

Creativity training programs in primary education: A systematic review and meta-analysis

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ABSTRACT

The aim of the systematic review was to examine the effectiveness of creativity training programs, interventions, or practices on creativity or divergent thinking in typical developing primary education pupils. A systematic review protocol was designed and implemented, and a systematic literature search was conducted across diverse electronic platforms and databases, as well as other resources. The final sample of high methodological quality studies reviewed was 6. A narrative content analysis approach was adopted, and a random effects analysis with restricted maximum likelihood was used to conduct the meta-analysis. The meta-analytic estimate of the overall effect size of the combined studies shows moderate effect across all studies. The results suggest that some programs, interventions, or practices exist that can effectively help teachers, practitioners, and policy makers to promote creativity or divergent thinking in school-aged children.

1. Introduction

Creativity is an essential human resource, one of the most important abilities required in the social and working domains in the 21st century (Jenaro-Río et al., 2019; Lucchiari et al., 2019). This is mainly due to the multiple and complex social, economic, and technological changes faced by today's society, and the need to keep pace with those changes and to meet challenges in the modern world (Said-Metwaly et al., 2021). Creativity is linked to the development of new social institutions and the leadership of existing ones (Mumford, 2002). If in previous decades creativity has usually been limited to specific subjects such as visual arts or music, it is now considered an ability that is constantly related to all areas of knowledge (Sátiro, 2012). As a result, in recent decades there has been an increased interest in the study of creativity in different fields of research.

Creativity is a dynamic and multidimensional construct, involving cognitive, personality-related, and environmental factors, so it is difficult to provide a single and universally recognized definition (Lucchiari et al., 2019; Said-Metwaly et al., 2021; Van de Zanden et al., 2020). Nonetheless, Guilford (1975) defines creativity as the "capacity or ability to generate alternatives from given information, with emphasis on the variety, quantity and relevance of the results" (p. 40). Therefore, the act of creating could be defined as the process of generating original (i.e., novel, unusual, or unique) and effective (i.e., useful, fit, or appropriate, with value) ideas or products (Runco & Jaeger, 2012), a complex process, which requires skills to integrate different cognitive processes (Jenaro-Río et al., 2019).

Indeed, convergent thinking and divergent thinking are involved in the creative process because, while divergent thinking is the

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basis of creativity, convergent thinking provides the prior knowledge necessary to create (Guilford, 1975). Convergent thinking consists of the production of a result that is completely determined by the given information, in which established guidelines are followed and the received teachings are reproduced (Prieto et al., 2002). Munari (2018) states that memorizing or having as much information as possible generates more connections between different things, which facilitates the development of creativity and imagination in a child, providing the prior necessary knowledge. By contrast, divergent thinking is defined as “the intellectual process that the organism carries out from a given information (raw material) tending to produce quantity and variety of information (result), starting from the same source” (Núñez-Gómez et al., 2020, p. 737). This intellectual process is an important predictor of creative thinking, as both share the same cognitive processes (Segundo et al., 2020). In fact, divergent thinking is considered “the cognitive key to creativity” (Valgeirsdóttir & Onarheim, 2017, p. 431). In this regard, creative thinking has been defined as the ability to generate new concepts or solutions, although underlying this process of observing and analyzing a problem from different perspectives are other thinking processes that are based on the subject’s skills, understanding, motivation, knowledge, and emotions (Lucchiari et al., 2019).

In the creativity literature, problem solving (i.e., a process of closing the gap between a current and a desired situation) is often linked to creative thinking (Isaksen et al., 2011; Runco, 2014). However, as Isaksen et al. (2011) state, there are at least two different kinds of approaches to problem-solving: creative and non-creative thought processes. A creative approach emerges when individuals work on ill-defined, ill-structured, unspecified, or open-ended problems, with multiple appropriate solutions (i.e., individuals need divergent thinking), while when individuals work on a well-defined, well-structured, specified or closed-ended problems emerge a non-creative approach (i.e., individuals need convergent thinking) (Isaksen et al., 2011; Pretz et al., 2003). Problem solving often has creative thinking aspects, but creative thinking is not always problem solving (Isaksen et al., 2011).

In relation to the nature of creativity, there is strong support for theories that state that the ability to generate new ideas in a problem situation is inherent in the generative and adaptive nature of human thinking (Segundo et al., 2020; Wang, 2012). Many authors indicate that creativity is an inherent human trait, but that it needs to be cultivated, as its improvement depends on the subject’s knowledge, skills, and attitudes (Garaigordobil, 2006; Pérez, 2009). Certainly, creativity has been studied from different perspectives (Beghetto & Kaufman, 2007): (a) from a subjective level, creativity has been understood as a product or result of the learning process; and (b) from an intersubjective level, creativity has been considered a means for learning, since through the creative resolution of tasks and the sharing of ideas the development of divergent thinking is favored. Moreover, it has not only been understood as a means or end of learning but has also been associated with variables that have influenced it. Creative thinking, as Pérez (2009) states, is influenced by evolutionary, social, and educational factors. However, these are not the only factors that condition the development of creative thinking. As collected by Scott et al. (2004), novel and original problem solving is influenced by the cognitive processes that everyone possesses, by affective factors and even the motivational aspects that drive the creative effort.

There is evidence to suggest that creativity can be developed through training and facilitated through creative environment and interventions (Gutman & Schoon, 2013). In this line, a pragmatic approach to creativity emerged in the 1980s that promoted the development of creativity within the educational context (Prieto et al., 2003). Since that time, interest in creativity in schools has been increased to the point where it has been recognized as an essential ability to improve performance and productivity in different life domains (Lucchiari et al., 2019). Furthermore, the organisation for Economic Co-operation and Development highlights creativity as one of the key educational goals for the 21st century (Lucas et al., 2013; Said-Metwaly et al., 2021). Authors like Robinson (2011) argue that today’s schools must prepare students for the uncertain future that awaits them. Children need to develop creative thinking to successfully deal with complex situations and provide original solutions to many problems in their daily lives (Kashani-Vahid et al., 2017).

Nevertheless, fostering creative capacity in schools requires assessment of the creative thinking skills (Jenaro-Río et al., 2019). There is currently little consensus on the best procedure to measure creativity, although one of the few classifications of methods to measure it distinguishes between (Freund & Holling, 2008): (a) self-reports or observational scales, which are mainly inventories that measure the intensity of behaviors and observable creative activities or achievements; and (b) standardized tests, which is also possible to classify them distinguishing between verbal standardized tests (i.e., participants must give a verbal response), and figurative standardized tests (i.e., participants must draw the solution) (Gajda et al., 2017). From this perspective, one of the most widely used standardized tests to measure creativity in children and adolescents is the Torrance Test of Creative Thinking (TTCT) (Torrance, 1990), which assesses four creative thinking skills (Almeida et al., 2008; Clapham, 2004; Prieto et al., 2003; Scott et al., 2004; Torrance, 1990): (a) fluency, number of adequate and non-redundant verbal responses; (b) flexibility, diversity or variety in verbal responses; (c) originality, novel, uniqueness or unconventional of verbal responses; and (d) elaboration, refinement of verbal responses or the number of details that enhance the creative output. Additionally, there are other standardized tests that assess these same creative thinking skills, such as the “Test zum Divergenten Denken: Kreativität” (Test on Divergent Thinking: Creativity) (Mainberger, 1977), “Test di Creatività Infantile (TCI)” (Test of Child Creativity) (Antonietti & Cerioli, 1992; Gilberti et al., 2004), Test for Creative Thinking–Drawing Production (Urban & Jellen, 1996), “CREA-Inteligencia Creativa (CREA)” (Creative Intelligence) (Corbalán et al., 2003), or “Prueba de Imaginación Creativa-Niños (PIC-N)” (Creative Imagination Test-Children) (Artola et al., 2010).

According to De Bono (1994), all children have creative potential, the problem is knowing the procedures, strategies, techniques, resources and/or activities to develop it. Corbalán et al. (2003) argue that the development of creativity requires a context of disinhibition, motivation, and free production, while Davies et al. (2013) recommend creative learning environments for this (i.e., flexible use of space and time, appropriate materials, working out-side the classroom/school, “games-based” approaches, peer collaboration, partnerships with outside agencies, etc.), and Gutman & Schoon (2013) focus on several interventions that have been development to try and promote it (i.e., creativity programs, mentoring programs, service-learning programs, outdoor adventure programs, and social and emotional learning programs). Many studies have confirmed that play stimulates creativity, especially in the early years, where there is no difference between playing and learning (Garaigordobil & Berruenco, 2011; Hammershøj, 2021). Play is the first creative

activity of the child and stimulates curiosity, flexibility, imagination, improvisation, etc. (Garaigordobil, 2006; Garaigordobil & Berruero, 2011; Hammershøj, 2021; Pramling & Asplund, 2008; Russ, 2003). During the process of experimentation, the quality of inputs should not be judged in the first instance, but the ability to make inputs should be valued. Beguette and Kaufman (2007) propose that the educational goal should be to stimulate children's ability to develop new interpretations and ideas. This stimulation therefore requires a school environment where standardization, and routine and strictly regulated behaviors are avoided, because these situations allow for quick and linear responses that limit the creative process (Lucchiari et al., 2019).

More concretely, considering the evidence that suggests that creativity can be experimentally manipulated, several Creativity Training Programs, Interventions or Practices (CTPIP) have been implemented and evaluated throughout the last decades. CTPIP have been characterized by having the main objective of increasing the creativity or divergent thinking of the participants through a set of sessions with a predefined structure and, although there is no consensus on how they should be designed and planned (Valgeirsdottir & Onarheim, 2017), Scott et al. (2004) recommended the establishment of the following common guidelines for their design and planning: (a) the activities proposed for the development of creativity or divergent thinking should be based on a previous cognitive process; (b) the training provided during the development of the program should be relatively challenging for the subject receiving it; (c) training should also be approached from a contextual perspective; and (d) the program should include a series of practical exercises to apply the strategies acquired. Therefore, there is still a lack of competent integration and analysis of data that could lead to more systematic shared practices (Lucchiari et al., 2019).

In addition, evidence on the effectiveness of CTPIP remains elusive (Valgeirsdottir & Onarheim, 2017). Our scoping search has identified only three systematic reviews in students or general population focusing on the impact of CTPIP (i.e., Davies et al., 2013; Scott et al., 2004; Valgeirsdottir & Onarheim, 2017). However, the reliability level of the evidence provided by these systematic reviews on the effectiveness of CTPIP is low, because the number of studies based on robust evaluation research designs (e.g., Randomized Control Trial –RCT) that includes is clearly insufficient. Indeed, Valgeirsdottir & Onarheim (2017) propose a methodological research standard consisting of three criteria (i.e., measure creativity of participants both pre- and post-training, use an attention-placebo control group, and ensure a sufficient sample size), to which researchers can look when designing and planning future research of the effectiveness of CTPIP.

In this sense, in order to improve creativity or divergent thinking, teachers and practitioners need, among other factors, to have access to high-quality evidence-based programs and/or practices, but those types of interventions can only be identified by systematic reviews, which are widely believed to provide the best evidence to inform decision-making (Stewart et al., 2012). The differences between our systematic review and those referred to above are that (a) we have implemented a pre-specify protocol based on international high-quality standards for systematic reviews (The Campbell Collaboration, 2019); (b) we have included studies published since 2000 in order to add to previous systematic reviews rather than replicate them; (c) we have only included studies based on robust evaluation research designs (Slavin, 2008; Valgeirsdottir & Onarheim, 2017); and (d) we have only included studies of typical development pupils between the ages of 6 and 12 years, because of two reasons. On one hand, this age group corresponds to primary education in the Spanish educational system (i.e., grades 1 to 6 of primary education in Spain; grades 1 to 6 of elementary school in the United States of America, and years 2 to 7 –key stage 1 to key stage 3– in the United Kingdom). On the other hand, as Said-Metwaly et al. (2021) point, at the end of this age group takes place the commonly coined “seventh-grade slump” (i.e., a temporary decline or significant drop in the development of divergent thinking which occur at around age 12), where CTPIP have to take into account other specificities associated with neurobiological changes of puberty, the emergence of hypothetical reasoning and abstract thinking, etc.

Therefore, taking previous considerations into account, the aim of this study was to identify, describe, evaluate, and synthesize research on the effectiveness of CTPIP on creativity or divergent thinking in typical developing primary education pupils. In addition, the research questions to answer were:

- 1 What are the salient features of the studies (i.e., geographical and temporal distribution, type of publication, sample selection procedure and group configuration, sample characteristics, standardized test to measure creativity or divergent thinking, and methodological designs) on CTPIP?
- 2 What are the most relevant characteristics of the CTPIP (i.e., duration, environment in which they are developed, intervention procedures, practices, strategies, techniques, resources, activities)?
- 3 What are the evidences accounting for the effectiveness of CTPIP on creativity or divergent thinking in typical developing primary school pupils?

2. Method

2.1. Inclusion and exclusion criteria

The review team developed a systematic review protocol following Campbell Systematic Reviews Policies and Guidelines (The Campbell Collaboration, 2019). We decided to follow these policies and guidelines for this systematic review due to its specific development and adaptation to the field of social sciences. The access to this protocol (Ruiz-del-Pino & Fernández-Martín) is available upon request to the contact author.

The eligibility criteria were defined in relation to the objectives of the systematic review. First, the operational characteristics of independent and dependent variables were established as follows.

CTPIP (independent variables or interventions). According to the definition proposed by Valgeirsdottir and Onarheim (2017), a CTPIP is a “predefined and structured program consisting of one or several sessions, with the main goal of increasing the creativity of

one or several participants” (p. 432). Additionally, [Scott et al. \(2004\)](#) summarized the four key aspects of the optimal delivery format for creativity training:

First, training should be based on a sound, valid, conception of the cognitive activities underlying creative efforts. Second, this training should be lengthy and relatively challenging with various discrete cognitive skills, and associated heuristics, being described, in turn, with respect to their effects on creative efforts. Third, articulation of these principles should be followed by illustrations of their application using material based on “real-world” cases or other contextual approaches (e.g., cooperative learning). Fourth, and finally, presentation of this material should be followed by a series of exercises, exercises appropriate to the domain at hand, intended to provide people with practice in applying relevant strategies and heuristics in a more complex, and more realistic context. (p. 383)

Therefore, this type of intervention usually aims at improving creativity or divergent thinking, while the comprehensive, prior, and planned design of these practices seem to be crucial to their effectiveness ([Valgeirsdottir & Onarheim, 2017](#)). In this regard, in order to be included, studies had to evaluate CTPIP.

Creativity or divergent thinking (dependent variables or outcomes). Although there is no agreement on the definition of creativity, many authors stand out that creativity is the result of a combination of originality, novelty, usefulness, and compliance with the constraints of a task, within a specific sociocultural context ([Beghetto & Kaufman, 2007](#); [Gajda et al., 2017](#); [Kashani-Vahid et al., 2017](#); [Said-Metwaly et al., 2021](#); [Simonton, 2012](#)). However, according to [Gajda et al. \(2017\)](#), this combination is the result of a product of the factors that form it; consequently, for something to be considered creative it is not enough that it is original or that it only meets the constraints of the task it is intended to address. The most common way of operationalizing creativity in Psychology and Educational Science has been divergent thinking or “the ability to generate multiple relevant and original alternative responses in response to a single problem or stimulus” ([Guilford, p. 48](#)). Divergent thinking has long been recognized as one of the central cognitive components of creative potential ([Said-Metwaly et al., 2021](#); [Valgeirsdottir & Onarheim, 2017](#)). Therefore, in order to be included, studies had to report on creativity or divergent thinking outcomes, measured through standardized tests ([Valgeirsdottir & Onarheim, 2017](#)).

Second, this review only included studies adopting RCT or Quasi-Experimental Design (QED) with comparison group (i.e., random assignment and/or matching with appropriate adjustment for any pretest differences) ([Campbell & Stanley, 1963](#)), because these provide the strongest evidence that programs rather than some other factor caused the improvement in creativity or divergent thinking ([Slavin, 2008](#); [Valgeirsdottir & Onarheim, 2017](#)). Moreover, studies had to have at least 30 students in each treatment and control group ([Slavin, 2008](#); [Valgeirsdottir & Onarheim, 2017](#)).

Third, eligible participants were typical developing pupils between the ages of 6 and 12 years, because this age group corresponds to grades 1 to 6 of primary education in the Spanish educational system (i.e., first years of compulsory education), before the “seventh-grade slump” ([Said-Metwaly et al., 2021](#)).

Fourth, time restriction was applied to this systematic review. The period covered in this study extends from 2000, the end-date of the studies reviewed by [Scott et al. \(2004\)](#) systematic review, onwards until 2021.

Fifth, no geographical and/or cultural restrictions were included. However, the language of publication was English and Spanish.

2.2. Search strategies

The review team aimed to obtain a comprehensive set of relevant studies that offered an unbiased perspective on the effectiveness of CTPIP on typical developing primary education pupils’ creativity or divergent thinking. To this end, the search for relevant literature was based on a wide variety of sources to ensure the inclusion of all those studies, published and unpublished, related to the topic of the review. Thus, the search process included a primary search, searching electronic platforms and databases, and a complementary search, searching other resources and hand searching of relevant websites, literature snowballing, and contacting experts. This search was conducted during March 2021.

Primary search was performed using the following electronic platforms and databases: Web of Science, Proquest, Scopus, OvidSP, EBSCOhost, Taylor & Francis, Springer Link, Science Direct, REDINED, Redalyc, and Dialnet.

After the primary search previously outlined, a complementary search was carried out to identify other potentially relevant studies. The resources selected for this search were the following: (a) a general web search was conducted using Google Scholar (including advanced search options) to identify potential unpublished studies; (b) hand searches: Reference lists of included studies and reference lists of relevant reviews were also searched; (c) personal contacts with national and international researchers were made to identify unpublished reports and ongoing studies; (d) ongoing research: Community Research and Development Information Service, Regard database of Economic and Social Research Council, center for Review and Dissemination, NBER Working Papers, and The Campbell Collaboration; (e) open access (gray literature): OpenGrey, GreyNet International-gray Literature Network Service, National Technical Information Service, COncnecting Repositories, and Directory of Open Access Repositories; (f) relevant institutions and networks (evidence networks): What Works Clearinghouse, Evidence for ESSA, Educational Evidence Portal, European Literacy Policy Network, IPPI center, IZA World of Labor, The Campbell Collaboration, and Social Science Research Network; and (g) additional key journals: Creativity Research Journal, Creativity and Innovation Management, International Journal of Design Creativity and Innovation, Journal of Creative Behavior, Journal of Educational Psychology, Psychology of Aesthetics, Creativity and the Arts, Roeper Review, and Thinking Skills and Creativity.

The search terms reflected the inclusion criteria, tried to strike a balance between sensitivity and specificity, and were selected using the Thesaurus. The search strategy was adapted according to the specifications of each electronic platform, database, and website. For sources with advanced search functions, the review team classified search terms were according to four categories (i.e.,

independent and dependent variables, study design, and participant population), which were combined by the Boolean operator “AND” (and they were also excluded by the Boolean operator “NOT”) to identify potentially relevant studies in each source in title, abstract and keywords. For sources with basic search functions, we adjusted the search terms to limited functionality of search functions (e.g., combination of keyword searches and/or topic/theme searches, or separate keyword searches). For example, the terms and strings used for the Proquest search were the following: (“program*” OR “train*” OR “intervention*” OR “practice*”) AND (“creativ*” OR “divergent think*”) AND (“experiment*” OR “randomized control” OR “control group”) AND (“primary” OR “elementary” OR “children” OR “pupils”) NOT (“qualitative study” OR “case study” OR “action research” OR “single subject design” OR “descriptive study” OR “correlational study” OR “case study” OR “kindergarten” OR “secondary” OR “high school” OR “pre-school” OR “preschool” OR “university” OR “higher education” OR “vocational education” OR “teenager*” OR “adolescent*” OR “disab*” OR “disord*” OR “disadvant*” OR “dysfunction” OR “gift*” OR “minorit*” OR “special education”).

Zotero software (Corporation for Digital Scholarship, n.d.) was used to manage and document the search process, because it allows decision tracking for each identified study throughout the search process. In this sense, bibliographic information of studies from sources was imported into Zotero, and records of the search process were kept.

As part of the selection process, the following tasks were implemented: (a) the first screening level was aimed at identifying and removing duplicate records, studies published before 2000, and studies which, based on their titles, were clearly related to other fields or topics; (b) the second screening level was aimed at identifying and removing those studies which did not meet the inclusion criteria, after further examination of the title and abstract; and (c) at the third screening level, after excluding studies published in languages other than English and Spanish, the full text versions of studies were read in order to confirm: (i) the study’s involving a CTPIP, (ii) reporting on creativity or divergent thinking outcomes, using a quantitative measures of creativity or divergent thinking, (iii) adopting either RCT or QED with comparison group methodological designs, and (iv) in a sufficient sample size consisting of typical developing pupils between the ages of 6 and 12 years. The first screening level was conducted by a single reviewer, as only studies that were obviously not relevant were excluded at that point. However, all the studies remained were examined in pairs at the second and third screening level, and a screening guide was used in these screening levels. Based on the review’s inclusion and exclusion criteria, discrepancies were resolved by further review of the respective titles, abstracts and full text, and discussion by the review team.

Data and information from selected sample of studies were extracted and coded independently by two reviewers, who resolved their differences, and it was verified by the other research team member. A data extraction sheet was created, and each selected study was coded for the following descriptors (Lipsey & Wilson, 2001): (a) contextual features (i.e., reference, country, and type of publication); (b) methodological characteristics (i.e., sampling and research design); (c) sample characteristics (i.e., size, mean and range age); (d) independent variables (i.e., CTPIP name, environment, duration, procedures, practices, strategies, techniques, resources, activities, etc.); (e) dependent variables (i.e., outcomes and instruments); and (f) results and conclusions.

Finally, a narrative content analysis approach was adopted (Dochy, 2006), and standardized mean difference Effect Sizes (ES) were calculated using the ES tool on the Campbell Collaboration website (Wilson, n.d.). We used a random effects analysis with restricted maximum likelihood to conduct the meta-analysis, while *Q*-statistic and *I*² were used to assessing degree of heterogeneity, and *Z*-statistic was used to check whether the combined results of this meta-analysis are significant or not (Borenstein et al., 2009).

Statistical analyses were carried out using JASP v0.11.1 (The JASP Team, Amsterdam, The Netherland).

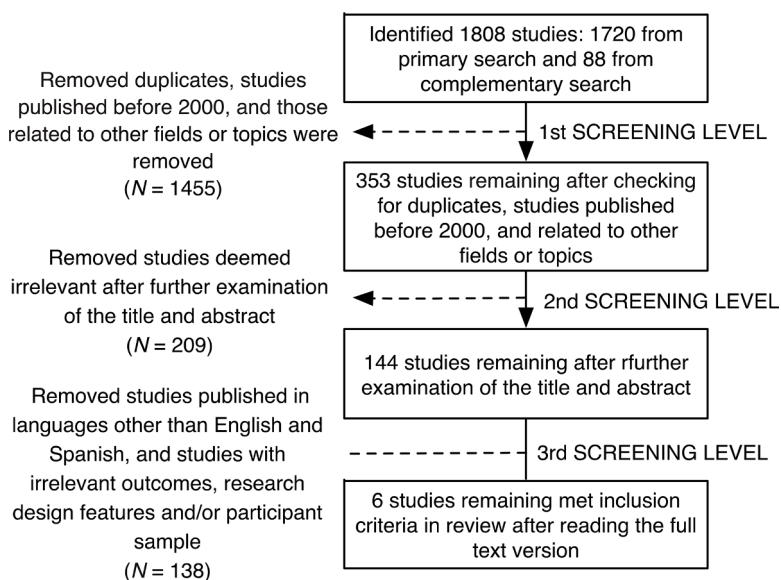


Fig. 1. PRISMA flowchart for the literature search and screening.

Table 1

Main contextual features of the studies and characteristics of the CTPIP.

Study	Country	Type of publication	Sample size Experimental (E) vs. Control (C)	Grade (age)	Sampling	Study design Statistical analysis	Standardized tests	CTPIP	Duration	Procedures, practices, strategies, techniques, resources, activities, etc. Environment in which CTPIP are developed
<i>*Colombo et al. (2014)</i>										
	Italy	Journal article	76 E = 44; C = 32	2 (7 - 8)	Non-Probabilistic (2 schools were not randomly chosen)	QED (4 classes were randomly assigned: 2 experimental group and 2 control group) Bivariate	TTCT figural subtest (Torrance, 1990)	Narrative video-training	3 sessions of 2 h each	Research aims to test the efficacy of a video-training in environmental sustainability attitudes throughout creative thinking. The video narrative consists of 13 short audiovisual clips. Each video asks for children's help or challenges them to do something. Each challenge is focused on a creative operation (Widening-Connecting-Reorganizing), which the pupils have to apply to an environmental problem. Program was implemented by the group's class teacher under the supervision of a researcher during school time.
<i>Garaiordobil (2006)</i>										
	Spain	Journal article	86 E = 54; C = 32	5 - 6 (10 - 11)	Probabilistic (2 schools were randomly chosen)	QED (4 classes were randomly assigned: 2 experimental group and 2 control group) Multivariate	TTCT (Torrance, 1990)	Creativity program	Weekly 2-hr session throughout academic year	The program was developed based on creativity, cooperation, and play. It involved two or three recreational activities and their corresponding debates or dialogues about the results of the activities performed. The games of the intervention program (i.e., transformations of animals, adverts, printing objects, new names for familiar objects, funny drawings, and incredible telephone conversations) aim to develop creativity in different domains such as verbal, graphic-figural or constructive; and to stimulate socioemotional and communicative development (e.g., communication, cohesion, confidence). The games have five structural characteristics: participation, communication, cooperation, fiction and creation, and fun. Program was implemented during school time. The sessions were led by the group's class teacher (trained for it) with the help of a researcher and always followed the same procedure.

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Table 1 (continued)

Study	Country	Type of publication	Sample size Experimental (E) vs. Control (C)	Grade (age)	Sampling	Study design Statistical analysis	Standardized tests	CTPIP	Duration	Procedures, practices, strategies, techniques, resources, activities, etc. Environment in which CTPIP are developed
<i>*Jenaro-Río et al. (2019)</i>										
	Spain	Journal article	64 E = 32; C = 32	1 - 6 (6 - 13)	Non-Probabilistic (Students were not randomly chosen)	QED (Students were not randomly assigned) Bivariate	PIC-N (Artola et al., 2010)	Creativity workshop	9 months, 2 sessions per week of 2 h each	All the activities are designed under a model of participation and personal involvement in the creative process, in its formal, material and content aspects. The activities, individual or group, are numerous and varied: painting on canvas, making three-dimensional works with different materials, use of the notebook of ideas, illustration of stories, use of electronic devices for the Stop Motion technique, etc. Program was implemented during after-school time by the researchers (extracurricular activity context).
<i>*Lucchiari et al. (2019)</i>										
	Italy	Journal article	224 E = 180; C = 44	2 - 3 (7 - 9)	Non-Probabilistic (3 schools were not randomly chosen)	QED (10 classes were not randomly assigned: 8 experimental group and 2 control group) Bivariate	TCI (Antonietti & Cerioli, 1992; Gilberti et al., 2004)	Creativity training	10-week training one-hour sessions, once a week	This program includes a series of group games and exercises. The aim of the interactive activities was to induce children to produce new ideas, the ability to imagine multiple ways to use an object, and the capacity to think potential consequences to events. The training mostly consisted in dialogical sessions, maieutic conversations, and ludic activities with the students, including drawings. Program was implemented by the group's class teacher under the supervision of the researchers during school time.
<i>*Prieto et al. (2002)</i>										
	Spain	Journal article	105 E = 53; C = 52	1 (6)	Probabilistic (2 schools were randomly chosen)	QED (4 classes were randomly assigned: 2 experimental group and 2 control group) Multivariate	TTCT figural subtest (Torrance, 1990)	Creativity Development Programme (Renzulli, 1986)	120 training activities throughout academic year	This program aims to encourage the development of creative skills: fluency, flexibility, originality, and elaboration. The program consists of 5 manuals to encourage divergent thinking in primary school children. Each manual contains 24 creativity training activities. It consists of a set of materials and tasks for teachers and children to learn to express their creative potential. The activities included in this program are

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Table 1 (continued)

Study	Country	Type of publication	Sample size Experimental (E) vs. Control (C)	Grade (age)	Sampling	Study design Statistical analysis	Standardized tests	CTPIP	Duration	Procedures, practices, strategies, techniques, resources, activities, etc. Environment in which CTPIP are developed
*Segundo et al. (2020)	Spain	Journal article	60 E = 30; C = 30	4 - 5 (9 - 10)	Non-Probabilistic (1 school was not randomly chosen)	QED (Students were not randomly assigned) Bivariate	CREA (Corbalán et al., 2003)	Program of reading and writing	7 weeks, 12 sessions of 120 min each throughout second trimester of the academic year	<p>designed to teach children to broaden their way of seeing and analyzing the world. Program was implemented by the group's class teacher during school time.</p> <p>This program is made up of a structured set of reading and writing activities. It was administered in the classroom. It included a total of 10 different activities which were based on the basic contents of the official curriculum: narrative-telling and fables, theater, poetry, didactics of biography and poetry, among others. All activities of the program were carried out in cooperative groups. Program was implemented by the group's class teacher during school time.</p>

3. Results

The overall search and screening process is depicted in a PRISMA flowchart (Page et al., 2021) (Fig. 1).

The reliability of the coding was 92% (it was never below 90% for any single item).

The total of studies selected belong to 2 countries (i.e., Spain and Italy), and they were parts of journal publications. The studies were published between 2002 and 2020, and the publication languages were English ($n = 4$) and Spanish ($n = 2$). In terms of total sample, 615 participants were examined in these studies ($M = 102.5$ participants), with a range between 60 and 224 participants. Sampling techniques were mainly non-probabilistic.

In relation to the research design, all studies adopted quasi-experimental designs with comparison group. The dominant statistical analyses were bivariate (e.g., t -test, U test), and the standardized test most frequently used to measure creativity or divergent thinking was TTCT (Torrance, 1990).

Regarding the most relevant characteristics of the CTPIP identified, each of them focused on different procedures, practices, strategies, techniques, resources, activities, etc., to achieve the expected impact (i.e., playful, and dialogical activities; problem or challenge activities to be solved through creative thinking; audiovisua clips; plastic and artistic activities; and cooperative reading and

Table 2
Evidence on the Effectiveness of CTPIP.

Study	Outcome	Statistically significant results	ES	Main conclusions
Colombo et al. (2014)				
	Fluency (Graphic-figural creativity)	*	0.363	Results proved that training promotes children's creativity. Experimental group gained a significant improvement in each of the 4 creativity factors assessed. Although the control group improved as well, it was much lower than the experimental group's improvement.
	Flexibility (Graphic-figural creativity)	*	0.376	
	Originality (Graphic-figural creativity)	*	0.742	
	Elaboration (Graphic-figural creativity)	*	1.482	
Garaigordobil (2006)				
	Fluency (Verbal creativity)	–	0.012	Results suggest a positive effect of the intervention, as the experimental participants significantly increased their verbal creativity (originality) and graphic-figural creativity (originality, elaboration). The program produced a significant improvement in those experimental participants who in the pretest phase, before the play program began, showed low creativity.
	Originality (Verbal creativity)	*	0.642	
	Flexibility (Verbal creativity)	–	0.176	
	Originality (Graphic-figural creativity)	*	0.533	
	Fluency (Graphic-figural creativity)	–	0.013	
	Elaboration (Graphic-figural creativity)	*	0.569	
Jenaro-Rio et al. (2019)				
	Graphic-figural creativity	–	–0.024	The most notable quantitative improvements were in perception and imagination. After the intervention, the experimental group scored significantly higher than the control group in verbal and general creativity.
	Verbal creativity	*	0.672	
	Total creativity	*	0.755	
Lucchiari et al. (2019)				
	Fluency (Verbal creativity)	*	0.578	Results showed a significant difference between the positive effect of the program in the experimental group and the unchanged results in the control group.
	Flexibility (Verbal creativity)	*	0.591	
	Originality (Verbal creativity)	*	0.593	
Prieto et al. (2002)				
	Fluency (Graphic-figural creativity)	–	0.309	The results make apparent the positive effects of the intervention in improving creativity, which vary according to the aspect of creativity evaluated. As for the total score on the creativity test, a shift towards a higher score is observed in the experimental group, while the control group experiences a minimal change with a slight decrease in the total score on the test.
	Flexibility (Graphic-figural creativity)	*	0.390	
	Originality (Graphic-figural creativity)	*	0.416	
	Elaboration (Graphic-figural creativity)	–	0.206	
	Total creativity (Graphic-figural creativity)	*	0.401	
	Total creativity	*	0.830	
Segundo et al. (2020)				
	Total creativity	*	0.830	Results showed that improvement was significantly greater in the experimental group as compared with the control group, suggesting that the intervention had an impact on creative thinking. Specifically, 90% of the children in the experimental group improved scores after the intervention, in contrast with only 43% of the children in the control group.

Note. ES = effect size; * $p < .05$.

writing activities). The duration of the CTPIP analyzed was variable, ranging between the 5 sessions of 1 h each and 9 months, 2 sessions per week of 2 h each. CTPIP were implemented mainly in school time, and the sessions were led by the group’s class teacher under the supervision of the researchers.

Table 1 show the main contextual features of the studies and characteristics of the CTPIP.

The meta-analytic estimate of the overall ES of the combined studies was 0.48 (95% Confidence Interval [CI] = 0.34, 0.62). Q-statistic (750.70; $p < .001$) shows that the ES are heterogeneous, while $I^2 = 98.38\%$ also means that the data are heterogeneous, confirming therefore that the effectiveness of CTPIP differed across studies. Moreover, the results of the studies show an improvement in the creativity or divergent thinking of the children in the experimental groups after the application of the CTPIP compared to the results obtained by the control groups. Table 2 shows the main evidence on the effectiveness of CTPIP.

Fig. 2 shows the forest plot enabling visual observation of the heterogeneity of ES in each of the selected studies. Z-statistic (6.88, $p < .001$) indicates a combined evidence denoting a non-null (significant) effect.

4. Discussion

The aim of this systematic review was to identify, describe, evaluate, and synthesize research on the effectiveness of CTPIP on creativity or divergent thinking in school-aged children. In this sense, regarding the first research question, the results obtained show that Spain and Italy have been the countries that have made the greatest commitment over the last two decades to the implementation and, especially, the systematic and rigorous evaluation of CTPIP in primary education. Obviously, the number of studies included in this review can be considered small, especially when compared to the number of studies included in other reviews on CTPIP (e.g., Scott et al., 2004; Valgeirsdottir & Onarheim, 2017). However, these results are determined by the high number of studies on CTPIP that have been excluded throughout the selection process of this systematic review, mainly because they adopted qualitative, pre-experimental or quasi-experimental designs, with quite some limitations in sample size or intergroup comparability.

In relation to the second research question, the results show that most of CTPIP have been implemented by teachers under the supervision of the researchers during school time, with a variable duration, including a wide variety of procedures, practices, strategies, techniques, resources and/or activities (e.g., playful, dialogical, artistic, cooperative activities). Regarding to the model of teacher professional development used (e.g., whether teachers had one-off training days, or if a support network was established, or whether the professional development was enhanced through a teacher learning community) or teachers’ beliefs about the modifiability of creativity, unfortunately, all the studies but one, do not report information on this issue. This underreporting data problem is particularly troublesome as it prevents determining the influence of these potential moderators when implementing a meta-analysis on the effectiveness of CTPIP. Therefore, it is important to emphasize the need for this information to be reported by primary research studies in the future.

These results align with those obtained by Scott et al. (2004), and clearly unveil that there is still no agreement on what

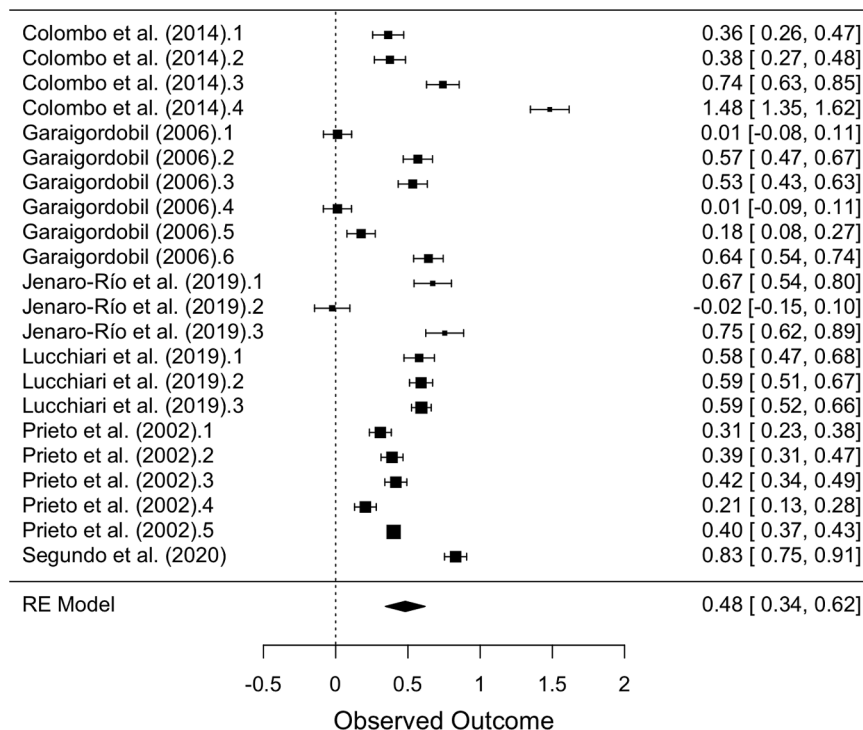


Fig. 2. Forest plot of the ES and CI of each study.

methodology should be used mainly in CTPIP to further enhance the typical developing primary education pupils' creativity or divergent thinking. Creativity or divergent thinking can be enhanced through various methodologies, not only through the performance of artistic activities as it is commonly trained (Sátiro, 2012). Nonetheless, it has been observed that most of CTPIP share a common basis: (a) the notion of creativity or divergent thinking (i.e., the ability to generate multiple alternative solutions as opposed to the one correct solution); (b) a wide variety of activities based on a previous cognitive process, which are relatively challenging from a contextual perspective and include a series of practical exercises to apply the strategies acquired (Scott et al., 2004); and (c) the use of standardized tests to quantify their results, such as TTCT (Torrance, 1990).

In addition, the results of this study reveal the importance of using curricular and extracurricular spaces for the promotion of creativity or divergent thinking, as established by Jenaro-Río et al. (2019). CTPIP carried out in extracurricular contexts included in this review agree that in the school context, intervention proposals should also be designed and worked by the group's class teachers on in the classroom to significantly increase motivation and the strengthening of creative thinking skills focused on the characteristics of creativity or divergent thinking. The school offers an environment rich in interactive experiences and expressive possibilities, which can be optimal for the promotion of creativity or divergent thinking (Segundo et al., 2020; Beghetto & Kaufman, 2014).

Regarding the third research question, it is relevant to highlight that most of the experimental groups of the studies on CTPIP included in this review have significantly improved their scores on creativity or divergent thinking in the post-test phase compared to the results obtained by the control groups. In fact, the value of the overall ES shows moderate effect (Cohen, 1988) across all studies, which can be considered of an important practical relevance (Hattie, 2009). Therefore, it is observed how typical developing primary education pupils' creativity or divergent thinking can be exponentially enhanced through training, and following this reasoning, it is demonstrated that CTPIP influence the development of their creative potential, as already exposed by authors such as Scott et al. (2004), and Valgeirsdóttir & Onarheim (2017). The creative thinking skills that seem to be most influenced by the CTPIP are flexibility and originality, while fluency and elaboration are the most resistant to change. These results support the findings of Prieto et al. (2002), who state that flexibility and originality are the skills most characteristic of creativity or divergent thinking. Elaboration seems to be less related to the creative process and more to conceptual organization and semantic relations (Prieto et al., 2002).

On the other hand, contrary to expectations, the control groups in most of the studies selected in this review experienced a decrease in their scores on creativity or divergent thinking at the end of the implementation of the CTPIP. These results may be due to multiple factors, such as the impoverishment of creativity or divergent thinking in the absence of stimulation, the negative impact of the promotion of other more academic skills throughout the school year, or even teachers' negative perceptions of students' behaviors associated with creativity or divergent thinking, as already evidenced by Gajda et al. (2017).

Finally, it should be highlighted that none of the studies provide evidence on whether the gains in the experimental groups or losses in the control groups are maintained over time. In this regard, CTPIP should include in their design, planning and implementation the evaluation of their effectiveness in the medium and long term.

4.1. Limitations

The limitations of this systematic review require that the results obtained should be approached with caution, because: (a) the period covered extends from 2000 onwards until March 2021, so literature published before and after that dates has not been included in the review; (b) the amount of gray literature included is limited, despite the use of the different search engines that collect this type of literature, which may have increased the threat of publication bias; (c) researcher bias in selecting studies may have influenced the final sample, although its effects were attempted to be attenuated by the parallel development of the selection process by two reviewers, resolving any dissonance with the participation of the other research team member; and (d) the number of studies included is not very high, although, as stated by Slavin (2016), the power of the available evidence on the effectiveness of the CTPIP can be considered "moderate", as they are supported by at least one quasi-experimental study, allowing them to qualify as evidence-based practices.

4.2. Conclusion

This integrated and comprehensive systematic review with meta-analysis of all CTPIP in school-aged children studies released between 2000 and 2021, using rigorous inclusion criteria designed to align with evidence-based practices movement, yielded a moderate positive effect and significant impacts for creative or divergent thinking skills. Therefore, taken together, the current findings provide support for the effectiveness of CTPIP on creativity or divergent thinking in typical developing primary education pupils. These results suggested that some programs, interventions, or practices exist that can effectively help teachers, practitioners, and policy makers to promote creativity or divergent thinking in school-aged children.

In this view, our findings are generally consistent with previous reviews focusing on CTPIP, so it will be essential to continue to explore for which procedures, practices, strategies, techniques, resources and/or activities are most effective and strengthen the effects of CTPIP on creativity or divergent thinking in school-aged children. Nevertheless, these findings emphasize the need to implement more studies based on robust evaluation research designs in order to increase the quality of the research in this field and highlight opportunities for improving the quality and rigor of CTPIP. Additionally, in order for future review studies to provide higher quality evidences on this topic for educators, more primary research studies should focus on research topics like when starting school later, or how play activities can boost creativity.

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CRedit authorship contribution statement

B.R., F.D.F., and J.L.A. were responsible for conceptualization, funding acquisition, investigation, methodology and project administration. B.R. was responsible for data curation. F.D.F. was responsible for formal analysis and software. All authors were responsible for resources, supervision, validation, visualization, writing - original draft and writing - review & editing, and have read and agreed to the published version of the manuscript.

Declaration of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The access to data and study materials is possible under request to the authors.

References with an asterisk (*) refer to studies included in this review

Data Availability

Data will be made available on request.

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