The Journal of Creative Behavior

WILEY

ORIGINAL ARTICLE OPEN ACCESS

Fostering Creativity Through Educational Interventions in Higher Education: A Systematic Review

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Received: 12 December 2024 | **Revised:** 14 October 2025 | **Accepted:** 27 October 2025

Keywords: didactics | teaching and learning | training | university

ABSTRACT

Creativity has gained relevance over the years in education, and especially recently due to its consideration as a transversal competency in higher education, but there is still a lack of integration of knowledge. This qualitative systematic review explores literature on educational interventions designed to enhance creativity and investigates possible changes regarding the influence of COVID-19. A pre-planned comprehensive search strategy was conducted across prominent databases (Web of Science, PsycINFO, and EBSCO). We used SANRA and ENTREQ as quality control. A total of 86 studies met our criteria. Our findings reveal no specific results regarding the influence of COVID-19. Our results show a peak of the publications in 2016, the predominance of the USA, the prevalence of these interventions in Social Sciences, and the increase of the impact and reach of such scientific articles. In addition, our data reveals the relation between concepts such as creativity, higher education (HE), creative thinking, critical thinking, or creative training. Moreover, these outcomes suggest didactic methods to foster creativity such as project-based learning, problem-based learning, and experiential learning. The implications of this review are related to the design, implementation and evaluation of the teaching and learning process, alongside the didactic process in higher education.

1 | Introduction and Background

Creativity plays a crucial role in contributing to history and cultural heritage, education, and innovation (Union Europea 2021), improving the quality of life and fostering inclusive, equitable, and sustainable development (United Nations General Assembly 2020). It is a highly demanded skill for overcoming situations of adversity, social inequalities, and the appropriate use of natural resources and biodiversity (UNESCO 2022a). UNESCO emphasizes the importance of creativity in education to address global uncertainties and encourages the consideration of creativity policies as a global public good in the digital environment and creative ecosystems (UNESCO 2015, 2018, 2022a, 2022b). Similarly, the OECD reports that many countries integrate creativity into educational policies (Maslin et al. 2023), although challenges and inequalities remain, as highlighted by PISA 2022 results (OECD 2024; Vincent-Lancrin et al. 2019).

Creativity is a complex and multifaceted phenomenon without a single definition (Amabile 1996; Ruiz-del-Pino et al. 2022). It is considered a resource for problem-solving, scientific discoveries, and the creation of social, artistic, and educational programs

(Sternberg and Lubart 1999), challenging conventional beliefs, personal assumptions, historical cultural presuppositions and limitations, and uncertainty (M. Runco 2022; Sawyer and Henriksen 2023a; R. J. Sternberg 2017). Various models have been proposed to study creativity, including psychometric, cognitive, humanistic, componential, and evolutionary approaches[1] (Megalakaki et al. 2012; Cabrera 2018), gaining significant interest in the 1950s (J. P. Guilford 1950). However, before that and according to Sawyer and Henriksen (2023b), the contributions of Galton, Poincaré, Terman, Vygotsky, and Wallas were influential in areas like psychometrics and the creative process, as Quintilian's Inventio in the first century (De Herrán 2012).

Nowadays, among the best-known models, we have the P-creativity model (P for psychological), which refers to everyday creativity, while the H-creativity model (H for historical) refers to historical creativity, which is outstanding and impacts human history (Boden 1998). Another framework divides the field into sub-personal (biological foundation), personal (cognitive and psychosocial domain), im-personal (epistemological context), and multi-personal (sociological or domain-related studies) (Gardner 2021). The well-known "Four P" model (addressing who, how, what, and where of creativity), corresponds to the categories of person, process, product,[2] and press (Rhodes 1961); or situation (MacKinnon 1975); or environment (Sikora 1979); or places (R. Sternberg 1988); or enhancement context (De la Torre 2006). Another proposal is the "Five A's" model, comprising: Actor (individual or group involved), Action (activities and processes to generate creativity), Artifact (tangible product or result), Audience (people who interact with and interpret it), and Affordance (limitations and opportunities of the environment for creativity) (Glăveanu 2013).

From a cognitive psychology perspective, creativity involves cognitive processes, personal traits, life development, and social context (Simonton 2000), including metacognitive and environmental factors (Lebuda and Benedek 2023; Said-Metwaly et al. 2021). It considers problem sensitivity, idea fluency and flexibility, generation of alternatives, and evaluation ability (J. P. Guilford 1950, 2017), which depends on both the creator and the audience (Abraham 2024).

Furthermore, the connections between the progress of creative ideas, their meaning, affect, and synergistic extrinsic motivation by those who participate and can influence and be influenced by the environment (Amabile and Pratt 2016). In this regard, there are different types of constraints that can come from the person, the creative task, or another external situation and act as inspiration promoters (Tromp 2023), as well as emerging from contexts of resilience (Sánchez Hernández et al. 2017). Driving elements of creativity include relevant domain skills, relevant personality and cognitive processes, and intrinsic task motivation (Amabile 2018). Also, the "creative flow," which involves being present in the moment, achieving an optimal and enjoyable experience, and contributing to the quality of life (Csikszentmihalyi 2014). As well as "openness to experience" in the context of art-oriented creativity, and "openness to intellect" in scientific creativity (Kaufman et al. 2016).

Therefore, it is important to keep in mind the relevance of context for creative processes (Abraham 2022) and their sequence of thoughts and actions involved in producing an original and valuable product (Lubart 2018). The creative environment favors learning and knowledge networks (Fan and Cai 2022). Furthermore, for a result or product to be considered creative, it must meet some criteria, such as having novelty and value (Newell et al. 1958); or having operational, existential, social, artistic, and symbolic structures (Gutman 1967); or degree of originality, relevance, complexity, and transformative power (Taylor and Sandler 1972); or originality, effectiveness, appropriateness, and communication (Amabile 2018).

In addition, creativity can be considered beyond its cognitive abilities and environmental factors. It is a way of being in the world, open to experience and self-realization (Maslow 2016). From this perspective, creative human relationships are proposed, linked to self-awareness individually, socially, and universally (Blay Fontcuberta 2008). One of the greatest obstacles is not the lack of creative skills, but the failure to deploy these skills, and, above all, addressing the purpose of creativity, with hope in positive ethical values, transformative creativity, with wisdom and for the common good (Sternberg et al. 2024).

Therefore, creativity is not only a skill at the individual level but is a transversal competence that can influence different levels of a system or organization, whether social, scientific, or educational such as higher education (Latorre-Cosculluela et al. 2020). The diversity of models reflects the complexity of creativity. Amabile's (1996) componential model emphasizes domain-relevant skills, creative thinking, and intrinsic motivation. Sternberg and Lubart (1999) integrate multiple dimensions, including the mystical, psychodynamic, psychometric, pragmatic, cognitive, social-personal, and confluence perspectives. Csikszentmihalyi (1998) proposes a systemic approach based on the interaction between the individual, the field, and the domain. Later models, such as the interactive theory (De la Torre 2006), evolutionary creativity (De la Herrán 2008), and the CCC model (Cabrera 2018), further expand this vision toward systemic creativity, human evolution, and complexity.

Creativity, as a systemic competence, involves disciplines and contexts relevant to research in higher education (Vallejo López et al. 2020), connecting the various elements of a system, such as people, processes, products and knowledge, such as designing sustainable solutions in engineering careers (Jiménez Galán 2019) with the aim of adapting, innovating and transforming complex environments and a future of work. In this sense, creativity must integrate a multifaceted vision, with different perspectives and knowledge for generating ideas in a process of collaboration and collective interaction among various disciplines and fields of knowledge (Morin 2011). As well as an educational reform that addresses contextualized knowledge (Morin 2021), such as the current implications of Artificial Intelligence (AI) in higher education linked to the development of creativity (Franco-Lazarte 2024), together with the ethical approaches it entails (Nguyen 2025).

Therefore, in addition to disciplinary subjects, the development of critical and scientific thinking is required (García-Carmona 2023); alongside systemic thinking with collaboration skills (Stefaniak et al. 2025); divergent and

convergent thinking (Runco and Acar 2012; Rawlings et al. 2025); and creative thinking with intrinsic motivation (Csikszentmihalyi 2014; Ryan and Deci 2020). Regarding the limitations of this approach, we could briefly point out that cognitive theories that evaluate creative thinking skills are not considering emotional or contextual factors. On the other hand, their strength is that they operate in a measurable way in tests. Furthermore, the component approaches mentioned, offer a broad and multifactorial view of creativity, but they are difficult to objectively measure.

These mentioned skills promote courage, curiosity, and resilience; they generate and disseminate knowledge that supports social, cultural, ecological, and economic development; and they also foster creativity to adapt to labour market demands (UNESCO et al. 2016). Recently, creative thinking has been defined as a competency in internal and external learning contexts that require imagination and expression of the inner world, with the aim of generating original and effective solutions for the advancement of knowledge and research (OECD 2024). In this sense, creative students are better prepared to develop innovative solutions from different perspectives (Elisondo 2015), which makes creative thinking necessary for both teachers and students (de Carvalho et al. 2021). In line with cognitive and componential approaches to creativity, the most commonly used pedagogical strategies to foster creative talent include autonomous creation projects, collaborative work and cooperative learning, enriched learning environments, and the role of the teacher as a mentor or facilitator (Reis et al. 2021), as well as co-creation strategies aimed at fostering collective creativity (Bovill 2020) and interdisciplinary collaborative projects that promote critical thinking and innovation (Xu 2025).

For all the above reasons, we consider it essential to integrate current knowledge about creativity into educational interventions at the higher education level. Nevertheless, we cannot think about current education without considering the impact of the global outbreak of the COVID-19 disease (WHO 2023). This outbreak has impacted the progress of the 2030 Sustainable Development Goals (Navarro 2020; United Nations 2020, 2021, 2022) and, specifically, on Goal 3 and Goal 4, as reflected in the concern and commitment expressed, among others, by the Conference of Rectors of Spanish Universities CRUE Comisión Universidades Españolas para la Agenda 2030. (2021). In this sense, this systematic review aims to explore and synthesize existing literature on educational interventions designed to enhance creativity among students in higher education, and to investigate possible changes in fostering creativity through educational interventions regarding the influence of COVID-19. An educational intervention, in this context, refers to a structured and intentional pedagogical strategy or program designed to enhance students' creative abilities through specific teaching methods, activities, or learning environments.

So, taking all this into account, we proposed the following main research question:

a. Are there any educational changes in fostering creativity in higher education due to the influence of COVID-19?

In addition to this initial research question, we also consider the following inquiries:

b. What is the timeline of the educational interventions in creativity?

c. Which contexts have implemented educational interventions in creativity?

d. What are the disciplines and fields of knowledge involved in the educational interventions in creativity?

e. What is the influence and the reach of educational interventions in creativity?

f. What are the concepts of the educational interventions in creativity?

g. What are the most important concepts extracted from this body of scientific literature and how do they relate to each other?

Attending to these research questions, we present the following sections of this research article.

2 | Methods

2.1 | Design

The purpose of this qualitative systematic review, with a preplanned comprehensive search strategy, was to analyze the educational interventions of creativity in higher education and if it produced any educational changes in fostering creativity due to the influence of COVID-19.

2.2 | Databases and Search Strategy

This study adhered to the PRISMA guidelines for systematic searches (Page et al. 2021) on the chosen topic about creativity and educational interventions in higher education. In this sense, data sources for this systematic review were scholarly and empirical journal articles resulting from three electronic databases searches carried out in Web of Science, PsychInfo, and EBSCO (CINAHL Complete, E-Journals, Library, Information Science & Technology Abstracts, Teacher Reference Center, MILA Directory of Periodicals, MILA International Bibliography with Full Text, PSICODOC). The scale for assessing narrative review articles (SANRA) (Baethge et al. 2019) and the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) (Tong et al. 2012) were used as a quality control check of this review. This article focuses on the peer-reviewed. journal articles involving creativity and higher education published from any date up to April 1, 2022. The search string was developed with the following terms:

((TS=(creativity)) AND TS=("higher education" OR university OR universities OR undergraduate OR "bachelor degree" OR "bachelor's degree" OR "college degree") AND TS=("educational methods" OR "teaching methods" OR "educational innovations" OR "educational intervention" OR "educational resources" OR "educational technology" OR "interdisciplinary approach in education"

TABLE 1 | Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Type of articles: scholarly and empirical research, peer-review articles.	Type of articles: no original data such as reports, opinions, editorials, essays, doctoral thesis, systematic reviews, proceedings, and books or chapter of books.
Study populations and context: university students at any stage level.	Study populations and context: any other students or non-university students.
Keywords: Creativity.	Keywords: Not including creativity.
Thematic: higher education and educational interventions.	
Period: Published from any date up to April 1, 2022.	Article access: No abstract available (first round) and articles which couldn't be recovered (second round).
Publications criteria: written in Catalan, English, Galician, Portuguese, and Spanish.	Publications criteria: written in any other language.

OR "learning activities" OR "learning strategies" OR "motivation in education" OR "reading teaching methods" OR "science teaching methods" OR "social sciences teaching methods")).

2.3 | Eligibility Criteria

To systematically select studies adhering to specific criteria, we established explicit inclusion and exclusion criteria before initiating the search. Our criteria were designed contemplating the following items: (1) type of articles, (2) study populations and context, (3) keywords, (4) thematic, (5) period of time, and (6) publications criteria. To sum them up and offer a clear view on them, we present the Table 1:

2.4 | Study Selection

The PRISMA flow diagram (see Figure 1) illustrates the data collection and screening procedure of the systematic review. The search yielded a total of 1756 articles after eliminating repeated research (39), so a total of 1717 articles were screened with inclusion and exclusion criteria (see Table 1) in three rounds. The first two rounds were done in couples by consensus by the three researchers (CR-S, JCC, and VV-H); the last one was done by two of the researchers. The analysis of the first two rounds was performed following the consensus method (Arana et al. 2016; Arnau Gras et al. 1990), and the third one was performed separately by two researchers.

The first round was carried out by the three researchers, reviewing the articles in blinded peer-to-peer, and then displaying a consensus if needed, following this system: CR-S reviewed the total of the articles (100%), JCC reviewed half of the articles (50%), and VV-H reviewed the other half of the articles (50%). The screening was done by title and keywords. The titles, the keywords or the subjects of the articles must include the word "Creativity", or related words such as: "Creative thinking," "Creative development," "Creative English," "Creative ability in children," "Creative ability," "Creative ability study and teaching," "Creativeness," "Creative," "Creating," "Creative teaching thinking," "Creative ability in technology," "Creativity (Linguistics)," "Creative ability in science," "Creative ability testing," "Creative teaching," "Creativity in programming," "Creative space," 'Creative college," 'Creative collaboration," "Creativity measurement," 'Creative writing," "Creative and cultural education," "Creative in counseling," "Dance creativity," "Creative problem finding," "Creative drama education," "Creative design," "Creative reasoning." As a result of this first round of analysis following our inclusion and exclusion criteria, we obtained a total of 1118 articles.

The second round was carried out by the three researchers. In the screening, the researchers could consult the full text if needed to clarify whether or not the article was meeting the criteria. The screening was about the abstracts of the articles and they must meet the three following criteria: (1) the language of the article must be in English, Spanish, Catalan, Galician, or Portuguese (so excluding articles written in languages such as Korean, Taiwanese, or Chinese); (2) the study population must be directed to higher education (so including undergraduate, graduate, master's, or PhD studies); (3) the aim of the article must be oriented to communicate the empirical fostering of creativity in the higher education classroom (so excluding systematic reviews, theoretical articles, essays, editorials, interviews, and such). The consensus followed this system: CR-S reviewed the total of the articles (100%), JCC reviewed half of the articles (50%), and VV-H reviewed the other half of the articles (50%). As a result of this second round of analysis following our inclusion and exclusion criteria, we obtained a total of 155 articles.

The third round was carried out by two of the researchers. In the screening the researchers could consult the full text if needed to clarify whether or not the article was meeting the criteria. The full text of the articles must meet the following conditions: (1) being available to read, and (2) meeting the inclusion criteria listed above. Furthermore, for being able to extract data from the articles, we designed a table of contents with the following items: number, author(s), year, title, aim, applied intervention (yes or no, and the name of the intervention if needed), methodology, strategies, main results, context, educational

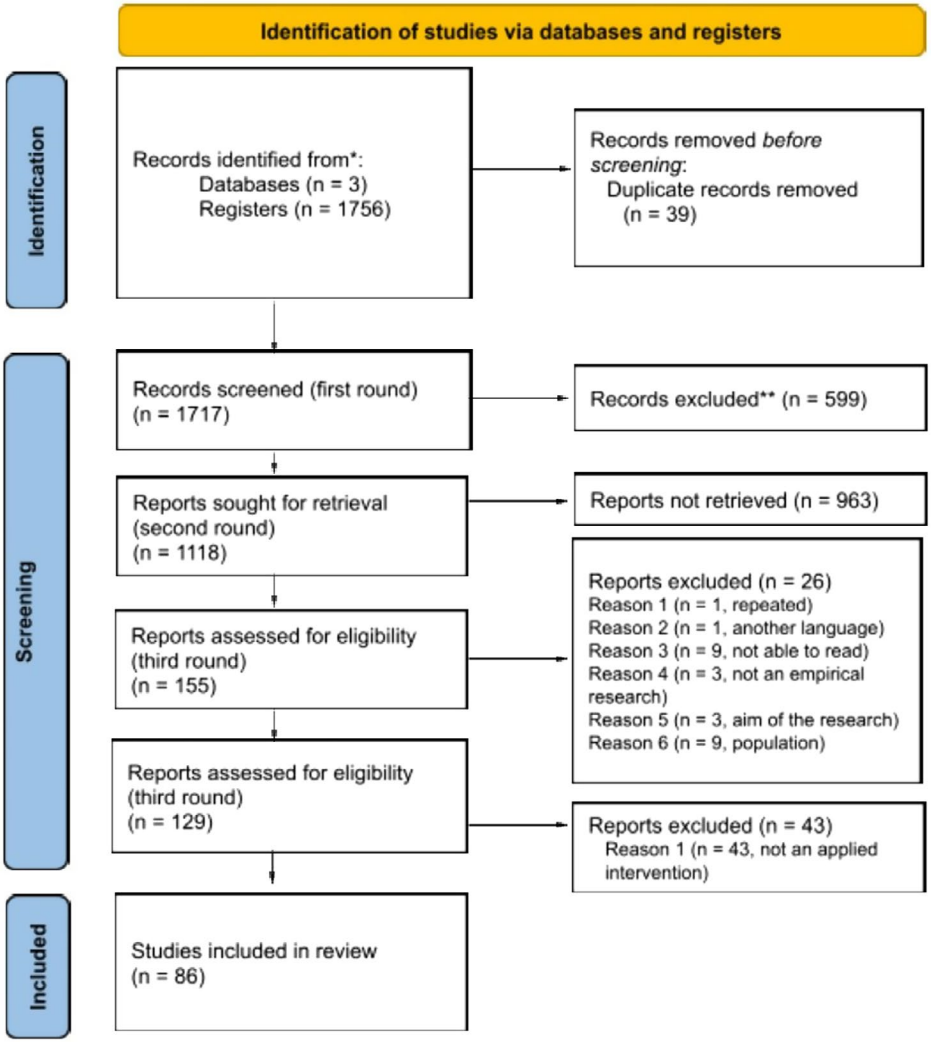

FIGURE 1 | The PRISMA flow diagram for the systematic review.

level (Bachelor's degree, Master's, PhD), pre-COVID-19 or post-COVID-19, and if it was considered in the intervention. CR-S reviewed a total of 105 articles, and JCC reviewed 50 articles. As a result of this data extraction conducted by the two researchers, 26 articles from the 155 were eliminated for different reasons according to our inclusion and exclusion criteria. We obtained a total of 129 articles. From these 129 articles, 43 articles were eliminated because they did not apply any creative educational intervention in the higher education classroom. So, in this case, these articles were not aligned with the inclusion criteria of the aim of the research. In this sense, after conducting this analysis of content, we included a total of 86 articles in this systematic review.

2.5 | Data Analysis and Software Support

Throughout the entire selection process, the traffic light technique was employed to visually categorize each article based on its alignment with the established inclusion and exclusion criteria: green indicated retention, red signified exclusion, and yellow denoted uncertainty. This color-coded system was complemented by detailed annotations documenting the rationale behind each decision, specifying the reasons for inclusion, exclusion, or the presence of uncertainty following the criteria. In case of uncertainty or disagreement between the researchers, the article was coded in yellow and was reviewed again in the next round.

After selecting the final set of articles, we developed a qualitative analysis using a content analysis approach to examine the data, with a deductive-inductive analysis process construction. To answer the research questions and systematize the analysis of the selected articles, we developed a data extraction matrix that included the following categories: (1) author(s); (2) year (specifically regarding RQb); (3) title; (4) objective; (5) main findings; (6) context (country/ies) (specifically regarding RQc); (7) field (specifically regarding RQd); (8) whether the study addressed the COVID-19 pandemic (specifically regarding RQa); (9) indexation of the journals; (10) theoretical framework; (11) intervention (components, such as pedagogical methods and strategies, and/or activities; duration of the interventions; main measured outcomes; main assessment tools; population); groups if needed and reported (e.g., experimental and control group). This stage was primarily manually

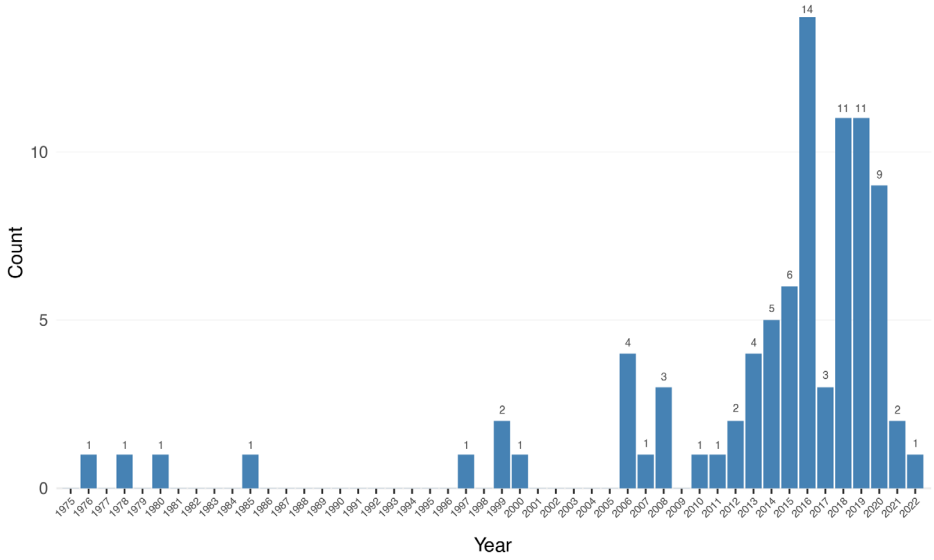

FIGURE 2 | Timeline of educational interventions in creativity in higher education.

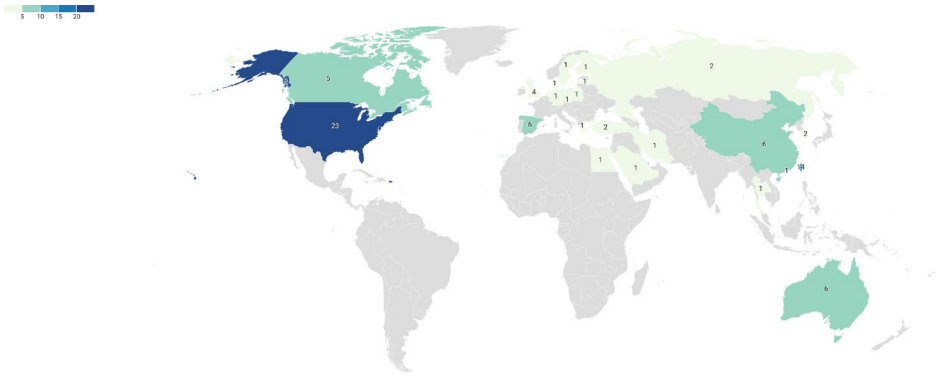

FIGURE 3 | Countries of educational interventions in creativity in higher education.

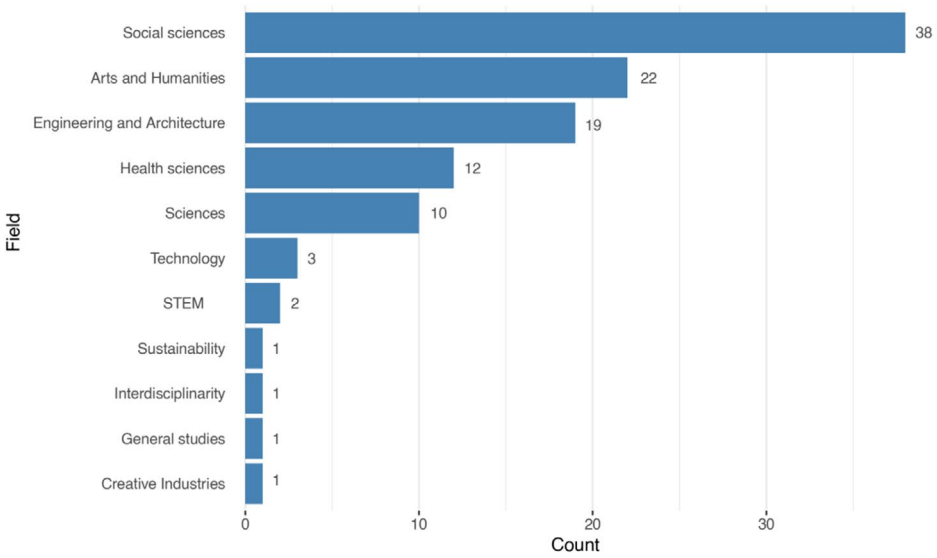

FIGURE 4 | Fields of knowledge of educational interventions in creativity in higher education.

developed, supported by Microsoft Office Excel 365 (licensed through the University of Barcelona), and slightly aided by Elicit Research Artificial Intelligence for topics 10 and 11.

Furthermore, the resulting data from the content analysis were later elaborated through programs such as R version 4.1.3 within the RStudio environment (R Core Team 2024) (see

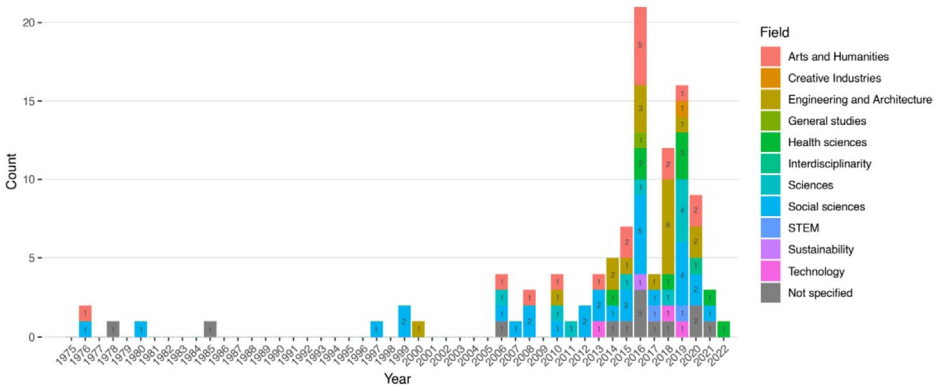

FIGURE 5 | Timeline of the interest developed by fields of knowledge about educational interventions in creativity in higher education.

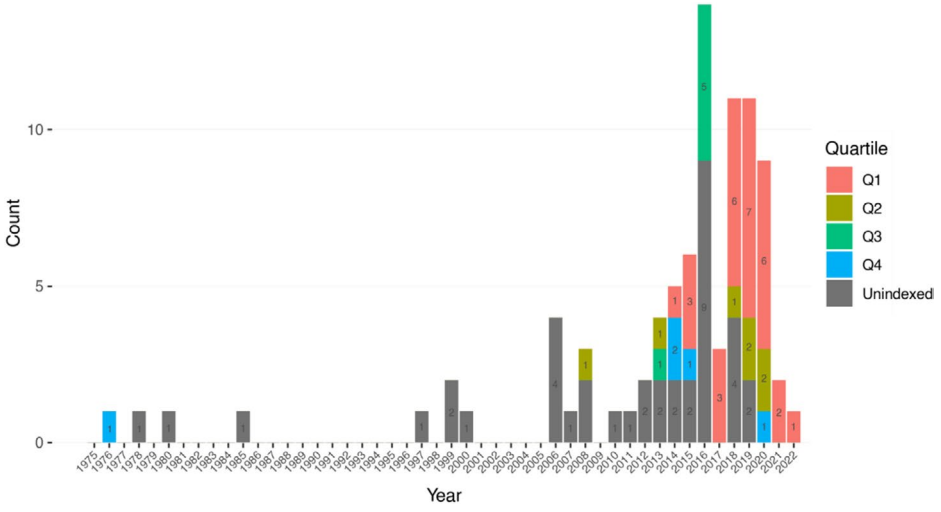

FIGURE 6 | Impact timeline of educational interventions in creativity in higher education.

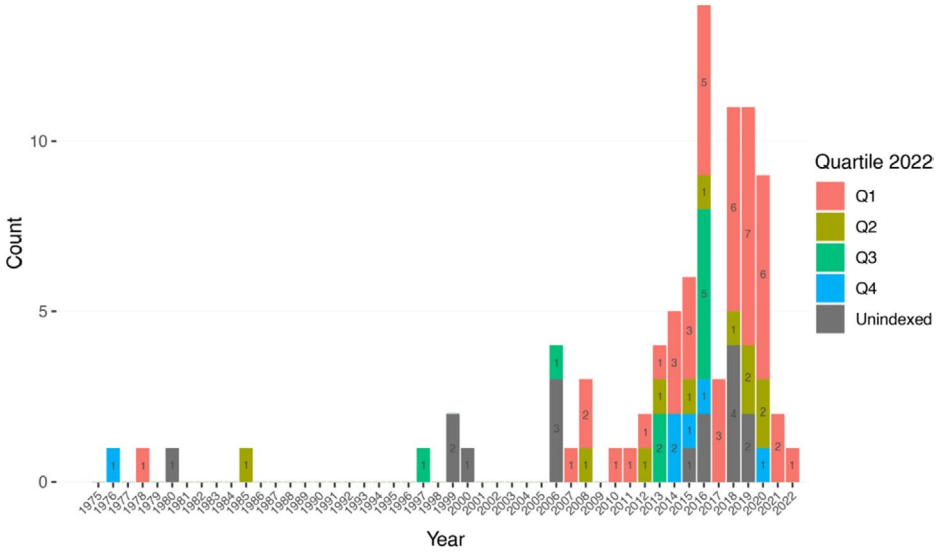

FIGURE 7 | Current impact timeline of educational interventions in creativity in higher education.

Figures 2 and 4–7) and Datawrapper open app (see Figure 3) to visualize the data with quantitative thinking and answering RQb-e. Furthermore, we used ATLAS.ti, assisted by Artificial Intelligence (licensed through the University of Barcelona), to analyze and represent the emerging concepts in the selected articles (see Figure 8) and answer RQf, and VOSviewer software of open access (see Figures 9 and 10) to visualize bibliometric networks and answer RQg.

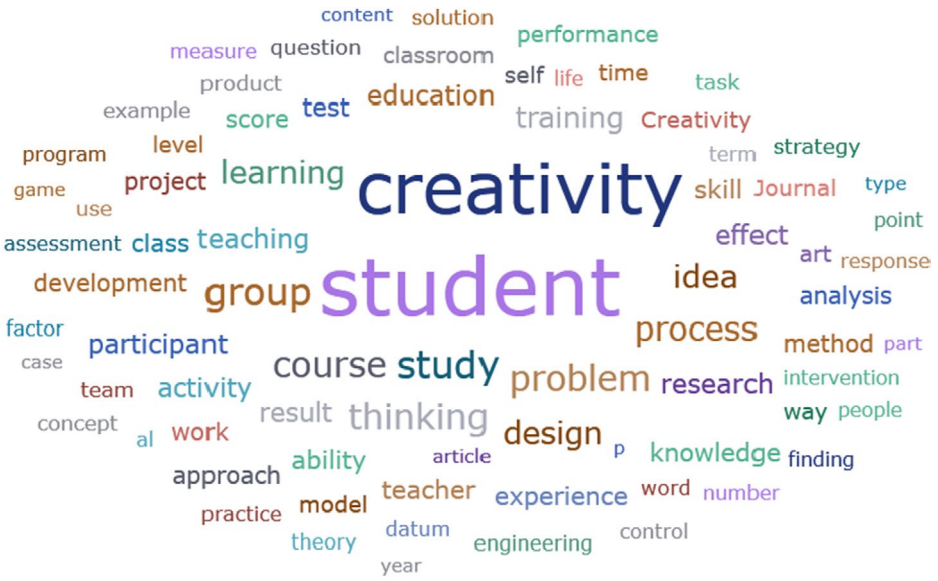

FIGURE 8 | Emerging concepts of educational interventions in creativity in higher education.

3 | Results

A total of 86 articles were obtained and are presented in Table 2.

3.1 | Educational Changes in Fostering Creativity due to the Influence of COVID-19

We did not find any specific consideration regarding the influence of educational changes in fostering creativity in higher education due to the influence of COVID-19. From 86 eligible articles, 74 were published before COVID-19, and 12 from 2020 to April 1, 2022. Therefore, based on the related results, our answer to this specific research question is that health is not yet integrated while fostering creativity in higher education, and so these two fields of knowledge (education and health) need further collaboration and dialogue in fostering creativity in higher education.

3.2 | Timeline of the Educational Interventions in Creativity

The results show a consistent interest in this field of study through the years (1975–2022), and especially a consistent interest from 2006 (4), and with a large peak of educational interventions in creativity in higher education in 2016 (14). In this sense, we want to highlight the possible influence of the Tuning Educational Structures in Europe Report (González and Wagenaar 2003) and its consideration of the capacity for generating new ideas (creativity) as a systematic competence. Also, we consider it important to note that these types of educational interventions and scientific reports could have been affected by the bursting of COVID-19. It is relevant to keep in mind that this literature search was made in April 2022, which could also influence the number of articles available that fit our criteria in the years 2021, 2022, and beyond. Nevertheless, it is evident that the interest in this research field has increased from 2006 until today.

3.3 | Contexts of the Educational Interventions in Creativity

There is an interesting insight into the geographical distribution of this field of study, as we can appreciate how the practices of the United States of America were the most reported (23), followed by Taiwan (14), Australia (6), China (6), and Spain (6). It is relevant to address that these interventions usually took place individually, and just a few times in combination between countries. Here they are represented at the individual level in order to visualize the involvement of each country in such developments. Also, there are some occasions (6) in which the countries involved were not specified, so logically we were not able to represent them here. The data reveal significant disparities in the number of articles outreached in relation to each context, which may indicate the attention paid in different countries of the world to educational interventions about creativity in higher education. Nevertheless, this also raises some questions about the countries that are not represented in these outcomes, and our methodological approach and decision making through the research.

3.4 | Disciplines and Fields of Knowledge in the Educational Interventions in Creativity

Regarding the disciplines and fields of knowledge of the interventions, it is relevant to mention that they often took place individually and not in a combined manner. Nevertheless, there are a few occasions in which they were developed across disciplines, which we broke down and then reintegrated in their corresponding fields of knowledge to visualize the interest developed in each field. Also, on a few occasions, interventions took place in an interdisciplinary approach, such as the reflected STEM (Science, Technology, Engineering, and Mathematics) (2) or Interdisciplinarity (1). Also, there are some articles in which disciplines or fields of knowledge were not specified (13), simply because they have not declared it or because they have referenced an intervention in relation to a wide range of disciplines

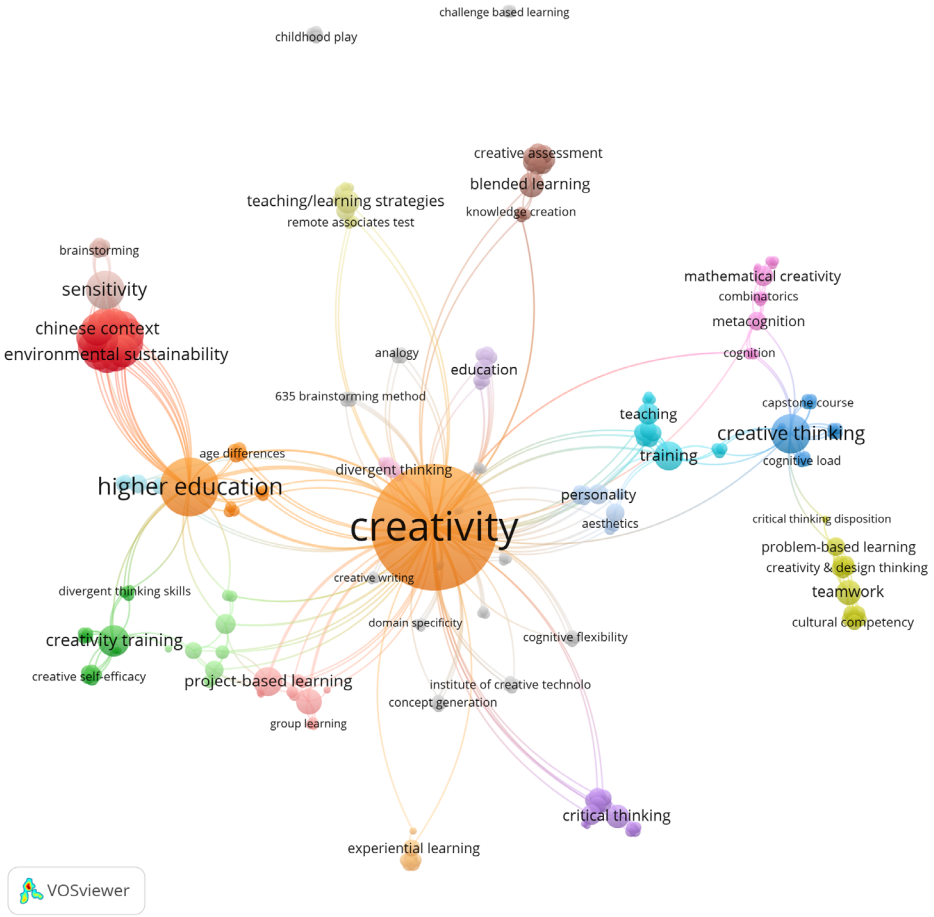

FIGURE 9 | Association strength of emerging related terms of educational interventions in creativity in higher education.

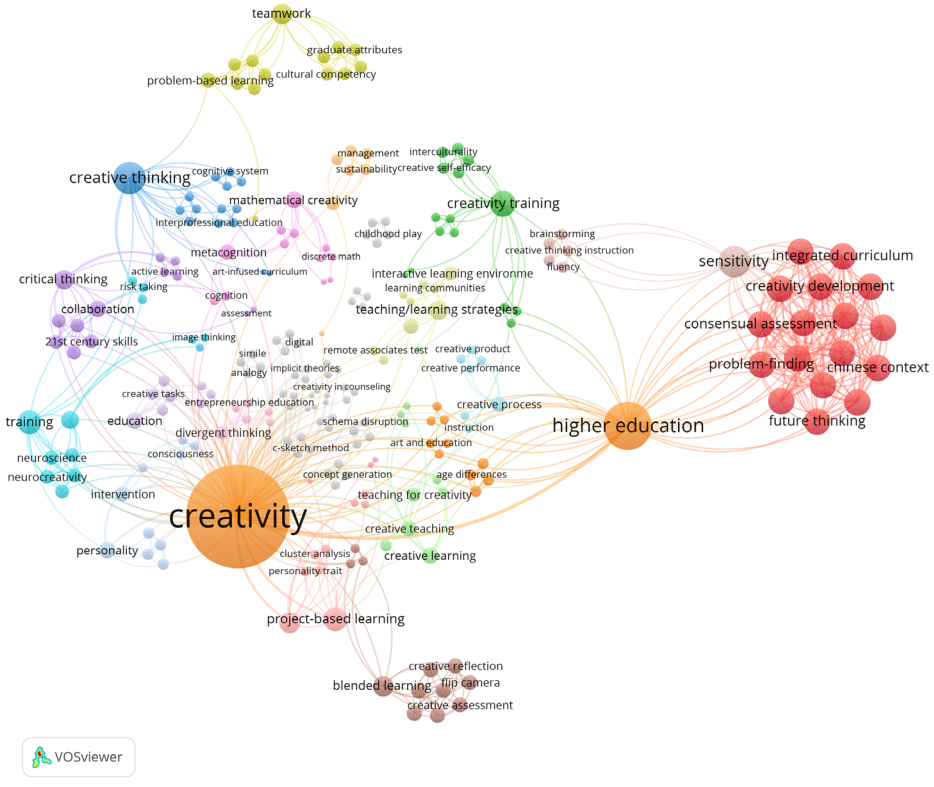

FIGURE 10 | Clusters and communities of emerging related terms of educational interventions in creativity in higher education.

TABLE 2 | Summary of included studies.

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Domino and Wechter (1976)	1976	To analyze some aspects of two creativity courses given to university students: the studio seminar entitled "Art and Creativity Research" and another course on "Psychology of Creativity" and the authors' experiences in bringing the two offerings together.	No explicit theoretical framework is mentioned in the paper.	• Intervention: Experimental union of a psychology course on creativity and a complementary course from the arts. • Components: Group project, evaluation of joint meetings, formal evaluation. • Duration: 20-week-course. • Assessment: Questionnaire. • Population: Collage students.	Ideas about creativity were shared and a programme was generated whereby students from both courses shared a **multidimensional interaction** from a psychologist researching the **nature of creativity** and an artist seeking to understand the **effects of creativity**. The frank discussion indicated that both classes had enjoyed the interaction and felt that each class had contributed to the growth of the other.	United States of America
Davis and Bull (1978)	1978	To evaluate the hypothesis that affective components of creativity (e.g., attitudes, values, interests, motivations) may be strengthened in a university creativity course.	Cognitive abilities.	• Intervention: Creative thinking course. • Components: Creative and problem-solving processes, the creative personality, reviews of creativity training materials and strategies, creativity tests, theories of creativity, creative dramatics, creative thinking techniques, brainstorming topics. • Duration: 5-week course. • Assessment: How Do You Think (HDYT) and Adjective Check List (ACL) tests. • Population: Undergraduate students. • Groups: Experimental group (Class A, with 87 students) and control group (Class B, with 60 students).	The intervention resulted in objectively **measurable increases in creativity** and informal reports of **personal benefit**, in a university course on creative thinking.	United States of America
Glover (1980)	1980	To report the short- and long-term effectiveness of a creativity training workshop developed directly from reinforcement game models used in previous research and to investigate transfer effects of the training.	Operant conditioning (reinforcement, instruction, and practice approach).	• Intervention: Creativity-training workshop in an undergraduate educational psychology course. • Components: Unusual uses exercise, problem solutions exercise, with competitive elements and incentives. • Duration: 16 weeks, fall semester course. • Assessment: Subjective ratings of student papers and Torrance Tests of Creativity. • Population: Undergraduates, sophomores and graduates. • Groups: Experimental and control group.	The fluency response measure increased significantly from baseline levels in the **Unusual Uses** condition. **Flexibility** and **originality** also increased during the Unusual Uses condition and increased further during the **Problem-Solving** condition. Elaboration remained relatively constant.	United States of America
Daniels et al. (1985)	1985	To ascertain the potential influence of training activities among university women and between experimental and control groups.	Perspectives on the creative production woman.	• Intervention: Creative perception training sessions. • Components: 20 individual training activities designed to simulate inquiry, flexibility, questioning strategies, attribute listing, morphological analysis, synectics, fluency, originality, tolerance for ambiguity. • Duration: Two sessions, 2 h each. • Assessment: The Something About Myself (SAM) inventory (50 item self-report inventory). • Population: 140 university women (freshmen and senior). • Groups: Experimental and control groups.	Findings of this study indicated the need for university **women** to be encouraged to become more **resourceful**, more **versatile**, and more willing to take **risks**. Though not statistically significant, the increase in the post-test scores for grades (freshmen and seniors) and group (experimental and control) is worthy of attention.	United States of America

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Pýchová (1997)	1997	To foster the future teachers' creativity and to make them familiar with the basic principles of creativity training, the purpose of the latter being to raise their ability to organize their future instruction in a creative way, and to adapt the teaching materials they will use toward creativity training aims.	Creative attitudes and abilities of teachers in guiding gifted pupils.	• Intervention: The creativity training project under the title of "Creative English Course." • Components: Involved creative activities like simulations, brainstorming, and role-playing. Activities such as fostering empathy, generating ideas, fostering fantasy, fostering positivising, fostering assertiveness. • Duration: A two-semester program with three 135-min sessions per week for 10 months. • Assessment: Test of Creative Thinking-Drawing Production (TCT-DP). • Population: 13 fourth-year undergraduates of English.	Final measurements showed considerable increases in creativity, and other benefits. This work confirmed the feasibility of creativity development through **planned instruction**, and new insight into the question of **variability** of creative components.	Czech Republic
Cole et al. (1999)	1999	To investigate a supportive classroom environment for developing student creativity.	Supportive classroom environments for creativity, teacher-student relationships in creative environment, methods of assessment.	• Intervention: Graphics communication course. • Components: Establishing personal relationships, teaching style, creative processes with brainstorming, thumbnail sketches, matrices, small group work, supportive attitude. • Duration: Not specified. • Assessment: Open assignments. • Population: 18 undergraduate students, junior, and senior.	The following supporting elements of the **environment** to foster creativity were identified: **Teacher-student relationship**; **assessment**; **openness** and **freedom of choice** and **activities** in the classroom.	United States of America
Everhart et al. (1999)	1999	To determine the effects of a creative problem-solving intervention series on the game-play decision making of university badminton students.	Teaching Games for Understanding Model (GFU), Parnes' 1981 work on creative problem-solving.	• Intervention: Creative problem-solving intervention. • Components: Generic creative problem-solving sessions; half devoted to idea finding, half to seven steps of creative problem-solving (the mess, fact finding, problem finding, idea finding, solution finding, acceptance finding, new challenges). • Duration: 2 h weekly, not specified. • Population: Students in a Physical Education Teacher Education (PETE) badminton strategies course (university badminton students). • Groups: Experimental group (12 students) and control group (12 students).	Results suggest that although certain categories did not generate positive support, the experimental intervention tended to continually improve **decision making** in the most strategic categories (running opponents and jamming them) during game play in badminton.	United States of America
Cropley and Cropley (2000)	2000	To facilitate an intervention programme that promotes creative and innovative strategies for engineering students.	Creativity as an integral part of giftedness.	• Intervention: Engineering Innovation and Practice (second-year course). • Components: Creativity lectures, creativity counseling, practical exercise, extrinsic motivation. • Duration: 6 weeks. • Assessment: Test of Creative Thinking-Drawing Production (TCT-DP). • Population: Engineering students.	Upon retesting 6 weeks later, the counseled students were more **innovative**, whereas the control group were simply less **inhibited**. In addition, machines constructed by the counseled students were more **elegant and creative** than those of the 27 students who merely attended the lectures. Thus, the training was associated with **changes in behavior** not only on the **test**, but in a **practical activity** too.	Australia

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Cheung et al. (2006)	2006	To examine the effect of a short (one-semester) course, which included elements of creativity training and practice, at a Hong Kong university.	Creativity ability, creativity thinking, creativity training.	• Intervention: The Creativity Course. • Components: Training in creative thinking techniques, authentic multifocus tasks, group activities, non-threatening environment. • Duration: One-semester course, 13 weeks of an elective course. • Assessment: Creativity tests conducted outside the classroom (verbal creativity, drawing creativity). • Population: 75 undergraduates from any discipline.	Training in creativity techniques for part of the semester led to increases in two key aspects of creative ability as measured by standard creativity tests conducted outside the classroom: **verbal creativity** increased compared with a control group, and **drawing creativity** also increased. Students enjoyed the course, felt it was useful and rated themselves as more creative after the course. Short-term out-of-discipline training courses in creative thinking have a number of other benefits, demonstrably for **learning strategies**, in addition to an increase in creative abilities.	Hong Kong
White (2006)	2006	To report on a 5-year Australian study where pre-service primary and secondary teachers were encouraged to enhance their creativity through the development of ethnographic operatic performances. The creativity focus of this project was the important aspect of risk-taking and daring.	Gardner's multiple intelligence theory, performativity, performance pedagogy, postmodernism, poststructuralism.	• Intervention: Ethnographic operatic performances to explore narratives and develop creativity. • Components: Composing and performing songs, dance, pieces, performance, poetry and raps, collaborative work (with consensus or voting decisions). • Duration: 9 weeks (part of a semester-long course), integrated into regular tutorial sessions. • Population: 300 pre-service education students (to become primary and secondary teachers).	Rather than learning 'about' **curriculum** and **pedagogy**, participants were encouraged to learn "through" **action** and **involvement**. A new conceptualization of **performance** pedagogy is provided as well as a discussion of two different interpretations of performativity. The implications for creative climate in education are the following: creativity is derived from **risk-taking** and **daring**, **support** and **encouragement** for students is specially needed when working in unfamiliar ways, **collaboration** is key for dealing with **challenges**, negotiating and solving **problems**, **innovative thinking and ideas** should be encouraged and included, and the exploration of ideas and learning though **creation** should be developed.	Australia

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Yuk and Cramond (2006)	2006	To combine both the Western perspective of creativity as productivity and the Eastern perspective of creativity as enlightenment and to devise a program.	Western and Eastern perspectives of creativity, spiral curriculum of Bruner, creative problem-solving process of Wallas, relationship between scientific inquiry and creative ability, creative thinking and abilities (fluency, flexibility, originality, elaboration, sensentivity to problems, problem defining, visualization, ability to regress, analogical thinking, analysis, synthesis, transformation, extension of boundaries, intuition), relationship between insight and enlightenment.	• Intervention: Program for Enlightened and Productive Creativity (PEPC), Creative Problem Solving (CPS) model, Spiral Curriculum. • Components: Five stages-finding the problem, restructuring, solving the problem, applying results, and enlightenment. Overlapped patterns with moiré patterns lesson. • Duration: Not specified. • Population: General and scientifically gifted students of Physics.	This study introduces the **Program for Enlightened and Productive Creativity** (PEPC), designed to enhance the creative abilities of gifted students by overlapping **patterns** found in **daily life**. The PEPC can be applied to students from elementary to high school, including those who are scientifically gifted. The program aims to foster **everyday creativity** using **nonlinear quantum spiral stages**, where students can progress through hierarchical steps, potentially skipping or repeating stages based on their readiness. The study focuses on the first level of PEPC, dealing with general overlapped patterns.	United States of America
Macdonald et al. (2006)	2006	To examine a group composition task to study the relationships between creativity, flow and the quality of the compositions produced.	Musical creativity, flow by Csikszentmihalyi.	• Intervention: A group composition tasks. • Compositions: Creativity, flow and the quality of the compositions. • Duration: Three meetings. • Assessment: Experience Sampling Form (ESF), the consensual assessment technique, and a staff criteria scoring form. • Population: 45 first-year university students, undergraduate music students.	Results show increased levels of **flow** are indeed related to increased levels of **creativity**. For example, there was a significant correlation between mean group ESF score and mean creativity rating by all staff. This suggests that higher levels of flow reported by individuals within a group correspond to that group's **composition** being rated as having higher levels of creativity.	United Kingdom

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Dewett and Gruys (2007)	2007	To understand whether a creativity management course in an MBA can increase creative self-efficacy.	Creativity and innovation in the curriculum, classroom environment supported risk taking and creativity, creativity training, creativity-related ability.	• Intervention: "Managing for Creativity and Innovation" is an elective MBA course offered at an AACSB accredited business school. • Components: Readings, interactive experiential activities (self-efficacy), letter to young self, coin catch, journaling, two individual projects. • Duration: Not specified. • Outcomes measured: Creativity, creative self-efficacy, willingness to take risks, creativity, ideational fluency, importance of journaling, enjoyment of journaling. • Assessment: Pre and post course survey. • Population: 52 MBA students.	There was a significant improvement of creativity students in **risk-taking** and creative **self-efficacy**. The non-conventional methods used in the intervention appear to have facilitated important changes in perceptions of creativity enhancement.	United States of America
Karwowski and Soszynski (2008)	2008	To present the main information about the new way of developing creative abilities, especially creative imagination, the Role Play Training in Creativity (RPTC).	Role Play Training in Creativity (RPTC), cognitive processes.	• Intervention: Role Play Training in Creativity (RPTC). • Components: Workshop method with group work: short lecture on creativity and imagination, interpersonal and visualization exercises, creation, and development a story with various exercises. • Duration: 1-day meeting (8 h) and 4 meetings (2 h each). • Assessment: Test of Creative Thinking–Drawing Production (TCT-DP) and creative Imagination (TCI). • Population: 47 undergraduate education students.	The effectiveness of the **Role Play Training in Creativity** (**RPTC**) was evaluated with the use of two creativity tests: (1) Urban & Jellen **Test of Creative Thinking: Drawing Production** (**TCT-DP**), and (2) **Kujawski Test of Creative Imagination** (**TCI**). Comparison of post-test and pre-test results shows statistically significant increase of the results in TCT-DP and two of three TCI scales: **fluency** and **originality**.	Poland
Dineen and Niu (2008)	2008	To test the efficacy of UK creative teaching approaches in the Chinese educational context.	Creativity and social and cultural contexts, cultural differences in artistic creativity, creative education in the domain of art, and design.	• Intervention: Creativity Workshop. • Components: Physical environment, timing and scheduling, teaching style and approach, teaching methods, project or task, assessment, and feedback. • Duration: 7 weeks, activities spread over 22 days. • Outcomes measured: Creativity, originality, overall quality, confidence, work level, motivation, enjoyment. • Assessment: Effective Teaching. • Evaluation (ETE) questionnaire and student art projects. • Population: 54 college students from arts and design. • Groups: Experimental and control groups.	Both quantitative and qualitative results suggest that the **creative methods** developed in the UK were highly effective in **encouraging** learner creativity and related attributes such as intrinsic **motivation**, **enjoyment**, and **confidence**.	China
Wood and Ashfield (2008)	2008	To consider the ways in which the interactive whiteboard may support and enhance pedagogic practice through whole class teaching within literacy and numeracy.	Creative learning and teaching.	• Intervention: Opportunities to consider the potential of Interactive Whiteboards (IWBs) to facilitate a more creative approach to whole-class teaching. • Duration: Not specified. • Assessment: Observations, interviews, focus groups discussions. • Population: 75 students of Initial Teacher Education.	This research seems to indicate that it is the **skill** and the **professional knowledge of the teacher** who mediates the **interaction** and facilitates the **development** of pupils' creative responses at the interface of **technology**, which is critical to the enhancement of the whole-class teaching and learning processes.	United Kingdom

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Robbins and Kegley (2010)	2010	To develop and evaluate the effects of an online Creative Thinking Program.	Creative thinking, creative abilities, creative self-efficacy, divergent thinking, cognitive framework.	• Intervention: Online Creative Thinking Program (CTP). • Components: Instructional media: Thinkertoys. Online delivery allowing self-paced work. • Duration: 6 weeks, module assignments due at three weekly intervals. • Outcomes measured: Fluency, flexibility, originality, self-efficacy. • Assessment: Pretest and posttest measures with Torrante Tests of Creative Thinking (TTCT). • Population: 51 university students of a Principles of Management course or a stand-alone free elective course titled Creative Inquiry.	The results suggest that participation in the program significantly enhanced the student's **creativity self-efficacy** as well as their actual **creative abilities** measured by the TTCT.	United States of America
Nordstrom and Korpelainen (2011)	2011	(1) To provide evidence for deep learning of scientific facts by using non-conventional tools of teaching and to evaluate how the skills associated with scientific disciplines can most effectively be adopted into student learning processes. (2) To propose that focusing on group activities and development of the learning space allows students more broader means for deeper learning. (3) To demonstrate the value of creativity as part of coaching novices into experts as part of a team via continuous engagement.	Problem-solving, critical thinking, group work, learning by experiencing.	• Intervention: Compulsory lecture attendance. • Components: Group work assignments (minimum of 3 h per week for 7 weeks); Use of non-conventional tools for teaching and presentation (throughout the 7-week course); Freedom to choose presentation methods (throughout the 7-week course). • Duration: 2 h per week for 7 weeks. • Population: 26 students of a Master's degree program in Chemical Technology.	The teachers should view **teaching innovation as an incremental process**, where the learning approach is in line with the **learning styles** of the students. Therefore, is essential to the learning in a **group** was the ease of **communication** within the group and allowing students to address the issues at hand via the **terminology**, **attitudes**, **humor** and **empathy**, which is inherent to their frame of mind as novices. The teacher needs to become **integrated into the learning environment** and to learn to **trust** the student's ability to learn and take **responsibility**.	Finland

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Jiménez and Muñoz (2012)	2012	To know the misconceptions that pre-service Preschool teachers have about the education for creativity and, secondly, to develop a practical training course, based on free-play techniques, which they can apply in their professional future.	Theoretical and practical beliefs about creativity, Vygotsky's theory, Lapierre, and Lapierre's theory.	• Intervention: Misconceptions. • Components: First phase: Six sessions of free play with various materials (e.g., balls, hoops, strings, and fabrics) for approximately 1–1.5 h per session. Relaxation period: 10–15 min after each play session. Collective verbalization: After each play session. Second phase: Three sessions where participants take on the role of empathetic teachers, observing, and listening without interference. • Duration: 9 sessions, each lasting approximately 1–1.5 h. • Assessment: Pretest and posttest of theoretical questions based on Vigotsky's approach and practical questions based on Lapierre's approach. • Population: 36 third-year students of Early Childhood Education degree program, taking "Creative languages" mention.	Results showed many **incorrect beliefs**, especially applied ones, regarding to the design of a **free-play** situation used as a **resource** to enhance creativity, which were modified after experiencing the training course.	Spain
Yeh et al. (2012)	2012	To develop and evaluate an instructional program for improving university students' creativity based on a blended knowledge-management (KM) model that integrates e-learning and three core processes of KM: knowledge sharing, knowledge internalization, and knowledge creation. The proposed hypotheses were: (1) blended KM-based instruction would improve university students' knowledge of creativity; (2) blended KM-based instruction would improve university students' dispositions of creativity; and (3) blended KM-based instruction would improve university students' creative abilities.	Influential factors, personal characteristics, individual's creative performance (knowledge, disposition, and abilities), knowledge-management.	• Intervention: "Instruction of creativity." • Components: Blended knowledge-management (KM) model integrating e-learning with knowledge sharing, knowledge internalization, and knowledge creation. Use of e-learning platform, group assignments, lectures, self-awareness, and self-reflection exercises, creation of creative products. • Duration: 17 weeks, with weekly activities and assignments. • Assessment: Inventory of Knowledge in Creativity (IKC), Inventory of Personal Factors in Technological Creativity Development (IPFTCD), • New Creativity Test (NCT), and a reflective questionnaire. • Population: 36 university students prepared to be secondary school teachers.	The findings from both quantitative and qualitative analyses suggest the following: the **blended KM model** is effective in improving knowledge, dispositions, and abilities of creativity. The online sharing and **evaluation of creative products**, learning communities and discussions, and the **practice of creativity strategies** have substantial effects on all three aspects of creativity. The observation and peer evaluation of group assignments and **creativity-related feedback** enhance the learning of knowledge and dispositions. Finally, the **creation of products** and **scaffolding of a teacher** are critical to skill improvement.	Not specified
Hugill and Smith (2013)	2013	To investigate how transdisciplinary approaches to curriculum design on a taught master's programme in creative technologies enhance digital creativity in students.	Transdisciplinary teaching and learning, transdisciplinary approaches to curriculum design, creative technologies, digital creativity.	• Intervention: Masters in Creative Technologies. • Components: Compulsory and optional modules. Creative technologies, group assessments, project planning and delivery, communication and presentation, sharing, and dissemination, cooperation and collaboration, interdisciplinary collaborative projects. • Duration: Weekly session: "Adventures in Creative Technologies," no duration specified. • Population: Mater's students.	The article discusses how the **programme** has developed a **climate** for creativity and outlines how the **knowledge and skills** gained during a **creative technologies-related transdisciplinary** programme meet the needs of a changing workplace.	United Kingdom

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Kirk and Pitches (2013)	2013	To share the findings of a teaching and learning project (Digitalis) that investigated ways in which digital technologies can be used by teaching staff to facilitate reflection on creative practices within performing and creative arts disciplines.	Reflective practice based on Schön's ideas, Tracey's four-stage model of creative reflection (preparation, play, exploration, synthesis), the authors' model of digital reflection.	• Intervention: Digitalis, project to facilitate reflection on creative practice and creative forms of reflection. • Components: Dance, Music, Theater, and Performance, Museum Studies. Design Presentation: Photo Story 3 software for visual engagement with text (duration: Semester 2). Choreography II: Flip cameras for capturing thoughts and rehearsal material (duration: 11 weeks). Instrumental or Vocal Recital: Flip cameras for recording private or public practice (duration: Semester 2). Performer Training: Flip cameras for documenting training practice (duration: Semester 2). Leeds Collections in Context: Reflective learning blogs for non-assessed reflective learning (duration: Two semesters). • Duration: 18 months. • Assessments: Student focus groups, observation of student work, reflective interviews. • Population: Students in performing and creative arts disciplines (level 2 and MA postgraduate).	Through a thematic analysis of the data, the paper shares the learning from these modules, along with a suggested **model of digital reflection**, outlining the place of capture, documentation and organization technologies in the **reflective process**. The paper concludes that there are benefits to be gained from digital reflection, given its facility to aid students to '**look again**' at their own **ephemeral creative processes**.	United Kingdom
Onarheim and Friis-Olivarius (2013)	2013	To argue for the usefulness of neuroscience for creativity training and support this claim with empirical data collected from the creativity training programme Applied NeuroCreativity (ANC).	Creative environment, creativity training, teaching creativity, creative ability, neuroscience of creativity, cognitive processes and associational and affective mechanisms, Mednick's theory.	• Intervention: The Applied NeuroCreativity course (ANC). • Components: Understanding creativity through neuroscience, understanding divergent and convergent thinking, learning creative tools from a neurological perspective, practicing these tools. Theoretical part: 3 weeks, focusing on understanding brain processes involved in creative thought. Practical part: 5 weeks, applying knowledge to real-world creative challenges. • Duration: 8 weeks, weekly sessions of approximately 4 h, with 2–6 h of independent project work between sessions. • Outcomes measured: Divergent thinking measured by fluency. • Assessment: Pretest and Posttest of Alternative Uses Test. • Population: 147 participants (99 students performed both tests). • Group: Experimental and control group.	Inhere there are presented pre- and post-training tests showing that ANC students gained more fluency in **divergent thinking** (a traditional measure of trait creativity) than those in highly similar courses without the neuroscience component, suggesting that principles from neuroscience can contribute effectively to **creativity training** and produce measurable results on **creativity tests**. The evidence presented indicates that the inclusion of neuroscience principles in a creativity course can in 8 weeks increase divergent thinking skills with an individual relative average of 28.5%.	Denmark and Canada

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Barrett et al. (2013)	2013	H1: Providing instruction in viable strategies for thinking about applications will contribute to the production of creative problem solutions evidencing greater quality, originality, and elegance. H2: Training in application strategies will lead to changes in the mental models people apply in understanding creative problems. H3: Training application strategies will result in the development and application of more effective mental models for use in creative problem-solving. H4: Providing training in application strategies for thinking about user groups, user group preparation, solution setting, and solution sustainability will contribute to the acquisition of better mental models for understanding problems calling for creative thought and production of creative problem solutions evidencing greater quality, more originality, and better elegance. H5: Training in application strategies bearing on user groups, user group preparation, setting, and sustainability will exert stronger effects on mental model quality and the quality, originality, and elegance of creative problem solutions for talented as opposed to less talented individuals.	Creative problem-solving, innovative achievement, training.	• Intervention: Instructional program. • Components: Training in strategies for thinking about applications of creative problem-solutions, including introductory module and up to four additional modules: user groups, setting, preparation, and sustainability. Participants could receive any combination of these modules. • Outcomes measured: Quality, originality, and elegance of solutions sating scales for the post-training problem. • Duration: 4-h study. • Population: 248 students from undergraduate psychology courses.	It was found that training people to think about the **uses of ideas** and preparation for **idea implementation** contributed to the acquisition of stronger mental models and production of advertising campaigns evidencing greater quality, originality, and elegance.	Not specified

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Karimi et al. (2014)	2014	To test the ability of students to generate new business opportunities when they participated in a redesigned entrepreneurship course with specially developed creativity exercises.	Creativity theory, divergent thinking.	• Intervention: Redesigned Fundamentals of Entrepreneurship course with specially developed creativity exercises. • Components: 12 creativity exercises and activities (e.g., five Whys, bugs report, problem reversal, brainstorming, elevator pitch, ideas notebook). • Duration: 16 weeks (32 sessions, bi-weekly, 2 h per session), 64 h. • Outcomes measured: Divergent thinking (fluency and originality), number of business ideas generated, innovativeness of business ideas. • Population: Undergraduate students of agricultural sciences.	Pre- versus post-test comparisons showed the students who followed the course to subsequently have a higher level of **divergent thinking**, also with respect to the students who did not enroll in the course. The results also indicate that the course has a significant effect on the students' abilities to **generate** a greater number and more **innovative** business **ideas** in the experimental group; while the control group showed no significant changes in business idea generation.	Iran
Kienitz et al. (2014)	2014	(1) To test the hypothesis that creativity is a fluid construct that can be enhanced in a targeted intervention. (2) To exam whether domain-general targeted-training would significantly increase creative capacity as compared to control training. (3) To exam whether individuals with greater openness and extraversion personality traits would show increased creative enhancement following training as compared to individuals with low openness and extraversion.	Models of creativity, dynamic understanding of creativity, divergent thinking, assessments of individual creative capacity, enhancing creative capacity using targeted training.	• Intervention: Creativity Capacity Building Program (CCBP), in parallel with Language Capacity Building Training Program (LCBP) • Components: Applied design-thinking, creative skills, rapid prototyping, fast-paced exercises. • Duration: 5 weeks. Frequency: Weekly 2-h group sessions (10 h total). • Assessment: Pretest Five-Factor personality model (NEO-FFI-3); Pretest and Posttest Torrance Test of Creative Thinking (TTCT). • Population: College-level education.	Results revealed greater increase for the **Creativity Capacity Building Program** (**CCBP**) than **Language Capacity Building Program** (**LCBP**) on two primary factors of the **Torrance Test of Creative Thinking-Figural** (**TTCT-F**): **Resistance to Premature Closure** and **Elaboration**. Analysis of **NEO-Openness** and **Extraversion** factors revealed more improvement on the TTCT-F scores after intervention for individuals with high Extraversion (E) scores, but this did not differ between groups. Altogether, the results indicate that **creativity is a fluid construct**, functioning independently of **personality traits**, which can be enhanced through **targeted creativity intervention**.	United States of America
Kassim et al. (2014)	2014	To measure the effectiveness of using multimedia learning materials on students' creative performance by using established creativity measurements.	Creative cognitive processing, cognitive system models for information processing and creativity.	• Intervention: Multimedia learning tool (MLT) titled "Mechanism Design." • Components: MLT. • Duration: 7 weeks, 30 min at the beginning of each lab session, with additional access as needed. Frequency: Weekly lab sessions over 8 weeks. • Outcomes measured: Creative thinking: Fluency, Flexibility, Originality. Product creativity: Novelty, Resolution, Style. • Assessment: TTCT, CPSS, student questionnaire, and semi-structured interviews. • Undergraduate mechanical engineering students.	For creative thinking the results showed that the **multimedia learning tool** (**MLT**) was instrumental for students to generate **flexible and original ideas**, but not fluent ideas. This was reflected through **students' product creativity** which showed **novel and aesthetic qualities** but lacked practicality. Students' perceptions supported the MLT's partial influence especially using **animations**. The findings suggest possible **effects of dynamic learning materials on creative performance** which however require further exploration.	Not specified

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Auttawutikul et al. (2014)	2014	To determine if weblog usage would both facilitate group learning as well as enhance creativity in Thai undergraduate students.	High creativity versus ordinary creativity, creativity can be developed and learned, creative environment, creative abrasion.	• Intervention: Part of a course on "The Production of Creative Educational Media." • Components: Use of weblogs as a teaching tool for group learning and creativity enhancement. Weblogs used for individual and group assignments. Activities divided between classroom and weblog in a 60:40 ratio. • Duration: 15–18 weeks (typical semester). • Assessment: Verbal TTCT administered at regular intervals. Student perceptions and experiences with questionnaire scores. • Population: University students.	Results showed a significant improvement in assessed creativity at the end of the trial period with **weblogs** being perceived as enhancing both group learning and creativity. Overall, the results suggest that the use of weblogs provide an **environment** in which Thai students can more freely show **individual creativity** within an enhanced peer collectivism structure.	Thailand
Kuo et al. (2014)	2014	To evaluate the effectiveness of the creative thinking approach in terms of different cognitive-type students' learning performance.	Creative problem solving.	• Intervention: Creative thinking approach integrated into a web-based learning environment using Meta-Analyzer. • Components: Creative Problem-Solving skill instruction, theme-based discussions guided by prompt questions for Fact Finding, Problem Finding, Ideas Finding, and Solution Finding. • Duration: 6 weeks. Frequency: Weekly engagement in theme-based discussions. • Population: University freshmen. • Groups: Experimental group of 40 students.	The experimental results show that the **creative thinking approach** improved the students' **web-based problem-solving** performance in comparison with the conventional approach in terms of "**problem finding**" and "**idea finding**." Moreover, it was found that the creative thinking approach could improve the "**fact finding**" performance of the students with **intuitive-type cognitive style**.	Taiwan
Munakata and Vaidya (2015)	2015	To describe a project that was developed for an introductory-level physics course, which aim was to encourage the creative process in science, as science is seldom mentioned in discussions about creativity.	Sternberg and Lubart's framework on creativity, STEM learning.	• Intervention: Project-based learning experience for an introductory-level physics course. • Components: Discussions on energy generation and sustainable practices. Development of a bicycle-powered generator. Writing a joint paper and user's manual. Open-ended approach with no set instructions. Instructor acted as a facilitator/coach. • Duration: A semester. Frequency: 3 h each week. • Assessment: Qualitative assessment through surveys and focus group interview. • Population: 25 undergraduate students with disciplinary background of Physics and Arts.	Results indicate that students recognized that other than the physics concepts covered in the course, the structure of the laboratory portion of the course was **different** from the typical science laboratory exercises. Though for some students, it was difficult to connect the physics theories to the **project**, several students appreciated the **application of theory**, and the **connections** made between lecture and the project. Students also enjoyed the **teamwork** aspect of the project. They learned how to work on their own piece of the project while keeping the big picture of the group project in mind. Teamwork allowed them to combine their **knowledge** and to share **ideas**. Although some alluded to different starting points within the group, groups were able to find their **rhythm** and learn to **communicate** efficiently and effectively.	United States of America

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Chang et al. (2015)	2015	To explore the effects of cloud-based m-learning on students' creative processes and products in engineering design.	Creativity theories, creative problem-solving (CPS), Amabile's five-stage model of creative problem-solving.	• Intervention: Cloud-based m-learning. • Components. Use of cloud and mobile devices, cloud-based storage (e.g., Google Drive, Dropbox), communication interfaces (e.g., Skype, Facebook), and creation software (e.g., Gimp, CamStudio). • Duration: 7-week period. • Outcomes measured: Overall creative performance. Creative process (problem presentation, preparation, response generation, response validation), creative product (novelty, value, elaboration) • Population: 30 first-year university students. • Group: Experimental group.	The results showed that **cloud-based m-learning** had a positive effect on **creative performance** in engineering design. It also improved the **creative process** in terms of presenting **problems** and of generating and validating **responses**. Additionally, cloud-based m-learning effectively improved overall **performance**, **novelty**, **value**, and **elaboration** in designing **creative products**.	Taiwan
Al-Zahrani (2015)	2015	To investigate the impact of the flipped classroom on the promotion of students' creative thinking.	Higher order thinking skills as creativity, creative abilities, Stenberg's theory.	• Intervention: Flipped classroom intervention. • Components: Pre-class activities: video lectures on YouTube. In-class activities: discussion, problem solving, feedback. • Duration: 4 weeks. • Outcomes measured: Fluency, flexibility, novelty. • Assessment: Qualitative creativity test. • Population: 27 students from Education.	The findings suggest that the **flipped classroom** may promote students' creativity, especially regarding **fluency**, **flexibility**, and **novelty**. Furthermore, the students viewed the flipped classroom as an approach that may significantly facilitate their creativity. However, several difficulties were associated with the flipped classroom, especially the students' limited **preparation** for this strategy.	Saudi Arabia
Santandreu and Safiullin (2015)	2015	To test whether the three diversities (cultural, disciplinary, and educative diversities) have an impact on team creativity and productivity.	Creativity in diverse groups, team effectiveness and creativity, information, and decision-making theory, brainstorming, generating ideas.	• Intervention: "Creativity, Innovation and Design Thinking" course. • Components: Self-selected, self-managing teams of 4–5 members. Nine creative projects with increasing difficulty. Team switching after each project. Minimal instructor feedback. • Duration: 3 weeks. Frequency: 2.5 h per day, Monday to Friday. • Outcomes measured: Creativity and productivity. • Assessment: Pre-course and post-course questionnaire. • Population: 89 students.	There was a statistically significant shift in the students' perceptions from pre-test to post-test in agreeing that **diversities help teams to be more productive and more creative**.	South Korea

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Hargrove and Nietfeld (2015)	2015	(1) To teach creative problem-solving strategies through an approach that simultaneously emphasized metacognitive awareness, monitoring, and regulation. (2) To investigate (a) the effect of the integration of the creative thinking strategies in a metacognitive instructional framework on self-report metacognitive awareness, and (b) the relation between creativity scores and self-report metacognitive awareness.	Metacognitive theory, creative abilities, sequenced classroom-base curriculum, problem-solving, divergent thinking, innovation.	• Intervention: Supplemental course. • Components: Introduction of new creative thinking strategies each week. Activities to encourage metacognitive skill development. Direct instruction, modeling, and paired problem solving. Emphasis on self-regulated metacognitive approach to design thinking. Use of tools like strategy evaluation matrices and regulatory checklists. • Duration: 16 weeks. Frequency: Weekly sessions. • Outcomes measured: Fluency and originality; Metacognitive thinking. • Assessment: Similarities Test, Remote Associates Test, Design thought model. • Population: 30 university design students, freshman students.	Upon completion of the course the treatment group had significantly higher scores on **fluency** and **originality** measures compared with their matched peers. In addition, students in the treatment condition received higher ratings on a summative domain-specific project judged by external design experts. **Metacognitive Awareness Inventory** scores increased for the treatment group but were stable over time for the comparison group.	United States of America
Im et al. (2015)	2015	To share the content and philosophy behind the course structure and the results of a longitudinal assessment of its effectiveness on the creative problem-solving ability of undergraduate students majoring in retail merchandising.	Problem-solving capability, cognitive processes, the concentric model of creativity of Hennessey and Amabile.	• Intervention: Creative problem-solving course. • Components: Knowledge: Assigned readings, lectures. Habits: Weekly different activities. Skills: In-class exercises and practices for generating divergent ideas. Beliefs: Development of creative self-efficacy through successful experiences. • Duration: 15 weeks. Frequency: Offered twice a year. Weekly activities and lectures throughout the semester. • Outcomes measured: Fluency, flexibility, and originality. • Assessment: Torrance Test of Creative Thinking (TTCT). • Population: Undergraduate students in a retail merchandising program.	Overall, the participants evaluated the **creative problem-solving** course positively. The study contributes to enhanced understanding of the effectiveness of creative problem-solving training by providing longitudinal data that indicates the effect of such training does not quickly diminish. The results also provide additional evidence that creativity can be trained and developed through **classes**. Indirectly, results support a technique consistent with generativity theory that states a creative solution can be generated by combining and applying old **experiences** in new ways. Thus, participants may have benefited from expanding their base of experiences via the "different" **exercises** to be able to continue to generate **innovative ideas** over time. Moreover, results imply that apparel **educators** can be active in motivating and educating students to enhance their creativity.	United States of America
Lin and Wu (2016)	2016	H1: Web-based creative thinking teaching would positively affect creativity. H2: Creativity would positively affect learning outcome. H3: Web-based creative thinking teaching would positively affect learning outcome.	Cognition, affection, and skill dimensions, creative thinking teaching, web-based creative thinking teaching.	• Intervention: Web-based creative thinking teaching program. • Duration: 4 months. • Outcomes measured: Creativity (fluency, flexibility, uniqueness, elaboration), learning outcome. • Assessment: Self-evaluation. • Population: 186 university and college students.	The research findings show: (1) Positively remarkable effects of **web-based creative thinking teaching** on creativity, (2) Positively notable effects of creativity on **learning outcome**, and (3) Positively significant effects of web-based creative thinking teaching on learning outcome.	Taiwan

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Huber et al. (2016)	2016	(1) To describe how the teaching strategy of active learning assignment evolved into a group of student learners engaging in the development of a creative advanced clinical care scenario in an online graduate core course on leadership and management. (2) To serve as a model of ways to engage students in active learning for synthesis and evaluation to enable creativity and innovation.	Active learning, development of creativity.	• Intervention: Online graduate course on leadership and management in nursing. • Components: Discussion assignment, team formation, consensus document development, analysis of gaps in care delivery, development of strategies for improvement • Duration: part of a 3-semester-hour course. • Outcomes measured: Effectiveness of active learning strategies in promoting learning and engagement. Development of creative solutions to care delivery challenges. Enthusiasm and engagement of students. • Population: Masters' and doctorate students.	The **active learning exercise** presented in this article is one example of how **intentional strategies** have applicability in graduate and continuing education programs. Educators and continuing education professionals can structure **online** (**even asynchronous**) **discussion forums** with exercises that are innovative and spark creativity, which helps students to **learn concepts through application and active learning**.	United States of America
Shangaraeva et al. (2016)	2016	To identify and test pedagogical conditions of formation students' creative independence studying the English language.	Creative independence, creative skills, creative tasks.	• Intervention: Implementation of a didactic model for forming students' creative independence in English language classes. • Components: Collective formation of creative independence, performance of creative educational and informative tasks, performance of creative individual educational tasks, writing of compositions and essays, use of games in teaching. • Duration: Not specified. • Outcomes measured: Formation of students' creative independence, ability for creative independent activity, ability for creative independent work, ability to extrapolate and apply knowledge in new situations, ability to transfer acquired knowledge and skills. • Population: First and second year students. • Groups: Control and experimental groups.	The results indicate that the development of **creative independence** in native and foreign pedagogics is an important qualitative characteristic of a person which is a unique phenomenon. It differs with individual selection of features and its own variant of development. Also, that a **foreign language** is an important means of the development of creative independence with the **use of contents**, **forms and methods** which have definite creative potential. Results also indicate that the effectiveness of the development of creative independence increases thanks to the following pedagogical conditions: (1) The process of **involving the student into creative activity** in phases such as individual **transferring of skills into a new situation**, **seeing new problems in a familiar situation**, **new functioning of an object**, **finding new ways of solving**; (2) Structuring the **content** of the course in **class activity and in extra-curricular activity**; (3) Providing **organization of students' cognitive work of intentionally established problem tasks and situations**. And that the model developed and tried out in experiment helped to increase the effectiveness of the development of students' creative independence in linguistic higher educational institutions.	Russia

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Sadykova and Shelestova (2016)	2016	To design and put into practice the conditions of development of students' creativity in the learning process: motivational involvement of students in the teaching-learning process of mastering the methods of creative activity; the use of the content, forms and methods, stimulating the implementation of developmental nature of learning; ensuring the integrity of the components of creativity development (Gnostic, projecting, structural, organizational, and communication) to create a new product of intellectual creativity in the process of cognitive activity.	Foreign language as the means of development of students' creative activity, creativity as a special attitude to life, creative problem solving, creative methods, heuristic methods.	• Intervention: Exercises for creative activity. • Components: Students repeated actions to deepen knowledge and develop creative skills. Active learning methods: Used to promote creativity in foreign language learning. Brainstorming: Group activities and thinking to generate ideas. Educational games: Puzzle games, simulations, competitions. Role-playing: Enhanced by computer technology. Problem-based learning: Theory of gradual improvement of creative mental actions. Teamwork: For creative activity development. Creative tasks: Individual and group activities. Use of games: Projects and conferences. • Duration: 4 months. • Outcomes measured: Motivational component (focus on and interest in the subject), Cognitive component (activity of students in mastering educational material, manifestation of intellectual initiative and creative thinking), Operational component (manifestation of creative abilities and skills, independent generating new methods). • Population: 58 students. • Groups: 28 students in control group, and 30 students in the experimental group.	The study obtained the following results: (1) The definition of a set of **pedagogical conditions** that increase the efficiency of development of the students' creative activity while learning a foreign language; (2) The development of **content**, **forms** and **methods** of stimulating the formation of creative abilities and skills while learning a foreign language; (3) The experimental **verification** of the effectiveness of pedagogical conditions for the development of students' creative activity. And it has been proven that the importance of development of the students' creative activity in the process of learning a foreign language will be effective on the following conditions: (a) Ensuring **motivational inclusiveness** of students in the teaching-learning process for mastering the **techniques** of creative activity; (b) The use of the content, forms and methods, enabling the realization of developmental education and the formation of creative skills; (c) Ensuring the **integrity** of the functional components of the students' creative activity in creating a new product of intellectual creativity in the process of cognitive activity. **Structural components** of the students' creative activity were considered: (1) The system of creative activity components, serving the professional and personal characteristics of students (motivational, cognitive, behavioral); and (2) Functional components of creative activity development (Gnostic, design, structural, organizational, communicative).	Russia

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Wu et al. (2016)	2016	To propose a concept transformation learning model to achieve the learning objective via the input-process-output learning process, which focuses on: (1) the information transmission of the concept (or conceptual frame); (2) the students' simulation, analogy, analysis, and innovation; and (3) the works output (or learning output).	Analogical thinking, analogical, learning, social interaction learning, active learning, creativity thinking, problem-solving capacity, 4Ps, componential theory of creativity, interactions of persons, products, and environments, confluence approaches.	• Intervention: Concept transformation learning model based on cognitive conflict, analogical thinking, and analogical learning. • Components: Classroom teaching with teacher guidance, use of relevant cases for analogical thinking, student interactions with teachers and peers. • Duration: 18 weeks. Frequency: 3 assignments (2D composition, 3D composition, architecture form composition). • Outcomes measured: Learning performance (score), creativity development (score), 2D composition (score), 3D composition (score), creative composition (score), concept of transformation (score), creativity improvement (score). • Assessment: Pretest and posttest. • Population: Freshmen students of Architecture.	The effectiveness of the **concept transformation learning model** is verified by comparing the results of the pre-test questionnaires and the post-test questionnaires. The questionnaire results also indicate that, with the concept transformation learning model, students' creativity can be effectively promoted so that they can become more **interested** and more **active** in their learning. The research results can be referred by further teaching and studies of architectural design.	Taiwan
Hu et al. (2016)	2016	To investigate the effects of teaching approaches and strategies on students' learning achievements and interests as well as the use of distinct teaching strategies for the promotion of teaching effectiveness.	Creative thinking instruction, creative thinking ability.	• Intervention: Creative Thinking Instruction. • Components: virtual reality, immersion and interaction. • Duration: 16 weeks, 3 h per week (total of 48 h). • Outcomes measured: sensitivity, fluency. • Population: 104 university students. • Groups: control class (52 students) and experimental class (52 students).	The research results show that: (1) Creative Thinking Instruction presents higher **sensitivity** than general traditional instruction; (2) Creative Thinking Instruction reveals higher **fluency** than general traditional instruction; (3) Immersion in **virtual reality** appears the highest sensitivity on Creative Thinking Instruction, and (4) Interaction in virtual reality presents the highest fluency on Creative Thinking Instruction.	Not specified
Daly et al. (2016)	2016	To document how college students learn about creative process through a study of their reported course experiences.	4P's framework, creative process approach.	• Intervention: Educational experiences provided by 19 different courses across 5 disciplines: Arts, Education, Engineering, Humanities, and Social Sciences. • Components: The courses are designed to develop creative skills. • Duration: Not specified. • Outcomes measured: Course Impact Rating (on a seven-point scale), Critical Experiences, Suggested Changes, Influence of course activities (on a five-point scale). • Assessments: Scales. • Population: University students, majority of undergraduates.	The main finding was a high degree of commonality in students' perceptions of effective learning experiences across disciplines. Common themes included **open-ended projects**, practice on **exercises**, and instructor **feedback**. Analyses revealed a greater perceived impact of instruction in the humanities, social sciences, and the arts compared to engineering and education. The results of the study document the qualities of learning experiences in university classrooms during creative process instruction. Suggested improvements of pedagogy include building a **repertoire of successful works** within a field, and **self-reflection** about the creative process.	United States of America

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Cheng (2016)	2016	To scope the changes in conception, attitudes, skills, abilities, and behavior outside the toy domain that students perceived as originating from the learning of the course.	Model of personal transfer of creative learning.	• Intervention: Thematic toy course. • Components: Explicit introduction of learning transfer as the ultimate goal. No direct teaching of transfer knowledge or strategies. Analyzing, inventing, and making toys; problem-solving using toys; creative uses of toys; and studying the historical and sociocultural development of toys. • Duration: Implied to be a standard academic course duration (likely a semester). • Outcomes measured: Changes in conception, attitudes, skills, abilities, and behavior outside the toy domain; Creativity-related attitudes, conceptions, and behavior. –Assessment: Questionnaire. • Population: University students in various disciplines.	This study helps to establish a new conception of creativity education as a type of education that values and facilitates **personal transfer**. It was found abundant evidence for **far and spontaneous personal transfer of creative learning**. It showed that significant parts of creative learning could be transferred in personal ways if the **curriculum** is appropriately **designed** and **implemented** to suit the **needs** of students in the **local context**. Some of these transfers had sustained as long as 1 year after the course study, thus creating long-term significant impacts on some students. In the thematic toy course, creativity-related attitudes, conceptions, thinking strategies, and thinking habits were commonly transferred from the initial study over to **daily life**, **new learning** and **teaching**. Curricular, contextual, and personal factors were identified to be either **facilitating or hindering** factor to the personal transfer. Though these factors differed substantially among individuals, they were mediated by nearly the same **learning characteristics**–the **impressiveness**, **novelty** and **perceived usefulness** of the initial learning.	China

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Bonnardel and Didier (2016)	2016	To explore the effects of two types of design project-oriented methods (one centred on the evocation of ideas and the other on the management of constraints), which were operationalized as specific courses offered to design students. The objective was to determine the impact of the training on creativity, and to look at both the students' evocation processes and their creative output.	Teaching creative design, problem-solving process, interaction between individual and social system, creative process, analogy, and constraint management (A-CM) model, analogical thinking, constraint management, assessment of student's creativity, divergent thinking.	• Intervention: Project-Oriented Methods. • Components: Brainstorming method, CQFD, and CQHD methods. • Duration: 4 h. • Outcomes measured: evocation processes (ideas and constraints), creative output (rated on criteria related to divergence and convergence). • Population: 32 students of first year of a design course.	This research developed two design project-oriented methods. The first one was designed to stimulate designers to come up with creative ideas and is called **CQFD** (**no**-**Censure**, **Quantity**, **Farfelues**, **Demultiplication**). The second one was developed to stimulate designers to take into account and manage the constrains of the design problem and is called **CQHD** (**Constraint**, **Quantity**, **Hierarchization**, **Demultiplication**). These two studies showed that the two types of training had a differential impact. Results showed that training focused either on the **emergence of ideas** or on the **management of constraints** influences the numbers of ideas or constraints produced by design students. These results confirmed expectations and hypotheses and demonstrated the efficiency of the two types of **training** developed, in that they led to differentiated **behaviors**. It is also observed that, regardless of the training method, the total number of constraints proposed by participants was higher than the total number of new ideas. Therefore, **design problem framing** seems to take up a substantial proportion of designers' activities, especially during the early design stage, as was the case in this study. Moreover, the **process of evoking ideas** is possibly more difficult than the evocation of constraints, and the generation of ideas may require several constraints to be taken into consideration, possibly combining them at a certain stage of design problem solving.	Not specified

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Kao (2016)	2016	To examine the effects of stimulus words' positions and properties on the words subjects responded with and their creativity performance using four types of analogical sentence completion.	Analogical asymmetry, analogies and creativity, simile, metaphor, and analogy.	• Intervention: Part of instructional activities related to creative thinking or multiple intelligences. • Components: Simile sentence completion task. Version A: stimulus words in target position; Version B: stimulus words in base position. • Duration: 12 min. • Outcomes measured: Originality, concrete-word responses, abstract-word responses. • Assessment: Concrete/Abstract stimulus words. • Population: College students.	A significant directionality existed in **simile** sentences. Typical **analogies** led to higher creativity performance, but atypical analogies could significantly explain the variance of creativity performance over and above typical analogies. No matter whether **stimulus words** are concrete or abstract or whether they are placed in the target or in the base of sentence completion items, participants were inclined to respond with concrete words. Abstract stimulus words placed in the target position with concrete words answered in the base position had the highest incidence of all combinations. However, participants did not necessarily tend to respond to concrete stimulus words in the base with abstract words. The directionality of typical analogies and the strong proclivity for responding with concrete words are two factors that affect participants' performance.	Taiwan
Ulger (2016)	2016	To extend the creative training through an original approach with the adaptation of curriculum to determine whether the creative training had a significant effect on creative thinking and problem solving.	Divergent thinking (fluency, flexibility, originality, novelty), solution process, sensitivity to problems, open-ended and ill-defined problems, creative trainings, creative problem solving (CPS), non-routine problems.	• Intervention: Creative training program. • Components: Pre-open-ended tasks. Main open-ended task: "We will paint our house." Non-routine problem activities. Brainstorming sessions. Hierarchical technique. • Duration: 12 weeks (72 lesson hours). • Outcomes measured: Creative thinking (Titles, Elaboration, Strengths), Problem solving (PSI factors: Confidence, Approach-Avoidance, Control). • Population: University students.	The ANCOVA analysis revealed the significant creative training effect on **creative thinking**, but it was not determined to have a significant effect on problem solving.	Turkey
Chang et al. (2016)	2016	To evaluate a 6-week educational program, we explored the effect of the Theory of Inventive Problem Solving (TRIZ) on the creativity of 121 university freshmen studying engineering.	TRIZ, creative performance, creative process, creative products.	• Intervention: TRIZ educational program. • Components: Designing and making model solar cars using TRIZ principles. • Duration: 6 weeks. • Outcomes measured: creative processes (identifying and analyzing problems, proposing, selecting and executing strategies) and creative products (novelty, resolution, elaboration, synthesis). • Population: 61 first-year university students. • Groups: Experimental group of 61 students.	Results indicate that **TRIZ** has a strongly positive effect on a student's ability to analyze **problems**, and to generate, select, and execute a **strategy**. TRIZ also increased the **creativity** with which students designed **products**, including their ability to develop and implement **novel ideas**.	Taiwan

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Hass and Burke (2016)	2016	To propose that thoughts about one's own creativity are related to implicit views about the similarity of one's traits to those of creative exemplars.	Implicit theories of creativity, Stenberg's theory, Runco, and Bahleda's theory.	• Intervention: Between-subjects experiment to compare implicit theories of creativity. • Components: Third-person condition: Participants were instructed to imagine an existing creative product from one of three domains (art, music, and gadgetry). First-person condition: Participants were instructed to imagine themselves creating a new product in one of three domains (art, music, and gadgetry). • Outcomes measured: Fitness ratings of creative traits by perspective (first-person and third-person) and domain (art, music, and gadgetry). • Population: 390 students enrolled in an introductory psychology course.	Results were like those reported in two prior studies such that people's conception of **creative traits** differ from **domain** to domain, particularly that musicians and artists are considered more nonconforming, aesthetic, and imaginative than gadget inventors. Results add to previous findings by suggesting that people may view themselves as embodying a different level of creative traits than existing creative exemplars. They also suggest that the perspective manipulation (first-person ratings vs. third-person ratings) may be moderating the domain effect, a hypothesis subject to further testing.	United States of America
Simper et al. (2016)	2016	To explore the use of two types of scaffolding to support the development of narrative plans for photo story production.	Concept maps for creative development.	• Intervention: Two types of scaffolding. • Components: Digital concept map, photo stories. Concept map template and basic connections between concepts, text-based template and sequential listing of concepts. • Duration: 3 h-session. • Outcome measured: novelty, interest, clarity, ability to understand. • Assessment: The performance factor of Creative Achievement • Questionnaire (CAQ). • Population: 28 undergraduate education students.	Results indicated that, after controlling for age and previous concept map experience, **photo stories** in the concept **map group** were rated as significantly more creative than those in the text-based planning group. The specific difference between the groups was in terms of clarity.	Canada
Pollard et al. (2018)	2017	To present a study that defines creative teaching in the STEM context and investigates attempts to teach creatively as experienced by nine STEM educators in an Australian university.	Creative teaching, Boden's, and Stenberg's definitions.	• Intervention: Re-imagining curriculum of STEM education. • Components: Curriculum, assessment tasks, readings, teaching practices. • Outcomes: Experiences of creative teaching, struggling to teach creatively, assessment challenges, assessment change success, creative teaching practice (problem-based learning framework, flipped classroom approach). • Assessment: Semi-structured interviews. • Population: STEM students and teachers.	The results highlighted that achieving creative teaching is difficult and that the element of **surprise** is essential. Despite the **struggle** required, creative teaching afforded **fulfillment** for teachers. The study examines the characteristics of those interviewed, such as **determination**, **openness** to the unexpected and **curious**, **confident risk taking**; and suggests strategies for fostering creative teaching, such as the **problem-based learning framework**, the introduction of **arts-related stimulus** (**as music and drama**), and the **flipped classroom approach**.	Australia

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Tang and Werner (2017)	2017	To evaluate the immediate and sustained effect of a 2-week intensive program (IP) applying an interdisciplinary and intercultural approach to increase creative self-efficacy (CSE) and creativity level of college students.	Interdisciplinary and intercultural approaches to creativity, creative self-efficacy, creativity training.	• Intervention: Intensive Program (IP) with interdisciplinary and intercultural approach. • Components: Interdisciplinary approach, group collaborations within and across disciplines. Intercultural approach, national groups exploring cultural perspectives. "4P-2C" framework. Common framework for curriculum development and teaching. Coteaching: Workshops delivered by at least two instructors from different institutions. "Total Involvement Management": Student involvement in organizing and managing the learning event. • Duration: 2 weeks. • Outcomes measure: Creative self-efficacy (CSE), Self-reported creativity (SRC), understanding of creativity and related concepts. • Assessment. Pretest and posttest. • Population: 75 college students from different countries and disciplines.	Overall, the evaluation provides evidence to the **effect** of this training initiative both right after and 1 year after the program. Multilevel analysis of the pre- and posttests indicates the positive effect of the intensive program (IP) after controlling for gender, age and cohort of the students. Students' understanding of creativity, innovation, and the management of creativity and innovation increased substantially through the 2 weeks' training; they rated their own level of creativity significantly higher right after the IP; and their creative self-efficacy (CSE) was also significantly increased. The 1-year follow-up study revealed that the high self-rated creativity (SRC) of the participants could retain 1 year after the IP. The 1-year follow-up study revealed different developmental patterns of CSE for the student and young professional groups: the CSE of the young professional group tended to further grow, whereas that of the student group dropped significantly. The sustained effect of the IP was further confirmed by the participants' evaluation on to which extent the three goals of the IP were achieved 1 year after the IP.	Germany, Spain, Latvia, and Sweden
Perry and Karpova (2017)	2017	(1) To evaluate the efficacy of a creative thinking course using three different assessments. (2) To analyze changes in creativity as a result of the training for individual participants. To investigate reasons for individual decreases in creativity after the training.	Creative thinking, creativity training, creativity assessment, efficacy of creativity training.	• Intervention: Creative thinking course. • Components: 24 creative mini-projects (individual), three full-scale projects (team-based). • Duration: 16-week semester. • Outcome measured: Creative thinking; belief in their own creative abilities; attitude toward risk-taking. • Assessment: TTCT, self-assessment. • Population: 47 undergraduate students.	The results of the study indicate that the **creative thinking** course was effective in increasing participant creativity measured by two different assessments: expert-assessed, using the TTCT, and self-assessed, using the belief in their own creative abilities scale.	United States of America

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Yang et al. (2018)	2018	To evaluate the effectiveness of Challenge Based Learning on students' creativity and innovativeness.	Innovation and creative thinking, challenge-based learning (CBL).	• Intervention: Challenge Based Learning (CBL) intervention in an elective course "Innovation and Creative Thinking." • Components: Lectures, CBL group work, CBL presentation. • Duration: 36 h of class contact (18 h of lectures, 12 h of CBL group work, 6 h of CBL presentation) and 144 h of self-study, spanning over a 12-week semester. • Outcomes measured: creative consciousness, curiosity, pattern breaking skills, idea nurturing ability, willingness to experiment and take risks, courage and resilience, energetic persistence. • Assessment: Creativity and Innovation Effectiveness Profile (CIEP) pretest and posttest. • Population: 60 nursing students.	Apart from descriptive statistics, the mean scores of the Creativity and Innovation Effectiveness Profile between the pretest and post-test assessments were analyzed using the Wilcoxon signed ranks test. The results showed that the mean scores of all 7 domains (i.e., creative **consciousness**, levels of **curiosity**, **pattern breaking** skills, **idea nurturing** ability, willingness to **experiment** and take **risks**, **courage**, and **resilience** and energetic **persistence**) of Creativity and Innovation Effectiveness were significantly higher in the post-test.	China
Pi et al. (2018)	2018	To test the hypothesis that peers' ideas and students' openness to experience would predict student creativity and attention to peers' ideas.	Creative stimulation in online collaborative groups, peers' ideas, openness to experience.	• Intervention: Exposure to peers' original ideas at different proportions: high (40% original), medium (20% original), low (10% original). • Components: Online collaborative groupware system, creative tasks, and proportion of peers' original ideas. • Duration: Approximately 10 min per task, with a 5-min rest period between tasks. Total duration: About 30 min for all three tasks. Frequency: Ideas presented at equal 20-s intervals during each task. • Outcomes measured: Openness to experience. Creativity in terms of fluency, originality and usefulness. Attention to peer's original ideas by eye tracker. • Assessment: Chinese version of the Openness to Experience scale. • Population: 60 undergraduate students.	Specifically, students with higher (but not lower) **openness**, when exposed to a high (but not low) rate of peers' **original ideas**, paid greater attention to those ideas, and were more creative.	China

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Hsu et al. (2018)	2018	(1) To fuse the 635 brainstorming method and the C-Sketch method by alternatingly passing pictures and words in the divergent thinking phase to help group designers with stimulating and integrating their ideas from different aspects for developing innovative products. (2) To help industrial designer groups collaborating to design innovative products, this study develops an online collaborative design system that could support several divergent thinking methods, including the hybrid technique proposed in this study. (3) To evaluate the feasibility of this hybrid technique, this study conducts two experiments. (4) To propose a creative thinking methodology that, by passing pictures and words alternately among group designers in the divergent thinking phase, helps the group designers think divergently. (5) To evaluate the feasibility of this hybrid technique this study compared it with the 635 brainstorming method and C-Sketch method on the performances in the divergent thinking phase, the performances on the final product designs, and the performance of creative thinking.	Creativity in design, creative design process, innovative solutions or ideas, idea generation, brainstorming, group creativity, divergent thinking.	• Intervention: Alternate writing and sketching brainstorming method. • Components: 635 brainstorming method and c-sketch method. • Duration: Not specified. • Outcomes measured: Fluency, flexibility, originality, elaboration. Innovation, Aesthetics, User, Business. • Assessment: Pretest and posttest Torrance Tests of Creative Thinking (TTCT). Performances on the final product designs. • Population: Freshmen students. • Groups: Experimental and control groups.	For the results in the first experiment, using the **alternate writing and sketching brainstorming method**, the **originality** and the **elaboration** of group creativity score significantly higher than that using the **635-brainstorming method**, but the fluency and the flexibility do not. In the second experiment, using the alternate writing and sketching brainstorming method, the originality and the elaboration of group creativity score significantly higher than that using the **C-Sketch method**, but the flexibility does not. Nevertheless, the C-Sketch method performs significantly better in the **fluency of group creativity** than that of the proposed method. The alternate writing and sketching brainstorming method scores significantly higher than the 635 brainstorming method and the C-Sketch method do in improving **designers' creative thinking**. Nevertheless, the measurements of the performances on the final products yield no significant differences between the alternate writing and sketching brainstorming method and the 635 brainstorming method or the C-Sketch method.	Taiwan

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Morin et al. (2018)	2018	To describe an innovative cognitive/metacognitive approach to enhance creativity as well as the pedagogical strategies underlining a creativity course for engineering students. To present the pre-post results measured with a revised version of the CEDA (Creative Engineering Design Assessment).	Creativity programs, Integration of supportive environment, knowledge, cognitive and thinking style skills, task motivation and tolerance for ambiguity, risk taking and desire to overcome obstacles, Creative process, Cattel-Horn-Carroll (CHC) model of intelligence.	• Intervention: Course titled "Creativity in applied sciences and engineering." • Components: Games inspired by various sources to stimulate creativity Forum on creative behaviors to relate creativity to real-world examples. "Warm-up" period to focus on cognitive activities underlying creative efforts. "Mouse Trap" project for hands-on conception and construction skills. Group project focusing on engineering-related problems. Logbook to develop critical thinking. Research and presentation of different approaches to stimulate creativity. Active participation in class discussions and forums. • Duration: 45 h. Conducted over three semesters (Fall 2014, Winter and Fall 2015). Weekly exercises to improve cognitive abilities associated with creativity. • Outcomes measured: Fluidity, flexibility, originality, and usefulness. • Assessment: CEDA test. • Population: 59 students.	The students' scores on four variables measured by CEDA—**fluidity**, **flexibility**, **originality** and **usefulness**—were statistically higher after the course than before. Students' written comments provided further evidence of the course's relevance and effectiveness. Researchers concluded that students' creativity was increased and that the course enabled a better **understanding of creativity** and how to foster it.	Canada
Fischer and Golden (2018)	2018	To explicitly identify the theory that both underpinned and resulted from practice.	Teacher creativity, creative thinking as a neurological process, creative process and environment, modeling creativity, Rogers' concept of fully functioning person (FFP).	• Intervention: Creative project-based learning (PBL) approach in English language learning (ELL) classrooms. • Components: Formative stage: Teaching students how to give workshops. Summative phase: Students identifying field-related issues and planning projects. Certificative stage: Realizing projects and learning to communicate them through narrative. Feedback loops: Teacher-to-student, student-to-student, and teacher-to-teacher feedback. • Duration: 15 weeks (one semester). Frequency: Regular feedback loops throughout the semester. • Outcome measured: Observable products, Engagement of students, Motivation and Learning, Feedback. • Population: College student and teachers.	The experience with this approach confirmed previous findings on **creative teaching**, but also included unanticipated challenges and benefits, such as a greater need for **feedback** and an increased sense of **empowerment** and **ownership** in students.	Canada

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Y. Li (2018)	2018	To add the development content of right-brain function to the architectural teaching program.	Imagination and creativity in architectural design, right-brain function, image thinking.	• Intervention: Decomposition and combination training, Associative ability training. • Components: Summarizing the received information and further recombining decomposing and recombining the information, Rubik's cube, puzzles, and simulation splicing tools. In the specific associative training, the same thing was shown to the students, such as a pair of pants, and they're asked to use the information of the pants to make associations, carry out architectural design, and ultimately the teacher made evaluations. • Duration: 1 semester. • Population: Junior college students.	The results showed that the creativity and **aesthetics** of the first three groups of students' architectural design had been greatly improved, and the content of brain **endorphins** was significantly higher in the architectural design than the fourth group of students. This shows that the first three groups of students have stronger ability to mobilize the **right brain** during the architectural design. In addition, the combination of "**decomposition and combination training + associative ability training**" is better than any method alone. This fully proves the significance of focusing on the development of right brain function in architectural teaching.	China
Omar et al. (2018)	2018	To encourage undergraduate students' exploration as well as develop their technical writing skills.	Critical-thinking skills, creativity, problem-solving skills, Creativity-in-Progress-Rubric (CPR) on Proving.	• Intervention: Problems and assessment to promote creative effort. • Components: Challenging mathematics problems (portfolio problems) assigned as homework, with a duration of approximately 2 weeks. Use of the Creativity-in-Progress Rubric (CPR) on Proving for reflective write-ups. Two major projects: First project: A minimum 10-page document investigating a combinatorial problem, with a duration of about one and a half months. Second project: A group project with 3–4 students per group, with a duration of about one and a half months. Encouragement for collaborative work with individual write-ups. • Duration: Not specified. • Outcomes measured: Self-reported boost in students' proving confidence. Students' perception of themselves as practicing mathematicians. Development of mathematical creativity. Enhanced awareness of problem-solving processes. • Population: 19 Mathematics and Computer Science majors.	Though student reflections, the structure led to a self-reported boost in student's proving **confidence** and led the to view themselves as practicing mathematicians.	United States of America

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Li and Cheng (2018)	2018	To cultivate students' ability of divergent thinking and enhance their creativity through the implantation of art.	Problem-solving ability, creative thinking, divergent thinking, STEAM.	• Intervention: Elective course. • Components: Integration of art into engineering curriculum using CAPE teaching strategy. Four stages: exploration, cooperation, records, and reflection, use of "video art" as the art form. Setting: Equipped with computers for operations, open art classrooms, and outdoor campus activities Focus: Artist's concept transformation, intention creation, and new thinking. • Duration: 18 weeks. • Outcomes measured: Correspondence of art teachers' teaching contents with divergent thinking categories. Shift in engineering teachers' focus from technical to application-level teaching. Induction of students to raise questions and generate different solutions. Students' ability to redefine problems through divergent thinking. Students' learning motivation when facing technical difficulties. • Population: 20 senior students from a university science and technology.	The results show that the art teachers' teaching contents are corresponding to the **divergent thinking** categories, and that **classroom contents** enable engineering teachers to focus their teaching from purely technical teaching to the technical application level. When the art teacher and the student discuss their creative techniques and presentation form, it will induce students to challenge old methods and generate different solutions.	Taiwan
Ulger (2018)	2018	To implement PBL approach as a treatment for higher education visual arts students and to examine its effect on the creative thinking and critical thinking disposition of these students.	Nonroutine problems, creative thinking, novel solutions, critical thinking, problem solving, problem-based learning (PBL).	• Intervention: Problem-Based Learning (PBL). • Components: involving stages of defining the problem, identifying known, needed, and unknown information, determining possible solutions, collecting and analyzing data, and providing feedback, with a teacher acting as a facilitator. • Duration: 11 weeks. • Outcomes measured: Creative thinking, critical thinking disposition. • Assessment: Pretest, Posttest and Follow-Up Test TTCTs and CCTDI. • Population: 17 Undergraduate students in the Visual Arts Education. • Groups: Experimental group.	**Poblem-Based Learning** (**PBL**) had a significant effect on **creative thinking**, but critical thinking disposition was affected to a lesser degree. One possible reason for this result is that in this study, open structures were used for learning activities as a **nonroutine problem-solving process** to develop creative thinking. Accordingly, the results of this study indicate that PBL can help students with nonroutine problem-solving processes by maintaining **uncertainty** and enhancing creative thinking. However, a similar conclusion could not be reached for critical thinking disposition. Therefore, future studies regarding critical thinking disposition and the PBL approach should be conducted.	Turkey

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Huang (2018)	2018	To investigate the effectiveness of different types of Remote Associates Test (RAT) materials and to examine whether the pairing of learning style and creative learning materials influence the outcome.	Creativity as the ability to create novel and valuable ideas, reorganizing problems, creativity training, Remote Associates Test (RAT), divergent thinking, associative theories of creativity (Mednick's), Functional Remote Associates Test (Worthen and Clark's FRAT).	• Intervention: Online Remote Associates Test (RAT) Training System (ORTS). • Components: Text and image RAT questions. Immediate feedback on answer correctness. • Duration: 10 days. Frequency: 20 training questions per day. Total of 240 questions (200 for training, 40 for pre- and post-tests). • Outcomes measured: Creativity. • Assessment: Problem Solving Creativity Test (PSCT), RAT. • Population: 117 college students, information technology majors. • Groups: Participants divided by preferred learning style (visual or read/write) and received training in either text or image format.	The overall experimental results suggest that respondents' creativity improved significantly after receiving training using **RAT materials** in different formats. Results show that matching training material type with students learning style seems to be unnecessary. Further, the results imply an interesting relation between creativity and association ability in terms of three aspects: **teaching materials**, **individual learning style**, and **neuroscience** and **association training**.	Taiwan
Stolaki and Economides (2018)	2018	(1) To design an educational intervention with Information and Communication Technologies (ICTs) integration that will stimulate students' creativity and administer it for a sufficient time, so as to bring its cognitive effects. (2) To examine if students will respond to the intervention differently based on their individual habits and characteristics (academic achievement, computer knowledge, Facebook usage etc.). (3) To find if there are any correlations between student creativity, academic achievement, ICT knowledge and Facebook usage. (4) To evaluate the overall effects of the creativity enhancement intervention on students' creativity and draw useful conclusions.	Creativity as a dynamic life-long process of self-expression, creative as a cognitive process, creativity as a multifaced phenomenon, convergent and divergent thinking, The Componential Theory of Creativity, creativity and play.	• Intervention: Educational Intervention with Information and Communication Technologies (ICTs) integration. • Components: Main project with 5–6 essay questions and answers; smaller projects with answers to other teams' questions. Extensive use of Facebook. Collaborative team structure. Game-like competitive environment. Question generation and answering. • Duration: 1 semester. Frequency: Three projects per team. • Outcomes measured: Fluency, flexibility, elaboration, originality. Academic achievement. • Assessment: Divergent Thinking Test (DT) and exam results (academic achievement). • Population: 90 undergraduate students.	Results show that the intervention was overall effective in stimulating creativity. There was a statistically significant increase in **fluency**, **flexibility**, **elaboration** and **originality**, as measured by **divergent thinking tests**. Total student creativity calculated with the use of principal component analysis showed a significant positive link to **academic achievement** and **ICT knowledge**. Students with almost zero Facebook usage exhibited the highest levels of creativity followed closely by their peers with the highest Facebook usage. Creativity enhancement was not related to Facebook usage or ICT knowledge.	Greece

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Caballero García et al. (2019)	2019	To examine creativity among university students and the differences that may arise due to gender, age, and choice of studies.	Creative thinking, critical thinking, CREA test, TTCT, CPAC scale, A New Test of Creativity, CAC, creativity gender, age, and choice studies differences.	• Intervention: Creativity enhancement program as part of a broader emotional intelligence, happiness, and life satisfaction program. • Components: Bono's 6 thinking hats technique, and Scamper techniques, combined with positive emotion elicitation and management. Teacher Training: 10 h in the first semester for creative techniques and positive emotional management. • Duration: 8 sessions of 90 min each, distributed over a semester (a total of 720 min). Frequency: 4 sessions focused on creativity. • Outcomes measured: Creativity. • Assessment: CREA test. • Population: 206 undergraduate and professional training students. • Groups: 104 students in control group and 97 students in experimental group.	The results found an increase in student creativity after the intervention program. However, statistically significant differences were found between the two forms of the **CREA test** (A and B). Significant differences were also observed according to **gender**, with women demonstrating more creativity than men on the pre-test and post-test of the CREA test form B. In reference to **age**, the youngest students (under 20 years old) showed more creativity on the pre-test and post-test of form B of the CREA test. Finally, regarding choice of **studies**, data reveals that education sector students have a higher creativity index than students who did not belong to the education sector, before and after positive emotion intervention, on form B of the CREA test.	Spain
Liu et al. (2019)	2019	To evaluate whether a teaching for creativity module (TCM) can enhance teaching behaviors and self-efficacy of teaching creativity for capstone course nursing faculty.	The Creative Education White Paper of Taiwan, creativity training, design thinking, divergent thinking creative production, self-assessment creativity, teaching behaviors, creativity self-efficacy, Process of Creative Problem Solving (CPS's Parnes), and Componential Theory of Creativity (Amabile's theory).	• Intervention: TCM training program. • Components: Stage 1: Teaching creativity workshop with introductory and advanced levels of creative thinking techniques. Stage 2: Reinforcement of creativity skills in the classroom with nursing and design faculties teaching side-by-side. Techniques included: design thinking, brainstorming, attribute listing technique, human-centered design thinking, assessment matrix technique, and paired comparison method. • Duration: 16 h of course work and 6 h of teaching creativity in the classroom. • Outcomes measured: Teaching behaviors, teaching technology creatively, personality traits associated with creative teaching self-efficacy, efficacy of teaching creativity. • Assessment: CTBS, CTETITS, SECTS. • Population: 42 capstone nursing faculty. • Groups: 21 participants in the control group and 21 participants in experimental group.	Analysis of covariance (ANCOVA) demonstrated the TCM intervention group had significantly better post-test mean scores for **creative teaching behaviors** and **self-efficacy of teaching creativity** than the control group. These findings suggest participation in a creativity **workshop** and **reinforcement** of teaching skills with classroom **interdisciplinary** teacher training can augment teaching for creativity of nursing faculty.	Taiwan

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Lee (2019)	2019	To develop students' creativity through a digital game and design of a creative writing project to provide an authentic learning opportunity.	Creativity as self-realization, creative writing, digital game-based learning.	• Intervention: Creativity in an English as a foreign language (EFL) class. • Components: Digital game "Her Story" played in and out of the classroom using PCs or mobile phones. Views of at least 60% of archived videos. Maintain a log journal. Reconstruction the story. Production a two-page piece of creative writing based on the game. Recreation of their own stories with chosen genre and viewpoint. • Duration: 8 weeks. • Outcomes measured: Originality, flexibility, elaboration. Self-assessment. • Assessment: Creative writing papers, reflection papers, pre and post-project surveys. • Population: 25 sophomores, juniors, seniors students of English.	The results indicate that the participation in the project improved students' **motivation** and **engagement** in **learning**. The students' high levels of interest, **curiosity** and **sense of immersion in** the **game** ultimately served as motivation to write their own **stories**. and these positive affective factors probably resulted in better learning outcomes. The findings of this article also suggest that **creative writing** can be an effective conduit for invoking and fostering creativity.	South Korea
Hains-Wesson and Ji (2019)	2019	To improve students' non-explicit cultural competence, non-explicit employability skills with a focus on managing complexity, developing agility, and creativity.	Creativity as an employability skill, Work-Integrated Learning (WIL).	• Components: Short-term interdisciplinary study tour program offered twice per year, involving teamwork assessment tasks in international contexts as an elective unit worth 6 credit points. Students worked in interdisciplinary teams on global issues or industry-linked projects. • Duration: From 2014 to 2017. • Outcomes measured: Managing complexity, developing agility, creativity. • Assessment: Online surveys and Employability Development Profile (EDP), focus groups interviews. • Population: Undergraduates studying various majors.	The results indicate that the integration of a purpose-designed **interdisciplinary teamwork** assessment task, through a short-term study tour model, uncovered certain untapped employability skills, namely managing **complexity**, developing **agility**, and **creativity**. Also, students improved their creative skills as a synergistic result due to the purpose-designed **international experience** that incorporated an interdisciplinary teamwork assessment task. This, in turn, meant that they maintained a high level of effort and fostered an adequate level of team cohesion.	Australia

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Rodríguez et al. (2019)	2019	To examine how the implementation of flipped classroom methodology fosters the development of creativity and critical thinking skills in undergraduate health science students, assesses the students' opinions on this methodology, and measures its effects on their learning results.	Creativity for changing circumstances, creativity and critical thinking, creative in science, creativity as the interaction between aptitudes, process and environment, creativity as a social and collaborative phenomenon.	• Intervention: Flipped classroom. • Components: Mandatory pre-class learning, face-to-face sessions for application of knowledge, problem-solving, cooperative work, and inquiry. Activities: Jigsaw, cooperative work, pyramid dynamics, role-play. • Duration: Academic year 2016–2017. • Outcomes measured: Creativity, critical thinking skills, students' opinions, learning results. • Assessment: Flipped classroom questions, Lecture-based questions. • Population: 93 students (44 Human Biology, 49 Medicine).	The results showed that (i) students had the perception of having developed creative and critical thinking skills and social awareness throughout the **flipped classroom** methodology; (ii) students were highly satisfied with this teaching method and recommended implementing it as a regular activity of the **curriculum**; (iii) better **learning** results were obtained using this method than with traditional learning; and (iv) the length of sessions and the type of knowledge to be assessed have been identified as the main limitations to implementing this method. Data of this study provide insight to how complex skills (e.g., creativity and critical thinking), and their effects on learning results, can be improved in undergraduate students of health sciences throughout the flipped classroom method.	Spain
de Arriba et al. (2019)	2019	To propose that contemporary art, which reflects the problems and attitudes of our times, can be used as a way of promoting creativity in disciplines that are not traditionally associated with the arts.	Imagination and creativity for a world of unprecedented global challenges, art and education, creativity and education, Anna Craft's notion of creativity with a small "c."	• Intervention: An activity in political economy. • Components: Selection of a work of contemporary art related to political economy and in-class presentation. • Duration: 4 weeks. • Outcomes measured: Ability to establish innovative connections and associations, increased interest in learning, personally relevant learning, holistic thinking, transformative learning. • Assessment: Group discussion, brief questionnaire • Population: 12 students in the International Economic Policy course in a master's program.	The findings indicate that it is particularly effective at enabling them to establish **innovative connections and associations**, increasing their interest in learning and developing a personally relevant body of **knowledge**. Furthermore, taking into consideration **contemporary art**'s ability to highlight the **problems** of our times and to react to them, we consider whether the works presented by the students display these problems and are capable of offering **solutions**, or elements of solutions, to them, and find that they are indeed capable of doing so.	Spain
Eissa (2019)	2019	(1) To investigate how the vertical thinking mode can help architects with the concept generation phase. (2) To explore the possibility of using De Bono's lateral thinking techniques for the same purpose, since creative problem solving has long been linked to design and both words are often used interchangeably.	Vertical versus lateral modes of thinking, concept generation.	• Intervention: "Theories of Architecture: The Design Process." • Components: Pedagogical course introducing concept generation methods. (1) Vertical thinking: analysis/synthesis. (2) Conjunctures map. (3) Lateral thinking map. Three successive cycles, each 2 h long. Group work in charrette-like workshops. • Outcomes measured: Fluency, flexibility, originality, elaboration. Assessment: TTCT. • Population: 120 sophomore students in Architecture.	The study highlights the importance of **teaching concept generation methods** at an early stage of architecture education and suggests an outline for its implementation. It underlines different outcomes achieved through following different thinking modes and recommends blending both thinking modes for generating creative concepts in architecture.	Egypt

(Continues)

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Cheng (2019)	2019	To understand the development of "creativity for Environmental Sustainability (ES)" (pro-ES creativity) of common tertiary students.	Creativity education and environmental education, mini-C and little-C levels of student creativity, dual approach to domain-specific and general creativities, problem-finding, methods of creativity training (embodied exercises, life experiences, inquiry-based learning), interdisciplinary approach of creative learning, curriculum, pro-ES competences.	• Intervention: A pro-ES creative learning curriculum integrated into an existing toy course. • Components: Study the reduction, reuse, replacement, and recycling of toys – Upcycling and repairing toys. Hands-on toy making with trashes and everyday materials. Designing and making pro-environmental toys. Re-inventing older toys. Designing exercises that use creative thinking strategies, such as SCAMPER, CPS, and forced association. Critical analysis of existing eco-toys, comparisons with ancient and modern toys and reflections on whether people really need to buy toys. Critical analyses of the impacts of industrialization, commercialisation and advanced technology on toys, including the issues regarding waste, production, repair and reuse. Formulating future sustainable toy scenarios, including comparing past and present toy characteristics, identifying trend, problems and their causes, envisioning possible futures of toys and making evaluation of the scenarios with the aim of their realization. Reconstructing present social systems for realizing future toy scenarios, including critical analyses of ancient and modern social systems, understanding the relationships of toys and the toy industry with society and children, and suggesting system changes. Designing and making pro-environmental toys, re-inventing older toys and discussing how government, industry and parents can effect changes in toy culture. • Duration: 39 h. • Outcomes measured: Sensitivity and problem-finding, creative problem-solving abilities, affinity for self-creating lifestyle, creative systems thinking and futures thinking, reconceptualization of creativity and ES. • Assessment: Semi-structured interviews. • Population: 32 university students from diverse academic majors, majority in year 3, 4, and 5 of university.	The study discovered that creativity, as a kind of **self-actualization**, had developed both individual competences and intrinsic motivation, which are conducive to life-long self-determining ES behaviors. This study informs the education field that the five attributes of **pro-ES creativity** can be enhanced in a **curriculum** based on a simple everyday theme: (1) Sensitiviy and problem-finding in ES issues, (2) Creative problem-solving abilities for everyday ES problems, (3) Affinity for a self-creating lifestyle, (4) Creative systems thinking and futures thinking for societal ES problems, (5) Re-conceptualization of creativity, ES and their relations. As such, pro-ES creativity education can be integrated into many existing curricula. Going beyond ES, this study shed light on creativity studies of other less popular areas. It suggested a dual **domain-specific-general creativity education approach** and a dual **deductive-inductive research approach** for developing **creativity theories** and curriculum of "low-creativity" domains.	China

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Munakata et al. (2019)	2019	To describe the development and implementation of course modules intended to encourage creative thinking in an undergraduate general education mathematics course.	Creativity in STEM, creativity as the ability to innovate, connect ideas, see similarities and differences, have flexibility and aesthetic taste, be inquisitive, question norms, make decisions about which approaches are worthy of pursuing, and convince others of the values of their ideas.	• Intervention: Course modules intended to encourage creative thinking in "Contemporary Applied Mathematics for Everyone" general course. • Components: Team-taught by three instructors. Hands-on learning with minimized lecture-style teaching. "Making math" activity with object-based exploration. "Making sense of data" activity with self-discovery and data analysis. Journaling for reflection. Book club with assigned books. Creative midterm and final assessments. • Duration: 1, 15 h per meeting, twice a week. • Outcomes measured: Students' ability to read and interpret data and graphs. Students' ability to develop a sense for numbers and orders of magnitude. Students' appreciation for the historical development of mathematical ideas. Students' ability to learn basic computations. Students' conceptions about mathematics. Students' connections between mathematics and creativity. Students' understanding of the importance of collaboration. • Assessment: Student work (participation, preparation, engagement, assignments, discussions, experiences). • Population: Undergraduates, usually non-mathematics majors, from various disciplines.	Student work, including journal entries, surveys, and class assignments, provide evidence that this intentional focus on creativity in mathematics challenged student's **conceptions** about mathematics, allowed them to reconsider the mathematics familiar to the in new ways, and engaged them in meaningful **collaborations**. Interviews of instructors revealed that they, too, engaged in **creative processes** as they planned the course and thought about innovative ways to engage students with mathematics.	United States of America
Regier and Savic (2019)	2019	To explore how fostering mathematical creativity may impact student self-efficacy for proving.	Mathematical creativity, the Gestalt principal, the aesthetic principal, the free-market principle, the scholarly principle, the uncertainty principle, self-efficacy for proving (enactive experiences, vicarious role-modeling, verbal persuasion, physiological reactions).	• Intervention: Implementation of Sriraman's five principles for fostering mathematical creativity in a Discrete Mathematics course using inquiry-based learning. • Components: Gestalt principle, aesthetic principle, free market principle, scholarly principle, uncertainty principle. • Duration: Integrated throughout the semester, 15 weeks. • Outcome measured: 5 principles, self-efficacy for proving. • Assessment: Online surveys (Five Principles Survey [5PS], Self-efficacy for Proving Scale [SEPS]), classroom observations, interviews. • Population: Undergraduate students.	The study revealed associations between four of the five principles (1) The Gestalt principle, (2) The aesthetic principle, (3) The free-market principle, (4) The scholarly principle, and (5) The uncertainty principle and changes in student **self-efficacy** for proving, along with two instances where the combined use of principles may have provided students greater opportunities for building self-efficacy for proving.	United States of America

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TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Mayes-Tang (2019)	2019	To describe three ways an existing first-year math seminar was modified to increase its focus on creativity: introducing readings and discussions related to creativity, drawing connections to creativity in other disciplines, and adding an open-ended project.	Creativity in Mathematics, the Curriculum Guide to Majors in the Mathematical Sciences (CUPM), combining previous knowledge and discovering unknown relations, Torrance's definition.	• Intervention: Three ways to modify an existing course. • Components: (1) Introducing readings and discussions about mathematical creativity. (2) Drawing connections to creativity in other disciplines. (3) Adding an open-ended project called the Mathematical Creations Project. • Duration: 3.5weeks, 3h each day. • Outcomes measured: Effectiveness of the creativity-focused first-year seminar, increasing students' understanding and experience of creativity in math • Assessment: post-Theme Stream survey, end-of-course discussion, students' Creations Project journals. • Population: 12 students	The course was effective in not only helping students understand the **nature of mathematical creativity**, but also further **engaging** them in the subject and helping them to better **understand** how mathematicians work.	Canada
Villarreal-Davis et al. (2020)	2020	To describe three creative approaches used to engage education counselors during their experience of supervising internships in an online learning environment.	Creative techniques and strategies, creativity in counseling supervision, expressive art therapies and experiential learning theory	• Interventions: (1) Phoenix–out of the ashes art-based activity and online counseling. (2) Digital creative writing collage and online counseling supervision. (3) Pictured miniatures and mindfulness in online counseling supervision. • Components: Creative approach, instructions given to students, case example applications. • Population: Students and faculty.	Incorporating creative interventions in online counseling has several benefits: fostering **student-teacher engagement**; promoting **professional development**; stimulating **conceptualisation of cases in practice**; promoting **self-awareness of professional development**; developing **skills**; identifying different **alternatives** for practice; promoting **self-reflection** in students through **cognitive and emotional experiences**.	United States of America
Ritter et al. (2020)	2020	To test the effectiveness of a creative thinking skills training programme for higher education students.	Daily life problem solving, maintaining and fostering well-being, adaptation to change, creative as the ability to generate original and useful ideas, creative thinking, creativity teaching and practicing, creativity as a mental phenomenon, convergent and divergent thinking, 4P's model of creativity (person, process, press, product).	• Intervention: 1-year creativity training program (mandatory course worth 5 ECTS credits). • Components: Theoretical lectures. Practical exercises in international business. Six Step Cycle of Creativity. Four tools: simplify, differentiate, visualize, tag the problem. Four types of assignments: Detox, Training, Jump. Practice with neural headsets (Mindwave and Mindflex). Warming-up video clip at each session. • Duration: 140 h over two semesters. • Outcomes measured: Divergent thinking (fluency, flexibility, originality creativity, usefulness), convergent thinking, creative problem solving. • Assessments: Pre-post-test (pre-measure, half-way measure, post-measure), Alternative Uses Task (AUT), Remote Associates Test (RAT) • Population: 78 students and an applied university. • Groups: 21 Control group and 57 training group.	Creativity training increased students' **ideation skills** and, more importantly, their **cognitive flexibility**. However, no difference in originality was observed. An increase in **performance** was observed for one of the convergent creativity tasks. With respect to creative problem-solving skills, no differences were observed between the training and control condition on the pre-measure, but a significant difference in **creative problem-solving skills** was observed between the two groups on the post measure.	Netherlands

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Li (2020)	2020	To explore an innovative method based on magical performance activity with the aim of facilitating flexible thinking in an interactive and engaging way.	Flexible thinking, mindset priming, mindset change, magic performance-based teaching method.	• Intervention: Magic performance-based teaching method. • Components: Participants watched magic performances, learned secrets and principles, and practiced performing tricks. Included learning and applying principles to design projects. • Duration: Three times over 2 weeks, each intervention lasted approximately 30 min. A total of 90 min. • Outcomes measured: Theories for mindset priming and mindset change. • Assessment: Semi-structured interviews, pre-and-post Guildford's Alternative Uses Task. • Population: 27 students in a design course at a public university.	The **magic performance** as a unique schema disruption stimulus influences students' flexible thinking in three aspects: **imagination**, **curiosity** and transfer of **flexible thinking**.	United States of America
Milicevic et al. (2020)	2020	To investigate the effects of an integrated curriculum that includes core training in creativity and meditation for graduate writing students.	Torrance's definition, creative writing, integrated curriculum with creativity and meditation	• Intervention: Integrated curriculum with core creativity and meditation training. • Components: Attentional balance, cognitive balance, conative and emotional balance, loving-kindness, empathy, compassion, and psychology of affect and emotion. • Duration: 18 weeks, 2 h per session, a total of 36 h. • Outcomes measured: Creativity, processes associated with creativity. • Assessment: TTCT, TEA, FFMQ, PANAS-X, NFCS. • Population: 7 postgraduate students enrolled in the Masters of Fine Arts.	The results showed a significant increase in creativity in general and, in particular, a significant increase in the **originality** and **flexibility** of creative ideas in **verbal expression**. There was a significant increase in aspects of working **memory**, divided **attention** and positive **affect**, as well as a tendency to be **less judgmental**. Introspective cognition was a central feature of the qualitative findings of the study. On the other hand, the sense of **community** and **belonging** enhanced students' creativity.	Australia

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Tang et al. (2020)	2020	(1) To present a three-phase mapped process for Playful Design Jams (PDJ) that identify the phases and activities, which incorporates playful elements and support the development of positive interdependence within team-based activities. (2) To introduce the Playful Design Jam (PDJ) process as an effective approach to teamwork that incorporates playfulness, physical engagement and experiential learning. (3) To interrogate the theoretical characteristics of a Design Jam and aimed to establish whether the experience engaged participants in the 4C's. (4) To contribute a clear theoretical mapping of PDJ relating to the concept of play, positive interdependence and factors that can enhance team affiliation	Critical thinking and problem-solving, creativity and innovation, communication, and collaboration (4C's), distributed creativity, creative exploration.	• Intervention: Playful Design Jam (PDJ) process. • Components: Rotational brainstorming, working with props and games, and prototyping, to enhance collaborative teamwork and learning. Playfulness, physical engagement, experiential learning, rotational brainstorming, props and games, prototyping. • Duration: 48 h. Frequency: 9 PDJs. • Outcomes measured: 4C's. • Assessment: Pre-and-post-jam questionnaires, unstructured observations, semi-structured interviews. • Population: 53 design undergraduate and postgraduate students.	Participants reported on their experiences during the **PDJs**, which highlight their engagement with **critical thinking processes**, **creative explorations** and **communication** through **collaborative team activities**. Participants showed high levels of **motivation** and **engagement** in group work and collaboration during the PDJ. They reported that they felt the event improved their creativity, critical thinking, communication and collaborative engagement (**4C's**).	Not specified
Warr and West (2020)	2020	To describe the implementation of an interdisciplinary design studio as a mean to teach creative problem-solving through project-based learning.	Critical thinking and problem-solving, communication, collaboration and creativity, interdisciplinary project-based learning.	• Intervention: Interdisciplinary design studio created to support project-based learning in the university library. • Components: Fundación Paraguaya, DUST, Social Innovation Design. • Outcomes measured: Interdisciplinary design studio experience (faculty mentorship, open-ended learning, customizing the learning experience, managing work and deadlines, authentic motivation) and interdisciplinary collaboration (teamwork and interpersonal skills, learning from other students, collaboration challenges, communication, disciplinary knowledge, learning about other disciplines, preparing for the future). • Assessment: Interviews, observations, surveys. • Population: 196 participants from diverse majors.	Students described courses as flexible and reported high levels of **motivation** stemming from the authenticity of the problems. Because of the interdisciplinary nature of the studio, some students described deepening disciplinary skills while at the same time being exposed to cross-disciplinary skills. They believed the courses helped develop **interdisciplinary collaboration**, **creativity**, and **communication skills**.	United States of America

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Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Wade and Piccinini (2020)	2020	(1) To provide the theoretical background to future scenario planning and its importance in sustainability management education. (2) To present the instructional innovation of the Creative Play Method for teaching scenario planning for a sustainable future, describing how this method unfolds across two stages of classroom learning activities. (3) To report an evaluation of the effectiveness of the instructional innovation to give sustainability management educators confidence to adapt it for use in their own classrooms. Specifically, the Creative Play Method is evaluated for how it improved student's skills in creative thinking following implementation in a postgraduate sustainability course at a major Australian university. (4) To offer conclusions on the Creative Play Method and how it may be used by educators to teach scenario planning for a sustainable future in other courses.	Creative thinking, divergent and convergent thinking, the Creative Play Method for teaching scenario, experiential learning.	• Intervention: Creative Play Method. • Components: Unlocking creativity through play (introduction, team formation, creative play, activity debrief), harnessing creativity in scenarios (introduction, team formation, creative scenarios, activity debrief), LEGO. • Duration: 12-week semester course. • Outcomes measured: Scenario construction (appropriateness of factors, logic of factor combination, novelty of critical events) and scenario story (imaginativeness, insightfulness of event links, meaningful) • Assessment: Pre-and-post-team assignments. • Population: Postgraduate students.	Overall, the results of the analysis of student assignment data and a survey provide evidence of the effectiveness of the **Creative Play Method** in improving student skills and creativity in **scenario planning** when incorporated into a postgraduate sustainability course.	Australia

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Wu and Wu (2020)	2020	To introduce project-based learning and SCAMPER teaching strategies.	Creative thinking skills, creative behavior, motivation, personality traits, creativity instruction.	• Intervention: Project-based learning focusing on problems that encompass multiple disciplines and connect concepts with real-life experience. • Components: SCAMPER instructional strategy for product refinement and project execution and improvement. Structured activity steps: preparation, implementation, presentation, evaluation, and revision. • Duration: Over 2 semesters, each lasting 18 weeks (a total of 36 weeks), with 2 classes per week. • Outcomes: Creativity, creative thinking, learning motivation, personality traits. • Assessment: Pre-and-post-TTCT, discussion content, WPI, two questionnaires (Elliot and McGregor's, and Jabri and Koestler's). • Population: 55 Information engineering junior students.	According to the statistical analysis results, high-creativity learners in the information engineering project course exhibited more **fluency** after engaging in **project-based learning** and being exposed to the **SCAMPER instructional strategy** than did low-creativity learners. They proposed more **ideas** during discussions and interactions and expressed more personal **views** and opinions. In addition, according to the personal **motivation** result, high-creativity learners enjoyed the work. Although project design and development were challenging, high-creativity learners **coped with the difficulties** and intended to enhance personal **skills** and **knowledge**. The result is consistent with the personality trait analysis. During discussions and interactions, high-creativity learners exhibited **problem-solving abilities** intuitively. Thus, they tended to express personal ideas and opinions and could propose alternative perspectives. They expressed **opinions informed by multiple views** to demonstrate their superior competence. Because they enjoyed the **challenge**, they intended to absorb **new knowledge** through their efforts. Thus, they were more willing to actively seek **solutions** to strengthen their personal capacity.	Taiwan
Chien et al. (2020)	2020	To develop a model for predicting creativity based on the discussion records of students during creative activities.	Creativity teaching, creativity assessment, data mining in education.	• Intervention: Project-Based Learning (PBL) and SCAMPER activities on the Moodle platform. • Components: PBL, SCAMPER, Moodle platform. Steps: understanding the problem domain, understanding the data, preparing the data, mining the data, evaluating the knowledge obtained, and using the knowledge obtained. • Duration: 2 semesters, each lasting 18 weeks, a total of 36 weeks. Frequency: 2 classes per week. • Outcomes measured: Fluency, originality, elaboration, flexibility. • Assessment: Pres-and-post-TTCT. • Population: 4-year-university students.	The experimental results revealed a model accuracy of 93%, thus demonstrating the **model's feasibility** for predicting creativity. Furthermore, the students' key terms were obtained by using k-means clustering with the proposed model, thus yielding valuable Supporting Information for exploring the development of creative ideas. These results revealed that **data mining** has substantial value in creativity education. Therefore, the proposed predictive model is suitable for predicting creativity in learning activities based on discussion records. It can support **teachers' assessment of student performance** and provision of timely **guidance** and **feedback** to enhance creative thinking and stimulate **imagination** among engineering students.	Taiwan

(Continues)

TABLE 2 | (Continued)

Authorship	Year	Aim or hypothesis	Main aspects of the theoretical framework regarding creativity	Intervention characteristics (components, duration, outcomes, assessment, population, groups)	Main results	Context
Caballero-García and Sánchez Ruiz (2021)	2021	To analyze the changes produced in both creativity and life satisfaction in university students by a positive emotional and creative intervention and explore individual differences by gender.	Creativity and life satisfaction, general competences, creativity as a multidimensional concept, CREA test.	• Intervention: Positive Emotional and Creative Intervention Program (EPOCREU). • Components: 30 different activities, 17 positive emotional education, 13 creativity. • Duration: 4 months. 60 min per session. Frequency: 7 sessions (4 on life satisfaction, 3 on creativity). • Outcomes: creativity, life satisfaction. • Assessment: pre-and-post-tests, CREA test (A, B, C), Satisfaction With Life Scale (SWLS), Overall Life Satisfaction (OLS). • Population: 300 university students. • Groups: Control and experimental groups.	The results show significantly higher results in **creativity and life satisfaction in women**, who continued to achieve high results after the intervention.	Spain
Yeh et al. (2021)	2021	To understand the conscious practice of Aesthetic Experience (AE) centred on products designed every day to enhance creativity.	Creativity for employment, aesthetics as an essential component of creative products, conscious practice of aesthetic experience (AE) focused on everyday designed products as an effective way to enhance creativity.	• Intervention: Aesthetic Experience (AE) practice on products. • Components: Free observation, perceptual analysis, life-experience association, functional analysis, aesthetic-emotion evocation. Stimuli of AE: 50 photos. Superficial, symbolic, functional and conceptual strategies. • Duration: Not specified. • Outcomes: Participants' and products' creativity. • Assessment: Pre-and-post-tests IEAEDP and creativity test, observation of the product, evaluation of emotion and product, PBFCT. • Population: 180 college students. • Groups: 1 control group and 4 experimental groups (each group with 36 participants).	The results revealed that engaging participants in **conscious practices of aesthetic experience**, especially those that contribute to the **association between imagined narratives and participants' life experiences**, enhance **analytical thinking** about product value and can improve students' creativity. It was also found that providing **scaffolding according to personality traits** can magnify the effects of learning creativity. The result revealed that participants with a lower level of everyday AE benefited more in the perceptual analysis group and in the aesthetic emotion evocation group (especially in the aesthetic emotion evocation group) than in the other intervention groups.	Taiwan
Liu (2022)	2022	To evaluate whether there is an effect of interdisciplinary teaching on nursing students' creative thinking abilities.	Interdisciplinary teaching, divergent thinking, TTCT.	• Intervention: Capstone course. • Components: Identification of a healthcare problem, development of a prototype, lectures and instructions, discussions. • Duration: 18-week course. 3 4-h workshops. • Outcomes measured: Divergent creative thinking (fluency, flexibility, originality, and elaboration). • Assessment: Pre-and-post-test for TTCT-F. • Population: 191 nursing students. • Groups. 3 groups. 2 experimental groups (80 students, 30 students) and 1 control group (81 students). Non-randomized.	Comparisons between mean total and subscale scores for **Torrance Tests of Creative Thinking-Figural** (**TTCT-F**) for the two intervention groups and controls demonstrated only Group 2 students (teaching assistants) had significantly higher scores than the control group. Teaching assistants also had significantly higher scores than Group 1.	Taiwan

Note: In this table, we have highlighted the key concepts in the results from a pedagogical point of view. This aims to offer scientific evidence considering possible didactical elements (such as aims, contents, methods, strategies, techniques, activities, resources, materials, climate, or evaluation measures and instruments), to the university community for fostering creativity in higher education. We have tried not to be redundant with the information highlighted.

without specifying. In this sense, the field of knowledge that stands out in the deployment of creativity in higher education is the field of Social sciences (38). This lights up that there is still opportunity to consolidate the design, implementation and evaluation of teaching and learning processes linked to the fostering of creativity, specifically regarding the fields of Health sciences (e.g., Medicine, or Nursing) (12) and Sciences (e.g., Biology, Chemistry, Mathematics, or Physics) (10).

As we have stated before, it is important to clarify that some interventions took place in a combined manner (meaning involving more than one discipline, and possibly more than one field of knowledge). And so, to reflect the interest developed in each field, we broke down and then reintegrated this data in its corresponding fields of knowledge. That is the reason for, for example, having two different fields of knowledge (Arts and Humanities and Social sciences) in the article published in 1976. That said, we find it to be really interesting how we can appreciate the interest developed in the fields of knowledge over the years. As we can see in Figure 5, there is a sustained interest in fostering creativity in the fields of knowledge Arts and Humanities and Social sciences. In this regard, it has also come to our attention that the field of Engineering and Architecture has been developing recent interest and educational interventions to promote creativity among its students, having reached its peak in 2018 (6). Also, we want to highlight the importance of clarifying the disciplines and fields of knowledge involved when reporting and publishing about educational interventions, as it offers valuable information and contextualizes the intervention.

3.5 | Influence and Reach of Educational Interventions in Creativity

As shown in our results, the impact of the highest level (represented by the Q1 quartile) has been developed from 2014, with a particular increase in 2018 (6), 2019 (7), and 2020 (6). This impact is also represented in the Q2 quartile, which gains presence from 2008, but in the background compared to the first quartile. However, it is also necessary to note the large body of articles that are published in unindexed journals at the time of the publication, which reduces the impact and the reach of interventions. Regarding this question, we wanted to find out whether this impact and scope has been reduced, maintained, or increased over the years, especially in the light of the latest known indexing data. And this is why we present the following results.

These results show that the impact and reach of the publications of educational interventions in creativity in higher education has increased with the latest data indexation available. We appreciate the increase in the impact of the journals that have published the selected educational interventions in creativity in higher education, especially regarding the first quartile (Q1). Furthermore, we can see how there is also an increase in the journals indexed in Q2, Q3, and Q4, to the reduction of non-indexed journals in comparison to Figure 6. We find this to be really interesting in terms of impact and reach of these educational interventions, especially seeing how this topic gains presence through specialized journals addressing these interventions.

3.6 | Emerging Concepts of the Educational Interventions in Creativity

The concepts emerging from the selected studies are, among others, student (6698 references (r)) and creativity (5736r). Both take place at the centre of the image because they are the most repeated words in these interventions, as this reflects the focus of the systematic review, but also about the view of the selected studies: to enhance students' creativity. This concept analysis shows us some perspective on the set of our review and its empirical intervention core with related concepts such as study (2250r), group (2229r) (especially when considered in the sense of control group or experimental group), or course (1993r). Another issue we want to highlight is the relevance of the concept thinking (1990r), and its related concepts, such as creative thinking (326r), divergent thinking (168r), critical thinking (110r), and flexible thinking (38r). This certainly raises the pedagogical and didactic question of what the purpose of these educational interventions on creativity is, and why it is apparently important to shape thinking into a creative or divergent thinking. Furthermore, it is clear how these articles emphasize activities such as process (1740r), specifically regarding the creative process (148r) or the learning process (48r), which both speak about a continuum and not in terms of product.

3.7 | Identification and Relational Mapping of the Educational Interventions in Creativity

These results balance the importance of items and the strength of their connections. As shown, creativity is the emerging related term with a central weight, followed by higher education. We consider these results to reflect a consistency with previous ones (see Figure 8), and it is coherent regarding the scope of this systematic review. At the same time, higher education is connected to the Chinese context (related to Figure 3), and to creativity training (related to Figure 8). In addition, we find creative thinking to be an important term, also connected to teaching and training. In second place, we can also find critical thinking and divergent thinking. Regarding the didactic methods, we identify related concepts in this category, such as project-based learning, teamwork, problem-based learning, experiential learning, blended learning, or 635 brainstorming methods. This reflects possible teaching and learning strategies (to design, implement, and evaluate) for fostering creativity in higher education. This figure also connects to the highlighted concepts in the results of Table 2.

These results identify and visualize clusters or communities among this body of scientific literature. As shown in Figure 10 (and in relation to Figure 9), we appreciate the central weight of creativity and higher education due to our scope and aim. Nevertheless, these results show a consistency regarding Figures 8 and 9. Regarding higher education, it is related to a cluster of terms such as sensitivity, integrated curriculum, creativity development, consensual assessment, problem-finding, future thinking, and Chinese context (see Figure 3). Also, we appreciate the representation of creative thinking and critical thinking. Regarding this last one, we see other related terms such as collaboration and 21st century skills. This reflects a possible understanding and direction to educational interventions

in creativity in higher education. This figure also connects to the highlighted concepts in the results of Table 2.

4 | Discussion

As we have stated before in the present research, our main aim was to explore and synthesize existing literature on educational interventions designed to enhance creativity among students in higher education, and to investigate possible changes in fostering creativity through educational interventions regarding the influence of COVID-19. In this sense, as we have previously clarified, we did not identify results regarding this question. Due to these results, it is important to develop new studies with new reviews. This impact has been mostly reflected in social innovation, business innovation of new ventures, and adapting to uncertainty (Lee et al. 2023). Nevertheless, this scientific gap points to future lines of educational research in higher education literature, regarding the importance of understanding the influence of COVID-19 in such matters (Shirish et al. 2021). Furthermore, there is evidence about the relationship between creativity and health, especially regarding mental health in everyday life (Cropley 1990; Gillam 2018; Sánchez Hernández et al. 2017). In this sense, it would be interesting to explore its impacts on didactics and the teaching and learning process at the university (Rodríguez-Silva and Violant-Holz 2023), and also to integrate the evidence of the impact of COVID-19 on the health of the university education community (Coakley et al. 2021; Dellafiore et al. 2022; Marcén-Román et al. 2021; Martín-Cano et al. 2021; Odriozola-González et al. 2020; Stock et al. 2022; Zurlo et al. 2022) in order to materialize the conception of the university as a system that promotes creativity alongside health (Muñoz and Cabieses 2008).

Our findings also highlight the influence of educational policies on both research and intervention practices, as evidenced by our timeline showing a steady increase in interest in this topic since 2006, with a notable spike in 2016. We interpret this pattern as reflecting broader developments in creativity scholarship. Specifically, we consider the influence of the Tuning Educational Structures in Europe report, alongside the Bologna Process, and its recognition of creativity as a key generic competence in higher education (González and Wagenaar 2003), conceptualized as a systemic competence (Beneitone et al. 2007). This international educational agenda, which frames creativity as a transversal skill essential for lifelong learning (Venckutė et al. 2020), has also been reflected in global policy initiatives. For example, the World Economic Forum has included creativity among the core competencies for the 21st century, alongside critical thinking and communication. Furthermore, national education systems appear to echo this trend, as in 2016 numerous countries had incorporated creativity into their official educational goals (Care et al. 2016). This convergence of international and national policy frameworks likely stimulated scholarly interest, and the design of educational interventions focused on creativity. As noted by Mejia et al. (2021), 2016 marked a peak in the exponential growth of creativity-related publications, particularly in applied contexts such as education, business, and innovation. These converging dynamics help explain the intensification of research output observed in our review. Of course, our data are correlational, as the timing aligns with these developments, but does not prove causation. Nonetheless, the convergence of policy initiatives, curriculum reforms, and scholarly emphasis on creativity supports the idea that external influences drove the observed trend.

Moreover, the predominance of certain countries, particularly the United States, followed by others such as Taiwan and China, in research on educational interventions in creativity warrants closer attention. Several interrelated factors may explain these results. As these three countries are economic powers, for us this could reflect the so-called creative economy (Asamblea General de las Naciones Unidas 2020). Also, national research funding priorities play a crucial role. Countries like the USA allocate substantial resources to creativity and innovation-driven research, as a key linked to economic growth and competitiveness (Audretsch and Link 2012). For Taiwan and China, the increasing presence may be linked to national education reforms that emphasize creativity and innovation as central to global competitiveness and economic agendas. In both countries, policy initiatives have explicitly called for pedagogical transformation and creativity-enhancing methodologies at all educational levels. Furthermore, the differences observed in national contributions to creativity research may also reflect deeper cultural and epistemological variations in how creativity is conceptualized and prioritized across countries. As Shao et al. (2019) highlight, creativity is not a culturally neutral construct: Eastern cultures often emphasize usefulness, social harmony, and incremental innovation, whereas Western cultures tend to privilege novelty, individuality, and radical change. These cultural models shape not only how creativity is understood, but also how it is assessed; many widely used tools and frameworks for creativity evaluation are rooted in Western norms, which may not align with the values or expectations of other cultural contexts. Complementing this, McCarthy (2019) highlights how cultural preferences, rooted in cognitive, motivational, and attributional differences, affect creative information-processing strategies, which in turn produce culturally distinct expressions of creativity. These conceptual divergences, coupled with national education and research and innovation agendas, may explain why some countries contribute more intensively or in more intervention-focused ways to the field of creativity in education. Although further research is needed to unpack these patterns in detail, our findings suggest that international and national educational agendas, strategic research investments and even their understanding are important drivers shaping the global landscape of creativity-related educational interventions. Nevertheless, as we stated before, we also find it interesting to think about the countries that are not included in these outcomes, and to question our epistemic and methodological approach. Furthermore, we think it speaks about the pedagogical necessity of expanding the knowledge of creativity across countries and educational systems (European University Association 2007) but also considering its cultural roots and differences and fostering greater complexity and interdependencies in the field.

Also, our results show a wider interest in the Social Sciences and Arts and Humanities, recently growing in other fields of knowledge. Fields such as Education or Psychology have traditionally engaged with processes like idea generation and learning, viewing creativity as a fundamental human capacity that merits exploration and development. In contrast, fields of knowledge such

as the Natural Sciences and Health Sciences often prioritize technical or clinical outcomes (such as the development of new treatments) over the study of creativity as a construct. In addition to that, faculty definitions of creativity might differ slightly by discipline and creativity teaching may be at least partially discipline-specific (Marquis and Vajoczki 2012). Furthermore, in fields like Medicine and Nursing, where safety and evidence-based practice are critical, creativity may be viewed with caution, as it is frequently associated with uncertainty and risk (Crepaldi et al. 2024). This perception can render creativity ethically problematic, especially when its application does not lead to demonstrably beneficial outcomes (Thabane et al. 2025). Such disciplinary constraints may partly explain the relatively limited attention given to creativity in medical education and research, and the need for further research and innovation in such fields. Nonetheless, a growing body of literature has begun to address this gap, although systematic investigations in these fields remain limited (Thabane et al. 2025). Nevertheless, as creativity is considered a transversal and systemic competence, it would be interesting to extend these educational interventions, especially regarding those classic fields of knowledge reported on a minor number of occasions. For this purpose, it would be required to provide creativity transversal training (De la Torre 2006) for enhancing teaching practices at university (Morais et al. 2017; Normawati and Kurniawati 2023; Torre 2009), while contextualizing its domain-specific creative processes (Abraham 2022), and considering its temporalities (Tolkamp et al. 2023). Furthermore, this transversal training also should consider the education needs of the creative-innovative profile of the university teacher (Alburquenque Campos and Tejada Fernández 2023). In this sense, we find our results of emerging concepts and their associations to be very useful, as they could guide the pedagogical and didactic actions of the teaching and learning process.

Regarding pedagogical and didactical approaches in the reported educational interventions in creativity, our findings indicate consistent teaching proposals such as problem-based learning, project-based learning or experiential learning, which align with other recent studies (Heng and Jin 2025). These methodologies are inherently adaptable, and their impact depends largely on their design, implementation and evaluation. Nevertheless, these pedagogical methods may vary depending on the fields of knowledge and disciplines and their idiosyncrasies (Frambach et al. 2019), or even regarding teachers and learners' prior educational experiences, teaching and learning preferences, or cultural background (Morais et al. 2017), highlighting the need for a thoughtful contextual design, implementation and evaluation, while considering simultaneously both local and global frameworks and applications of creative methodologies. In this sense, it would be recommendable to also explicitly research and inform such variables.

Within these results we also question the purposes of educational interventions in creativity as well as the aspects of them, such as their so-called creative methodologies, or the measuring instruments that are used and their construction, among other questions raised from this study. We are concerned about the purpose of the educational interventions to foster creativity, as we have come across some affirmations that center their interventions to develop a more "creative" workforce through the education system (Caballero-García and Sánchez Ruiz 2021; Cheung et al. 2006; Hains-Wesson and Ji 2019; T. Li 2020). From our understanding, creativity aims to improve the quality of life and to foster inclusive, equitable and sustainable development (Asamblea General de las Naciones Unidas 2020) and social justice (Violant-Holz et al. 2020) which contradicts the understanding of it as an instrumental tool at the service of other operating systems. The orientation of the competences will not be to achieve competitive results according to the dictates of globalization and the economy, but rather in quality and competent learning that promotes cooperation, sustainable development and solidarity (López Herrerías 2010). Also, it is necessary to go beyond disciplinary limits, and to intertwine the different domains of creative projects (Oxman 2016), as well as the different dimensions of being, in addition to creative thinking, the creative potential of embodiment in didactic dynamics, metaphors and creative metacognition (Anderson 2024).

Our systematic review shows some measurement instruments used to assess different indicators or traits (see Table 2), being the most common one the Torrance Tests of Creative Thinking (TTCT). Certainly, measuring creativity generates a debate carried out by many authors, both from a theoretical point of view (e.g., Fischer and Golden 2018) and from an empirical point of view (Im et al. 2015). The question remains: can creativity be measured? What is certain is that one of the problems lies in how we approach this evaluation and, specifically, the trait or attribute being measured. To design effective creativity assessment instruments, it is crucial to define the concept of creativity itself. What is understood by creativity? (Green et al. 2024) in their recent article distinguish creativity concept as an attribute and as a process. Creativity for these authors is defined as internal attention constrained by a generative goal. This definition comprises three criteria: (1) attention is directed internally (toward mental representations); (2) attentional operations (e.g., search, manipulation) are constrained to fit parameters of a to-be-achieved goal state (whether a goal is achieved); and (3) the goal state is generative (not already precisely held in memory). On a different note (Horikami and Takahashi 2022) define creativity as an interaction between three modes of thinking (logical, critical, and lateral), conceptualized as a Tripartite Thinking Model of Creativity (TTMC). In having proposals such as these in mind, we consider it useful to explicitly define the understanding of the construct and its operationalization through the teaching and learning process reported in educational interventions and, in doing so, clarifying if they develop domain-general or domain-specific creativity, or individual or collaborative creativity (see Cheng 2019). Alongside these considerations, it would be desirable and recommendable to have unambiguous reflection of the measurement and assessment, including its evaluation criteria and using standardized measurement tools when needed, such as TTCT.

Creativity can be measured, among others, from precursor cognitive and metacognitive skills; precursor non-cognitive attributes (creativity attitudes, thinking styles, personality dispositions); systematic evaluations with neurological cognitive (e.g., Onarheim and Friis-Olivarius 2013); affective components (Davis and Bull 1978); motivation (e.g., Sadykova and Shelestova 2016); and actual creative performance (e.g., Kassim et al. 2014). However, creativity is more than the sum of its

parts (Sternberg et al. 2024). For instance, divergent thinking assesses creative thinking only partially, capturing just one dimension of creativity (M. A. Runco 1993). Therefore, if divergent thinking is measured, it cannot be said that creativity has been measured (Sternberg et al. 2024). (Weiss et al. 2021) proposed new framework for categorizing creativity measures including the identified 228 creativity measures appearing in the literature since 1900s; they classified each measure according to their task attributes by two independent raters following attributes: (a) measurement approach (self-report, other-report, ability tests); (b) construct (e.g., creative interests and attitudes, creative achievements, divergent thinking); (c) data type generated (e.g., questionnaire data vs. accomplishments counts); (d) prototypical scoring method (e.g., consensual assessment technique-CAT), and; (e) psychometric problems. So, it would be enriching for the educational interventions and creativity knowledge to incorporate and report these specifications regarding the attributes guiding and measuring their designs, implementations and evaluations.

If we focus on measuring creative competence in higher education, two concepts align in our systematic review: the convergence of critical thinking and creative thinking; the latter being related to problem-based learning and cultural competence among others. These results converge with the curricular ideals of future students who access higher education, both from the International Baccalaureate-IB (IBO 2019) conception of the Baccalaureate itself, and at the competence level, such as cultural competence (IBO 2021). While the IB aims to prepare future tertiary-level students to become citizens equipped with creative competencies (conceived as the self in the world), it promotes both an internationalist and globalist outlook. The IB seeks to cultivate future university students toward professional excellence through creativity, initiative, and problem-solving skills (Bohorquez and Violant-Holz 2023). In contrast, the National Baccalaureate system (as in the case of Spain), following PISA standards (OECD 2024), evaluates creative thinking by assessing students' competence in three cognitive processes: generating diverse ideas, producing original ideas, and evaluating and refining those ideas.

Regarding the measurement instruments used to test the impact of interventions, this study raises the question not only about the measuring instruments used to prove the impact of the intervention, but also about the design, implementation and evaluation of the teaching and learning process. In this sense, for ensuring the methodological quality of the intervention process, we find it interesting to employ methodological guidelines following a mixed methods research framework (Anguera et al. 2018; Chacón-Moscoso et al. 2019), and to ensure high-quality intervention programs (Chacón-Moscoso et al. 2013; Portell et al. 2015; Portell et al. 2019). For this reason, alongside our findings and our suggestions in the present section, we elaborate and synthesize here the following recommendations for educators, researchers and policymakers based on our research. First, and as stated before, it is essential to clarify the underlying conceptualization of creativity in each study (whether general or domain-specific, individual or collective) and to specify which dimensions of creativity are prioritized (e.g., person, process, product, or environment) (see Cheng 2019). Second, studies should report the design, implementation, and evaluation processes in a clear, concise, and coherent manner, providing a well-grounded operationalization of creativity and its pedagogical foundations. Third, we recommend detailing the context, participant characteristics, and all actors involved in the intervention, ensuring transparency and replicability. Fourth, both the methodological approach of the intervention and the research design (when applicable) should be thoroughly described. Fifth, it is important to specify the core elements of the intervention itself, such as methods, strategies, activities, and duration (see Rodríguez et al. 2019). Sixth, studies should clearly outline the evaluation process, including its phases and models, from both pedagogical and creativity-specific perspectives (see Regier and Savic 2019). Finally, future research should address the current gaps in the literature by focusing on understudied contexts, disciplines, and populations, particularly in non-Western settings or among diverse learner groups, to broaden the field's relevance and applicability.

As limitations of this study, we highlighted the finding of no specific results on the influence of COVID-19 regarding the fostering of creativity in higher education. Although we should wonder if this could be caused by research priorities, delays in publications or any other possible new hypotheses. We are also aware of the temporal dimension that this research has reached, but we believe that the reporting we present is of interest to the university community, and that we manage to answer our objective and our research questions. In our systematic review, China is a highlighted country in the emerging related terms, but it could be even more represented if we had considered as inclusion criteria the languages spoken in this country, such as Mandarin. Finally, this systematic review aimed to be a pedagogical, didactic and training resource for teachers. In this sense, as future lines of research, we consider it interesting to deepen in the creative methodologies from the discipline of Pedagogy and, specifically, from the Didactic knowledge and its relation to other didactic elements such as the pedagogical relationship (Rodríguez-Silva 2023; Rodríguez-Silva and Violant-Holz 2024).

Another limitation of this review was not including a meta-analysis, which could have provided a more robust statistical analysis and synthesis of the findings and would have allowed for a more precise estimation of the overall effects of the interventions (in the quantitative and homogeneous research intervention). There is no detailed assessment of the heterogeneity among the included studies, which poses a difficulty to generalizability. Understanding the sources of heterogeneity could have provided insights into the variability of the findings and the factors that influence the outcomes. In SANRA's analysis, though the relevant outcome data are presented appropriately, we cannot present either the absolute vs. relative risk of data nor effect sizes without confidence intervals, affecting the data quality of control. In ENTREQ's analysis, we didn't describe the rationale and approach used to appraise the included studies or selected findings, either the tools, frameworks and criteria used to appraise the studies or selected findings in each eligible study, a fact that affects the replicability and the analysis of the control of the quality in each study. In this regard, it should be acknowledged as a relative limitation that the inclusion or exclusion of articles was not determined by the quality assessment. Consequently, the strength of the results may be somewhat constrained. Nevertheless, the narrative synthesis retains

considerable robustness given the number and diversity of studies included in the review.

5 | Conclusion

In conclusion, we highlighted the pedagogical contribution of this systematic review of literature to the design, intervention and evaluation in matters of creativity in higher education, considering the concept of creativity itself and related terms, such as creative thinking. Also, we emphasize that no specific results were found regarding the possible changes in fostering creativity through educational interventions influenced by COVID-19. In this review we offer a timeline of such interventions that helps to understand the influence of educational politics and changes in higher education, and a mapping of countries developing such interventions, with the United States of America and Taiwan standing out. We also present the disciplines and fields of knowledge reflecting the predominating interest in creativity in Social Sciences. Also, we appreciate an increase in the influence and impact of scientific journals on creativity. Furthermore, we explore pedagogical and didactic elements regarding creativity, such as the classic indicators of creativity explored and measured in these interventions or the creative methods employed to foster creativity in higher education such as project-based learning, teamwork, problem-based learning, or experiential learning. From our point of view, all these contribute to the educational interventions in creativity in higher education and provide the educational community of the university with evidence and guidelines to foster creativity.

Acknowledgments

We thank the support of the Department of Research and Universities of the Generalitat de Catalunya to the Group of Research and Innovation in Designs (GRID). Technology and multimedia and digital application to the observational designs (2021, SGR00718), in which Carlota Rodríguez-Silva and Verónica Violant-Holz participate as members. We also acknowledge the International Observatory in Hospital Pedagogy of the University of Barcelona (OBI-PH, UB), in which Carlota Rodríguez-Silva and Verónica Violant-Holz participate, respectively, as secretary and director. Finally, we thank Dr. Eloi Parladé Molist (Departament de Genètica i de Microbiologia, Universitat Autònoma de Barcelona) for his support with data visualization.

Funding

The authors received no specific funding for this work.

Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Endnotes

[1] We will present them in order of increasing or evolutionary complexity.

[2] These categories (person, process and product) are repeated in each one of the following proposals, so we decided to indicate it in this footnote for avoiding repetitions.

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