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DIVERGENT THINKING IN HIGHER EDUCATION (2004-2024): SYSTEMATIC LITERATURE REVIEW AND GLOBAL BIBLIOMETRIC ANALYSIS

Elka Jennifer Almeida Monge[1]*, Mildred Milagro Pérez Pérez[2]

Universidad Espíritu Santo (UEES), Facultad de Artes y Humanidades, Ecuador, Km 2.5 vía La Puntilla, Samborondón, Guayas, Ecuador. Universidad Estatal de Milagro (UNEMI), Cdla. Universitaria "Dr. Rómulo Minchala Murillo" Km. 1.5 vía Milagro – Virgen de Fátima; Milagro EC091050, Ecuador. Universidad Espíritu Santo (UEES), Facultad de Postgrado Programa doctoral de Educación , Km 2.5 vía La Puntilla, Samborondón, Guayas, Ecuador.

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Corresponding Author: Elka Jennifer Almeida Monge (elkalmeida@uees.edu.ec)

ABSTRACT

Objective:** This review maps the scientific production on divergent thinking in higher education (2004-2024) in order to identify thematic trends, effective pedagogical strategies, and persistent research gaps affecting curricular innovation and institutional policies. **Design/methodology/approach:** The study combines a PRISMA-2020 systematic review with a dual-source bibliometric analysis. A corpus of 1024 articles and reviews was retrieved from Web of Science and Scopus. ScientoPy, VOSviewer and Biblioshiny were used to obtain indicators of productivity, collaborative networks, keyword co-occurrence and thematic evolution. Fifty highly cited studies were examined in depth to synthesize the empirical evidence. **Findings :** The literature is growing at an annual rate of 20.5% and is dominated by twelve macro-themes grouped around cognitive processes, interdisciplinary pedagogies and digital environments. The United States, China and Russia lead in production and citations, while Thinking Skills and Creativity and Creativity Research Journal concentrate the greatest impact. Systemic theories that integrate personal traits, contextual resources and sociocultural validation prevail. Interdisciplinary, collaborative, and technology-enhanced interventions, including generative AI, consistently increase fluency, flexibility, and originality, although ethical and methodological challenges remain. Longitudinal data on employability are scarce. **Originality:** This is the first study to triangulate PRISMA-2020 with multibase bibliometrics to span two decades of research on divergent thinking in higher education, offering a replicable protocol and an integrated agenda that bridges neurocognitive, cultural, and pedagogical perspectives. **Research limitations/implications:** The predominance of cross-sectional designs and English-language publications limits causal inference and cultural generalization; future work should incorporate longitudinal and multicultural samples. **Practical Implications:** Results inform curriculum designers about evidence-based combinations-active learning, metacognitive scaffolding, and AI tools-that enhance creative cognition without sacrificing disciplinary rigor. **Social implications:** Strengthening divergent thinking prepares graduates to tackle complex regional problems with original and ethically grounded solutions, thus fostering inclusive innovation ecosystems.

KEYWORDS: Divergent thinking; creativity; higher education; bibliometrics; bibliometrics; systematic review; artificial intelligence.

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1. INTRODUCTION

Global contextualization

Creativity has established itself as a pillar of competitiveness in knowledge economies and, in fact, appears among the five most valued skills by multilateral agencies and employers for the next decade (Wechsler et al., 2018). Digitization and the complexity of contemporary challenges simultaneously demand graduates capable of generating original solutions and universities that function as engines of regional innovation (Peppler & Wohlwend, 2018). Recent bibliometric studies identify twelve macro-topics and thirty-six emerging trends around creativity, with interdisciplinarity and multiculturalism as transversal axes (Mejia et al., 2021). Likewise, a meta-evaluation of 332 interventions confirms that adult creativity is trainable and that complex programs, meditation and cultural exposure are the most effective methods (Haase et al., 2023). In parallel, the debate on the "4 Cs" (creativity, critical thinking, collaboration and communication) is progressing towards institutional certification systems (Thornhill-Miller et al., 2023).

Conceptual foundations of divergent thinking

Divergent thinking, defined by Guilford in the 1950s, has been refined by frameworks such as Investment Theory or Geneplore, which explain the generation-evaluation interaction of ideas (Medeiros et al., 2018; Qian & Plucker, 2018). Recent neurofunctional evidence shows differential connectivity: openness to experience and divergent thinking share the default network and the attention network, while the former also recruits sensorimotor and frontoparietal control networks (Wang et al., 2022). In addition, variables such as lexical frequency modulate fluency when time is limited (Ogurlu et al., 2023) and preference for complexity or asymmetry favors overcoming structured imagination (Kharkhurin & Charkhabi, 2021). The field-independent style enhances originality in visual synthesis (Giancola et al., 2022) and virtual reality environments allow observing, with temporal granularity, the alternation between ideation and prototyping (Neroni et al.,2021). In the measurement domain, C-CRAFT employs Word2Vec models to automatically score creativity (Sung et al., 2022), while the CREA play suite integrates divergent and convergent modes (Rafner et al., 2023).

Importance of divergent thinking in higher education.

The pedagogical impacts are tangible. Initial creative potential predicts final grades in engineering and, moreover, increases during the career (Kim, 2020). Explicit teaching of divergent strategies enhances scientific creativity, an effect that is reinforced by greater disciplinary mastery (Sun et al., 2020). Methodologies such as design thinking, Lego® Serious Play® or high-level thinking labs elevate engagement and ideational flexibility (Holubchak, 2020; Malik & Ubaidillah, 2020). At the affective-motivational level, the combination of mindfulness and contemplation enhances creativity linked to sustainable development (Hensley, 2020); similarly, goal-oriented motivation increases originality in adults with ADHD (Boot et al., 2020). At the organizational level, transformational leadership and engagement-based HR systems facilitate idea generation and execution in multicultural universities (Almaskari et al., 2021; Batistic et al., 2022).

Knowledge gap

The literature still presents gaps. Methodological heterogeneity persists, making it difficult to compare results, as evidenced by discrepancies on the creativity-ADHD relationship (Hoogman et al., 2020), on the influence of fluid intelligence on the originality of "old" versus "new" ideas (Miroshnik & Shcherbakova, 2019). Moreover, gender and cultural context differences are not resolved: male variability depends on disciplinary domain (He & Wong, 2021) and bilingualism only enhances creativity when it involves different cultures (De Prada Creo et al., 2023). The ethical dimension appears underexplored, despite the fact that the shift from creative potential to malevolent behaviors depends on moral reasoning (Zhao et al., 2022). Finally, the cross-cultural validity of digital automatic measurement and game-based assessment tools needs longitudinal confirmation (Rafner et al., 2023).

Objectives and research questions

This study aims to map the evolution of divergent thinking research in higher education between 2004 and 2024, and to synthesize the available pedagogical evidence. Three questions are posed: what thematic lines and methodological approaches dominate production; what combinations of strategies-meditation, complex courses, gamification, generative AI, formative feedback-maximize creativity without sacrificing convergence; and how do moral, motivational, and cultural variables moderate the effectiveness of such interventions?

Contribution of the study

The article offers a replicable protocol linking PRISMA-2020 with multi-base bibliometric analysis and thematic network mapping, incorporating the

most recent neurocognitive, cultural, and pedagogical evidence. The findings will enable the formulation of evidence-based curriculum guidelines, guide 4 C certification systems, and underpin university innovation policies in the era of generative artificial intelligence (Vecchiarini & Somia, 2023).

Literature review

Epistemological framework of creativity

Current explanations converge in describing creativity as a system where the individual invests in undervalued ideas (Investment Theory), combines traits and contextual resources (Componential Theory) and negotiates social value in communities of practice (Systems Theory). That holistic view is confirmed when entrepreneurship education incorporates sustainability: multidisciplinary teams produce more original and "lateral thinking" proposals (Karlusch et al., 2018) while personal moral values activate the detection of green opportunities (Ploum et al., 2018). Music students, comparing ten classical theories, already opt for pragmatic mixtures of the four-stage, systems and divergence models (Huovinen, 2021), and the distinction between excellencism and perfectionism reveals that pursuing high but realistic standards drives ideation, as opposed to rigid perfectionism (Goulet-Pelletier et al., 2022). Finally, recent experiments demonstrate that social support simultaneously increases well-being and creative output, underpinning the motivational loop of the process (Tan et al., 2022).

Measuring divergent thinking

The Torrance Test of Creative Thinking (TTCT) and the Alternate Uses Test remain valid, but their factorial stability varies across cultures: the Arabic version of the TTCT requires a bifactor model with six sub-factors (Said-Metwaly et al., 2020), and the Thai adaptation of the Runco Ideational Behavior Scale (RIBS) retained only 17 items to preserve its structure (Tep et al., 2021). A meta-analysis of 86 Cronbach's alpha confirms, however, a high average reliability of the RIBS, modulated by version and educational level (Sen, 2022). In the Latin American university setting, the Creative Personality Scale shows good convergent evidence (Freiberg-Hoffmann et al., 2019), and the factorial separation between ideation and perseverance was clear when analyzing in parallel the RIBS and the Grit scale (Rojas & Tyler, 2018). On scoring efficiency, the Snapshot index provides equivalent validity to the average method with lower effort (Shaw, 2021). Predictability is improved by combining conceptual and perceptual metrics: originality in design is increased by adding the Figural Interpretation Quest to the Alternative Uses Task (Erwin et al., 2022), and playful environments such as Minecraft demonstrate ecological validity by correlating in-game creativity with openness and SAT (Shaw, 2022).

Individual factors

Executive functions, emotional intelligence, and intrinsic motivation continue to explain creative differences. ADHD traits elevate originality but penalize GPA in engineering (Taylor et al., 2020), while flexibility, originality, and complexity are negatively related to anxiety, evidencing a regulatory role for creative thinking (Chiu et al., 2019). In contrast, insomnia combined with high intellectual ability mitigates the advantage provided by schizotypal traits (Polner et al., 2018) and age, gender or leisure shape creativity in older (Cera et al., 2018). Brief interventions (e.g. 20 min of Hatha-yoga) improve divergent fluency without affecting convergence (Bollimbala et al., 2020). At the cultural level, inducing creative activities elevates well-being (Tan et al., 2021); integrative zhongyong favors remote associations (Zhou et al., 2021); and the interplay between fluid intelligence and executive control nonlinearly predicts originality (Taylor & Zaghi, 2021). In addition, cognitive flexibility mediates the relationship between bilingualism and creativity (Kim & Runco, 2022; Xia et al., 2022) and seniority in social networks enhances elaboration and originality in Generation Z (Díaz Chica et al., 2021). Social support priming confirms that perceived support increases fluency and originality (Tan et al., 2022).

Creative environments and pedagogies

Universities experiment with intensive, cooperative, and digital formats. Interdisciplinary PBL-based workshops elevate the originality of business models (McDonald et al., 2018); cooperative learning in linear algebra enhances creative intelligence (Catarino et al., 2019); and online focus groups achieve ideas as valuable as face-to-face ones at lower cost (Richard et al., 2018). A favorable socio-psychological climate increases teacher willingness to innovate (Avakyan, 2018). During the pandemic, distance music education maintained interpretive quality thanks to synchronous tutorials (Lebid et al., 2021). In AI courses, patterning with assigned leader and group consensus enhanced overall creativity (Hu et al., 2022), although adding argumentative scaffolding reduced category exploration (Gao et al., 2022). Joint nursing-design teaching increased team fluency by creating healthcare prototypes (H.-Y. Liu et al., 2022), and diversity management predicted idea generation, promotion, and implementation via

engagement (Ganji et al., 2021). The landing of ChatGPT reinforces these synergies: it improves narrative fluency and originality (de Vicente-Yagüe-Jara et al., 2023), teachers value its potential with ethical cautions (Fiialka et al., 2023), and its formative use enhances teacher creativity (Z. Liu et al., 2023), provided there are clear institutional guidelines (Chergarova et al., 2023).

Disciplinary and geographic variability

Effects differ by domain and culture. In architecture, students seek individual visual inspiration rather than collaboration (Meyer & Fourie, 2018); in interior design spatial conceptualization is decisive (Ozyildiz & Yildiz, 2020). ADHD elevates divergent fluency but reduces normative performance in engineering (Taylor et al., 2020). Geographically, the gap between potential and actual creativity in Kazakhstan is attributed to institutional factors (Burayeva et al., 2020). Thai and Arabic versions of the TTCT show disparate structures (Said-Metwaly et al., 2020; Tep et al., 2021); in music, improvisation is best explained by plural models (Huovinen, 2021). A comparative study between Malaysia and Japan revealed that willingness to lead in sustainability varies by university culture and gender (Ghasemy et al., 2023). The creative advantages of bilingualism depend on language proficiency and local practices (Kim & Runco, 2022; Xia et al., 2022). Argentine adaptation of creative personality scales confirms the relevance of validating instruments in situ (Freiberg-Hoffmann et al., 2019).

Longitudinal impact and academic outcomes

Longitudinal evidence is limited but encouraging. A semester course in UAE increased originality, fluency, and creative self-efficacy, although not executive functions (Vally et al., 2019). Learning strategies tracking revealed that social cooperation and metacognition anticipate scientific reasoning and creativity (Aizpurua et al., 2018). In China, autonomous supervisor support favored all phases of innovative behavior through creative self-efficacy (Han et al., 2022). Entrepreneurial intention mediated between personal creativity and social innovation in Portugal (Cunha et al., 2021). Interdisciplinary teaching enhanced the ultimate creativity of nursing teams (H.-Y. Liu et al., 2022) and 35 management factors facilitated the move from idea to adoption in Scandinavian hospitals (Palm & Persson Fischier, 2022).

Synthesis of empirical gaps

Methodological challenges persist: cross-sectional designs and short trials predominate, which prevent estimating the stability of creative gains; quasi-experimental trials with follow-up are still in the minority (H.-Y. Liu et al., 2022). The ecological validity of classical metrics is questioned in the face of the proliferation of generative AI, which can inflate originality without cognitive correlation (Vicente-Yagüe-Jara et al., 2023). There is a lack of triangulations that combine processes and products, as evidenced by the complex relationships between mental wandering, creativity and health (Yamaoka & Yukawa, 2020). Greater attention to vulnerable collectives is also needed: connectivity issues limit online formative assessment in the global South (Ndibalema, 2021), and the sensitivity of some tests may not capture effects of brief interventions, as the experiment with exercise and music showed (Frith & Loprinzi, 2018). Longitudinal, multicultural, and mixed studies are therefore needed to clarify when, how, and for whom creative pedagogies are effective.

Methodology

To ensure multidisciplinary coverage and minimize the bias derived from selective indexing, we combined Web of Science Core Collection (WoS) and Scopus, two databases considered benchmarks in bibliometric studies both for their citation robustness and historical stability (García-Aroca et al., 2017; Li & Cheng, 2018). Several papers have shown that simultaneous querying of both platforms increases document retrieval and reduces discrepancies in citation counts (Wadhwa et al., 2020; Yadava et al., 2019).

Data sources and search strategy.

The time window was set between January 1, 2004, and December 31, 2024; record download was performed on April 20, 2025. The thematic equations, identical in Boolean logic but adapted to the syntax of each source, combined terms from divergent thinking with higher education descriptors and restricted the documentary type to articles and reviews, formats that offer greater methodological rigor and traceability (Ruiz-Rosero et al., 2017).

Search equation

Web of Science

TS=(("divergent thinking" OR "lateral thinking" OR "creative ideation" OR "idea generation" OR "ideational fluency" OR "creative fluency" OR "creative potential" OR "creative cognition") AND ("higher education" OR universit* OR "tertiary education" OR postsecondary OR "post-secondary" OR "college student*" OR "undergraduate student*" OR "graduate student*" OR "university student*" OR

"higher learning" OR "HEI")) AND PY=(2004-2024) AND DT=(Article OR Review)

Scopus

(TITLE-ABS-KEY("divergent thinking" OR "lateral thinking" OR "creative ideation" OR "idea generation" OR "ideational fluency" OR "creative fluency" OR "creative potential" OR "creative cognition") AND TITLE-ABS-KEY("higher education" OR universit* OR "tertiary education" OR postsecondary OR "post-secondary" OR "college student*" OR "undergraduate student*" OR "graduate student*" OR "university student*" OR "HEI" OR "teacher training college*")) AND PUBYEAR > 2003 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"re")) Document type retained: articles and reviews, because of their greater scientific rigor (Ruiz-Rosero et al., 2017).

Dataset and initials.

The initial search retrieved 1 478 records (WoS = 740; Scopus = 738). The cleaning process followed four successive stages see Table 1:

Table 1: *Initial dataset*

Description	WoS	Scopus	Total
Documents uploaded	740	738	1 478
- Articles	727 (49.2 %)	711 (48.1 %)	1 438 (97.3 %)
- Reviews	13 (0.9 %)	27 (1.8 %)	40 (2.7 %)

Source: Own elaboration based on Web of Science and Scopus (20 April 2025)."

1.1.1. Duplicate purification

Internal detection by exact match of titles.

DOI normalization (lowercase and without spaces) to contrast equivalent records between bases, retaining the WoS version when there were discrepancies in the citation count, recommended practice to maximize the reliability of the indicators (Walker, 2016).

WoS and Scopus cross-referencing by DOI; the WoS version was retained when citations differed see Table 2 and Table 3.

Fuzzy matching with RapidFuzz (threshold ≥ 95 %) for titles without DOI (Ye et al., 2021).

Table 2: *Duplicate purification*

Metric	n	%
Total duplicates	**454**	30.7
- Deleted WoS	2	0.3
- Removed Scopus	452	61.2
Duplicates with different citation counts	314	69.2 (of total duplicates)
Final corpus after cleaning	**1 024**	69.3

Source: Own elaboration based on Web of Science and Scopus (20 April 2025)."

Table 3: *Final distribution by document base and type of document*

Source	Articles	Reviews	Total
WoS	725 (70.8 %)	13 (1.3 %)	**738 (72.1 %)**
Scopus	270 (26.4 %)	16 (1.6 %)	**286 (27.9 %)**
Total	995 (97.2 %)	29 (2.8 %)	**1 024**

Source: Own elaboration based on Web of Science and Scopus (20 April 2025)."

Preprocessing and normalization

Textual debugging had two fronts. First, ScientoPy was used to unify author name variants and calculate the thematic h-index, making up for the lack of multibase integrators noted in the literature (Ruiz-Rosero, 2019; Cortés & Bahamón, 2024). Second, spaCy was applied to clean, lemmatize and merge Title, Abstract, Author Keywords and Index Keywords into a single field (FullText). This procedure is supported by the effectiveness of spaCy for multilingual pipelines (Berbatova, 2023) and by experiences of adaptation to languages with scarce resources (Etezadi & Karrabi, 2022).

- Before normalization, "?" keywords were counted in Index Keywords and 7,162 in Author Keywords.
- After normalization, 2247 Index Keywords and 3334 Author Keywords were obtained, respectively.
- Finally, the unification resulted in a set of 5581 terms, of which a filter was applied that retained only terms with frequency greater than 1, resulting in 4312 "Author's Keywords".

The country standardization algorithm, normalizing regular expressions, identification of geopolitical entities, with spaCy NER and RapidFuzz ≥ 95 %, this is to validate errors following the methodology of Walker (2016) applied to institutional affiliations.

1. **Countries**: normalize_country() function (regular expressions) + spaCy NER + RapidFuzz (≥ 95 %): standardized variants ("USA" = "United States", "England" = "United Kingdom", etc.).

Classification by bibliometric influence

To identify studies with the highest impact, the 75th percentile of the citation count (≥ 15 citations) was set as the threshold. Following Bornmann and Daniel, papers that exceeded this threshold and met the empirical heuristics described were labeled as Paradigmatic; the rest were considered Seminal. This cutoff showed stability in sensitivity analysis (10-40 citations) and minimized temporal bias

(Wadhwa, 2020). Of the total 1 024 empirical articles, 50 (4.9 %) were classified as Paradigmatic.

Thematic filtering and empirical heuristics.

We exclusively retained literature that simultaneously met:

Thematic match: occurrence in the full text of divergent thinking core words and higher education descriptors.

Empirical evidence: co-occurrence of a methodological term (e.g., experiment, randomized, survey, mixed methods, case study) and a data marker (participants, sample size, n =, data were collected).

A manual validation of 10 % of the sample (n = 102) obtained a concordance κ = 0.88, comparable with automatic validations performed with VOSviewer in other domains (Z. Liu et al., 2024; Xiao et al., 2023).

1.2. Bibliometric analysis procedures

- ScientoPy 2.1 for productivity and citation indicators (Ruiz-Rosero, 2019).
- VOSviewer 1.6.19 for co-authorship, co-citation and keyword co-occurrence networks (Fu et al., 2022; Liu et al., 2024).
- Biblioshiny/Bibliometrix 4.0 for trend analysis and subject clustering (Liu & Zhou, 2023; Ascandari & Aminu, 2023).

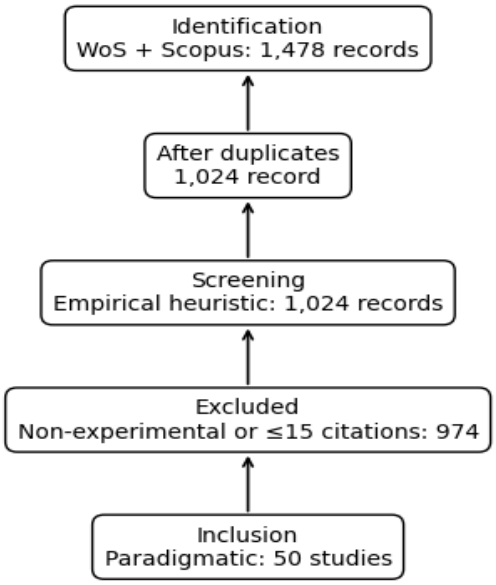
The selection flow was represented using the PRISMA 2020 diagram (Page et al., 2021). The phases of identification (1 478 records), screening and purification (454 duplicates), and eligibility (1 024 items) are transparently described to facilitate replicability.

Integration of results

Global Bibliometrics: the 1,024 records form the basis for indicators of productivity, impact and intellectual structure mapping. Systematic review: the 50 Paradigmatic studies are analyzed in depth (designs, instruments and effect sizes), fulfilling the double requirement of theoretical relevance and robust evidence. The combined strategy aligns best practices in multi-base bibliometric analysis (Li, 2018; Wadhwa, 2020) with PRISMA transparency standards, offering a replicable and robustly grounded methodological framework for the study of divergent thinking in higher education.

Figure 1 reveals that the empirical corpus is made up of 1 024 documents, of which 50 (4.9%) are identified as paradigmatic and 974 as seminal. The average number of citations amounts to 17.9 with a standard deviation of 44.6.

Figure 1: *Prism diagram*



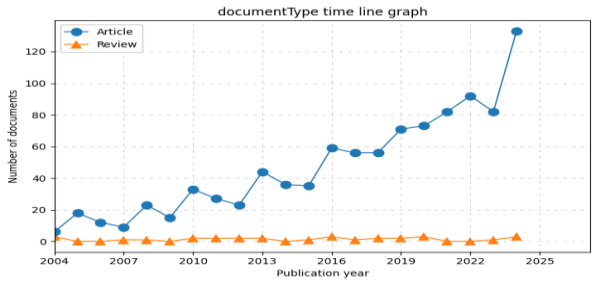
Source: Own elaboration based on Web of Science and Scopus (20 April 2025)."

Results

Annual scientific production

Between 2004 and 2024, 985 articles and 29 reviews on divergent thinking in higher education were published, with an average annual growth rate of 20.5% and an average increase of 107.5 papers per year, which is evidence of the dynamism of this line of research (Carson et al., 2005; Nistad et al., 2004). In an initial period of consolidation (2004-2007), annual production ranged between 6 and 12 papers, but from 2013-2014, when for the first time it exceeded 40 papers per year, a phase of accelerated expansion began, marked by the incorporation of approaches as diverse as the intervention of Hatha yoga to stimulate divergent thinking (Bollimbala et al., 2020) or the primacy of zhongyong integrated thinking in remote association tasks (Zhou et al., 2021). For their part, revisions maintained a marginal character until 2011 (0-2 per year) and only showed a slight increase in the last decade, reaching three in 2021 and again three in 2024 (de Vicente-Yagüe-Jara et al., 2023). Finally, comparing the 2004-2013 and 2014-2024 subperiods, the average annual output rose from 21.8 to 83.9 papers, while the impact per citation rose from 13.5 to 24.7 per publication, confirming the consolidation and growing influence of divergent thinking in higher education (Papousek et al., 2017; Pretz & McCollum, 2014), see Figure 2.

Figure 2. *Annual scientific productionby institution and country (2004-2024).*

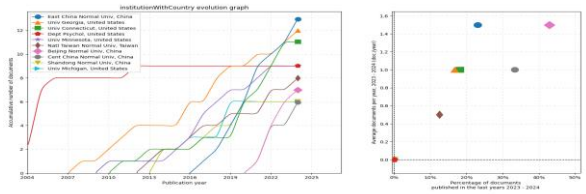


Source: Own elaboration based on Web of Science and Scopus (20 April 2025)

Institutions Countries

The pattern observed in the institutional contributions shows a sustained leadership of East China Normal University and several US universities, including the University of Georgia and the University of Connecticut, as well as a growing prominence of Chinese and Taiwanese centers in recent years. The prominence of the University of Georgia aligns with the meta-analysis of Acar & Runco (2012), which, after reviewing 32 studies with 6 771 participants, documented a small overall effect (r = .16) and significant heterogeneity, but revealed a large effect (r = .50) when using specific measures of creativity and psychoticism. At the University of Minnesota, research focused on design product ideation tasks has identified figural interpretation seeking as a robust predictor of originality and has shown that over-challenging can limit creativity (Erwin et al., 2022). For its part, the University of Connecticut has contributed studies that highlight the role of emotional traits-particularly emotional intelligence and openness to experience-in artistic and scientific creativity, without relevant findings on cognitive ability per se (Sánchez-Ruiz et al., 2011). Likewise, contributions from National Taiwan Normal University reflect the mediation of intrinsic motivation in the effects of personality traits on reproductive and creative imagination, with openness exerting the strongest influence and conscientiousness specifically impacting reproductive imagination (Liang et al., 2013). Finally, think-aloud protocols implemented in engineering design studies have shown that intentional exploration of multiple perspectives and deliberate reframing of statements promote more diverse and innovative solutions (Murray et al., 2019). Taken together, these findings reinforce the relevance of the different methodological approaches and psychological dimensions developed in the more productive institutions shown in Figure 3.

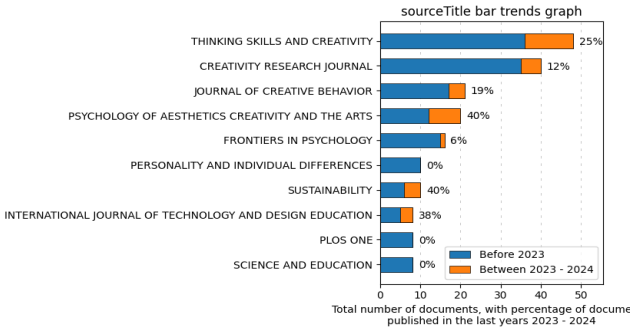
Figure 3 *Contributions by institution and country (2004-2024).*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025)

Most relevant journals

Figure 4 *Most relevant journals (2004-2024)*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025)

Figure 4 shows the editorial landscape shows a clear predominance of journals specialized in creative processes and skills, led by Thinking Skills and Creativity (with 48 papers and an h-index of 22) and Creativity Research Journal (40 papers, h-index 22), which have consolidated their leadership since the middle of the last decade. Thinking Skills and Creativity has been a central forum for experimental work and representational theories, such as the study by Dumas et al. (2016) on cognitive predictors of creative solution in engineering design (THINKING SKILLS AND CREATIVITY), and the influential research by Oppezzo & Schwartz (2014) that demonstrated the positive effect of walking on original idea generation. Meanwhile, Creativity Research Journal has published meta-analyses of gender variability in divergent thinking (Alabbasi et al., 2022) and studies on perfectionism and excelencism by Goulet-Pelletier et al. (2022), exploring how self-regulated standards impact fluency and originality.

The Journal of Creative Behavior (21 papers, h-index 13) has specialized in individual and academic correlates of creativity, hosting papers such as that of Puryear et al. (2019) that compared self-reported versus externally assessed creativities, on ADHD

traits and divergent thinking in engineering. For its part, Psychology of Aesthetics, Creativity and the Arts (20 papers, h-index 11) has been the site of rigorous meta-analyses, such as Acar & Runco, (2012) on the association between psychoticism and creativity, which revealed a modest (r = .16) but substantial (r = .50) overall effect when specific measures were employed.

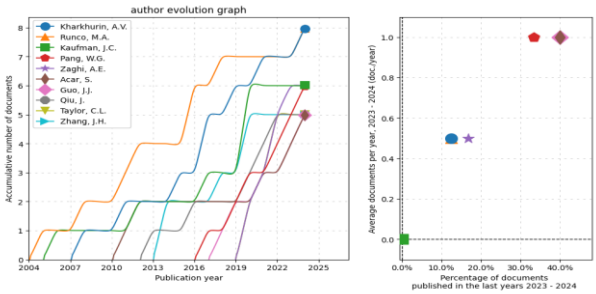
Open access journals have also gained ground: Frontiers in Psychology (16 papers, h-index 9) stands out for its multidisciplinary approach and recent growth, while PLOS ONE (8 papers, h-index 7) publishes studies with a broad methodological scope, such as that observed in research on professional actors (Dumas et al., 2020). In addition, titles specialized in educational and organizational applications such as International Journal of Technology and Design Education and Sustainability reflect the expansion of creativity towards pedagogical and sustainable innovation fields. Overall, this editorial distribution confirms the consolidation of a few high-impact journals as a refuge for theoretical and empirical advances in creativity, while at the same time it evidences the diversification of publication spaces where everything from meta-analysis of personality traits to educational and organizational interventions are addressed.

Most relevant authors

Kharkhurin and Runco are at the top with eight publications each and an h-index of 7, which denotes not only productivity but also sustained recognition: Kharkhurin burst in 2008 and accumulates appearances until 2024, while Runco debuts in 2005 and maintains activity until 2024. Both exhibit a relative age of 0.5 and an average debut year (ADY 0.5), suggesting a stable and early presence in the period analyzed.

Kaufman and Pang, with six papers, exhibit divergent trajectories: Kaufman reaches an h-index of 6 starting in 2006, while Pang, a debutant in 2018, maintains an h-index of 5 despite an AGR of 0, indicating a concentrated impact in a shorter time span. Zaghi, identical in total of six but with h-index 4 and negative AGR, reflects late and less cited productivity. Among authors with five contributions, Acar and Guo stand out for an ADY of 1.0 and AGR of 0.5, combining an h-index of 5 and 4 respectively; both emerge strongly from 2011 (Acar) and 2019 (Guo), underpinning lines of research in self-efficacy and collaborative environments. Qiu and Taylor, with negative or zero AGR and ADY and h-index of 3, evidence a more recent and limited positioning in citations, while Zhang, despite a total of five, accumulates an h-index of 4 and distributes his activity between 2016 and 2022 see Figure 5.

Figure 5 *Top authors in creativity and education, comparing productivity, relative seniority and academic recognition (2004-2024).*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

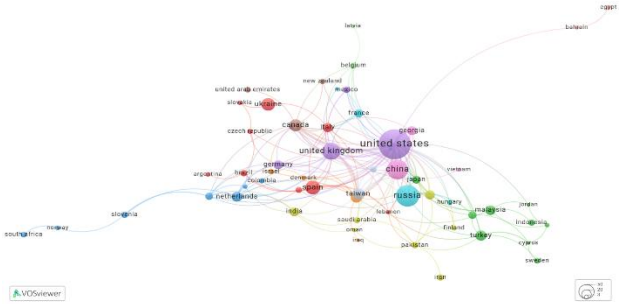
Countries of collaboration networks

Figure 6 as "Global network of scientific collaboration in creativity by country".

The analysis of the network of international collaborations reveals that the United States leads with 226 papers and 10 656 citations, followed by Russia (116/1 367) and China (96/2 432), confirming its central role in academic production and impact in the field. The grouping by modularity shows ten clusters: thus, Cluster 5 (United States, United Kingdom, Australia, Austria, Germany, Mexico and Thailand) agglutinates the main English-speaking powers and some emerging economies in research, as illustrated by the study of Dumas et al. (2016) linking the United States with New Zealand in the analysis of originality in engineering design . In Cluster 1 (Argentina, Brazil, Czech Republic, Italy, Lebanon, Portugal, Slovakia, Spain and Ukraine) synergies between Southern Europe and Latin America are reflected, exemplified by Aizpurua et al., (2018) from the University of the Basque Country, who demonstrated how creativity is related to metacognitive and motivational strategies in Spanish university students, and by Fiialka, Kornieva and Honcharuk (2023) in Ukraine, who warned about the challenges and opportunities of ChatGPT in local higher education. More regional clusters such as 9 (China, Georgia and Vietnam) or 2 (Cyprus, Indonesia, Japan, Jordan, Kazakhstan, Malaysia, Nigeria, Sweden and Turkey) highlight areas of growing collaboration; for example, Tan et al. (2022) showed in Malaysia the causal effect of perceived social support on divergent thinking , while Ganji et al. (2021) in Iran and Pakistan demonstrated that diversity management enhances innovative behavior through affective employee engagement. Other clusters, such as cluster 4 (Finland, India, Iran, Oman, Pakistan, Saudi Arabia, and South Korea), could be enriched by studies such as Polner et al. (2018) in Hungary, which explores how insomnia modulates the relationship between

schizotypal traits and creative achievement. These mappings not only identify key players, but also make visible bridges of co-authorship and knowledge flows between nations with widely varying practices and resources. To illustrate this dynamic see Figure 6.

Figure 6 *Global network of scientific collaboration in creativity by country.*

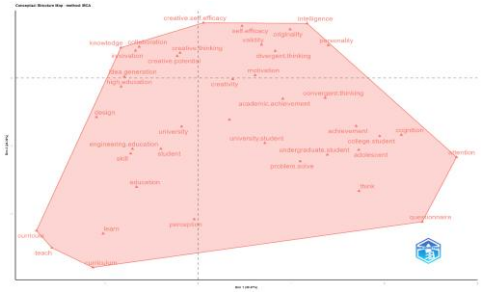


Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

Factorial Analysis

The factor analysis reveals two clearly differentiated thematic axes in the corpus of terms. First, the cognitive-process dimension groups concepts related to mental capacities and the mechanism of idea generation, such as divergent thinking, cognitive flexibility, intelligence and originality. This grouping underlines the importance of internal processes underpinning creativity, as demonstrated by Crossley et al. (2016) by linking linguistic characteristics with writing quality and Dollinger et al. (2005) by associating identity styles with creative potential. On the other hand, the context-educational dimension integrates terms linked to the formative environment, including student, higher education, curriculum, and collaboration. Such a set highlights the role of the academic framework and pedagogical strategies in creative development, in line with the findings of Catarino et al. (2019) on the effectiveness of cooperative learning and Bender et al., (2013) about gender differences in educational contexts, see Figure 7.

Figure 7. *Factor analysis of key terms in creativity research.*

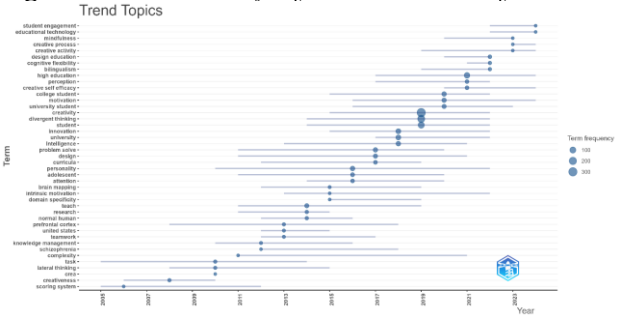


Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

Trend Topics

The analysis of thematic trends shows four clearly differentiated phases. The initial stage (2005-2012) was dominated by a focus on task organization and the design of collaborative environments, as exemplified by the study by Chang (2011), which demonstrated the effectiveness of anonymous and structured virtual teams in generating innovative ideas. The second period (2011-2015) marked the rise of cognitive processes fundamental to creativity, with emphasis on fluency, flexibility and originality; Frith & Loprinzi (2018) evaluated how exercise and music interventions affect these processes, finding no significant changes but highlighting the need to improve measurement methodologies. Between 2015 and 2022, interest in creativity applied to university and business settings was consolidated: Karlusch et al. (2018) described a collaborative course for the development of sustainable business models that enhanced lateral and interdisciplinary thinking. Finally, in more recent years (2020-2024) themes linked to creative self-efficacy and student engagement emerge; Vally et al. (2019) documented significant increases in creative self-efficacy after a 13-week training program, with no variations in neuro-executive functions, see Figure 8.

Figure 8. *Time trends of key terms in creativity research.*



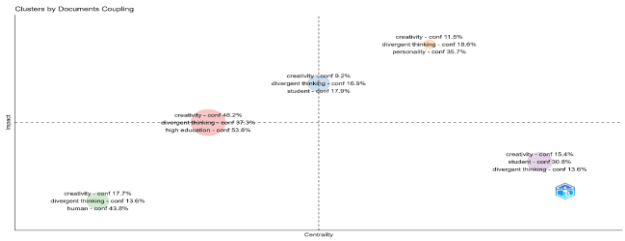
Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

Clustering by Coupling

In the document coupling analysis, five thematic clusters were identified, each characterized by its most representative label, the frequency of documents included, and their centrality and impact values (Figure 5). Cluster 1, focused on "creativity; divergent thinking; high education", groups 89 papers with a centrality of 0.389 and impact of 1.131 and includes papers such as the study by Gomes et al. (2011) on sleep patterns and academic performance in university students, and the research by Hudson et al. (2020) on the integration of gifted education in pre-service teacher education. Group 2, with 43 papers and centrality and impact values of

0.409 and 1.144 respectively, addresses "creativity; divergent thinking; student", highlighting contributions in active pedagogies and instructional design aimed at improving student engagement in formative contexts. Group 3 also gathers 43 papers under the label "creativity; divergent thinking; human", with centrality of 0.328 and impact of 1.064, exploring cognitive models of motor creativity and routes of flexibility and persistence in divergent tasks. Group 4, which groups 51 papers and presents the highest centrality (0.464) and an impact of 1.099, emphasizes "creativity; student; divergent thinking" and collects findings on the positive effects of physical exercise on idea generation, as shown by Oppezzo & Schwartz (2014). Finally, Cluster 5, composed of 24 papers with centrality of 0.417 and the highest impact (2.099), is defined by "creativity; divergent thinking; personality", reflecting the importance of individual traits (especially openness to experience) in creative behavior, see Figure 9.

Figure 9: *Clustering by Coupling*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

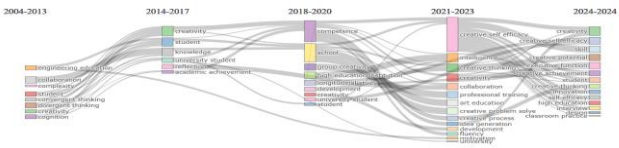
Thematic Evolution

Over the four periods analyzed (2004-2013, 2014-2017, 2018-2020 and 2021-2023), the theme of "cognition" gave way to both an interest in "academic achievement" (focused on motivation and performance in Chinese contexts) and the subfield of "creativity" in university settings, where attention to creative potentiality and the educational environment became key (cognition; university student; WII 0.20; Occ. 9) (Preiss et al., 2016). At the same time, "collaboration" evolved from a marginal role to become "knowledge" with a maximum inclusion index (1.00) in 2014-2017, marking the recognition of collaboration as a driver of knowledge management (collaboration: knowledge; II 1.00) (Richard et al., 2018). In the same stretch, "convergent thinking" maintained strong links with "creativity" (II 0.31) and with "student", consolidating its methodological relevance (convergent thinking: creativity; II 0.31) (Ploum et al., 2018).

During 2014-2017, "creativity" notably expanded its scope (reflected in 61 occurrences and a WII of 0.50) by incorporating personality variables (imagination, openness, originality) and starting longitudinal research among university students (creativity: creativity; WII 0.50; Occ. 61) (Perrine & Brodersen, 2005). In 2018-2020, this line reconnected with "creativity" prior to 2021-2023, registering a peak of 63 occurrences and a WII of 0.68, where classic constructs (fluency, flexibility) converged with new methods based on active learning (creativity: creativity; WII 0.68; Occ. 63) (Moraru et al., 2016). Already in 2021-2023, mature thematic nodes emerge such as "competence: collaboration" (II 1.00) (Ploum et al., 2018) and "group creativity: idea generation" (II 1.00) (Rankin & Brown, 2016), while the category "creativity" redirects part of its strength towards "creative self-efficacy" (II 0.33) and "creative thinking" (II 0.50), underlining the growing concern for creative confidence and its internal processes (creativity: creative self-efficacy; II 0.33) (Oppezzo & Schwartz, 2014).

In turn, "high education institution" becomes "professional training" (II 1.00) (Hudson et al., 2020) and "school" becomes "university" (II 1.00), signaling a clear institutional transition towards continuous formative modalities. In the most recent stage (2024), the evolution crystallizes in the continuity of "creative thinking" (II 0.60) and "creativity" (II 0.61), together with the consolidation of "skill" (II 1.00) and "innovation" (II 0.60). These changes reflect a shift from the analysis of cognitive processes towards the practical application of creativity and the development of skills in educational and organizational contexts (creativity: innovation; II 0.60) (Probst et al., 2007), see Figure 10.

Figure 10 *Thematic Evolution*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

Network of words

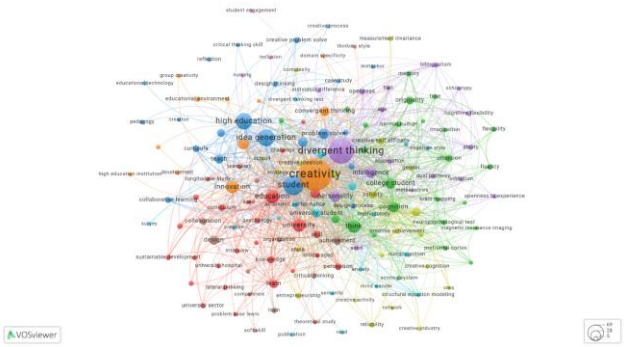
The configuration of scientific collaboration articulates a diverse community around training and professional practice in higher education and organizational settings. In the first cluster, topics such as curriculum, medical education and longitudinal study point to research focused on medical students and continuing education in university hospital and university sector, which evidences the application of mixed methodologies in cohort follow-up. The fourth cluster, on the other hand, brings together concepts

such as creative self efficacy, entrepreneurship and measurement invariance, reflecting the passage from the theory of creativity to its practical evaluation in professional contexts.

The second cluster privileges the study of executive function and the neurocognitive bases of creativity, grouping terms such as executive function, prefrontal cortex and neuropsychological test. The third cluster groups design thinking, creative problem solving and curricula, recognizing the influence of educational engineering and design process models in promoting creative potential in the classroom (Jain & Sobek, 2006).

In the smaller clusters, one focused on student engagement and inclusion highlights lines of research in nursing students, while another, focused on thinking style, exemplifies highly specialized academic niches. Between these poles, intermediate clusters dedicated to the psychometric assessment of creativity emerge: the Runco Ideational Behavior Scale (RIBS) and the Grit Scale demonstrated two-factor factor structures in university samples (Rojas & Tyler, 2018) and variability in the reliability of scores according to educational level and instrument version (Sen, 2022), see Figure 11.

Figure 11. *Network of ten thematic clusters in collaboration around creativity and education (2004-2024).*



Source: Own elaboration based on Web of Science and Scopus (20 April 2025).

Discussion

The resulting panorama confirms a sustained expansion of research on divergent thinking in higher education, but reveals conceptual and methodological tensions that still hinder the consolidation of the field. First, the convergence among the major systemic theories found in this study coincides with music students' preference for eclectic explanations (Huovinen, 2021) and with evidence that excellencism standards enhance ideation (Goulet-Pelletier et al., 2022). However, the paradigmatic literature maintains segments that remain isolated; for example, work examining the moral dimension of creativity (Ploum et al., 2018) hardly dialogues with the empirical body analyzing the interrelationship between social support and creative well-being (Tan et al., 2022).

In the realm of measurement, the bifactor validity of the Arabic TTCT (Said-Metwaly et al., 2020) and the reduction of the Thai RIBS (Tep et al., 2021) question the appropriateness of employing "universal" instruments without prior cultural adjustments. This finding relativizes Sen's (2022) claims about the high average reliability of RIBS and agrees with Shaw's (2021) warning about the need to balance accuracy and economy in scoring. Moreover, the incorporation of perceptual metrics (Figural Interpretation Quest) provides additional explanatory variance (Erwin et al., 2022), which calls into question the reviews that continue to equate creativity with verbal ideation.

Regarding individual factors, the data confirm the paradox formulated by Taylor et al. (2020): ADHD traits favor originality, although they compromise traditional performance. However, the regulatory effect of insomnia detected by Polner et al. (2018) suggests that the ADHD advantage is not uniform and depends on health variables that the mainstream literature barely considers. Similarly, the mediation of cognitive flexibility between bilingualism and creativity (Kim & Runco, 2022; Xia et al., 2022) qualifies the more enthusiastic theses on bilingualism as a universal advantage.

As for pedagogical settings, evidence confirms that interdisciplinary and cooperative formats elevate fluency and originality (Catarino et al., 2019; McDonald et al., 2018). However, studies with intelligent agents show that the same argumentative scaffolding can stimulate analytical depth and simultaneously reduce thematic breadth (Gao et al., 2022); this result relativizes the optimism of Hu et al. (2022) on the figure of the assigned leader and suggests that consensus seeking may limit divergent exploration. The irruption of ChatGPT reinforces the double face of the technology: while De Vicente-Yagüe-Jara et al. (2023) document improvements in fluency and originality, Fiialka et al. (2023) warn about the risk of bias and loss of critical thinking, confirming the need for clear ethical policies (Chergarova et al., 2023).

Disciplinary variability remains marked. The prevalence of visual inspiration and solitary work in architecture (Meyer & Fourie, 2018) contrasts with the reliance on collaborative leadership in nursing-design., (H.-Y. Liu et al., 2022). Furthermore, institutional factors holding back potential creativity in Kazakhstan (Burayeva et al., 2020) invite

relativizing the superiority of highly competitive systems and underscore the importance of context.

Finally, longitudinal studies remain scarce; only a handful offer semiannual or annual follow-up (Han et al., 2022; Vally et al., 2019). This limits causal inference and understanding of transfer to employability, a gap also detected by Cunha et al.(2021). The predominant presence of cross-sectional designs and the heterogeneity of metrics weaken the comparability of effects and explain the observed dispersion in impact sizes.

In summary, this analysis confirms substantial progress, but also evidences the fragmentation of the field and the urgency of integrating frameworks that articulate theory, measurement and pedagogical practice.

Conclusion

The corpus analyzed demonstrates a sustained growth and thematic diversification of divergent thinking in higher education during the period 2004-2024. Evidence indicates that systemic approaches, culturally tailored metrics and interdisciplinary interventions offer the most consistent effects on fluency, flexibility and originality. However, conceptual fragmentation persists, especially in the integration of moral, emotional, and contextual factors. Moreover, the prevalence of cross-cutting designs limits the understanding of the transfer of creative competencies to employability and professional innovation.

The deployment of generative artificial intelligence technologies opens up significant opportunities for ideation, but introduces ethical dilemmas and risks of bias that require regulatory frameworks and digital literacy. The field requires psychometric instruments with cross-cultural validity, longitudinal studies that assess the durability of pedagogical effects, and the inclusion of traditionally underrepresented populations. The consolidation of global research communities, the adoption of PRISMA 2020 protocols, and the use of multi-base bibliometric analyses emerge as essential strategies to strengthen evidence and guide curricular policies that raise the innovative capacity of future professionals.

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