METACOGNITIVE, CRITICAL AND CREATIVE THINKING IN EDUCATIVE CONTEXTS: CONCEPTUALIZATION AND DIDACTIC SUGGESTIONS

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ABSTRACT

The present article deals with the concepts of metacognitive, critical and creative thinking, proposing a revision from the contributions from psychology and cognitive neuroscience, and its impact on both learning and academic performance. As a first objective, a conceptualization of metacognitive, critical and creative thought processes according to classical and current literature is proposed. Second, some didactic actions are suggested to education professionals to stimulate the development of each type of thinking. As a result of the review and reflection, it is concluded that the development of thinking is key to making the teaching and learning processes more efficient, since the student acquires an active role and autonomy in the construction of knowledge and the development of skills, that transcend the different spheres of human development.

Keywords: Metacognition; critical thinking; creativity.

Pensamiento metacognitivo, crítico y creativo en contextos educativos: conceptualización y sugerencias didácticas

RESUMEN

El presente artículo aborda los conceptos de pensamiento metacognitivo, crítico y creativo, planteando una revisión desde los aportes desde la psicología y desde la neurociencia cognitiva, y su impacto tanto en el aprendizaje como en el rendimiento académico. Como primer objetivo, se plantea una conceptualización de los procesos de pensamiento metacognitivo, crítico y creativo según la literatura clásica y actual. En segundo lugar, se sugieren algunas acciones didácticas a los profesionales de la educación para estimular el desarrollo de cada uno de los tipos de pensamiento. Como resultado de la revisión y la reflexión, se concluye que el desarrollo del pensamiento es clave para hacer más eficientes los procesos de enseñanza y aprendizaje, puesto que el estudiante adquiere un rol activo y autonomía en la construcción del conocimiento y el desarrollo de habilidades, que trascienden a las diferentes esferas del desarrollo humano.

Palabras clave: Metacognición; pensamiento crítico; creatividad.

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RESUMO

O presente artigo aborda os conceitos de pensamento metacognitivo, crítico e criativo, abordando uma revisão desde os aportes da psicologia e da neurociência cognitiva, e seu impacto tanto na aprendizagem como no rendimento acadêmico. Como primeiro objetivo, aborda-se uma conceitualização dos processos de pensamento metacognitivo, crítico e criativo segundo a literatura clássica e atual. Em segundo lugar, sugerem-se algumas ações didáticas aos profissionais da educação para estimular o desenvolvimento de cada um dos tipos de pensamento. Como resultado da revisão e da reflexão, conclui-se que o desenvolvimento do pensamento é a chave para fazer mais eficientes os processos de ensino e aprendizagem, posto que o estudante adquire um papel ativo e autonomia na construção do conhecimento e o desenvolvimento de habilidades, que transcendem as diferentes esferas do desenvolvimento humano.

Palavras-chave: Metacognição; pensamento crítico; criatividade.

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INTRODUCTION

In the current national and international educational context, it is proposed that student learning should focus, in addition to the content, on the development of cognitive skills. However, it is possible that classroom teachers tend to emphasize the learning of disciplinary content over the explicit stimulation of thought necessary to learn it. Faced with this situation, the concern arises about the ways in which thought stimulation can be explicitly considered in educational contexts, with the aim of promoting quality learning.

The present work presents theoretical and reflective elements about metacognitive, critical and creative thinking from a cognitive perspective. Based on these contributions, some specific and possible suggestions are proposed to be carried out in different learning situations, without differentiating in the age, educational level or characteristics of the students. Finally, some conclusions are presented that reinforce the importance of thinking development as a way to enhance learning in the educational context.

Metacognitive thinking

Theoretical contributions on metacognition originate historically from the Canadian psychologist John Flavell, in the 1970s. In his classic publications, he defines this concept as thinking about thinking, allowing himself constant monitoring of this process.

Metacognitive thinking can be described as that ability to inspect our own mental activities, recognizing in them the sequenced actions that we perform. It is to be aware of our mental processing having control over it (Lacón & Ortega, 2008). Therefore, metacognition helps to self-monitor mental activity, making decisions about it to improve it and control elements that can favor or hinder it (Sinatra & Taasoobshirazi, 2017).

From a psychological perspective, metacognitive thinking consists of two main dimensions or components, according to Soto (2002): *cognitive knowledge* and *cognitive regulation.* On the one hand, the *cognitive knowledge* dimension refers to both conceptual and experiential information that is held and believed about factors that can influence the performance of a task, for example: knowing oneself about cognitive strengths or resources. The author mentions that knowledge can refer both to the person who may be oneself or another with whom one interacts, the nature of the task the student faces and the difficulty it represents, and the effectiveness of the strategies that are used to face it and solve it. On the contrary, regarding the *cognitive processes regulation*, Soto suggests that some specific mental functions are involved, such as *planning, supervision* and *evaluation*.

In the last two decades, contributions from neuroscience researchers have begun, which show some

neural bases and correlates that support metacognition processes. In this sense, it is linked to the neural bases of memory and decision-making, present above all in the dorsolateral and anterior area of the brain prefrontal cortex, and its connections with more internal areas (Fleming & Dolan, 2012). Some executive functions have also been linked to metacognitive processing. Executive processes such as self-regulation, inhibition and executive attention that are part of complex neural networks associated with the prefrontal cortex of the brain, would collaborate for the functioning of metacognition (Shimamura, 2000). At the same time, it has been investigated that affective elements can modulate the execution of metacognition, both in situations or tasks of a social and affective or cognitive-academic nature. Molenberghs, Trautwein, Böckler, Singer and Kanske (2016), in their research, found that self-confidence affects metacognitive performance, decreasing precision if it is excessive, or triggering uncertainty if self-confidence is low. Therefore, complex and interconnected brain networks are the basis of metacognition.

Some authors argue that metacognitive thinking is important for learning throughout school and academic life. During the first schooling, it would be an important process for the achievement of learning such as written production (Aguirre, 2016) and as reading Veenman (2015). During primary and secondary education, the study by Tanikawa and Boruchovitch (2016) found that younger students have better supervisory skills than older ones, and even present better academic performance. In secondary education, according to studies, metacognition also shows its implication in learning processes of reading comprehension (Karbalaei, 2011), especially so that the student can give adequate answers to the questions that require inferential understanding (Soto et al., 2019). In higher education, metacognitive thinking impacts the quality of learning in areas, for example, of learning other languages (Karbalaei, 2011). Likewise, in the improvement of the reading comprehension of future teachers, who must be prepared to teach these strategies to their future students (Iwai, 2016). From the aforementioned studies, the relationships between metacognition and learning in educational contexts are evidenced.

Critical thinking

From a cognitive perspective, critical thinking refers to the process of reflection, evaluation of reasoning and subsequent decision-making to solve problems. For Nieto and Saiz (2011) critical thinking must be carried out intentionally or deliberately, in order to arrive at a judgment based on the reason that will guide subsequent actions, decisions and even beliefs. In addition to the cognitive, critical thinking has an impact

on the way in which the person faces and integrates into a society, how they are able to reflect about it and, in turn, be an active subject in it (Jiménez-Aleixandre, 2010). Therefore, its stimulation in the early stages is important, as it is necessary to face problems or situations as citizens (Gormley, 2017).

One of the first authors to publish on critical thinking was Ennis. The author suggested that critical thinking had three dimensions*: logical dimension* (relation of the meanings of verbalizations), *criterial dimension* (to express opinions on these verbalizations and judge them) and *pragmatic dimension* (relation judgment-decision and its impact on the context). In his most current works for the theory of critical thinking, Ennis (2011) raises the presence of both *skills* and *dispositions,* necessary to carry out critical thinking. Regarding skills, Ennis proposes the following grouped into categories:

> 1. *Basic clarification skills*. Focus on the question, analyze arguments, ask for clarifications regarding the questions.
>
> 2. *Basic skills for making a decision*. Judge the credibility of a source, observe and judge what is reported through observation.
>
> 3*. Inference skills*. Deduce and judge their own deduction, make specific inferences, generate and judge their own *value judgments* and those of others.
>
> 4. *Advanced clarification skills*. Define terms and judge their own definitions and those of others, assign assumptions that are not declared.
>
> 5. *Assumption and integration skills*. Take into account and reason from premises, assumptions, reasons and positions with which you do not agree or cause skepticism, without this doubtful state interfering with thinking.
>
> 6. *Auxiliary skills*. These skills are complementary and allow to optimize the execution of critical thinking. Among them we find: proceeding in an organized way when faced with the situation, and being sensitive to the level of knowledge, feelings and degree of sophistication of others.

In relation to the dispositions, which are defined as the internal state of the apprentice to carry out something, Ennis raises the following categories:

> 1. Take care that their decisions are duly founded and their beliefs are credible, within their possibilities. To do this, the critical thinker will be willing to look for options or possible alternative routes, to seek points of view different from their own, to stay well informed, to approve different positions whenever they are well justified, and

to make use of their own thinking skills critical.

> 2. Take care of the understanding and clear presentation of a position, be it their own or that of others. To achieve this, you will be willing to listen to the opinions and arguments of others, to be clear when transmitting information without altering its meaning, to maintain the focus on the questioning or conclusion, to seek and deliver arguments, to visualize the situation in a comprehensive way, and to be aware reflecting about their own beliefs that are based.

Like metacognition, critical thinking also has implications in different disciplines according to studies. In secondary education, the literature suggests including didactic strategies for their stimulation and the teachers' training which must carry them out (Moreno & Velázquez, 2017). At the level of university education, it has been found according to the literature that this has an effect on the development of critical thinking (Huber & Kuncel, 2016). The importance of evaluating this process has also been verified, to be enhanced and improve performance in professional training in health careers (Ospina, Brand, & Aristizabal, 2017).

Creative thinking

Creative thinking is the mental activity in which new non-obvious information is generated for a specific purpose. This new information is a proposal for a procedure or a non-existent or unknown element (Abraham, 2018), regardless of whether it already exists or has been previously created by others. It goes beyond art. It is the original investigative capacity, which provides the novel, the practical, the useful (Belmonte, 2013). Likewise, it allows an innovative approach to any given situation or conflict, by generating divergent responses and ideas to resolve it (Rawlinson, 2017).

Scientific research on creative thinking began in the 1950s, when the first conceptions of creativity, the first proposals for its measurement, as well as incipient strategies for its stimulation, were formulated from psychology. In the 1970s, renowned authors such as Torrance and De Bono appeared, who developed some conceptual elements, proposed instruments for their evaluation and proposed specific programs for their stimulation (Prieto, López, Ferrándiz, & Bermejo, 2003).

Torrance, in his classic work of 1974 (cited in López & Navarro, 2008) points out that creativity allows detecting difficulties, blank spaces, dissonances and errors; which leads to the statement of hypotheses and the search for solutions recursively. In addition, the author suggests that creative thinking would consist of components such as fluidity or ability to produce ideas, flexibility or ability to adjust, originality and elaboration. For his part, De Bono argues that in order to formulate

creative solutions or proposals that are truly original and useful, it is necessary to handle the information, certain bases or specific parameters from which the creation or new proposal is born (De Bono, 2012).

Regarding the stimulation of creative thinking, in young people and adults it has been shown that it is stimulated regardless of age (Madore, Jing, & Schacter, 2016). Specifically in educational contexts, in secondary education students work is suggested through the resolution of problematic situations (Birgili, 2015), whose treatment must be carried out by asking open questions, which make the student question themselves (Borjas & De La Peña, 2009). The school would be an appropriate place to stimulate creativity, especially in primary and secondary education, since later there is a decrease in the manifestation of the components of creative thinking (Kim, 2011).

During the last two decades, recent contributions have been made on creative thinking from cognitive neuroscience. Regarding this topic, it is important to understand that there is no specific neural area for creativity, but rather complex interconnected networks that allow this higher-level process to take place (Beaty, Benedeck, Silvia, & Schacter, 2016; Beaty et al., 2018). On the one hand, it is pointed out that there is a predominance of the right hemisphere when executing creative tasks of various kinds (Mihov, Denzler, & Förster, 2010). However, the model proposed by Flaherty in 2005 explains network creativity, where it gives importance to the brain prefrontal area of (base of executive functions), and the existing connections with the temporal lobes and areas of the limbic system. In other words, creative ideas arise considering complex functions such as executive functions: idea generation, hypotheses, working memory, planning, self-regulation, as well as memory, language and emotion processes (limbic system). Regarding emotions, and as other more recent studies point out (Perchtold et al., 2018) Flaherty proposed in his model that the emotional component of the network would be a regulator of this, especially of mental activity in the prefrontal zone. Flaherty's model is still valid and is consistent with the most recent literature (Beaty et al., 2018; Green, Cohen, Raab, Yedibalian, & Gray, 2015). Finally, the evidence also indicates the participation of consciousness with a fundamental role, since these processes also have their main neural bases in the prefrontal area and that is where ideas would be generated (Dietrich, 2004).

Metacognitive, critical and creative thinking in current education

In educational contexts, it seems that there is clarity that in order to learn it is important to think. However, it does not appear that all teachers teach students thinking skills explicitly and intentionally. For this reason, not all students manage to see improvements when executing these skills during the learning processes.

Regarding metacognitive thinking, its link with academic performance and in various areas of learning has been evidenced (Aguirre, 2016; Karabalei, 2011; Soto et al., 2019; Tanikawa and Boruchovitch, 2016; Veenman, 2015). The literature suggests that it is necessary to generate educational research about effective teaching strategies for the development of thinking, especially metacognition and self-regulation for learning in the school context. The development of metacognitive thinking requires the implementation of strategies by the learner that, previously, are intentional and explicit in the learning environment (Soto et al., 2019). However, it is not required to carry out a structured program complementary or annexed to the teaching of the common curriculum, rather it is necessary to develop them transversally in education within the classroom (Monereo, 2001). In summary, metacognitive thinking contributes to the autonomy of students' learning, and to its transfer to other contexts of life, for which it must be intended transversely at different times and contexts.

Regarding critical thinking and as mentioned previously, it is also related to executive processes such as decision-making for problem solving (Gormley, 2017), before which we must make an assessment of the elements or components, regarding: their strengths and weaknesses, objectively, appreciate its functionality, efficiency, contributions and projection over time. All these processes generate a load of cognitive elaboration to activities that explicitly involve critical thinking. However, students, even at the university level, show low performance in this type of thinking (Tenías, 2012). Therefore, it would be necessary to bring practical didactic strategies to the classroom and train teachers in it (Moreno & Velásquez, 2017), to execute it in a concrete way and not only carry out their study at a theoretical level. This would be relevant, since critical thinking allows a continuous transformation of thinking and the consecutive resolution of various problems both in the school-academic context and in life (Elder & Paul, 2008).

In relation to creative thinking, current education continues to be linked to artistic creation processes. The strategies for the development of creative thinking and even the tests that are used are still based on classic paradigms from the decade of the seventies, their adjustment being important from the current contributions of psychology and cognitive neuroscience. These updated contributions are also required to permeate the educational context to educate more reflective learners who show greater interest in their process of creating or confronting the problem situation (Birgili, 2015; Pacheco, 2003).

Didactic guidelines for the stimulation of metacognitive, critical and creative thinking in the educational context

Metacognition is activated when there are errors or situations that generate conflict, because it is in these situations that self-regulation processes are activated (Lucangeli et al., 2019; Petrova & Kozarova, 2018) and allow self-correction (Veenman, 2015). Taking this into account, when stimulating metacognitive thinking, it is important to consider the following guidelines:

- It is pertinent that the teacher makes explicit the way to perform metacognition (Soto et al., 2019). For example, make explicit the stages of planning, supervision, regulation and evaluation while carrying out the pedagogical activity. This can be specified by means of visible guides or supports, images or logos, verbalizing what stage they are in and giving a specific time for their execution. After doing it several times, students begin to internalize the procedure and gain autonomy.

- Stimulate awareness of their own mental processes, encouraging the student to use self-questions as self-instructions (Veenman, 2015), such as Did I do this? Do I think I did it right? What could I improve? Did I meet my goal? What difficulties did I have? How could I solve them for the next time? The use of self-questions gives an active role to the learner and allows him to organize the information when processing it. In addition, through self-questions, the student can be encouraged to question their metacognitive strategies to progressively improve them.

- Guide the knowledge of personal resources, their own strategies and the task, through dialogue with the student. It is important to provide spaces in the class to talk explicitly about thinking and how we do it, sharing experiences and strategies among learners and mediated by the teacher in the context of collaborative learning (Wismath & Orr, 2015).

- Propose challenging activities, problematic situations (Iwai, 2016) and contextualized (Wismath & Orr, 2015), that put the learner in a cognitive conflict. These types of situations stimulate levels of motivation that allow to stay on the task until it is finished, and are appropriate to install the verbalization of the mental steps or metacognitive actions that have been carried out to carry it out.

- Determine the progression of the visibility of metacognition. In a single class, the learner cannot install all the strategies or a deep level of awareness about their own way of learning, since it takes several weeks to settle (Iwai, 2016). It is suggested to start with short activities, with specific questions about thinking and how they self-check or self-observe. Progressively, enrich with more questions and more references to the metacognitive process that is taking place.

In order to stimulate critical thinking, it is important to consider that learning in the educational context already allows in itself the indirect development of thinking skills, but this is not a guarantee of the development of critical thinking. Likewise, problem-solving and technology environments can be considered (Lawless & Brown, 2015). It is necessary to stimulate certain skills that allow students to question, assess and argue their actions, improving decision-making in different aspects of academic life. Some suggestions in this regard, considering contributions from Ennis (2011) and other authors, are:

- Put the students in situations in which they make an assessment of the sources: if they are reliable, if they are validated, if the author knows about the topic, if the source is appropriate to the context of the situation.

- Giving students the possibility that, through teaching strategies such as debate or discussion through questions (Borjas & De La Peña, 2009), formulate arguments with adequate information, organization and language so that it is understandable for the interlocutor.

- Through questions or peculiar situations, arouse curiosity about the information and the search for another that can complement it or even serve as a contrast.

- In students with a little more abstract thinking, such as those in secondary education, promote reflection on the ideas of other authors, to elaborate their own arguments.

- When making use of the *debate*, it is important that the teacher encourages to assess the use of the argument: if the argument is relevant to the questioning, or if it is not related or lacks connections with the situation, for example. This can be done through some questions (Borjas & De La Peña, 2009), such as Is this appropriate to answer or resolve the situation? Can the idea or argument be improved? How can it be improved to make it more relevant? With this, it would be possible to achieve the objective of responding appropriately to the issues raised and progressively reducing deviant and ambiguous responses.

- Through the use of fictitious cases, dilemmas

or problems (Birgili, 2015) already solved (some well solved and others badly solved), the ability to persuade or convince the interlocutor with objective, pertinent and well-founded reasons can be worked on punctually.

- Carry out activities or games where a wide range of arguments are proposed to a problem, in a problem-solving context (Birgili, 2015). Then ask the students to organize them according to their priority and relevance.

- It is very important to do practical activities where students manipulate or have concrete learning experiences, where they inquire and experiment, for example: learning to find and use reliable sources, valuation of validated knowledge versus *ordinary knowledge*. In online sources (Lawless & Brown, 2015), for example, comparing information from a blog with information from a digital book.

- Provoke the learners to develop individually and collectively the arguments and the story for persuasion. It can be incited through challenging situations or specific questions that generate a cognitive conflict, for example: giving wrong information and that they are aware of it, giving a problem situation stimulating its resolution as a challenge (Birgili, 2015), among others.

- In the activities, a final stage should be intended, where the gestation of own, objective conclusions is given, and questions about their transfer to reality are questioned (Borjas & De La Peña, 2009) such as: In what situation of my daily life could use this? How can I adjust it? How useful is it?

The stimulation of creative thinking, as indicated above, must go hand in hand with learning experiences that present dilemmas, challenges, real daily problems or dilemmas that require proposals or solutions that optimize resources, time, space. Considering Rawlinson (2017), De Bono (2012) and other authors, it is suggested:

- The approach to a problem or situation to be solved that is well characterized or is presented in a specific way to the student (Birgili, 2015). In addition, the situation must be significant for the apprentice: they may be situations in his/her environment but still unknown to him/her. They can be presented through: videos with dilemmas, real unsolved or already solved problems, news (for example: on pollution, optimization of resources, real problems in the city), among others.

- The teacher must pose the problem as a challenge (Birgili, 2015), which tests personal abilities and which can be solved with the personal strategies and resources of the learners.

- Carry out verbalizations, in which an objective assessment of the conflict or situation faced by students is made. For example, asking questions about strengths and weaknesses, barriers, (for example, SWOT analysis) that later sheds light on possible solutions or proposals.

- Explain that a prioritization of problems or conflicts must be carried out according to their level of urgency or progression in order to be resolved (De Bono, 2012). For example, in a problem or dilemma situation there may be various barriers or conflicts that must be located by the students. Once identified, they are requested to organize them by priority or by appropriate order of progression to be resolved.

- Discussion should be opened in the classroom, tending to the generation of varied alternatives as possible ways to solve the proposed situations (Rawlinson, 2017). It can be done by brainstorming ideas that are organized on the blackboard, or that they develop in a group and the final synthesis is organized on the blackboard to create a macro network of ideas that the students themselves originated. This helps learners to visualize ideas and proposals more concretely, linking them together.

- It is essential that you insist as a teacher that the students themselves evaluate whether the strategies or proposals they propose are really novel or original, since it is a fundamental component of creative thinking. In addition, evaluate its usefulness in the context of the problem or dilemma presented to solve.

- Carry out activities that make use of other existing and known ways or strategies but in a new context, adjusting to the situation (contextual modification) (De Bono, 2012).

- The activities must always intend the efficient use of resources oriented towards the economy of materials, time, environment and people; or the use of opportunities that guarantee the economy in these aspects (De Bono, 2012). You can dialogue with the learners about it at the end of the activity, as a closing of it.

- Ask questions (Borjas & De La Peña, 2009) about the assessment of the strategy or solution, and the process of searching for it, with a view to future procedures (what would remain from the process carried out, what would be suppressed,

what would be adjusted).

- Promote that the activities to be developed allow social interaction between learners, since creative thinking is a process determined by social interactions and situations (Loi & Dillon, 2006).

CONCLUSIONS

Thought, as explained throughout this article, involves complex and integrated mental processes, which must be considered in educational contexts and at their various levels. In the case of metacognitive, critical and creative thinking, contributions from psychology and the most recent from neurosciences reveal that they are highly elaborate mental processes that have implications for learning and academic performance.

Each of these types of thinking must be stimulated in an integral way, in real contexts and in learning situations that allow constant dialogue with the learners (Wismath & Orr, 2015). It is essential that they are explicitly stimulated (Lawless & Brown, 2015) without waiting for their development intuitively by the apprentice, taking into account that the activities must have a certain frequency and consistency for the processes to be installed (Birgili, 2015), because if they are isolated activities, this cognitive construction is diluted in time. Likewise, it is relevant that thinking is stimulated and with it learning in social contexts (Wismath & Orr, 2015), since these are the situations in which, through interactions, mental representations are built and higher mental processes are developed.

All of these aspects allow professionals working in education to focus on the scope of student learning and not just on the execution of teaching. This would allow a greater development of thinking in students to provide solutions to real situations and not only the acquisition of information through reproductive instruction. In this way, it will be possible to generate a progressive construction of autonomous and self-regulated learning in the apprentices, and it will tend to an adequate integral development as people.

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