactions inherited by infants. The context, initially seemingly disorganized, is transformed through movement and the repetition of the child's actions, giving rise to schemes, which are internal models of action upon objects and people that the child comes to understand through the experiences established with them.

According to Piaget (2011), in this stage, actions originate from reflex movements, such as sucking and grasping. Through the lips and mouth, the child is able to perceive the shape, texture, and temperature of objects—experiences that contribute to the development of the senses, alongside motor refinement achieved through the repetition of movements. Vision also assumes an important role during this phase, as the child begins to focus on, track, and recognize objects. Furthermore, the repetition of actions and the constant bond with people in their surroundings provide the child with a sense of security that fosters new discoveries.

Furthermore, the concepts that mark sensorimotor intelligence are perception and object permanence. Perception is a means of acquiring knowledge through direct/immediate contact with an object without maintaining continuity across cognitive schemes within a unified group; thus, it is knowledge that originates from immediate contact through successive states that are not necessarily generalized to the same set or group (Piaget, 1983b, p. 125).

Over time, this intelligence becomes refined, and the concept of object permanence emerges. For Piaget (1983b, p. 112), permanence occurs when



the child comes to “[...] attribute the perceived figure to a substantial support, such that the figure and the substance of which it is thus the index continue to exist outside the perceptual field.” In other words, this means that the object continues to exist outside the perceptual field, a realization that did not exist at an earlier point. For example, if an adult held a toy and hid it from the infant, it was as though the object no longer existed. However, from the moment the child acquires the structures pertaining to object permanence, this changes, as they know that even if they do not see the toy, it continues to exist, leading them to actively search for it. This awareness takes time to build and is achieved according to the child's experiences—in this case, sensory and motor.

The preoperational stage, which begins around two years of age and extends to approximately seven years, is characterized by being a representative period. This is because the child begins to use symbols to represent images, words, ideas, and objects due to the cognitive emergence of the symbolic function. It is worth noting that during this phase, the child is bound to a subjective mode of thinking and relies on concrete elements to provide explanations and understand everyday situations.

The symbolic function is the ability to mentally represent one's schemes of action. Thus, through interaction with the environment, an individual is able to form a representation of what has occurred by applying symbols (whether of objects, people, etc.) to their schemes, thereby assigning meaning. A way to exemplify this function is through pretend play—highly prevalent during this phase—wherein a child symbolically represents an event they have observed. Furthermore, it is through the symbolic function that language, and subsequently thought, gradually emerge.

We can also consider that it is during this period that the vast majority of children begin attending school—a social environment that, as previously mentioned, brings about significant and necessary changes in cognitive development. It is through the social environment that language, for instance, progressively develops through exposure to speech and dialogue with other



people. It is worth emphasizing that language also constitutes a form of representation, as it enables the subject to verbally represent objects and events that are not present at that moment.

Egocentrism is also a prominent characteristic of the preoperational stage, given that during this phase, the child is not yet capable of taking into account the perspective of others. According to Piaget (2011), this represents a form of centration; the child is so focused on their own perspective that they are unable to comprehend that of others. In this period, the child's thought is tied to concrete action upon objects, interpreting reality by acting directly upon it. Over time, this mode of thinking gradually moves away from the concrete, becoming increasingly abstract.

These aspects discussed thus far, alongside other specificities of each stage, are fundamental to the development of the subsequent stage. In this instance, the relevant stage is the concrete operational stage, a transitional period between the preoperational and formal operational stages. It occurs around seven to eleven years of age and is primarily characterized by the emergence of the capacity to interiorize actions, namely logical operations. It is at this point that concepts of conservation, seriation, classification, and reversibility, among other operations, emerge.

According to Wadsworth (1997), a child in this stage develops modes of logical thought, understood as operations, which are applied to concrete or material problems. The hallmark of this stage is precisely its characterization by the cognitive capacity for operations—which are interiorized and reversible actions—even though they are “limited” by requiring concrete situations; that is, they apply logic to material circumstances.

When we speak of reversible actions, we are referring to the operation of reversibility. It is characterized by the ability to carry out mental reversals, to reverse an action, to “[...] do and undo, move in one direction and compensate for it in another direction [...]” (Furth, 1997, p. 68). This reversible capacity is not a cognitive ability that simply emerges once the individual enters this stage;



rather, it is constructed by the subject through physical and mental experiences. Like any cognitive aspect across all stages, these represent increasingly complex constructions on the part of the subjects.

Regarding the conservation of quantity, the child likewise performs a mental reversibility. To comprehend that a given object retains the same quantity following a change in shape, the child comes to understand that reversing the current state back to the initial one demonstrates that the quantity remains unaltered. Within the concept of conservation, changes may apply not only to quantity, but also to appearance, shape, and order or organization.

These concepts can be observed in any activity that utilizes logical thought to reverse an aspect; the concrete operational child is progressively capable of understanding that if $A=B$, then consequently $B=A$, or if $A>B$, then $B<A$. (regardless (whether we are altering among as can children cite clay concepts conservation containers crushed, crushing demonstrate different equal examples intact into it its maintains mass, material); modeling objects of or other others. placing quantities quantity regarding retains same shape shape, size); sizes, soda such the these through which children demonstrate these concepts regarding the conservation of mass, such as crushing a soda can (whether intact or crushed, it retains the same quantity of material); altering the shape of modeling clay (regardless of its shape, it maintains the same mass); or placing equal quantities of objects into containers of different sizes, among others.

This issue can also be observed in school through situations that seem simple to adults, but demand time for a child at this stage to construct. An example includes subtraction problems that represent an inverse form of addition. In addition operations with sums up to 10, subtraction can be used to find one of the components of the original operation. To do so, one must subtract one of the addends from the total to yield the other. For example: $5+3=8$, therefore $8-3=5$; $8+2=10$, therefore $10-2=8$; $5+5=10$, therefore $10-5=5$, and so forth. This example applies to any addition and subtraction calculation, including larger numbers, as it represents an inverse operation involving a



numerical reversal. To implement this in the classroom, teachers must utilize concrete materials, such as base ten blocks (*material dourado*), the abacus, or any type of physical object.

Furthermore, there are other characteristics of the concrete operational stage: the operations of seriation and classification. These arise from the children's actions upon objects, which, in turn, correspond to occurrences at the cognitive level (operations). Ferraz and Tassinari (2015, pp. 81-82) affirm this by stating that "these classifications and seriations result from logical-mathematical experiences, given that they extract information not from the objects as such, but from the operations performed upon such objects." In other words, experiences with the environment are transformed into operations, which are the products of these actions—organizational structures of the environment that generate cognitive structures.

Furthermore, according to Ferraz and Tassinari (2015, p. 16), the operations of classification and seriation emerge from the actions of organizing and disorganizing objects, understood as the coordination of actions. Thus, seriation is basically understood as the "[...] ability to mentally organize a set of elements in increasing or decreasing order of size, weight, or volume" (Wadsworth, 1997, p. 109).

The seriation process can be exemplified as follows: a child is playing with several colored pencils and decides to group them by color and size. The yellow pencils are placed in one group, the green ones in another, the pink ones in another, and so forth; the child also arranges the pencils in order of size, from smallest to largest. Through this experience—gradually and continuously—the child constructs operations upon the objects, derived not from the objects themselves, but from the action performed upon them. In this manner, the child cognitively registers their actions in the form of organization—in this case, through classifications and seriations. At a later point, this assists the child in understanding numbers, given that they possess an order/sequence and a structure—everything constitutes a process of construction.



Following in sequence, we have the final stage formulated by Piaget regarding cognitive development: the formal operational stage, which begins at approximately 11 to 12 years of age. The main hallmark of this period is the manner in which individuals acquire logical reasoning, which becomes abstract. Consequently, new capacities emerge within the cognitive structures that are completely distinct from those of preceding stages, owing to the absence of the need for the real, or for acting upon and from the concrete as a point of departure.

The individual becomes capable of thinking about situations or objects that are neither physical nor observable—in contrast to the concrete operational period, during which the individual still needed to act upon material situations. Thus, in this period, an adolescent possesses the capacity to solve a more complex mathematical problem without utilizing physical objects, for instance. It is worth emphasizing that abstract thought does not emerge suddenly; it is a process built throughout development, yet it emerges as a new cognitive structure distinct from previous ones, marking a defining characteristic of this period.

This aspect aligns with hypothetical-deductive reasoning, which is also characteristic of this stage. In this form of reasoning, the individual is able to reason about hypothetical circumstances and situations that may or may not occur, enabling them to consider how to resolve a given event—making deductions about possible occurrences. Frezza and Marques (2009, p. 286) express this form of hypothetical-deductive reasoning effectively when they state that:

[...] in the formal operational stage, the striking characteristic is the subject's ability to formulate hypotheses and work with deductions. This points to a coordination of operations that is no longer necessarily bound to reality. A subject possessing formal thought is not restricted to what can be realized, but speculates “ hypotheses, combining them to yield “ possibilities.



In the school setting, this mode of hypothetical reasoning can be engaged, for example, through discussion circles or classroom debates and reflections on hypothetical situations of a social and moral nature, such as justice, respect, solidarity, and inequality, among others. Furthermore, students can formulate solutions to problems presented solely verbally by the teacher—that is, without the presence of concrete materials—or generate logical possibilities and assumptions to solve a given task. In general, this involves problem-solving derived from abstract and hypothetical ideas.

The elaboration of concepts based on the stages of development proposed by Piaget is essential for children to construct their own knowledge, promoting their motor, cognitive, and emotional development. Renowned authors in developmental psychology, such as Piaget himself, highlight the importance of motor actions in the process of child growth, within both affective and cognitive dimensions.

According to Piaget (1964 cited in Chateau, 1987, p. 33), the body serves as the primary point of reference in a child's learning process. By acting and moving in a playful manner, the child discovers and develops their capacities for coordination, perception, exploration, concentration, and attention. It is therefore fundamental that children have the opportunity to explore their own bodies, manipulate objects, and interact with the environment and with others, enabling them to build knowledge about the world around them and gradually achieve autonomy.

In light of the above, it is possible to perceive that the stages of cognitive development proposed by Piaget provide a solid foundation for understanding how children construct knowledge over time. This understanding is essential for guiding pedagogical practices that are coherent with the needs and possibilities of students at each educational stage. However, considering education solely through the lens of these stages, without taking the contemporary context into account, would limit the transformative potential of Piagetian theory. It is



precisely at this juncture that the reflection on the challenges of pedagogical practice based on this theoretical conception emerges.

Piaget's constructivism and the challenges of pedagogical practice

Based on the concepts presented, it was possible to analyze that Piaget (2015) contributed significantly by explaining the importance of the subject's action upon the environment, emphasizing that this interaction is indispensable for the construction of knowledge. Thus, the student must actively participate in the learning process, becoming capable of developing new understandings rather than merely repeating or reproducing information transmitted by the teacher.

According to Lefrançois (2008), Piagetian theory exerted a profound influence on the school curriculum by demonstrating that learning extends far beyond simply transferring external information into the child's mind. From this conception, constructivism established itself as an approach to teaching and learning that recognizes the child as the protagonist and active agent in the construction of their own knowledge. This perspective operates on the principle that the student must be continually encouraged to think critically and autonomously, generating new understandings through action, reflection, and teacher mediation.

Piaget (2015) presented education with the challenge of understanding knowledge not as a finished product, but as a process in constant construction, characterized by the different stages that the subject reaches throughout their cognitive development. In this sense, the student must be viewed as an active agent, capable of producing new knowledge through interaction with the teacher and through their own action within the learning process, rather than merely as a passive receiver of information.

For the author, the primary goal of education is to cultivate individuals capable of creation and innovation, rather than simply reproducing what previous generations have produced. This implies recognizing that the school's



role extends beyond the memorization of content, thereby requiring the promotion of students' intellectual autonomy by encouraging them to invent, produce, and elaborate new knowledge. Thus, the student should not merely know the final product of instruction, but actively participate in the entire process of knowledge construction.

In this way, it is especially within the school environment that children demonstrate an active role in constructing their own knowledge. Through their experiences with the environment, interactions with peers, and notably the mediation provided by the teacher, the individual assimilates concepts and constructs their knowledge of the world.

With regard to classroom practices, Piaget advocates the importance of posing challenges that lead students to take an active role, thereby allowing knowledge to be effectively assimilated and accommodated. As Furth (1997, p. 182) highlights, the process of knowledge construction “[...] becomes operative only when the child confronts problems [...] as thinking activities that are in themselves challenging and conducive to healthy development.”

These challenges can be promoted through various pedagogical strategies, such as exercises, dialogues, problem-solving, and games, among other resources. In particular, games play a relevant role due to their ability to motivate students, awakening a spontaneous interest in participating and becoming involved in the activities, which makes learning more enjoyable. In this sense, Furth (1997, p. 184) emphasizes that “this is, of course, the secret of all good pedagogy. If the intrinsic motivation of thinking (= drive, = pleasure) can be kept alive in a given learning process, success is practically assured.”

Utilizing educational games designed specifically for students serves as a means of generating motivation that aids them in acquiring knowledge in a more enjoyable manner. Following this approach, the role of the teacher is to instigate students by creating situations through pedagogical practice—whether through written activities, games, play, or other resources—in which



learners develop their cognitive and intellectual capacities through their active engagement with the environment.

It is through interactions and actions within the social environment that human beings develop, and the school constitutes an essential part of this process, configuring itself as a fundamental social institution for individual and collective development. Social and educational inclusion is an indispensable condition for the evolution of subjects, given that, by interacting in multiple ways with others—especially in the school context—they gain access to a space of systematized knowledge that favors the active and meaningful construction of learning. In this way, Piaget (2015) asserts that education is not only necessary for our development, but also a right:

To declare that every human person has the right to education [...] is [...] to affirm that the individual could not acquire their most essential mental structures without an external contribution, which requires a certain social formation environment, and that at all levels (from the most elementary to the highest) the social or educational factor constitutes a condition of development (Piaget, 2015, p. 52).

Although Piaget's initial focus was not directly within the educational field, his research in psychology has been widely utilized as a contribution to the pedagogical domain. His theoretical approach engages in dialogue with education by conceiving the individual as an active agent in the construction of their own knowledge. Based on this constructivist perspective, it is incumbent upon teachers to structure pedagogical practice in a manner that stimulates students through challenges, such as problem-solving, the use of educational games, and the application of targeted exercises.

Piaget (2015) also emphasizes that the teacher's role extends beyond the transmission of knowledge and the valuation of mere content repetition. For the author, it is essential that pedagogical practice encourage students to create, produce, innovate, invent, and even reinvent ideas and solutions. This development occurs through experimentation and the student's own action upon the object of knowledge, enabling the active construction of learning and



the development of their intellectual autonomy. For example, rather than simply transmitting content and asking students to interpret it through questions, the teacher can enrich this experience by proposing situations that foster the active creation and expression of knowledge. This can take place through the design of educational games, play, the formulation of new questions about the topic, textual productions, drawings, models, or role-playing, among other possibilities.

For this purpose, the teacher's stance regarding the teaching and learning process must be one of instigating the student, fostering their creativity, and challenging them to innovate, rather than merely transmitting content through traditional lecturing. For Piaget (2015), "[...] what is desired is that the teacher cease to be merely a lecturer and instead begin to stimulate research and effort, rather than being satisfied with the transmission of ready-made solutions" (Piaget, 2015, p. 24).

Finally, the student must have the opportunity to test, in practice, the hypotheses previously studied and discussed on a theoretical level, analyzing the extent to which the elaborated concepts are confirmed or transformed when confronted with reality. It is essential that they learn to collect data, organize them, and develop critical and coherent analyses of what was investigated. From the Piagetian perspective, this process represents the true construction of knowledge, which occurs through the subject's action upon the environment. For Piaget, knowledge is not something static or finished, but a continuous process of construction and reconstruction in which the learner must act actively, rather than merely repeating what has already been produced by others.

Concluding Remarks

Revisiting the objective of this research, which was to analyze cognitive development in light of Jean Piaget's Genetic Epistemology and to discuss its implications for pedagogical practice, the literature review conducted allowed for an understanding that the construction of knowledge occurs through the



subject's action upon the environment, in a continuous process of assimilation, accommodation, and equilibration. It was also demonstrated that the stages of cognitive development represent progressively more complex forms of thought organization, and that understanding them provides teachers with tools to organize learning situations compatible with students' cognitive possibilities.

In the pedagogical realm, the analysis conducted indicates that Piagetian contributions support practices that value active student participation, problem-solving, experimentation, games, engagement with challenging situations, and the development of intellectual autonomy. In this sense, the teacher functions less as a transmitter of ready-made answers and more as an organizer of situations that foster student action, reflection, and the active construction of knowledge.

Piagetian theory allows for an understanding of cognitive development as a continuous process of constructing and reorganizing thought structures, arising from the subject's action and their interaction with the environment. From this perspective, learning does not correspond to the mere incorporation of information, but rather implies attributing meaning to it based on already constructed cognitive structures and the transformations brought about by new experiences. This understanding reaffirms the necessity of recognizing the student as an active participant in their learning process.

From this perspective, it becomes essential to analyze how this conception of the active subject materializes within school spaces. The educational environment is often not structured to promote the holistic development of the child. The organization of these institutions is intimately related to the conception of childhood that underpins them; when a view is adopted that perceives the child as passive and dependent on the adult, practices tend to be adultcentric, limited, and unstimulating. Conversely, a conception that recognizes the child as the center of the learning process fosters the creation of pedagogical contexts rich in experiences, interactions, and discoveries.



We understand, therefore, that although Piaget did not directly address pedagogical issues related to child care and education within school institutions, his theoretical contributions are essential for sustaining a conception of active childhood and for guiding the planning of a pedagogical praxis that considers the student in their entirety—as an active, autonomous subject who participates in the construction of their own knowledge.

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Notes

- 1 Statement on the Use of Artificial Intelligence – Gemini, an artificial intelligence tool developed by Google, was used to assist in translating this article into English. The translated version was fully reviewed and adjusted by the editorial team to ensure fidelity to the original text, terminological accuracy, and compliance with the journal's editorial standards. The tool was not used to generate the article's arguments, analyses, or academic content.



- 2 We use the term estágio [translated here as stage] based on Becker's (2012) understanding that the word "estágio denotes an experience to which we submit ourselves in order to achieve a level of learning that we currently lack," whereas "estádio signifies a division, a plateau, a phase, a clearly distinct and irreversible step that constitutes a balanced structural organization within the developmental process."



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