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Development of Creative Thinking Skills in the Teaching-Learning Process

Natalia Larráz-Rábanos

Abstract

Creativity is one of the most appreciated learning skills current the XXI century. The development of creativity has been considered essential in order to achieve an effective and a high-level learning. As different approaches to its study, creativity has been defined as a result, as a process, as a construct derived from the influence of the context and of the experience and as a personality feature of human nature. The aim of this contribution is to explain the study of creativity from the mentioned approaches to achieve a comprehension of such construct. In addition, the focus has been centred on highlight the development of creativity from an educational approach, starting from the description, implication of the use and application of creative strategies in the teaching and learning processes. Finally, a brief description is made of the most important or relevant strategies found in the literature, with emphasis on the incorporation of these strategies in the problem-solving process.

Keywords: Creativity, divergent thinking, thinking skills, teaching-learning process, creative strategies

1. Introduction

Creativity is one of the most appreciated learning skills current the XXI century [1]. Creativity is conceived as a higher-order thinking skill based on complex and postformal thought concerned with the creation of new and valuable ideas [2, 3]. Higher-order thinking skills are those involved in proficient and strategic thought, and these skills comprise critical, creative and metacognitive thinking, also known as deep learning [4]. In addition, the development of creativity is today considered essential in order to achieve an effective and a high-level learning.

Despite the observed need for the development of creativity in the curriculum, there is a general tendency to reproduce teaching and learning models and a constraint on teacher's search for procedures to teach creativity, which involves little creativity development in students, with a predominance of reproductive learning [5].

Creativity is inherent in human development and his personality. It begins to be developed from the first years of school and continues into higher education and increases through the number of experiences that the individual has, and to the extent that the activity of teachers could promote it [5, 6].

Therefore, creativity has been an essential competence for the curriculum design and development. In order to answer this deal, the concept and the psychological

construct of creativity has been defined and later, its psychological process involved has been treated to implement teaching and learning strategies oriented to such ends.

2. Concept and relevant aspects of the construct of creativity

There is a consensus among scholars that creativity is not just another skill, but rather a complex process of human subjectivity that is based on a set of psychological resources that are specifically configured and regulate human behavior [7]. Contemporary researchers have expanded the concept of creativity by recognizing that creative action is a dynamic and inconclusive process and is even co-constituted with the broader social context [8].

Considering the different approaches to their study assumed by Rhodes [9], creativity has been defined as a result, as a process, as a construct derived from the influence of the context and as a personality feature of human nature.

There is not a consensus about the definition of creativity, but it has been generally accepted as the ability to do creative products. A creative product is defined as something new, original and appropriate or valued in a particular context [10–13].

Most authors advocate understanding creativity not only from the results or the products generated, but also from the process from which it is reached. In this sense, Gardner's definition can be assumed for this purpose. For Gardner, a creative person is a person who solves problems regularly, develops new products and defines issues in a field that initially is novel but ultimately becomes accepted in a particular cultural context [12]. This definition includes the four approaches to the study of creativity: personality (creative person), the process (problem solving), the context (cultural context) and finally, the product (new products).

3. Approaches to the study of creativity

3.1 Creativity as a product

Regarding the definition of creativity as a result of human activity, many authors consider creativity as the ability to do creative products, hence a creative person is one that produces creative products regularly.

A creative product is defined as something new, original and appropriate or valued in a particular context [10–13]. These characteristics have also been summarized in two fundamental aspects of creative products, which are novelty and quality, which also must involve originality and adequacy respectively [14].

- What is something new?

Is something different to the previously existing things. There is nothing totally new because something new comes from something that previously exists. Therefore, novelty will depend on the frame of reference to which it is compared. For this reason, there are degrees of novelty. It has been considered these two types of creativity besides that [15–17]:

- P-Creativity: is new with respect to oneself (personal creativity). It is also called Little- c creativity.
- H-Creativity: is new with respect to History (social creativity). It is also called Big- C creativity

Also, there are some differences between the frequency of the novelty and the context where it is generated. Therefore, it has been described four types of creativity (see **Figure 1**). According to this continuum, Kaufman and Beghetto [18] have developed *the Four C Model of Creativity* which describes two types of personal creativity (Little-c and Mini-c-c) and two types of social creativity (Pro-C and Big-C) which are the follows:

- Mini-c: individual/personal and everyday creativity is used to define a type of creativity involved in performances, actions or new events of daily life with personal meaning [19]. This type of category also refers to a mental or emotional internal state of creativity [20] and helps to differentiate the subjective to the objective creativity and the Mini-c from the Little-c. Hence, it is also used to distinguish between subjective and objective forms of personal creativity.
- Little-c: individual creativity that is grown as a hobby. It is associated with the innovative contributions clearly useful but not exceptional.
- Pro-C: not eminent social creativity is given in a creative profession. This kind of creativity comes from people who are creative at their work and helps to distinguish between the area of the Big-C creativity and the area of the Little-c creativity, or between the social and personal creativity.
- Big-C: eminent creativity or exceptional creativity. Is used to indicate a type of eminent and exceptional creativity that stands out in a field or domain of knowledge and is socially recognized.

This model proposes that a person could be gradually creative, in a personal level (Little –c and Mini-c) fostering creativity in everyday life. Thus, increase the possibilities to be creative on a social level (Pro-C and Big-C) to become exceptionally creative.

- What is something original?

Originality implies that a product is different from other, highly unusual or statistically rare. Furthermore, for most authors, a product may be original to varying degrees (personal, social and universal).

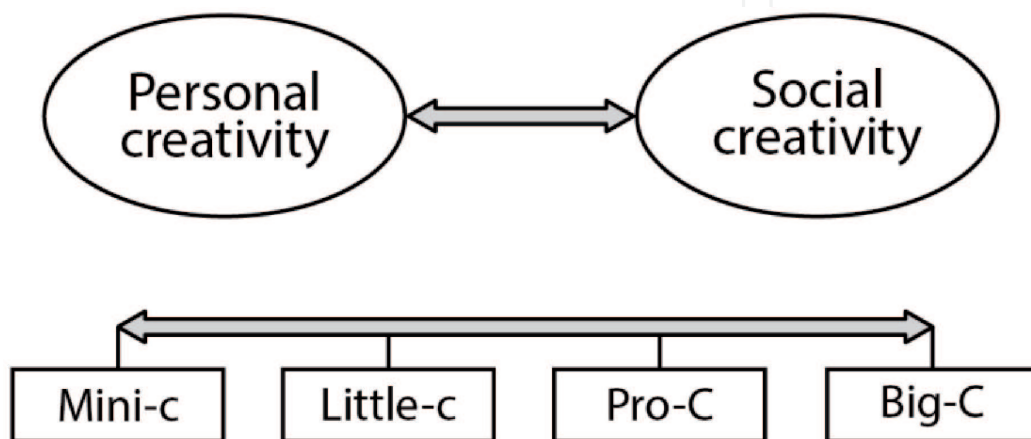


Figure 1.
Grades of creativity.

- What is appropriate or valued in a particular context?

The suitability of a product means that it is valued and/or appropriate in a particular context. To this end, a proper creative product must meet certain criteria or quality standards, providing true value or usefulness to society, culture or context in which it occurs.

As it was indicated in this section, a creative product can be creative to varying degrees (personal-social) and must meet certain levels of innovation and quality. Creative thinking skills development implies that novelty has to involve a certain level of originality, and quality must involve a certain level of adequacy in a particular social context [14].

3.2 Creativity as a process

Many authors have explained creativity as a process clearly differentiated from others cognitive process. Guilford [21] was one of the first authors to propose creative thinking as a cognitive process involved in the structure of intelligence. Today, his theoretical model remains a referent for explaining and predicting a person's creative potential and creative performance. His model of the Structure of Intellect (SOI) defined creativity as a result of a cognitive operation called divergent production, which is related to creative solutions of problems characterised by moving in many directions, in contrast to convergent thinking, characterised by moving in one direction to search for a correct answer (see **Figure 2**).

Furthermore, Guilford [21–23] proposed these four productive processes of divergent thinking:

- **Fluency:** the production of a large number of ideas. There are three types of fluency: (1) Ideational fluency: quantitative production of ideas in a given class, (2) Associational fluency: building relationships, (3) Fluency of expression: easy to build sentences.
- **Flexibility:** the ability to produce changes in thinking- a change of some kind, of meaning,-a change of meaning, interpretation or use of something, a change in the way of understanding a task or strategy intended to do it, or a change in the direction of thought, which may involve a new interpretation of the problem.
- **Originality:** the production of unusual and intelligent responses collected from premises distant or remote. In order to evaluate this component, the principle of statistical infrequency of an idea within the set of members of a given population has been proposed.
- **Elaboration:** the ability to produce the highest number of steps or details to execute a plan. It is related to the ability to make implications when planning skills are being applied.

Other authors are relevant in addressing and highlighting creativity as a specific thinking process, such as Torrance, Maslow and De Bono, among others. Torrance [24] describes creativity as the hypothesis development and validation process. Defines creativity as sensitivity to problems, deficiencies and gaps in information, the absence of certain elements, etc., which leads to formulate conjectures and hypothesis about their solution, evaluate, test and modify these assumptions to communicate the findings. Maslow [25] distinguished between two types of creative thinking and describes two types of creativity, primary and secondary. The creative process is largely composed of

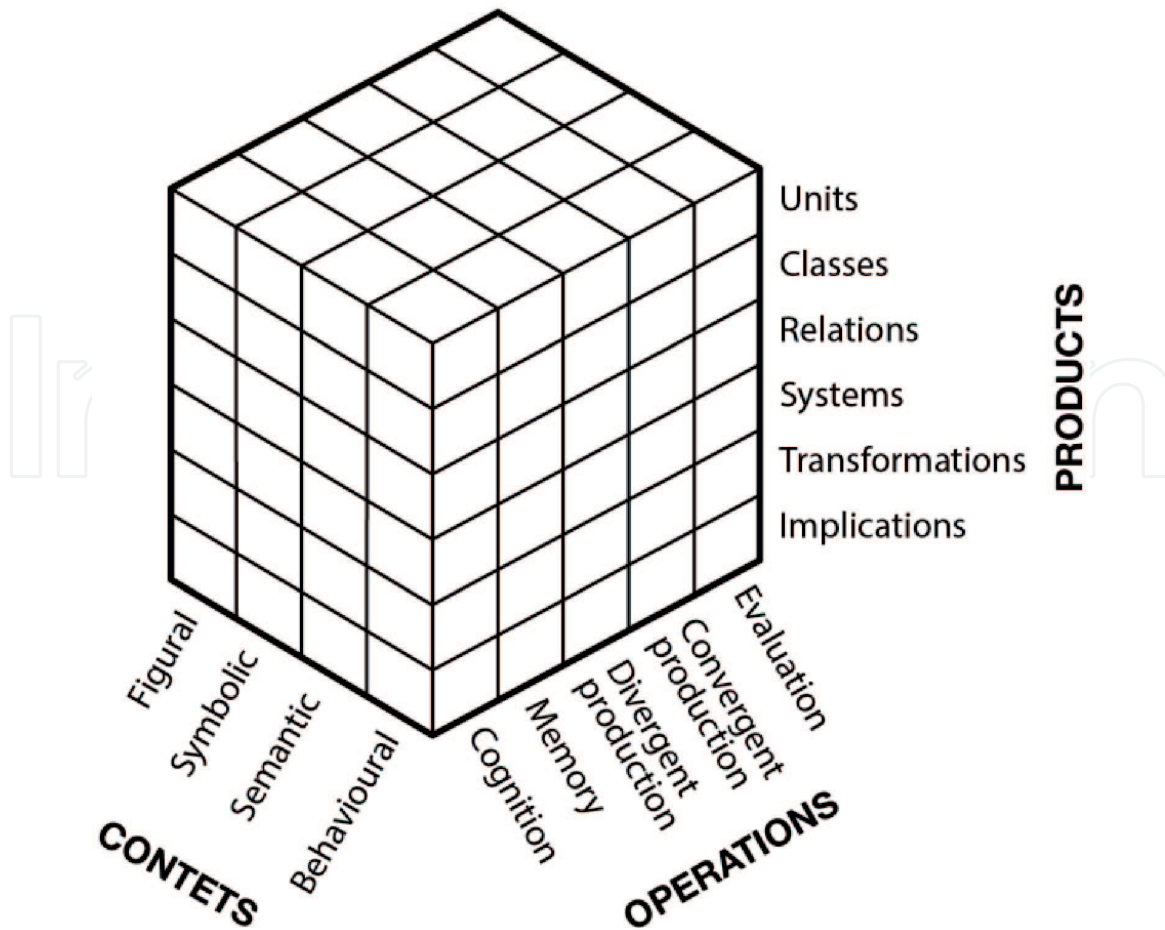


Figure 2.
 Guilford's Model Structure of Intellect (SOI).

the primary creativity, which is related to creative inspiration, and secondary creativity prepares and develops primary creativity and expresses the "finished product". Finally, De Bono [26] defined creativity as lateral thinking. Lateral thinking involves the generation of ideas, is not sequential, unpredictable and not limited by convention. Lateral thinking is the opposite of vertical thinking defined as sequential, linear, predictable and conventional. Both processes are necessary and complementary.

Hence, there are empirical evidences about two kinds of thinking, creative and critical thinking, that shows a cerebral correlate with both sides of our brain. It has been observed that both styles of thinking imply two different mental operations and processes such as: visual-verbal, parallel-vertical, unconscious-conscious, divergent-convergent, etc. Creativity is located in the right brain hemisphere and in the frontal lobe, as well as having a neurological basis of a stronger hemispheric connection, as a result of an optimal interaction between the two hemispheres. In addition, a high creative thinking ability consisting of frontal and parietal regions within default, salience, and executive brain system [27, 28].

A constant throughout the history of creativity has been to recognise the creative process as the semblance of problem solving [29]. This will be discussed in the last section of this chapter.

3.3 Creativity as an attribute of personality

There are some classic studies of the creative personality made by Mackinnon [30, 31]. Personal characteristics that performed highly creative products (buildings for architects, published works for novelists or writers) were assessed. The following characteristics of a creative person were founded:

- High intrinsic motivation to solve problems, rather intrinsic than extrinsic.
- Security and confidence, not worry about the opinion others have of them.
- Qualities for social success; they are balanced, spontaneous and confident in their social relations, while they are not particularly sociable temperament and cooperative.
- Not deliberately conformist though. They are truly independent.
- Prefer the aesthetic and theoretical values. They are searching for truth and beauty.
- Preference for intuitive perception resulting from flexibility, spontaneity and openness of mind to experience.
- Inclination towards the complex and asymmetrical.
- Two thirds of the study participants were introverts but there is no evidence that introverts are more creative than extroverts.
- According to mental health, creative individuals scored above average in the general population in certain psychological traits, but they had enough strength and mental control that allowed them to express themselves in a productive and in a creative way.

Other salient features that define the creative personality are [32, 33]:

- The flow of ideas and flexibility of thought.
- Not conventional thinking. Thoughts and associated ideas in unusual ways and use of unconventional strategies to solve problems.
- Independence and autonomy. High degree of autonomy, independence and confidence. They do not need to be seen or relied on.
- Self-discipline, self-control and perseverance. They are responsible for their own actions and have a high degree of strength and persistence to successfully finish a started project.
- High achievement motivation. They usually do not feel satisfied with their ideas or projects because they think they can improve them.
- Tolerance for ambiguity. They are more capable than most people to carry out the work in the absence of specific requirements.
- Preference for complex tasks and information.
- Strong sense of humor.

A recent meta-study highlights these same personal characteristics, emphasizing awareness, flexibility of thought, abundance of ideas and their ease and the originality of ideas as the fundamental pillars of creative personality and the core

of the main studies analysed [34]. In addition, creative persons must also find four essential factors for creativity potential: affect, cognition, willingness and empathy [29].

3.4 The context in creativity

The importance of the cultural value or the context in creativity has been highlighted by different authors. The influence of the social environment for creativity development, is essential; this is what makes it possible to provide innovative solutions to the problems i.e., what surrounds the student and contributes to the development of his personality [5].

In this sense, Glăveanu [35] has presented an overview of how expanded conceptions of creativity including the context dimension can help move the field from a *He paradigm* (limited to a few select creators) to an *I paradigm* (focuses on individuals, but acknowledges that all people are capable of being creative) and toward a *We paradigm* (sociocultural an expansive focus). The We-paradigm starts from the idea that creativity takes place within, is constituted and influenced by the social context [8]. These more expansive views about creativity are illustrated in a recent publication of a group of active creativity scholars that outlines the key assumptions of a socio-cultural conception of creativity [36].

Csikszentmihalyi [17] defined creativity as any act, idea or product that changes an existing domain or a transformation of an existing domain into a new one, and argues that creativity is to bring something truly new that is valued enough to be added to the culture. Gardiner emphasises interdisciplinarity and collaboration for greater creativity and epistemic control of knowledge [37].

The Amabile [10] *componential model* (see **Table 1**) highlights the importance of the context in the development of creativity; such model implies the following three components of creativity:

- Domain-relevant skills. It depends on the cognitive, perceptual and motor innate skills and formal and informal education of the person in a particular domain. It includes the knowledge in a domain, the technical skills and the special skills in that domain.
- Creativity-related processes. It depends on the experience in the generation of new ideas and personality. It includes the cognitive style, the use of heuristics to generate new ideas, and the style of work.
- Intrinsic task motivation. It depends on the initial level of intrinsic motivation toward the task, on the presence or absence of social inhibitors and on the individual abilities to minimize cognitively external inhibitors. It includes attitudes toward the task and the perception of one's motivation to undertake it.

A key issue in developing creativity context-related is motivation. To develop creativity, it should be a higher intrinsic motivation than an extrinsic one. Amabile [10] attaches great importance to the influence of social factors on creativity, so that intrinsic motivation, internal evaluation in accordance with technical criteria and the absence of external rewards are crucial factors for its development. Intrinsic motivation is particularly relevant in the early stages of the idea generation or in the early stages of creativity and extrinsic motivation is particularly relevant in the developmental phase of these initial ideas, when the product needs to be developed in detail. In turn, it has been shown that extrinsic motivation can encourage the creativity as long as it does not exceed the intrinsic motivation one, and both kinds

	Domain-relevant skills	Creativity-related processes	Intrinsic task motivation
Includes	<ul style="list-style-type: none"> • Knowledge in a specific domain • Technical Skills • Specific Talent 	<ul style="list-style-type: none"> • Cognitive style • Use of heuristics • Work style 	<ul style="list-style-type: none"> • Attitudes towards the task • Perception of one's motivation to undertake a task
Depends on	<ul style="list-style-type: none"> • Innate cognitive, perceptual and motor skills • Formal and informal education in a particular domain. 	<ul style="list-style-type: none"> • Experience in the generation of new ideas • Personality Characteristics 	<ul style="list-style-type: none"> • Initial level of intrinsic motivation • Presence or absence of social inhibitors • Individual abilities to minimize cognitive external inhibitors

Table 1.
Componential Model of creativity of Amabile (1983).

of motivation should be combined in a synergistic, additive and complementary way. In other words, “extrinsic incentives and task motivation must combine in a synergistic, additive, or complementary fashion” (p. 352) [38].

According to *investment theory* [39] and *creative self-efficacy* [40], success expectations are on the basis of which students are inclined to engage in creative behavior. That is, as teachers we need to encourage positive expectations of the use of creativity, in which behavior is proven a more effective performance in a creative way compared to a non-creative.

4. Teaching methodology for creative thinking skills development

According to De la Torre [41], creative teaching is characterized by being active, motivating, dynamic and involving. For this author creative learning refers to knowledge built with the active involvement of the subject, from its planning to its internalisation, characterised by intrinsic motivation, being learner-centred, openness of the process and self-evaluation.

The development of creative thinking skills is essential for turning creative potential into creative performance. That is, if creative skills are deliberately, consciously and voluntarily fostered, each individual will be able to convert his or her creative potential into creative behavior [2, 6, 42].

In this respect, the development of creative skills must be personal and voluntary, but it must also be stimulated by the educational context. From a didactic point of view, creativity is a concept that should be addressed curricularly in the objectives, as formative content, as a strategy, in learning activities and in assessment. If not, it is reduced to a mere aspiration for a good social reception [43].

In general, it can be stated that the recommendations from research, derived from the implemented programmes and strategies for the development of creativity are based on applying divergent thinking processes (fluency, flexibility, originality and elaboration, transformation, sensitivity and symbolic play) and convergent thinking processes (analysis, synthesis and evaluation of ideas) involved in the creation of products in the problem-solving process to achieve the optimal development of creativity [2]. An important finding of a meta-analysis was that more successful training programmes were more likely concerned with directed and structured exercises aiming at developing specific, task-relevant cognitive skills

operating on available knowledge, involving idea production and cognitive training in problem solving strategies [6, 42].

There is a considerable evidence revealing beneficial effects on different facets of creative potential. Studies on creativity in education field show an effective and real development of creativity if relevant efforts are made in this direction in all levels of education from pre-school to higher education [3, 8, 44–48]. In addition, evidence has been found to suggest the importance of the role of the educator as a basis for the development of creativity and an opportunity to guide the child's early development of creativity [49]. A recent meta-study, highlights the importance and the need to explain and explore the teaching-learning processes involved in the development of creativity, identifying the techniques and procedures used [8].

Therefore, there is an insistence on the need to promote educational measures and processes that involve teachers in the development of their students' creative thinking, based on teaching methods that allow them to generate knowledge and respond to social, scientific and technological problems [50, 51]. In this regard, a systematic review of 210 studies on education and educational policy suggests that teachers' skills, attitudes, willingness to act as role models, awareness of students' needs, flexible lesson structuring and certain types of classroom interaction are central to the teaching of creativity, and highlights the importance of educational culture in supporting creativity, where it is necessary to generate conceptions of creativity and for teachers to develop their own creativity, working constructively with a mentor, as well as the importance of action research and reflection on one's own educational praxis [52].

At this point, it is stressed the importance of applying the creative thinking process in problem solving, as it would be the ideal strategy in order to develop creativity, as creativity and problem-solving have many similarities [2, 53]. Thus, is applying creative strategies in those processes that require a divergent, productive or idea-generating thinking style and analytical and evaluative strategies in those phases of the process that require a more conventional thinking or a convergent thinking style, aimed at finding a correct answer or its final elaboration.

In this section a distinction between the development of creative skills is made through overcoming the creative thinking barriers as a way to be aware of the internal and external conditioning factors of creativity, and how they are perceived in the educational context. Finally, the most relevant strategies for the development of creative skills are described in order to use them specifically in the educational context, with emphasis on problem solving.

4.1 Knowing and removing barriers to creative thinking

Simberg and Osborn [54, 55] were the first to identify and analyse barriers to creative thinking under three types of blocks: perceptual, cultural and emotional. Simberg recommended overcome these blocks and described them as follows:

- a. Perceptual blocks. Assume not to see the problem or not to see what is wrong, due to several limitations such as to isolate the problem, define the terms of the problem, use the senses to observe the problem, perceive remote relationships, investigate the obvious or distinguish between cause and effect.
- b. Emotional blocks. Are those from the individual's own insecurities, such as the fear of being wrong or looking foolish, clinging to the first idea or solution that comes to mind, rigidity of thought, high motivation to succeed quickly, excessive desire of security, fear and distrust superiors, lack of energy to solve a problem, the experience and the lack of will to implement a new solution.

- c. Cultural blocks. Are those that derive from what is taught and has learned to accept as good or bad, such as the desire to adapt to an accepted rule, the desire to be practical and economical, the tendency to adopt an attitude of all or nothing, having too many or little knowledge about something, being too competitive, having too much faith in statistics or logic, believe that fantasy is not worth it and believe that is not polite to be very curious or doubtful.

Lorna [56] describes creativity barriers as obstacles affecting the creative and innovative skills of individuals. She considers that knowledge, identification and awareness of the barriers to creative thinking, could prevent their emergence and allow for the creative potential of individuals. To this end, Lorna has created the *Inventory of Barriers to Creative Thinking and Innovative Action*.

These blocks and barriers have also been summarised in two types: internal and external barriers. Internal barriers have been related to the perceptual blocks and the emotional blocks and external ones have been related to the cultural blocks.

More recent literature provides various examples of how people can be effectively cognitively stimulated in the context of creativity enhancement, and significant performance gains psychometrically determined creativity were also seen as a result of continuous engagement in divergent thinking task [57].

4.2 Strategies to develop creative thinking skills in the classroom

From this approach, the optimal methodology for the development of creativity would be the development of students' strategic thinking through the teaching of different creative strategies in the classroom. Creative strategies are an adaptive procedure or set of procedures by which action is sequentially organized to achieve the desired purpose or goal [58]. These strategies are characterized by flexibility in planning, contextual adaptation, the creation of a relaxed and rewarding atmosphere, participatory and interactive roles among students and between students and teachers, productivity or personal achievements, high degree of satisfaction and awareness of self-learning [58]. These strategies seek, among other aspects, to develop capacities and skills of ideation, interaction, elaboration, communicative competence, argumentation to express and defend one's own points of view, collaborative work and role-playing. They are characterized by being strategies oriented towards the development of attitudes, values, emotional sensitivity and persistence in the task initiated [59].

Classic creative strategies to develop creative thinking skill began to apply in training courses from the industrial field started in 1930 and 1940. These strategies could help to unlock and stimulate the divergent thinking and facilitate the development of creativity. Nowadays these strategies are applied in the educational context in different divergent thinking tasks [57]. These creative strategies are involved in idea production which is particularly effective in improving creative-related skills [42, 60].

A way to classify the strategies outlined in the scope of the development of creativity, it has been proposed three types of processes used in problem solving [61]:

- Analogical: is based on the similarity or the likeness as a solution of the problem.
- Antithetical: is based on solving the problem of the counter tide it had been done before.

- Randomly: once discussed the problem with similar methods and opposite, there is an area of seemingly unrelated concepts to the problem and random estimates are used for their solution.

The main strategies for the development of creativity are summarised below:

- Brainstorming [55]. Its objective is to conduct a group or a project to get as many ideas, suggestions, valid alternatives and original ideas as possible. This strategy can be applied in a single phase, in which each participant prepares its own list of ideas and then be shared with other individuals, in a second phase of work in pairs and in a third phase of group work. Eventually it is needed to evaluate all the ideas and choose the best.

This strategy has four basic rules:

1. Critical judgment is excluded. Do not reject or censor any idea how absurd or strange it may seem.
 2. The free imagination is welcomed.
 3. The amount is demanded.
 4. The combination and improvement of the proposed ideas is sought.
- Attribute listing [62]. This strategy consists of moving the attributes of an object or situation to another object or situation. Its aim is to sensitise the student to grasp the characteristics of the objects and transforming them to generate significant wealth of new ones. This technique should be applied as follows:
 - Focusing on a target or topic of a potential job.
 - Display various attributes or characteristics of the target of topic (e.g., if it is an object: shape, color, size, etc.).
 - Select those attributes that best describe the object or subject.
 - Thinking about possible changes in each.
 - Modify the characteristics of an attribute without changing other attributes and see what happens.
 - Checklist [55]. This strategy is based on the formulation of questions, because the questions are one of the supports of creative attitudes. Prior knowledge of a problem predisposes to the development of questions, because knowing involves wanting to know more and this can lead to many discoveries. This strategy proposes a number of questions issued by the educator to encourage creative thinking; these are the follows:
 - Use the existing elements that have been already used for other purposes.
 - Adapt or copy other similar realities to improve what we have.

- Modify; giving new forms, colors, aspects.
- Increase, make larger, stronger, higher, that multiplies the effects or appears more often.
- Reduce; make smaller, lighter, delete parts or complications, divide or ignore.
- Replace; change something by other ingredients, materials, procedures, techniques, etc.
- Change the order or sequence of its components.
- Reverse the object; replace the positive with the negative, to start at the end, to reverse a situation, use of irony.
- Combine the ideas to improve the object.
- Synectics [63]. The word comes from Greek and means the union of different elements and seemingly irrelevant. Is applied in group problem solving to increase the possibilities of its resolution. To applied it, activities are proposed to make the strange familiar and the familiar strange through free associations, involving four forms of metaphorical analogy, which are as follow:
 - Personal analogy: imagine that you are the object or situation of the problem to identify its elements.
 - Direct analogy: look for some phenomenon or similar solution in other areas of knowledge or disciplines.
 - Symbolic analogy: interpersonal or object images are used to describe the problem. Poetical and metaphorical type of responses can be used.
 - Fantastic analogy: fantastic events, imaginary or irrational ideas can be used to challenge the established laws and to create another kind of reality.
- Invention of products [64]. This strategy proposes the creation of inventions. The strategy to develop the invention comprises the following steps:
 - Analyse the design and the creation objectives.
 - Generate ideas. New ideas from different categories, original and infrequent ideas and detailed ideas are seeking.
 - Assess the ideas generated.
 - Designing something new or improve an existing design.
- Storywriting [65]. This strategy encourage imagination by the development of stories and provides the description of different ways for it. Some of these ideas are: create stories from a word or from a randomly selected image, change the main character of a familiar story, transforming traditional stories introducing changes to its continuation or ending, imagine a fantastic character and create a story from this character (e.g., a man of glass; a man of iron), setting riddles and metaphors of their characteristics, using analogies, synectics, etc.

- Method of the Six Thinking Hats [66]. This method tries to stimulate simultaneously six different ways of thinking related to the symbolic use of six different hats, including:
 - The white hat is neutral and objective. It relates to the facts, data and objectives.
 - The red hat suggests anger and emotions. It provides the emotional standpoint.
 - The black hat is somber and serious. Is cautious and careful, says the weaknesses and difficulties of the ideas.
 - The yellow hat is cheerful and positive. It includes optimistic hope and positive thinking.
 - The green hat symbolizes the abundant, fertile growth and new ideas.
 - The blue hat is cool, symbolizes the color of the sky that is above all. It relates to the control, organization of thought processes and the use of other hats. One could assume that this hat symbolises the use of metacognition.
- Design Thinking. Design thinking offers teachers needed support and skills. Design is a process of “making” solutions, and a well-recognized by-product of creative confidence and self-efficacy. Design thinking is an iterative process that repeatedly reformulates a problem to find its core and then analyses possible solutions to find the most favourable, allowing for the formation of ‘creative bridges’ between problems and solutions [53]. Thus, both analytical thinking and divergent creative thinking are key to design processes, worked through five core design thinking skills: Empathising, Defining Problems, Ideating, Prototyping, and Testing [67].
- Creative, metacognitive and critical thinking skills problem-solving model. Adapted from Allueva [68] is based on complex thinking and higher order thinking processes in problem solving [2]. See **Figure 3**. This model stresses the importance of developing creative thinking skills in problem solving, applying creative strategies in those processes that require a divergent, productive or idea-generating style of thinking and a more analytical and evaluative strategies in those phases of the process that require a more conventional or convergent thinking, aimed at finding a suitable response or its final elaboration. Throughout all the process, metacognitive skills involved in problem-solving are proposed. In this sense, there is some recent research on the implication of metacognition for the development of creativity [37, 69].

Figure 3 shows how to apply the creative, metacognitive and critical thinking process in problem solving. First, the problem is presented and simultaneously, divergent production processes (in those tasks that require the generation of novel and valuable ideas) and convergent production processes are applied (in those tasks that require valid and reliable answers). During the task, metacognitive thinking processes (planning, regulating-controlling and checking the task). The three mentioned thinking skills are applied until a mental product of the problem is achieved.

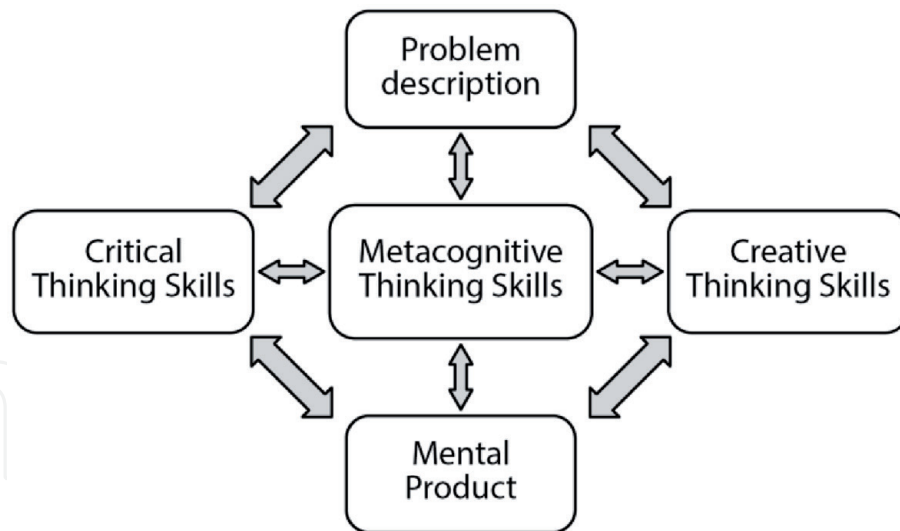


Figure 3.
Creative, metacognitive and critical thinking skills problem-solving model.

As an example, the sequence of activities in the expositive sessions is:

- a. At the beginning of the session: enquiry into prior knowledge: brainstorming, posing questions about subject content, knowledge activation questions, etc.;
- b. During the session: stimulate the creative thinking, creative strategies are proposed: brainstorming, synectis, proposing examples and counterexamples, generating lists of attributes to certain questions, visualisation, make questions, etc.;
- c. At the end of the session: relevance and educational implications in the classroom of the issues raised (creation of scenarios and narratives and search for solutions using divergent thinking skills in different cases).

The sequence of activities in the practical sessions is:

- a. Presentation of the activity through cooperative work in the classroom. Creative strategies are proposed to solve the different practical activities through the stimulation of divergent thinking and lateral thinking: "what if", creative narrative techniques, brainstorming, use of analogies, list of attributes, synectics, creative visualisation, among others. The explanation of each strategy will be done prior to the solution of the proposed activities;
- b. Development and supervision of the creative performance for the practical activities proposed;
- c. Shared discussion. Small group discussion and large group presentation of the proposals put forward, explaining the creative process carried out for their solution. To this end, the hypothesizing of possible alternative solutions will be encouraged, promoting hypothetical-deductive thinking, creative and metacognitive thinking skills are supported;
- d. Evaluation: group feedback on the creative resolution of the activity is done, suggestions for improvement of the solutions are proposed. Individual and group student's self-evaluation is carried out to analyse the creative strategies

application during the learning process. Finally, teacher's evaluation of the activity resolution (i.e., using a weighted evaluation scale) is proposed which is based on previously established evaluation criteria. Thus evaluation, should assess the main implemented creativity factors that were involved in the teaching sessions, as the indicators of creative thinking developed: fluency, flexibility, originality and elaboration, among others.

5. Conclusions

It can be affirmed that development involves skills of increasing complexity and, in general, it has been shown that human thinking is diverse, complex and multifaceted and that it requires the coordination of multiple cognitive processes.

For this reason, we highlight the importance of the development of higher order thinking skills, more specifically those that have been shown to be most effective in teaching-learning processes, namely critical, creative and metacognitive thinking skills. Traditionally, more attention has been paid in education to the development of critical, analytical or formal thinking skills, and creative thinking processes have been neglected. For this reason, it is highlight creative skills as an object of development and study in this chapter.

Creativity is a complex and multidimensional construct, which makes it difficult to define in a precise and consensual way. However, it can be affirmed that the different existing approaches to the study of creativity provide a complementary vision of creativity and shed more light for future research, which will serve to discover the mental processes and mechanisms involved in creative and human thinking and the factors that influence them.

So far, it has been highlighted the importance of creativity in society and in education, as well as the importance of creativity in everyday life, while it has been shown through research that the development of creativity can provide an improvement in educational quality and student learning. Accordingly, we believe that creative skills should be developed in all possible contexts, taking into account the personal characteristics of each student, so that they are able to generate creative products in a variety of contexts. It has also been highlighted that essential indicators of creative potential are creative thinking processes applied to problem solving in the curriculum and, more specifically, those involving divergent thinking for the generation of ideas.

From this approach, it is proposed that the development of creative thinking skills should be carried out in the different areas of the curriculum as a transversal competence and in a deliberate and specific way. Likewise, evaluation is proposed, with the intention of assessing whether their development has been effective. In order to develop creative skills and creative thinking, barriers it should be removed and it should be applied creative skills involved in the problem-solving process. The aim is to generate creative products through the use and application of creative strategies intentionally in the teaching-learning process.

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Author details

Natalia Larraz-Rábanos
Education Faculty, Zaragoza University, Zaragoza, Spain

*Address all correspondence to: nlarraz@unizar.es

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