



Review article

Cognitive and pedagogical foundations of active learning

Fundamentos cognitivos y pedagógicos del aprendizaje activo

Fundamentos cognitivos e pedagógicos da aprendizagem ativa

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ABSTRACT

For more than half a century, a set of theories have postulated the advantages of active learning, and the implications of this approach for pedagogy, however, not enough information was found to address this issue comprehensively from its different investigative perspectives. The article aims to expose the most recognized cognitive and pedagogical theories on the concept of active learning, as well as their practical application based on the positive effect they have on the acquisition of knowledge, with significant advantages in relation to traditional forms of learning. teaching. From the application of different theoretical methods such as historical logic, documentary analysis, analysis and synthesis and the structural systemic method, the description of the classic ideas of Dewey, Montessori, Piaget and Vygotsky was obtained as a result. Also addressing the pedagogical theories of active learning: learning by discovery, learning through experience, learning by inquiry and self-regulated learning; and also, the most recent cognitive approaches to active learning. The investigative analysis showed that the theories studied show the positive effect that active learning has on the acquisition of knowledge, as well as its advantages in relation to traditional forms of teaching. Consensus is reached that active learning implies high levels of reasoning and motivation, from which it follows that its impacts could be greater at higher levels of instruction.

Keywords: Learning; active learning; pedagogy; cognitive psychology.

RESUMEN

Durante más de medio siglo un conjunto de teorías han postulado las ventajas del aprendizaje activo, y las implicaciones de este enfoque para la pedagogía, sin embargo, no se encontró suficiente información que abordara este tema de forma integral desde sus diferentes perspectivas investigativas. El artículo tiene el objetivo de exponer las teorías cognitivas y pedagógicas más reconocidas sobre el concepto aprendizaje activo, así como la aplicación práctica de estas en función del efecto positivo que tienen en la adquisición de conocimientos, con significativas ventajas en relación a las formas tradicionales de enseñanza. A partir de la aplicación de diferentes métodos teóricos como el histórico lógico, análisis documental, análisis y síntesis y el método sistémico estructural, se obtuvo como resultado la descripción de las ideas clásicas de Dewey, Montessori, Piaget y Vygotsky. Abordando además las teorías pedagógicas del aprendizaje activo: aprendizaje por descubrimiento, aprendizaje a través de la experiencia, aprendizaje por indagación y aprendizaje autorregulado; y también los más recientes enfoques cognitivos sobre el aprendizaje activo. El análisis investigativo mostró, que las teorías estudiadas muestran el efecto positivo que tiene el aprendizaje activo en la adquisición de conocimientos, así como sus ventajas en relación a formas tradicionales de enseñanza. Se llega al consenso que aprender de forma activa implica altos niveles de razonamiento y motivación, de lo que se deriva que sus impactos pudieran ser mayores en niveles superiores de instrucción.

Palabras clave: Aprendizaje; aprendizaje activo; pedagogía; psicología cognitiva.

RESUMO

Por mais de meio século, um conjunto de teorias postulou as vantagens da aprendizagem ativa, e as implicações dessa abordagem para a pedagogia, no entanto, não foram encontradas informações suficientes para abordar essa questão de forma abrangente em suas diferentes perspectivas investigativas. O artigo tem como objetivo expor as teorias cognitivas e pedagógicas mais reconhecidas sobre o conceito de aprendizagem ativa, bem como sua aplicação prática com base no efeito positivo que têm na aquisição do conhecimento, com vantagens significativas em relação às formas tradicionais de aprendizagem. . A partir da aplicação de diferentes métodos teóricos como lógica histórica, análise documental, análise e síntese e o método sistêmico estrutural, obteve-se como resultado a descrição das ideias clássicas de Dewey, Montessori, Piaget e Vygotsky. Abordando também as teorias pedagógicas da aprendizagem ativa: aprendizagem pela descoberta, aprendizagem pela experiência, aprendizagem pela investigação e aprendizagem autorregulada; e também as abordagens cognitivas mais recentes para a aprendizagem ativa. A análise investigativa mostrou que as teorias estudadas mostram o efeito positivo que a aprendizagem ativa tem na aquisição do conhecimento, bem como suas vantagens em relação às formas tradicionais de ensino. Chega-se a um consenso de que a aprendizagem ativa implica altos níveis de raciocínio e motivação, de onde se conclui que seus impactos podem ser maiores em níveis mais altos de instrução.

Palavras-chave: Aprendizagem; aprendizado ativo; pedagogia; Psicologia cognitiva.

INTRODUCTION

There are dissimilar theoretical models that explain what learning is and how it occurs. Since the beginning of the 19th century, different psychological currents have approached this object of study. For example, classical behavioral approaches (Watson, 1913) define learning as the acquisition of new behaviors or behaviors as a result of the continued action of an environmental stimulus. On the other hand, the constructivist theory postulates that the individual has an active role in the process of selection and construction of new knowledge, which is not limited only to data processing.

The distinction between "active" or "passive" learning is one of the main controversies of these models, with marked importance in current research (Ruggeri, *et al.*, 2019).

Active or ecological learning theories address the ability of children and adults to solve problems and seek information in the environment, in order to build their own knowledge (Di Biase, 2019). It is argued that the content that is acquired through the search for information is more durable and solid than that obtained through exposure to a finished discourse, or mere repetition. Active learning implies greater interactivity and opportunities for control over the learning experience, methods, and content. The learner has the opportunity to choose the information they consider necessary and to process it following their own logic (Bush, *et al.*, 2018).

Active learning (AA) research from cognitive psychology has focused on problem-solving scenarios. Problem solving refers to a certain "situation in which we want to achieve a goal and we must find the means to do so" (Bush, *et al.*, 2018). The process deployed by the individual to reach the solution state triggers a complex form of learning, which involves reasoning, information search and own analysis, an ideal AA space. Authors such as

Coenen, *et al.*, (2019), have focused on the study of the strategies that allow obtaining information from the environment to solve these problems, and thus understand the various forms of reasoning involved.

Cognitive psychologists have studied the relationship between AA and cognitive processes such as memory or attention, which can benefit when the individual is exposed to an AA situation. Markant, *et al.* (2016) evaluated the impact of active control of information on memory. A tablet memory game was applied to 76 children (7"10 years old). The task consisted of memorizing cards, some of which were selected by the child himself, and others were selected by the game. As a result, it was obtained that the percentage of recall was higher for the cards selected by the child. The authors conclude that when you have the opportunity to decide what information to obtain, as well as the rhythm and sequence in which it is presented, the trace that said content generates in memory will be higher than that which would occur under conditions in which he had no opportunity to exercise control over the learning process.

Studies on the impact that exercising active control can have during learning have also addressed cognitive processes such as attention. Schulz, *et al.*, (2018) state that, in active learning environments, information control allows the person to adjust the pace at which they introduce new information, according to their attentional state. While, in passive learning environments, being someone else who guides the issuance of information, learners may experience momentary lapses in attention at key moments in the presentation of knowledge. Therefore, in active contexts, a learner more connected to knowledge is achieved, where attention corresponds to the rhythm of information input.

Pedagogy has also addressed the value of OA as a path to academic success. Charles

Bonwell and James Eison (1991) published the report *"Active learning: creating excitement in the classroom"*, where a pedagogical methodology that proposes AA as an alternative for the development of the university student is explained. Although the term AA had been treated indirectly by psychological currents such as Constructivism, or intuitively approached by pedagogues, these authors are the first in providing a concrete definition: *"form of learning that involves students in doing and reflecting on what they are doing"* (Bonwell and Eison, 1990, p. 19). As part of the practical output of AA, they refer that the student must be involved in different activities (reading, writing or debate) and in higher order thought processes (analysis, synthesis, evaluation).

Contemporary authors (Hernández, *et al.*, 2019), followers of the ideas of Bonwell and Eison, have updated this pedagogical proposal by proposing specific techniques, which differ according to their level of difficulty. Some of the most complex are cooperative learning, problem-based learning and team learning (Hernández, *et al.*, 2019). These active methods have gained strength in contemporary pedagogy due to the benefits they bring. Even recent research carried out in Latin America has proposed to validate instruments to assess university incidence in the attitudes of graduate students towards research (González-Rivera, *et al.*, 2021).

However, although active learning has been approached from different theoretical positions that, despite their differences, mostly defend the active role of the subject during learning, the research identified that there is not enough consolidated information on this topic since the different perspectives involved in the process; which hinders a faster and more comprehensive progress of the different dimensions that address the object of study. From this documentary gap, the article aims to expose the most recognized cognitive and pedagogical

theories on the concept of active learning and its practical application based on the positive effect they have on the acquisition of knowledge, with significant advantages in relation to traditional forms of learning. teaching.

The results show that learning actively implies high levels of reasoning and motivation. Therefore, AA could have more impact at higher levels of instruction.

The research was based on the dialectical-materialist method. As theoretical methods, it used the logical history for the retrospective search, its recovery and chronological analysis of the information of the domain under study. To carry out the theoretical systematization, an extensive documentary and bibliographical analysis of the state of the art was carried out, which included the search and recovery of information from databases such as Pubmed, MedLine, Scielo, among others; applying the method of analysis and synthesis to identify the main variables, conceptual categories and investigative trends of the domain. And, finally, the structural systemic method was used to break down the different elements and components that make up each school of knowledge and scientific perspective analyzed, until reaching the investigative essence and main contributions of interest for this study.

DEVELOPING

In the classic theories of active learning, throughout history the way of teaching has been related to the concept of learning. Frequently, a correspondence is established between teaching and learning, which can vary depending on the theories that address this relationship. In this sense, the classic theories of active learning represent a great change in relation to traditional pedagogical approaches, given the active involvement of the learner, based on reflection and awareness.

In this regard, the ideas of Dewey and Montessori stand out for their impact on the pedagogical task. John Dewey promoted the creation of the New School, an educational current that seeks a school based on experimentation and reflection, against traditional pedagogical ideas. For her part, Maria Montessori was a protagonist in the creation and publication of the first active methods. Next, some significant aspects of the theories of these authors are explored.

John Dewey and progressive education

John Dewey constitutes a fundamental point of reference for the Progressive Education movement in the United States. The author raises the importance of people assessing the likely consequences of their actions, and how these can impact the subject himself and his thinking (Dewey, 1916). Then, it is important to create environments that are conducive to activities that develop thinking. However, activity alone does not generate experience or change.

The author does not see the learning objectives as an individual result, he considers that the objectives provide directions and frameworks within which the student can be active. Based on this, students must know and plan the appropriate activities. In addition, these goals should be based on the interests and needs of the student. According to the above, the most important duty of the teacher is to create experiences that lead to growth through activity (Johnson, 2021).

Dewey emphasizes the importance of experience and/or environment in the learning process. In addition, it describes the conflicts between opposing ways of understanding the world, which suggests that learning comes from the resolution of these conflicts. Subsequent theories aimed at developing tools and methods aimed at promoting this ability to learn actively that Montessori and Dewey defend.

The Montessori Method

Montessori (1912) developed a pedagogical program called: "The New Education", with the aim of transforming the understanding of the child, and the place he occupies in the world. This educational method is based on freedom of decision, creativity in problem solving and self-control. Montessori refers to the "absorbent mind" of children, in relation to their ability to observe and absorb the elements of their immediate environment and learn how to adapt to it.

In this method, it is the child who discovers and learns, while the teacher must "follow the child", recognizing the evolving needs of each age, and building a favorable environment to respond to those needs.

After more than a century, the innovations of the Montessori method are used in primary education worldwide. Although there are around 65,000 Montessori schools around the world, only families of high economic status can afford the high price involved. Despite its acceptance, this method is not without criticism. Its emphasis on the child's independence, initiative, and autonomy can lead to disorganization in the learning process and overlook important skills and content for education (Catherine, Javier, and Francisco, 2020).

Although the Montessori method is not a consolidated scientific theory, the success of its educational practice demonstrated the relevance of knowledge construction as a result of individual analysis and direct interaction with the material. These are some of the ideas that he shares with the AA, and that allowed him to consolidate the concept years later. While in parallel other authors analyze aspects of this domain from other dimensions, as is the case of Jean Piaget and Vygotsky.

Constructivist Theory: Jean Piaget and Vygotsky

The constructivist approach posits that learning is an activity that the subject performs through their experience with the environment. One of its basic assumptions is that knowledge is not passively acquired, but actively constructed.

Piaget (1962), in his constructivist theory, proposes that humans share two "invariant functions": organization and adaptation. The adaptive function in psychological and physiological systems operates through two complementary processes: assimilation and accommodation. Assimilation refers to the way an organism deals with a stimulus from the environment in terms of current organization, while accommodation involves a modification of current organization in response to environmental demands. Through assimilation and accommodation, learning is cognitively restructured throughout development (cognitive restructuring).

Another central concept of his proposal is that of operating schemes. This refers to a type of cognitive organization that necessarily implies assimilation, since external objects are always assimilated into a scheme, into an organized mental structure (Piaget, 1962). People assimilate objects to actions, and these become schemes, which constitute the functional equivalent of the concepts and logical relationships necessary for further development.

In general, learning for Piaget is a process by which the individual, through experience and interaction with objects, builds knowledge. The arrival of this new information implies that their operating schemes are actively modified from the process of assimilation and accommodation. These ideas of updating previous knowledge through new experiences constitute a first explanation of how to learn actively. The link between

Piaget's ideas and OA is clear when he suggests teaching materials and tasks that encourage people to form their own conceptions of the world around them.

Vygotsky (1978), from his social historical perspective, also defends the active character of the individual in learning, but emphasizing the evolutionary, cultural and social aspect. For this author, learning occurs when students solve problems above their level of development or with the support of another. From this approach derives the concept of Zone of Proximal Development (ZPD), which constitutes the distance between the level of effective development of the student (what he is capable of doing on his own) and the level of potential development (what he would be capable of doing) do with the help of an adult or a more capable partner). Learning becomes a construction that the subject makes through the relationship with the other; either by direct contact with him, as in the ZPD or through language.

The ZPD as a concept, provided new ideas about the relationship between learning and development, in turn impacting the design of learning experiences. These experiences would no longer be designed exclusively on the level of development reached by the student, since those "more complex" but resolvable with the advice of others more capable would also be included.

Vygotsky's theory brings out two major themes: the role of personal history, culture in the evolution of human thought, and the role of others in educational development. Vygotsky goes one step further than Piaget, and complements the work that Constructivism had been doing. His position rescues the social as a factor of influence in all aspects of man's life, even during his learning, this being his main contribution. His vision has transcended into pedagogical models based on active learning. These models include techniques that promote

group work, as a way to build knowledge through the exchange of ideas with their peers (Di Biase, 2019).

The classic approaches exposed up to here, are considered a first approach to the essence of AA, which, in all the cases described, is incomplete. Some positions, such as the Montessori method or Dewey's principles, were a novelty impulse for the time. Pioneering ideas, which, although successful, lacked theoretical depth, focusing essentially on the practical success of promoting the activity and involvement of the individual during learning. Other positions, such as those defended from Constructivism, filled the theoretical gap of the first, and developed an explanation of how this form of learning works. However, none of the models described here recognized active learning as a concept, they work on it indirectly and recognize its practical value, but they did not build an explanatory model of the phenomenon.

Pedagogical theories of active learning: another dimension

Pedagogical sciences take the idea of active learning as a viable alternative for education, pretending that the student gets involved and participates in the process. The practical success evidenced by the classic models with an active approach constituted a warning signal for researchers and pedagogues interested in learning. It was time to build a pedagogical model that integrated theory and practice in defense of this active way of learning, which seemed to have good results.

The pedagogical theories that will be described below, develop techniques that promote reasoning, where students have the freedom to explore, discover, build and reconstruct their knowledge by their own efforts. Although sometimes these models do not refer explicitly to active learning, they do defend, in all cases, that real learning lies in achieving the involvement of people in the

process of collecting, analyzing and internalizing information. In essence, they all promote models and programs with an important component of "active" activities during learning, beyond the mere reception and reproduction of content.

Learning by discovery

Discovery learning was first defined by Bruner (1961). This author describes it as a type of learning in which people must build their own knowledge through experimentation with a domain of content, and inferring rules from the results of their experiments. It is a pedagogical model focused on the student and their intrinsic motivation. In situations of discovery, students must not only learn concepts or rules, but also the path of building their directions, responsibilities and forms of communication from a social point of view (Ellizar, *et al.*, 2018). The teacher would be in a role of assistant to the student in the selection and interpretation of the information of the learning environment.

Regarding their designs and work methods applied to the classroom, the literature describes two ways of operating: guided discovery and free discovery. For guided discovery, the teacher gives a problem, provides a context and provides the necessary tools. Students have the opportunity to discover information and solve the problem (Ellizar et al, 2018). While, in free discovery activities, higher than guided discovery activities, the students themselves must define what they want to investigate, select the path to follow, and investigate until they reach the result (Ellizar et al, 2018). Teacher involvement is less than in guided discovery.

The application of discovery learning as a pedagogical technique has been effective in some contexts. Balim (2009) developed a study with the aim of testing the effects of discovery learning on academic

performance, in a sample of 57 7th grade adolescents. An experimental group was created, where discovery learning techniques focused on the Science and Technology subject were used; and a control group. As a result, it was obtained that the students of the experimental group obtained scores 1.5 times higher than the students of the control group. The study concluded that the application of discovery learning techniques in the school environment favors academic success.

However, studies consulted (Nuridin, *et al.*, 2019) refer that the teacher's involvement in the teaching process must be greater than that proposed in the discovery learning model. Pure application of discovery methods, with little feedback from the teacher, leads to frustration, confusion, and misunderstanding of the subject. With which, it is considered a viable alternative for university students. Not so for more elementary grades of education, such as primary education.

This model, despite its theoretical successes, has flaws in its applicability. It is considered a beginning in the development of practical methods based on AA, but its procedures They still need to mature to achieve the expected results.

Learning through experience.

Experiential learning is described as the process that creates knowledge through the acquisition and transformation of experience. It is also a cyclical phenomenon, composed of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. The structural foundations of the learning process rest on the transition between these four adaptive modes (Kolb & Kolb, 2018).

student learning styles and context. institutional learning. The concept of learning

styles describes individual differences based on learner preferences to employ different phases of the learning cycle. Through the experiential learning space, a map of the regions of the learning space is created, in which individuals are located according to their learning style.

It is necessary to clarify that currently, the concept of learning styles defended by this approach has been dismissed by science. The lack of evidence and the failure in its pedagogical implementation have turned this content into a myth for psychology and pedagogy. However, other practical principles defined from experiential learning are salvageable.

Kolb and Kolb (2018) point out principles that the teacher must comply with to enhance experiential learning. Some of them are listed below:

- Learning begins with the student's experiences in the subject: Build learning on the basis of what students know and believe, and on the meaning, they have given to their previous experiences.
- Learning through conversations: Plan a space for a good conversation in order to make sense of experiences.
- Plan a space for the development of expertise/skills: A space is needed in curricula for students to develop skills related to their purposes in life.
- Plan spaces to act and reflect: The action puts the internal world of reflection and thought in contact with the external world of experiences created by the action.

Experiential learning theory has lost credibility in recent years due to the use of the concept of "learning styles". However, other authors (Morris, 2020) do not completely dismiss this approach, and have used experiential learning techniques as a pedagogical practice, but always focused on

teaching at the higher level (university, postgraduate courses).

inquiry learning

Kuhn Black, Keselman, and Kaplan (2000) study learning from another perspective, defining it as "an educational activity where students individually or collectively investigate a phenomenon and draw conclusions about it" (p. 497). The ultimate goal of his inquiry learning theory is to find the cause-effect relationship of the phenomenon to be understood. For this, the student must formulate which variables modify the phenomenon and analyze their level of influence (controlled comparison), similar to what happens in a real scientific investigation.

Kuhn *et al.* (2000) focused their attention on mental models, as representations of reality, given their influence on strategies applied to problem solving. They carried out an intervention in children from 6th to 8th grade, with the aim of promoting a change in the strategies used by students to acquire knowledge about a causal system (knowledge of strategies). Their results point to a hierarchical development of skills and understanding underlying knowledge acquisition, which should be identified as an inquiry learning goal.

According to this research, it cannot be assumed that the skills required to deal effectively with typical inquiry learning activities are present in adolescence (Kuhn, *et al.*, 2000). This study demonstrated that the strategies used by adolescents to evaluate, examine, and interpret the available evidence are far from an optimal standard.

More recently, Zheng, *et al.* (2018) have carried out a meta-analysis of research on the success of inquiry-based learning in pedagogical practice. The results show the positive effect of guided inquiry in all cases,

although with different effect size values depending on the variables studied.

In view of the research evidence, we can conclude that the success of inquiry learning depends on the kind of inquiry activities that have been carried out in the classroom, the level of guidance or support offered by the teacher and the type of measured learning outcome.

self-regulated learning

Self-Regulated Learning understands learning as "the process by which students activate and sustain cognitions, behaviors and affects, systematically oriented towards overcoming their goals" (Boekaerts, 1997, p.162), that is, learning is focusing all your resources, both cognitive and affective, depending on the learning objective.

Learning in a self-regulated way implies facing tasks with confidence and being fully aware of the qualities that one possesses and those that one does not. Seek information spontaneously when necessary, and take adequate time to master new activities.

Regarding this topic, Boekaerts (1997) developed a model that describes this way of learning. The model recognizes the role of cognitive strategies and motivational strategies, which have the same level of influence on learning. The latter refer to the individual's ability to push himself to learning, even when conditions are not favorable; while the cognitive ones refer to the generation of questions, the elaboration of the content and the decoding of the information.

Teachers have a central role as external regulators. First, they need to know what kinds of prior knowledge their students can draw on to give meaning to learning tasks, as well as prompt them to activate and apply it to new domains of knowledge. Second, teachers must be trained to create practice

sessions in which self-regulation is an explicit goal. Third, they must provide learning opportunities, in which students explicitly learn to select, combine, and coordinate their cognitive strategies connected to new knowledge. Finally, educators must design tasks that allow students to improve in the planning, initiation and completion of the conceived actions (Garcia *et al.*, 2018). These methodological resources are applicable to all levels of education, although it is fundamentally recommended for higher grades.

This learning method seems to work in practice. This is revealed by a study carried out by Sebesta and Bray (2017), with the aim of evaluating whether self-regulated learning leads to academic success in university students of the Biology career (n=414). The study concluded that the use of metacognitive strategies during learning has positive effects on school performance.

The pedagogical theories described expose different ways of understanding learning. They present approaches where theory and practice are articulated, and in most cases, their successful application in classrooms, mainly higher education, has been proven. These approaches advocate a student-centered way of learning, where the learner interacts, analyzes and formulates conclusions about the content of study.

The pedagogical theories of active learning provided a well-founded and successful practical outlet. However, they do not contain an explanation of how active learning occurs, what processes are involved during this form of learning, or on what its success in practice is based. Cognitive psychology is based on these shortcomings, which appears to clarify, from its perspective, how active learning works.

Active learning from Cognitive Psychology

Cognitive Psychology focuses on the study of cognitive processes related to the way people perceive, interpret, remember and think about the environmental events they experience. Contrary to pedagogical theories, the cognitive perspective is interested in the cognitive processes that underlie learning, and the nature of their influence on the strategies that people use to learn, solve problems and make decisions in their daily lives (Sternberg, 2018).

Cognitive psychology has studied active learning through problem solving, given that problem solving generates learning processes. If we understand as a problem "a task that requires relatively complex reasoning processes and not a mere associative and routine activity" (Young and McNeese, 2018, p. 3). The link between both processes becomes clearer, since the person will generate knowledge from their own analysis process.

Problem solving refers to a certain situation in which we want to achieve a goal and we must find the means to do so. Problems also have an initial state, the current situation or level of knowledge of the solver, and a goal, what the learner is trying to achieve. In problem solving, the individual must establish precise objectives and analyze the information available to meet them. Busch and Legare (2019) explain that when this information is not enough, the person must engage in a search process, which will provide the necessary knowledge to complement the goal.

Numerous studies address how humans seek information to solve problems. For example, how young children ask questions, or interact with a new toy (Oranç & Ruggeri, 2021), how people perform categorization tasks (Vasilyeva *et al.*, 2018) and how they explore environments to discover the position of

objects in space (Schulz *et al.*, 2018). These studies have in common the idea that this search process supposes high levels of reasoning that will lead to active learning.

Coenen *et al.* (2019) explain that in problem solving the first thing is to define the objective and the demands of the task. Then evaluate different types of information and determine if you have the necessary information to solve it. When there is a lack of sufficient knowledge, the selection of said information should be sought and optimized among that available in the environment.

For example, a child who wants to know why there is a bag of women's clothing in his living room and considers alternative hypotheses about the explanation. The hypotheses reflect the different possibilities about the true state of the world (Coenen *et al.*, 2019). People generate a set of alternative conceptions about the problem at hand (what is called a "hypothesis space"), and test these hypotheses by making empirical observations to verify or refine that space. In this case, the child's hypothesis space includes various alternative hypotheses: that they are going on vacation, that their mother will work away as usual, or that their grandmother is coming to visit. To test their hypotheses, people evaluate the possible actions or questions that they could carry out, a process in which three fundamental elements are differentiated.

First, the effectiveness of the question or action used to seek information. The usefulness of a question measures the person's progress toward achieving his or her goals (Coenen *et al.*, 2019). Second, to what extent the generation of questions and action sequences are constrained by current knowledge (Coenen *et al.*, 2019). Third, people must recognize when their current level of information is sufficient to stop searching for information, which is called the stopping rule (Ruggeri *et al.*, 2019).

The studies mentioned here offer an explanation of how AA occurs in problem-solving situations. This has served the scientific community to understand the processes involved in this way of learning. Theory and practice are articulated when the existing pedagogical models improve their proposals according to contributions that come from Cognitive Psychology.

CONCLUSIONS

The exposed psychological and pedagogical theories agree on some fundamental aspects. First, the notion that the skills necessary for students to be active learners develop gradually, throughout life. It leads to a second fundamental approach, the prior knowledge available to learners is of great importance for the development of these skills, since it influences the skills and tools used by students to deal with learning situations. These elements highlight the need for further research on the processes that underlie and influence learning.

Another factor common to all approaches has to do with the role of the teacher as a facilitator of learning. Although some theories give more (self-regulated learning) or less (discovery learning, experiential learning) prominence to the teacher, in all cases it is the student who decides the amount of content and the pace at which information is received. The student is the protagonist of learning.

Through the practical application of the exposed theories, the positive effect that active learning has on the acquisition of knowledge has been demonstrated, as well as its advantages in relation to traditional forms of teaching. Current studies address the demands of students in the academic context, and highlight the need to further investigate the necessary changes in educational modalities, in order to lessen the

negative impact of changes in educational programs, as a result of COVID 19 The theories presented in this work could be a viable theoretical-methodological solution to address this problem. However, active learning requires the deployment of cognitive resources, high levels of reasoning and motivation, which are generally not present in the early stages of life. Therefore, the form of pedagogy proposed by these approaches could have more impact at higher levels of instruction (secondary, pre-university, university). In the early stages of life, in contrast, specific activities and games could be introduced to perform individually and in groups, which contribute to developing AA strategies and skills, to the extent that children manage to guide their learning, become familiar with the study and acquire metacognitive skills.

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The authors have participated in the design and writing of the work, and analysis of the documents.



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