International Journal of Turkish Education Sciences,
2026, Advanced Online Publication
https://doi.org/10.46778/goputeb.1778627

ISSN: 2148-2314

Creative thinking in education: A comprehensive review on theory, instruction, and assessment

Seval Kula Kartal[a] Yasemin Aslan[b] Suna Çöğmen[c]

[a] *Pamukkale University, Denizli, Türkiye, sevalk@pau.edu.tr*

[b] *Pamukkale University, Denizli, Türkiye, ybakir@pau.edu.tr*

[c] *Pamukkale University, Denizli, Türkiye, sunadem@pau.edu.tr*

ABSTRACT

Creative thinking has long been the subject of growing interest in many fields as a multidimensional skill that refers to individuals' capacity to generate original, flexible, and functional ideas. Recognized as a skill that must be acquired through education, creative thinking is also one of the life skills of the 21st century. Based on the knowledge that every individual has creative potential, educational environments that support creative thinking, creative teachers, and the educational measurement of creative thinking form the framework of this study. The aim of this review study is to examine the theoretical foundations of creative thinking, measurement approaches, and their reflections in educational environments within a holistic framework. The study comprehensively examines the definitions and theoretical models of creative thinking, the tools used to measure creative thinking skills, and the characteristics of learning environments that support creative thinking. The study underlines that creative thinking is not limited to individual potential but is shaped by the pedagogical environment and assessment culture, offering practical insights for teachers and researchers.

Article Type
Review

Article Background
Received:
September 5, 2025
Accepted:
February 23, 2026
Published Online:
May 22, 2026

Keywords
Creative Thinking, Creative Instruction, Creative Classrooms, Measurement Tools for Creative Thinking, Creative Teacher

To cite this article: Kula Kartal, S., Aslan, Y., & Çöğmen, S. (2026). Creative thinking in education: A comprehensive review on theory, instruction and assessment. *International Journal of Turkish Education Sciences.* Advanced Online Publication. https://doi.org/10.46778/goputeb.1778627

Corresponding Author: Yasemin Aslan, e-mail: ybakir@pau.edu.tr

Introduction

The concept of creativity has been the focus of researchers for many years, with many disciplines — primarily philosophy, neuroscience, and psychology — approaching it from different angles. According to Baer and Kaufman (2006), although creativity has been studied since the 19th century, J. P. Guilford's 1950 presidential address to the American Psychological Association was one of the most important turning points that sparked scientific interest in the field. Following this approach, the Torrance Tests of Creative Thinking, developed by E. Paul Torrance in 1965, also marked an important milestone in creativity research (Sternberg, 2006). This research process began in the 1950s and has evolved over the years, incorporating various theoretical and measurement tools. In the 2020s, its international visibility has increased with PISA's creative thinking assessment.

Creativity is a multidimensional concept that emerges because of an individual's cognitive processes, developmental characteristics, and interaction with their environment. Cognitive approaches explain creative thinking through mental skills such as fluency, flexibility, and originality (Guilford, 1950; Torrance, 1965), while process-oriented models emphasize that creativity is dynamic and developable (Wallas, 1926). Socio-cultural approaches, on the other hand, address creativity in the context of individual-environment interaction; Rhodes' (1961) Four P model and Csikszentmihalyi's (1996) systems approach reveal that educational environments and the role of the teacher are decisive in the development of creativity. More recent theoretical frameworks address creativity within a developmental continuum; Kaufman and Beghetto's (2009) Four-C model defines the individual and meaningful productions (mini-c) that children exhibit in the learning process as a fundamental dimension of creativity. These theoretical approaches demonstrate that creativity can be supported through education from childhood onwards.

Since Guilford's speech seventy-five years ago, countless studies have been published on the role of creative thinking skills in education. These studies demonstrate that creative thinking is a skill inherent to everyone to some extent and highlight that it can be further cultivated and developed (Burkus, 2013; Calavia et al., 2021). All students possess creative potential, which they can express in various ways within the classroom. It is therefore important to consider how creative thinking skills can be encouraged and developed in classrooms (Beghetto & Kaufmann, 2014). However, despite the passage of time, creative thinking is still sometimes overlooked in teaching and assessment, and is sometimes seen as an activity limited to 'product'-oriented results. Although creative thinking has begun to be included in large-scale international assessment programs (e.g., PISA 2022) and has become more visible in teaching program objectives, uncertainties remain regarding how this skill can be developed and assessed in classroom practice. There is a particular need to support teachers in developing their competence in encouraging and assessing creative thinking.

This study aims to examine the concept of creative thinking in light of different theories, building on many years of academic research into various aspects of the subject. The study also aims to investigate the processes of teaching and measuring creative thinking, particularly in the context of education. In line with this objective, this study is a literature review that comprehensively and currently addresses the existing literature in this field. First, the study searched national and international academic databases for keywords such as 'creativity', 'creative thinking', 'creative thinking skills', 'creative teacher', 'creative thinking in education', 'creative classrooms', ' creativity assessment', and 'assessing creative thinking'. Care was taken to ensure that the obtained data were

comprehensive enough to reveal the theoretical foundations of the concept, and up-to-date enough to emphasize its place in educational settings. The resulting product was considered to contribute to the literature as a comprehensive and holistic reference source. In this regard, the study provides a thorough theoretical analysis of the principles and assessment of creative thinking. Subsequently, creative thinking and its assessment in educational environments are addressed in a comprehensive and holistic manner.

Theoretical Foundations of Creative Thinking

There are numerous definitions of creativity in the literature. Plucker et al. (2004) found that creativity was explicitly defined in only 34% of studies published in two leading journals in the field of creativity. Csikszentmihalyi (1996) emphasized that the term 'creativity', which is widely used, attempts to cover too many areas, resulting in considerable confusion. In their study analyzing 120 different definitions of creativity, Treffinger et al. (2002) stated that these definitions agreed on the fundamental characteristics of creativity. While there is no universal definition of creativity, the chosen definition influences the characteristics or evidence emphasized by different approaches and how they are interpreted. Nevertheless, despite the theoretical diversity of definitions of creativity, some common points stand out clearly. Firstly, all definitions emphasize that creative products or ideas must be novel or original as a fundamental condition (Kaufman & Beghetto, 2009; Plucker et al., 2004; Sternberg, 2016; Torrance, 1965). However, many definitions also state that novelty alone is not sufficient; it must also be useful, meaningful, or valuable (Kaufman & Beghetto, 2009; Sternberg, 2016). Gaut (2010) has termed this approach the 'standard two-element definition'. Additionally, creativity is often considered a cognitive process rather than a product. Researchers such as Torrance (1965) and Rhodes (1961), in particular, emphasize the relationship between creative thinking and mental processes. Conversely, creativity cannot be viewed solely as an individual process; the social and cultural context plays a decisive role in the value of a creation. Csikszentmihalyi (1998) and Plucker et al. (2004), for example, evaluate creativity in conjunction with the interaction between the individual, the product, and society.

Guilford (1950) approached creative thinking as both a process consisting of specific stages and a complex mental activity involving various cognitive abilities. In this context, the following skills have been highlighted as playing an important role in the creative process: sensitivity to problems; the ability to generate many ideas (fluency), flexibility in thinking; the ability to reorganize thoughts; the ability to cope with complex situations, and the ability to evaluate thoughts (Lubart, 2001). Gilhooly (2025) states that the stages of the creative process proposed by Wallas in 1926 (preparation, incubation, illumination, and verification) are still relevant today. Torrance, on the other hand, starts from four basic dimensions of the creative process: fluency (the number of ideas generated), flexibility (the variety of ideas generated), originality (the unusualness of ideas), and elaboration (the detailing of ideas) (Aslan & Puccio, 2006). Lubart (2001) emphasizes that the creative process is not a fixed structure consisting of certain defined stages, but rather a cyclical, individualized, and multifaceted process.

Mel Rhodes's 'Four Ps of Creativity' model has provided an important theoretical foundation for multidimensional research in the field of creativity. Based on four fundamental elements, person, process, press, and product, this model has gained widespread acceptance over time (Rhodes, 1961). When examining definitions of creativity, Rhodes identified these four elements, which tend to overlap and intertwine. The first element, 'person', relates to the personality traits, interests, motivations, and abilities of the creative individual. The second element, process, refers to the

mental operations or creative thinking processes that the individual uses to generate new and original ideas. The third element, press, encompasses the social and physical conditions that influence the individual's creativity, i.e., the interactions between the individual and their environment. Finally, the product represents the tangible output of the creative process. This can take the form of any creative production expressed through linguistic or practical means, such as an idea, a work of art, a proposal for a solution, or an invention.

In PISA 2022, creativity is addressed under two main headings: 'Big-C' and 'little-c' creativity (OECD, 2023). Based on Csikszentmihalyi's (1996) work, Big-C creativity relates to production in fields such as art, literature, science, and technology, while little-c creativity, which can be seen in almost everyone, refers to creative views on everyday situations. However, Kaufman and Beghetto (2009) argue that these two categories are insufficient, instead defining creativity under four headings. This model is known as the 'Four-C Creativity Model'. In this model, mini-c refers to a person producing something new and meaningful for themselves during the learning process (Beghetto & Kaufman, 2007). Small-c encompasses creative thinking and problem-solving skills in daily life; pro-c encompasses professional-level creative production in a specialized field; and Big-C encompasses creative achievements that make history and have a social impact. Mini-c is an individual's unique interpretation of new learning. Creativity at this level is usually related to the learning process and represents something new to the individual (Kanlı, 2021). Pro-c refers to creative production that requires professional-level expertise. However, it may not yet have reached the level of Big-C. This creativity is generally accepted by peers (Kaufman & Beghetto, 2009). Kaufman and Beghetto suggest considering creative production at four distinct levels, ranging from individual learning to professional development, as well as at the daily and extraordinary levels.

Although not synonymous, the concepts of creativity and creative thinking can be used interchangeably (Doğan, 2020). While creativity is associated with mental and performance-based activities, creative thinking is more closely associated with mental activities (Özkale et al., 2020). Creative thinking is a complex process involving the integration of various ideas, emotions, tendencies, abilities, and possibilities (Öz, 2024). PISA defines creative thinking as 'the ability to participate productively in the generation, evaluation and refinement of ideas that could lead to original and effective solutions, advances in knowledge and effective expressions of imagination' (OECD, 2023, p. 147). Creative thinking is a concept that ranks highly in the employee selection processes of many large organizations and is a focus of interest in many different fields. It is also one of the top national education goals (Yükcü Öztürk & Karakuş, 2023).

Creative thinking is not specific to a particular field or individuals, and it is not necessarily measured by academic performance. Furthermore, theoretical definitions commonly emphasize that creative thinking skills interact with cognitive factors and the individual's emotional and internal characteristics, as well as the characteristics of the social environment. The multidimensional nature of creative thinking is one of the fundamental assumptions that guide the field of assessment of creative thinking (Rhodes, 1961; Runco, 2007).

Assessment of Creative Thinking

It can be said that studies in this field generally follow one of two approaches. One focuses on measuring creative thinking potential, while the other focuses on measuring creative output. Tools and methods for assessing creative thinking have been developed in relation to the human, process, and environmental characteristics that affect this potential (Hinton, 1968).

The measurement of certain personality and motivational characteristics stands out among the human characteristics that constitute individuals' creative thinking potential (Amabile, 1983; Sternberg, 2016). Many studies have examined the common characteristics of creative individuals. For example, Gürel and Aslan (2023) describe creative individuals as being curious, patient, adventurous, and able to think abstractly. They are also said to be fond of dreaming, inquisitive, and highly motivated. They have aesthetic standards and are tolerant of the unknown and new ideas. They are energetic and unafraid to take risks. They can make independent decisions and are self-confident. They possess questioning skills and different perspectives. Tests based on Eysenck's personality model or the five-factor personality theory, such as the Eysenck Personality Inventory or the NEO-PI-R Personality Assessment Scale (Taymur & Türkçapar, 2012), are commonly used to measure personality traits thought to be related to creative thinking skills.

Certain motivational characteristics have been identified that make individuals more likely to initiate, sustain, and complete the creative thinking process. One such characteristic is an individual's creative thinking style. Numerous tools have been developed to assess these styles. One example is the widely used Basadur Creative Problem Solving Styles Inventory (Basadur et al., 2014). The Creative Cognition Scale by Rogaten and Moneta (2015) provides results regarding individuals' tendencies to use their creative thinking skills. Another characteristic associated with creative thinking potential is individuals' self-efficacy beliefs regarding creative thinking. The Creative-Self Scale is one of the measurement tools that can be used to determine individuals' beliefs about their creative self-efficacy and creative identity. Attitudes towards the nature of creative thinking are among the characteristics measured in correlational studies. The Creative Mindset Structure Scale is one of the tools developed for this purpose (Karwowski, 2014). Additionally, individuals' perseverance in creative processes is measured. The Motivational Persistence Scale is an example of a tool developed to measure persistence (Constantin et al., 2012).

When measuring creative thinking, the focus is on assessing individuals' thinking skills in terms of process-related characteristics. Among these, the assessment of divergent thinking abilities has been at the center of research. The ability to think divergently is widely accepted as an indicator of an individual's potential to generate original ideas that are also correct and useful (Guilford, 1950). Tests developed for this purpose aim to reveal the extent to which this potential exists in individuals.

One of the first tests developed to measure divergent thinking skills and still used in research today was developed by Guilford. In the “unusual uses” task of this test, individuals are given objects such as bricks or newspapers and must think of all the different uses for them. They must list all the uses that come to mind. In the 'consequences' tasks, participants are presented with hypothetical situations, such as 'all humans losing their sight' or 'gravity decreasing by half', and are asked to list all the possible consequences that come to mind. In non-verbal tasks, individuals are asked to create a new shape by modifying a given shape, such as a circle or square, or by combining two shapes (Guilford, 1956; Sawyer, 2012).

Developed based on Guilford's model, another test widely used in creative thinking research is the Torrance Test of Creative Thinking (TTCT). The TTCT consists of two test forms: verbal and figural. The verbal test includes six different task groups. One of these is the Ask-and-Predict group. In the tasks included in this group, the individual is expected to ask as many questions as possible about the picture shown to them. In the prediction tasks in this group, the individual is asked to predict all the reasons and consequences that come to mind regarding the action shown in the picture. The unusual uses task in this group is the same as the tasks in Guilford's test. In the tasks in the product

development section, the individual is asked to make changes to develop a toy. The tasks in the "Suppose That" group, like the tasks in Guilford's results test, require the individual to assume an unlikely hypothetical situation and list as many consequences of that situation as possible (Kaufman, 2015).

As Guilford (1950) stated, problem solving requires generating multiple ideas (divergent thinking) and selecting one of these ideas (convergent thinking). Recent cognitive science studies indicate that these two types of thinking are used together in the creative process (Beaty & Silvia, 2012; Palmiero et al., 2022). These findings led to the idea that creative thinking tests should measure pluralistic thinking skills, such as asking questions and generating original ideas, as well as convergent thinking skills, such as evaluating and developing ideas (Runco & Acar, 2024). Based on this understanding, the Evaluation of Potential Creativity (EPoC) test was developed. The EPoC measures creative thinking skills in three areas: verbal, figural, and social problem solving. Within these areas, there are four tasks, two of which assess divergent thinking and two of which assess convergent thinking. For instance, in a task assessing divergent thinking in the figural domain, an individual is presented with a shape and asked to produce multiple drawings based on that shape. By contrast, in a convergent thinking task, the individual is shown photographs of various objects and must create a meaningful drawing using at least four of them. In the verbal domain, divergent thinking ability is assessed through tasks involving generating multiple endings or beginnings for a story. Convergent-integrative thinking tasks in this domain involve creating stories based on given titles or characters (Lubart et al., 2013).

Tests that measure creative thinking based on the ability to think in multiple ways calculate individuals' scores in four basic dimensions: fluency, flexibility, originality, and elaboration. In the fluency dimension, scores are obtained that represent the quantity of ideas produced by individuals. Fluency scores are calculated by counting all the ideas that an individual generates in relation to a given task. Flexibility indicates the variety of ideas generated, showing an individual's potential to produce different ideas. Flexibility scores are calculated based on the number of categories into which individuals' responses can be classified. Originality scores reveal an individual's ability to generate unique ideas, i.e., ideas that are considered unusual. These scores are calculated based on how frequently responses are repeated in the group of respondents performing the same task. Individuals who provide responses that are rarely given by others in the respondent group have higher originality scores. Elaboration ability indicates an individual's potential to explain their ideas in a way that answers the 'why' and 'how' questions. In Guilford tests, no scoring is done for this dimension in the verbal section; however, tasks in the figural domain are scored based on the details contained in the drawings (Kaufman, 2015; Sak, 2018).

An important topic of debate in the field of measuring creative thinking skills is whether these skills can be assessed using general or domain-specific tests. Recent studies suggest that individuals' creative potential may differ across domains (Clapham, 2004; Dumas et al., 2016). These findings have informed the development of tests designed to assess creative thinking in educational settings. One example is the 2022 PISA Creative Thinking Test, which is the first international large-scale assessment of creative thinking.

In PISA, students' creative thinking skills were assessed based on their ability to generate various ideas, come up with creative solutions, and develop ideas in novel ways. These skills were assessed in two thematic areas: One of these themes was creative expression, and the other was knowledge production and problem solving. The creative expression domain comprises two subtests: creative

written expression and creative visual expression. In the written expression subtest, students are shown various images and asked to find creative and varied story or title ideas. Additionally, this domain includes convergent thinking tasks such as creating stories based on provided information or developing someone else's writing. Similarly, the visual expression domain includes divergent thinking tasks that require students to produce various creative ideas based on a given scenario using digital drawing tools. There are also convergent thinking tasks that require students to create original drawings and visuals, or to develop those presented to them. The theme of creative knowledge production and problem-solving covers two areas: social and scientific problem-solving. In the social problem-solving area, students are presented with individual or collaborative real-life scenarios and are expected to generate creative solutions to the social problems in the scenario, as well as propose original improvements to the solutions suggested in the task. In the scientific problem-solving area, students are required to generate hypotheses or solution ideas for scientific problems and propose creative improvements to experiments or solutions (OECD, 2023; 2024).

In addition to measuring creative thinking skills using divergent and convergent thinking tasks, a second approach is to measure creative products. In this approach, the creativity of the ideas or products developed by individuals is determined based on the opinions of raters. Two methods are used for this assessment: One is the Consensual Assessment Technique (CAT), which is based on Amabile's (1983) work. This method assumes that experts in a given field can recognize creativity when they see it. The creativity levels of the ideas or products developed by individuals are rated by multiple experts based entirely on their expertise, without any predefined set of criteria. If experts agree that a product is creative, it is accepted as such. However, this method is difficult to use in educational measurement applications due to the high probability of errors arising from subjective opinions, resulting in low inter-rater reliability, and the difficulty of accessing a large number of experts in applied fields. Rather than consensus-based approaches, scoring tools with clearly defined criteria are used to determine the creativity levels of ideas or products developed by individuals (Kaufman, 2015).

In summary, measuring human and process characteristics has been key to assessing creative thinking. Among human characteristics, tools that measure certain personality traits related to creative thinking potential, as well as attitudes, beliefs, and motivational characteristics, have been used. Measurements related to the process have focused on cognitive factors. Tests and tasks have been developed specifically to measure divergent thinking among these factors. However, current tests also include tasks that require convergent thinking skills employed in creative thinking.

The literature on the theoretical foundations and measurement of creative thinking suggests that creative thinking skills can be developed in students, and their progress can be monitored using various measurement tools and tasks. Nevertheless, some argue that schools and teachers fail to encourage students' creativity, potentially harming their innate creative potential (Susnea & Tataru, 2014). In fact, schools are important places where students can think creatively and produce creative work, either individually or as part of a group (OECD, 2024). Beghetto (2016) states that classroom environments play an important role in determining whether creative learning will be supported or suppressed. In this context, it is important to examine the place of creative thinking in educational settings.

Creative Thinking in Educational Settings

In the process of integrating creative thinking into education, Csikszentmihalyi's (1996) distinction

between Big-C and little-c creativity, discussed earlier in this study, offers a valuable theoretical framework. Little-c creativity, referring to everyday, ordinary, and common creativity, aligns with theories arguing that creativity is a socio-cultural interaction process rather than an individual trait (Csikszentmihalyi, 1996; Sawyer, 2011). Alongside studies focusing on the individual aspect of creativity and/or the creation of new and meaningful products, research focusing on the social and/or contextual dimensions of creativity addresses the processes by which creative thinking is supported and developed (Beghetto & Kaufmann, 2014; Niu, 2007). These findings demonstrate that creative thinking can be viewed as a skill that can be developed and internalized, regardless of the production of a concrete, genius-like product. In this context, Vincent-Lancrin et al. (2019) emphasize that educational environments should be structured to bring out the creative thinking potential of all individuals, not just those with specific areas of expertise or extraordinary talents. As Dweck (2017) also states, limiting creative thinking in an educational context to the great creators admired by humanity can be restrictive and may foster a fixed mindset rather than a growth mindset.

Learning Environments That Support Creative Thinking

As creativity is related to context and contextual conditions, it is important to create classrooms and learning environments that encourage creative thinking. Therefore, educational environments should be designed to allow creative potential to emerge, providing a multifaceted, open-ended, and discovery-based learning atmosphere. Learning environments that support creative thinking are defined as physical, social, and pedagogical spaces designed to nurture imagination, problem-solving abilities, the generation of original ideas, and the capacity for flexible thinking. Furthermore, to develop creative thinking skills, learning environments should not only focus on knowledge transfer but also encourage intrinsic motivation and provide opportunities for experiential learning. Research shows that creative thinking develops in environments that possess the following fundamental qualities (Beghetto, 2019; Jeffrey, 2006; OECD, 2024):

- A safe and democratic classroom environment: Students need an environment in which they can express their thoughts without fear of judgment, and where mistakes are accepted as a natural part of the learning process, in order to develop creative thinking.
- Open-ended tasks and authentic learning activities: Tasks that are connected to real life and allow for more than one correct answer develop students' ability to generate original ideas.
- Physical and mental flexibility: Elements such as flexible seating arrangements, colorful and stimulating classroom decorations, and a variety of tools and equipment can support creativity. Being open to change and deviation from plans also paves the way for an environment that supports creativity.
- Diverse learning experiences: Activities such as art, nature trips, interdisciplinary projects, media use, and technology- supported applications nurture different aspects of learners.
- Curiosity and discovery-based pedagogical approach: Learning environments that allow students to formulate their own questions and progress through them naturally encourage creative thinking.
- Confidence in uncertainty and risk-taking: An uncertain environment creates the conditions necessary for new thoughts and actions. A climate of trust allows learners and teachers to take risks and develop new ideas and solutions, supporting creative thinking.

Additionally, there are methods, techniques, and strategies that provide teachers with powerful tools for creating environments that stimulate the fundamental components of creative thinking, such as mental flexibility, originality, and imagination. Brainstorming, which allows learners to generate many ideas in a short time; six thinking hats, which provides a multifaceted perspective; creative problem solving, which structures different solutions to problems; SCAMPER, which enables the transformation of existing ideas; creative drama, which allows feelings and thoughts to be expressed creatively through physical expressions, reverse thinking, which approaches a problem or situation from the opposite direction; story completion, which requires completing an unfinished story in an original way; and visual thinking, which reveals different ways of seeing by sharing feelings and thoughts through a visual image, are some of these (Davies et al., 2014; Kakarla, 2024). All these characteristics and methods point to the relationship between learner-centered learning approaches and the creative classroom. As seen in the study conducted by Horng and colleagues (2005) in Taiwan, classrooms that establish connections between learner-centered classroom activities and real life, include open-ended questions, and support the use of technology to promote the development of creative thinking. A guidance process that enables learners to relate their individual or group-based creative thinking experiences to their context and integrate these experiences into the environment plays a critical role in effectively supporting creative thinking. This guidance process brings to the fore the teacher who thinks creatively and supports creative thinking.

Teacher Who Thinks Creatively

The sustainability of creative thinking in educational settings largely depends on teachers who think creatively (Borodina et al., 2019). Teachers are not just individuals responsible for imparting knowledge; they are also leaders who inspire students' creativity, motivate them, and design learning processes from this perspective. By encouraging reasonable risks and supporting student-centered, flexible activities, creative teachers use their own creativity to build learning environments that trigger students' creativity. Gajda et al. (2017) concluded in their studies that teacher behaviors such as active listening, non-judgmental attitude towards ideas, emotional support, and motivation promote creative learning. Classrooms in which students can freely express their ideas, in which making mistakes is accepted as a natural part of learning, and in which different ways of thinking are respected are the work of creative teachers.

Teacher creativity is not just an individual trait; it is a multi-layered characteristic that is influenced by cultural, pedagogical, and social contexts. Lubart (2010) emphasizes that creativity is perceived differently across cultures. In societies such as Turkiye, where teachers are traditionally seen as carriers of knowledge and figures of authority, students' creative behavior may be influenced by their teachers' perceptions and approval. Therefore, how teachers define creative thinking and what they consider 'creative' can be quite decisive in the classroom. While it is important for teachers to encourage creative thinking, factors such as system expectations, exam anxiety, and classroom discipline may reinforce their tendency to adhere to a structured plan. Teachers' beliefs about learning and teaching can also influence how they support creative thinking in the classroom (Beghetto & Kaufmann, 2014). Beghetto (2021) states that the degree to which teachers support creativity in the classroom is determined by their level of autonomy, whether they have sufficient academic time, and their knowledge of how to support student creativity. Therefore, it is important to outline the characteristics of creative teachers. Davies et al. (2014) state that a distinctive set of teacher behaviors is necessary to support creative thinking. According to them, creative teachers evaluate students' potential from a long-term perspective, basing their teaching on cognitive,

affective, and creative processes. Furthermore, these teachers:

- Open to innovation: They develop original teaching strategies that go beyond traditional methods.
- Intuitive: They allow for improvisation, which can take the learning process beyond what was planned.
- They create an environment of trust. They establish a classroom atmosphere in which students feel comfortable expressing their thoughts. They also make learning enjoyable by frequently using humor and encouraging others to do the same.
- They value supportive ecology: They intentionally design social learning environments that allow for both individual and collaborative processes.
- They allow time and space: They give students the necessary time and space to comfortably engage in creative thinking processes.

In this context, creative teachers influence students with their teaching skills and build environments that activate learners' creative potential. Approaching students as creative individuals, valuing their ideas, and guiding them to develop these are fundamental tasks of creative teachers. They plan and implement a teaching process that goes beyond merely imparting knowledge, effectively using approaches that encourage students to generate original ideas, think outside the box, and solve problems.

Teaching Creative Thinking

As Susnea and Tataru (2014) emphasize, the purpose of creative thinking education is not only to prepare students for the creative and innovative economy, but also to enable individuals to recognize their own potential and approach life creatively. This understanding positions creative thinking as a fundamental component of human development. As Guilford states, considering that the mind is constantly engaged in creative acts, creative thinking, the ability to view events from different angles, and offer various solutions to problems, can also be approached as a learning activity.

As discussed in the section on learning environments that support creative thinking, there are many effective methods, techniques, and strategies for teaching creative thinking, such as brainstorming, SCAMPER, visual thinking, and story completion. Beghetto and Kaufmann (2014) list several characteristics of effective creative thinking teaching, including offering opportunities for choice and discovery, encouraging intrinsic motivation, linking creativity and academic achievement, and fostering imagination. It is useful at this point to mention two fundamental approaches to teaching creative thinking (Davies et al., 2014; Jeffrey & Craft, 2004; Lin, 2014; NACCCE, 1999):

- Teaching creatively: In this approach, teachers use creative methods to make learning more interesting and exciting, and develop their own presentation style by incorporating humor, surprising techniques, and metaphors. Within this framework, creative teaching appears to be more closely related to 'effective teaching'. Therefore, creative teaching is embedded within effective teaching strategies. As Mayer (1989) states, creative teaching involves teaching methods that help students learn new topics and apply what they have learnt to new situations.

- Teaching for creativity: This involves teachers' planning activities that directly develop students' creative thinking skills. Teaching for creativity also encompasses creative teaching. This type of teaching does not follow a specific routine, but it may follow certain general principles. The fundamental components of teaching for creativity are encouragement (encouraging learners to believe in their own creative potential and to think creatively), identification (supporting learners in identifying their strengths in creative thinking skills), and development (guiding learners in developing and strengthening their creative thinking processes). Teaching for creativity involves autonomy, authenticity, openness, respect, and the encouragement of self-actualization.

These two approaches complement each other, and effective creative thinking instruction should incorporate both. However, studies on teaching creative thinking tend to focus more on integrating creative thinking into everyday life than on teaching creativity itself. Lin (2014) therefore suggests addressing both the teacher's creative role (creative teaching) and the student's creative learning process (teaching for creativity). In other words, teaching creative thinking is not merely pedagogical; it is also a learning process that raises learners' awareness of creative thinking. In this context, it can be said that teaching creative thinking shares some common characteristics (Davies et al., 2014; Kampylis & Berki, 2014; OECD, 2024; Vargel et al., 2024). Structured freedom is one such feature. Students are given a space for free thinking, accompanied by appropriate guidance. Another feature is authentic tasks that are relevant to real life and meaningful to the student. Such tasks play a crucial role in developing creative thinking skills. How the student experiences the idea generation process is as important as the process itself. Therefore, another common feature of creative thinking instruction is the ability to provide reflective feedback. Through this feedback, the teacher should comment not only on the final product but also on the process. Finally, allocating sufficient time for creative teaching and implementing it in a way that can be applied to everyday life encourages the process to be approached as a life skill.

Teaching creative thinking should involve pedagogical strategies that respect students' individual differences and nurture creativity. In this process, the teacher acts not only as a transmitter of knowledge but also as a guide who brings out the creative potential of each student. Effective teaching of creative thinking can be achieved by adopting an approach that enables creative thinking. This approach involves presenting students with tasks that require creative thinking in classroom assessments and providing evidence-based feedback on the development of their creative thinking skills.

Assessing Creative Thinking Skill in Educational Settings

It could be argued that the measurement of creative thinking skills is primarily used to identify gifted students or for scientific research purposes. However, as Beghetto and van Geffen (2024) point out, separating creative thinking skills from everyday learning creates inequalities in terms of students' opportunities to demonstrate and develop their creative potential. Furthermore, limiting these experiences to students demonstrating high levels of creative productivity or cognitive performance means that most students miss opportunities to recognize their creative potential and contribute creatively. When assessing creative thinking skills in educational settings, three important points must be considered. The first is the tasks used in the assessment tools, the second is the criteria considered in feedback processes, and the third is the measurement approach adopted.

Tasks that require creative thinking enable students to utilize their divergent and convergent

thinking skills to generate original ideas, solutions, and products. Tasks that do not have a single correct answer and allow students to develop numerous, diverse, and unusual ideas, solutions, and products based on their knowledge and experience should be used in the classroom to ensure that students use their creative thinking skills. Tasks requiring scientific creative thinking can be used in subjects such as science and mathematics. These tasks should encourage individuals to develop various solutions, products, and ideas by using their skills in hypothetical and abstract thinking, hypothesis development, and designing experiments to test these hypotheses. Tasks included in scientific creativity tests can be structured to match desired learning outcomes for students in the classroom. For instance, one of the tasks in a test created by Hu and Adey (2002) asks students to consider what life would be like without gravity. Science lessons focus on the effects of physical phenomena such as gravitational force, heat transfer, and energy cycles, as well as the cycles and results they produce. Scientific problem-solving tasks of this kind can help students to develop a deeper understanding of cause-and-effect relationships and to think hypothetically about different environments or conditions. Other tasks included in the scientific creativity test require students to draw a design for an apple-picking machine and label each part with its name and function. They are also asked to think of different ways to divide a square into four equal parts. In science and mathematics, students can work on tasks that require them to use abstract thinking skills, either to create a unique whole from parts or to divide a whole into unique parts. Other tasks in the same test require students to think of ways to compare the effectiveness of two products or objects.

Similarly, the Scientific Creativity Test developed by Ayas (2010) requires students to design an experimental setup according to a given hypothesis or to modify an experimental design in the fields of physics, chemistry, biology, and ecology. These types of tasks can require students to use their science and mathematics knowledge to predict outcomes in given situations, as well as design environments, situations, or experiments that will confirm these outcomes. Hypothesis development tasks, in which students are shown results and asked to explain them, can also be used to develop and measure creative thinking skills in scientific creativity tests. For instance, Ateşgöz's (2020) Animated Scientific Creativity Test for Children presents students with various situations and asks them to generate as many hypotheses as possible based on these. Such tasks can be used in the classroom to develop and monitor students' scientific problem-finding skills.

In the field of social studies, tasks that require individuals to generate diverse and original solutions to personal and interpersonal problems can be included. For instance, Okuda et al. (1991) employed a task in their real-life multiple-thinking tests that presented students with the scenario of missing an essential part of a lesson due to a friend's disruptive chatter during class. The students were then asked to generate as many solutions as possible to this problem. Plucker et al. (2006) asked students to generate ideas about how they would respond to an invitation to go sailing when they had a project due the next day that would take up their entire day. Tasks used in social studies classes can be based on situations related to school, home, and community life. This enables students to develop different, varied, and original solutions to such situations.

Writing activities, particularly in native or foreign language classes, significantly contribute to the development of creative thinking skills. As McVey (2008) states, writing itself is a process of idea generation and creative thinking. Tasks that require creative thinking can be used to develop reading and writing skills. Such applications are beginning to be included in large-scale testing programs. For instance, the 2026 National Assessment of Educational Progress (NAEP) has defined the cognitive level of 'application and use' as corresponding to creative thinking skills within the reading

comprehension framework. At this level, students are expected to use the information they obtain from a text to create their own writing (National Assessment Governing Board, 2021). As previously mentioned, the EPoC creative expression test includes tasks such as generating creative story ideas based on provided clues about events and characters and creating alternative beginnings or endings for a given story (Lubart et al., 2013). Supporting the development of creative expression skills can be achieved by having students work on tasks such as structuring their own opinion essays, developing creative stories, and modifying stories creatively in the classroom. The development of these skills can then be monitored based on performance in such tasks.

When assessing creative thinking in the classroom, the main objective is to monitor the development of students' creative thinking skills and provide feedback, rather than assigning a value to their creativity. As previously stated, creativity in educational settings is defined in terms of originality and usefulness (OECD, 2023; 2024). Teachers generally tend to focus on whether the answer is right or wrong in their feedback (Bolden et al., 2020). However, when providing feedback on answers or performances in tasks designed to develop creative thinking skills, it is necessary to focus not only on accuracy but also on the three accepted criteria for creativity. Specifically, teachers should provide feedback on the quantity, variety, and originality of ideas or solutions generated by students.

Research indicates that providing feedback on one's own ideas and those of one's peers (i.e., self and peer feedback) contributes to the development of creative thinking skills. Furthermore, research findings show that feedback processes contribute more to students' creative thinking skills when there are defined criteria guiding both teacher and self- and peer-feedback (Bolden et al., 2020). Based on these findings, in addition to using tasks that require students to engage their creative thinking skills for classroom assessment, it is necessary to implement processes involving teacher, peer, and self-feedback regarding responses to and performance in these tasks. In each of these processes, criteria such as fluency (the ability to generate many ideas), flexibility (the ability to generate diverse ideas), and originality (the ability to generate unusual ideas) should be considered, as well as accuracy. It is also important to develop clear, shared definitions of fluency, flexibility, and originality in the minds of teachers and students, using examples of creative and non-creative student responses to classroom tasks.

Barriers to Fostering Creativity in Education

As previously stated, a creative learning environment is an ecosystem where students feel safe, can take risks, and view mistakes as learning opportunities. However, certain factors related to cultural codes and beliefs on creativity, educational policies, and curricula can pose a risk of hindering creative environments. For example, many teachers may have inaccurate or incomplete concepts about creativity (Ata-Akturk & Sevimli-Celik, 2023; Mullet et al., 2016; Sun et al., 2025). In addition to these shortcomings, teachers may associate the questioning and independent thinking characteristics of creative students with perceptions of them as disruptive and unruly (Bereczki & Karpati, 2018; Kasirer & Schitzer-Meirovich, 2021; Yeşilyurt, 2020). Furthermore, the belief that creative thinking is an innate trait rather than a developable potential may also prevent teachers from implementing creative practices in their classroom activities.

The exam-focused education system creates concerns among teachers about content delivery. This can limit inquiry-based creative activities that require time and involve uncertainty. Educational programs that reduce creative thinking to only project/research-based activities may also fail to

provide teachers with sufficient guidance on creative classroom applications (Hadar & Tirosh, 2019; Yeşilyurt, 2020).

Like other higher-order thinking skills, creative thinking skills develop over time. As previously stated, it is also known that these skills interact with an individual's emotional characteristics and those of their social environment. When classroom assessments focus on grading and results, they negatively impact the development of students' creative thinking skills. In his research with middle school students, Baer (1998) found that the prospect of receiving a score or grade reduced creativity, particularly among female students. Furthermore, teachers state that an assessment approach focused on tests and grading causes them to prioritize success in the classroom over creative thinking skills. These findings emphasize the importance of conducting classroom assessments using a formative approach. By contrast, widely used creativity assessment tools such as the Torrance Tests of Creative Thinking (TTCT) and the Evaluation of Potential Creativity (EPoC) rely predominantly on on-demand tasks, assessing creative thinking through short-term, single-session, and highly structured performances. While these tools provide information about individuals' idea-generation capacities at a given moment, they capture only a limited aspect of creative thinking, which is inherently iterative, feedback-sensitive, and developmental over time. In educational contexts, where the primary aim of assessment is to support the recognition and development of creative potential rather than classification, exclusive reliance on on-demand tasks appears pedagogically insufficient. From a formative assessment perspective, extended performance task–based approaches allow creative thinking to be monitored and supported over time, making it possible to focus on processes of idea development, revision, and transformation. Accordingly, a more educationally meaningful assessment of creative thinking requires the complementary use of both on-demand and extended task approaches within a formative assessment framework. Such an approach prioritizes gathering evidence about students' creative thinking processes over time and using this evidence to provide targeted, process-oriented feedback. By shifting the focus from grading or judging final outcomes to supporting learning and development, formative assessment practices create more equitable opportunities for students to recognize and develop their creative thinking skills (Beghetto, 2005; Kula-Kartal, 2022).

Conclusions and Implications

This theoretical review aims to provide a comprehensive examination of the educational dimensions of creative thinking in the context of theoretical approaches, assessment tools, and classroom applications. It emphasizes that creative thinking is a multidimensional process shaped by pedagogical environments, teacher guidance, and classroom-based measurement and assessment practices, rather than merely an individual talent. Classroom assessments, feedback, and learning environments sensitive to creative thinking play a critical role in supporting the development of this skill. From an evaluation perspective, assessing creative thinking in educational settings should extend beyond short-term, on-demand performances and incorporate extended, process-oriented tasks that make students' creative thinking development visible over time. Such an approach aligns with formative assessment principles, as it enables teachers to collect evidence about how students generate, elaborate, revise, and transform ideas, rather than focusing solely on final products or scores. Teachers should therefore develop teaching and assessment strategies that support creative thinking by using open-ended questions and tasks that require multiple thinking skills and allow for diverse solutions. The evidence obtained from these practices should be evaluated not only in terms of scientific accuracy but also according to criteria widely accepted in the field of creative

thinking, such as fluency, flexibility, and originality. Moreover, feedback processes grounded in these criteria should be used to guide learning, encourage risk-taking, and support students' recognition and development of their creative potential, thereby contributing to higher-quality and more equitable educational practices.

The study is expected to provide a theoretical framework for integrating creative thinking into education systems and to facilitate the development of recommendations to guide teacher training and classroom practices. Furthermore, it is expected to serve as a reference source for researchers and practitioners. While the study's focus on the theoretical foundations of creative thinking, its role in educational settings, and how it can be assessed makes it comprehensive, it also has some limitations. The current study addressed creative thinking in educational contexts, and the literature review was conducted within this framework. Future research could use quantitative, qualitative, or mixed methods to explore teachers', teacher candidates', and students' experiences of developing, teaching, and assessing creative thinking. Studies can also be conducted to reveal how creative thinking develops in different cultural, social, or interdisciplinary contexts, and how this is reflected in educational environments.

Declarations

Ethics statement: Since it is a theoretical based review study, the current study does not require ethics committee approval.

Author Contributions (CRediT): S. Kula Kartal: Conceptualization, Investigation, Methodology, Writing-original draft, Writing – Review & Editing Y. Aslan: Conceptualization, Investigation, Writing-original draft, Writing – Review & Editing S. Çöğmen: Investigation, Methodology, Writing-original draft, Writing – Review & Editing.

Funding: This research received no specific grant from any funding agency.

Conflict of Interest: The authors declare no conflict of interest.

AI Tools Disclosure: The authors used ChatGPT (OpenAI) solely for language refinement and grammar correction during the revision process. No AI tool was used to generate research ideas, theoretical content, data, analysis, or interpretations. All substantive intellectual contributions were made by the authors.

Data Availability Statement: Since it is a theoretical based review study, the current study does not have any available data.

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