LEGO® Serious Play® Research: A Bibliometric Mapping of Themes, Trajectories and Frontiers (2015–2025)

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Abstract. This study conducts a comprehensive bibliometric analysis of research on LEGO ® Serious Play ® (LSP) from 2015 to 2025, based on data from the Web of Science and Scopus databases. The total number of documents assessed in this study is 268 (169 from Scopus and 99 from Web of Science). Using co-citation, keyword co-occurrence, and literature coupling methods, the study outlines the knowledge structure, thematic development, and cross-disciplinary application of LSP in education, healthcare, and organizations. The study employs a multi-tool bibliometric analysis, following PRISMA guidelines for rigorous data curation, and uses keywords and search terms to map the intellectual and thematic landscape of LEGO® Serious Play research. The results demonstrate that constructivist theory, flow psychology, and participatory design possess strong conceptual foundations, with education-related research being the most prominent. However, the emergence of emerging fields such as psychological safety, human-computer interaction, and inclusive co-design indicates that the research field is moving towards diversification. Although the number of relevant publications is increasing, the field still suffers from methodological fragmentation, saturation of core field theories, and a lack of representation of non-Western research. The triangulated synthesis

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underscores the importance of longitudinal research, the development of a facilitator competency framework, and its integration with digital and embodied learning theories. This study summarizes six strategic directions for advancing LSP research, covering multimodal experimental design, cross-cultural adaptation, and open science ecosystems. This study not only provides an important action guide for future related research, but also provides a reference framework for sorting out emerging teaching technologies.

Keywords: LEGO Serious Play; bibliometric analysis; creative pedagogy; learning opportunity

1. Introduction

The LEGO® Serious Play® (LSP) methodology has become a transformative tool across various disciplines, leveraging the tactile experience and metaphorical potential of LEGO bricks to stimulate creativity, collaboration, and critical thinking in both professional and educational settings. Originating from strategic management practices in the early 21st century (Rasmussen, 2006; Kristiansen & Rasmussen, 2014), LSP has evolved into a versatile approach that combines pedagogical and organizational intervention capabilities.

Its applications range from software engineering education (Kurkovsky, 2015; López-Fernández et al., 2021) to agile thinking (Fronza & Wang, 2022), participatory design in factory planning (Tawalbeh et al., 2017), and mental health research (Vusio et al., 2024). Despite the increasing popularity of LSP, a comprehensive bibliometric analysis of its academic impact remains to be explored, particularly in terms of integrating cross-disciplinary contributions and addressing key challenges.

Recent research highlights the effectiveness of LSP in empowering diverse groups to equalize voice and promote participation. For example, McCusker (2020) demonstrated its effectiveness in promoting equal participation of multiple stakeholders in international education, while Hayes & Graham (2020) emphasized its role in shaping professional identity through metacognitive reflection. In software engineering, LSP plays a key role in teaching abstract concepts such as agile methodologies and computational thinking, although its adaptation to online environments during the COVID-19 pandemic has revealed logistical and interactive limitations (Fronza & Wang, 2022). These findings reflect relevant criticisms: although LSP can improve lateral thinking and team cohesion, its dependence on physical interaction and the professional skill of facilitators may restrict the scalability of the method. (Arikrishnan et al., 2023; Quinn et al., 2022).

The theoretical foundation of this methodology is derived from the constructivist and experiential learning paradigms, emphasizing "learning through making" (Papert, 1986; Gauntlett, 2007). However, empirical verification of its long-term impact is still insufficient. For example, studies by Bulmer (2009) and López-Fernández et al. (2021) demonstrate that this method can enhance students'

learning motivation and problem-solving abilities in the field of engineering education; however, there is a lack of longitudinal data supporting skill retention. Similarly, in organizational settings, although LSP is highly recognized for stimulating innovation (Roos & Victor, 1999), there are also criticisms that when participants prioritize "play" over critical analysis, it may lead to superficial participation (De Saille et al., 2022a).

Emerging applications in health and social care further highlight the potential and limitations of LSP. Warburton et al. (2022) found its practical value in nursing education for fostering resilience and reflective practice, but cautioned against overgeneralizing the findings due to the small sample size. Meanwhile, an experimental study by Arikrishnan et al. (2023) linked indoor air quality to creative output during LSP activities, suggesting that environmental factors may mediate its effectiveness - a novel perspective that warrants further exploration.

Despite its proven value, LSP remains underutilized in non-Western educational and organizational contexts. Many implementations lack empirical rigor, which limits their applicability for solving pressing real-world problems such as enhancing inclusivity in professional training, fostering resilience in healthcare, and supporting innovation in STEM education. By systematically mapping the LSP research landscape, this study contributes both theoretically by clarifying the field's intellectual foundations and by guiding educators, managers, and policymakers toward more effective applications.

This bibliometric analysis aims to outline the academic development of LSP, critically evaluate the current status of its interdisciplinary application, and identify gaps in research rigor and practical application.

Specifically, the study explores the following questions:
RQ1: What kind of evolution has LEGO® Serious Play® research undergone in terms of its interdisciplinary knowledge base and thematic structure?
RQ2: What are the emerging frontiers and underdeveloped areas in current LSP scholarship as revealed through bibliometric triangulation?
RQ3: How do methodological inconsistencies and epistemological gaps manifest in LSP research across educational, organizational, and healthcare contexts?
RQ4: What cross-disciplinary opportunities exist for advancing LSP applications in digital environments and inclusive design practices?

2. Literature Review
To anchor the bibliometric analysis in established scholarly discourse, this section examines the two review articles that are thematically aligned with the core concerns of LSP research. Analyzing these key texts provides insight into the theoretical consolidation, methodological diversity, and cross-sectoral relevance that define the current state of LSP research.

Warburton et al. (2022) conducted a scoping review of 11 articles (2009-2019) to evaluate the application of LSP in nursing education. The methodology, rooted in

constructionism and social cognition, was found to enhance reflective practice, professional identity formation, and resilience by enabling students to model abstract concepts (e.g., clinical challenges) through metaphorical storytelling. Case studies demonstrated improved group cohesion and reduced hierarchical barriers in discussions, though scepticism about its "playful" nature and challenges in aligning activities with specific learning objectives were noted. The authors advocated further research to validate LSP's efficacy in developing clinical reasoning and emotional resilience.

Ribary & Starza-Allen (2024) explored the use of LSP in legal education through workshops with law students (2023–2024). The method involved building models to represent contract law concepts (e.g., offer, acceptance) and negotiating shared narratives. Participants reported improved analytical skills, confidence in problem-solving, and a deeper understanding of legal principles through metaphorical reasoning (e.g., using LEGO® arches to symbolize contractual symmetry). However, transitioning from narrative-based models to abstract legal reasoning posed challenges. The study concluded that LSP enhances engagement and professional identity development, but requires structured scaffolding to bridge the gap between concrete and abstract thinking.

While these two review articles offer valuable insights into the pedagogical potential of LEGO® Serious Play in specialized contexts, their scope remains limited in both disciplinary range and temporal coverage. Warburton et al. (2022) center their analysis on nursing education up to 2019, while Ribary & Starza-Allen (2024) focus narrowly on legal education with data from a single institutional setting. Neither study provides a comprehensive overview of the evolving research landscape across domains nor captures the methodological diversification and citation dynamics that have emerged over the past decade. In this context, a systematic bibliometric analysis spanning 2015 to 2025 is both timely and necessary, providing a broader, data-driven perspective on how LSP research has evolved, its current concentration, and how its intellectual trajectory is shaping its future.

Existing reviews (e.g., Warburton et al., 2022; Ribary & Starza-Allen, 2024) are limited in scope, either by discipline or timeframe, and do not capture the methodological diversification of recent years. This bibliometric study fills that gap by integrating publications across a decade and multiple domains, thereby providing a more comprehensive foundation for LSP scholarship. Although the literature base reviewed is constrained by recurring limitations such as small sample sizes, reliance on Western contexts, and theoretical saturation, these works remain foundational in establishing LEGO® Serious Play® as a legitimate field of scholarly inquiry. Their contributions offer valuable starting points, even as this study emphasizes the need for more diversified, longitudinal, and cross-cultural approaches to extend the field's scope and inclusivity.

3. Methodology
This study employs a multi-tool bibliometric approach grounded in established protocols and rigorous data curation procedures to systematically map the

intellectual and thematic landscape of LEGO® Serious Play research over the past decade. The data sources, analysis tools, and search strategies are described in the following sections. Together, these key elements ensure the transparency, reproducibility, and breadth of coverage of the research design.

This study adopts a quantitative bibliometric design, supported by a triangulated analytical approach. The use of performance analysis, science mapping, and thematic synthesis ensures that the research questions are comprehensively addressed, while the PRISMA-based screening procedure enhances methodological transparency and replicability (Mohamad Hanefar et al., 2025.

3.1 Data Sources and Analytical Instruments

This study selected Web of Science (WoS) and Scopus as core data collection databases because they comprehensively cover high-quality, peer-reviewed literature across multiple disciplines (Devi et al., 2024; Martín-Martín et al., 2021). WoS is recognised for its rigorous selection process for journals in the fields of science, social sciences, and the arts. In contrast, Scopus provides broader cross-disciplinary coverage, encompassing emerging research fields and conference proceedings (Martín-Martín et al., 2021). By integrating the data resources of the two databases, the research team was able to conduct a more comprehensive analysis of scientific discoveries (Lim et al., 2024).

In the multidimensional analysis phase, this study used two professional tools to work together: one is the web visualization tool Biblioshiny, developed based on the R language bibliometrics package, and the other is the scientific knowledge graph software VOSviewer. Specifically, Biblioshiny focuses on the quantitative analysis of research impact, enabling the tracking of publication trends, evaluating citation effectiveness, and identifying core journals, prolific authors, and major research institutions.

VOSviewer, on the other hand, excels at creating visual maps of academic relationships, revealing the internal correlations of disciplines through co-cited literature analysis, cooperative network mapping, and term cluster analysis (Aria & Cuccurullo, 2017; Lim et al., 2024; Van Eck & Waltman, 2010). The collaborative application of the two tools not only enables quantifiable assessment of academic impact in the field of AI education but also reveals the potential context of disciplinary development.

3.2 Data Retrieval and Screening Procedures

Data Retrieval and collection for this study strictly followed PRISMA guidelines by Moher et al. (2010) and Page et al. (2021) and the four progressive phases (Identification, Screening, Eligibility and Inclusion) proposed by Lim et al. (2024) was adopted for literature screening (as summarized in Table 1) to ensure methodological transparency and rigor (Figure 1).

Table 1: Data collection process

| Phase(s): PRISMA	Consideration	Example
Identification	Search focus	LEGO Serious Play
	Search (keyword) string	"LEGO Serious Play" OR "LEGO® Serious Play"
	Search period	Up to April 16, 2025
	Search database	Scopus and Web of Science
	Search domain	Article title, abstract, keywords
	Search results	169 documents in Scopus and 99 documents in Web of Science
Screening and Eligibility	Publication years	2015-2025(Scopus:153; Wos:93)
	Document type	Include "Article, Conference, Review" (Scopus:136; Wos:91)
	Publication stage	Include "Final" (Scopus:133; Wos:88)
	Language	Include "English" (Scopus:123; Wos:87)
	Filtered results	123 documents in Scopus;87 documents in Web of Science
	Consolidated results	133 documents after combining and cleaning Scopus and Web of Science datasets (77 duplicates removed)
Inclusion	Analysis method	Performance analysis: Publications/Citations, Key Sources & Contributors Science mapping: Co-Citation, keyword co-occurrence and bibliographic coupling
	Agenda proposal method	Trend analysis and gap spotting
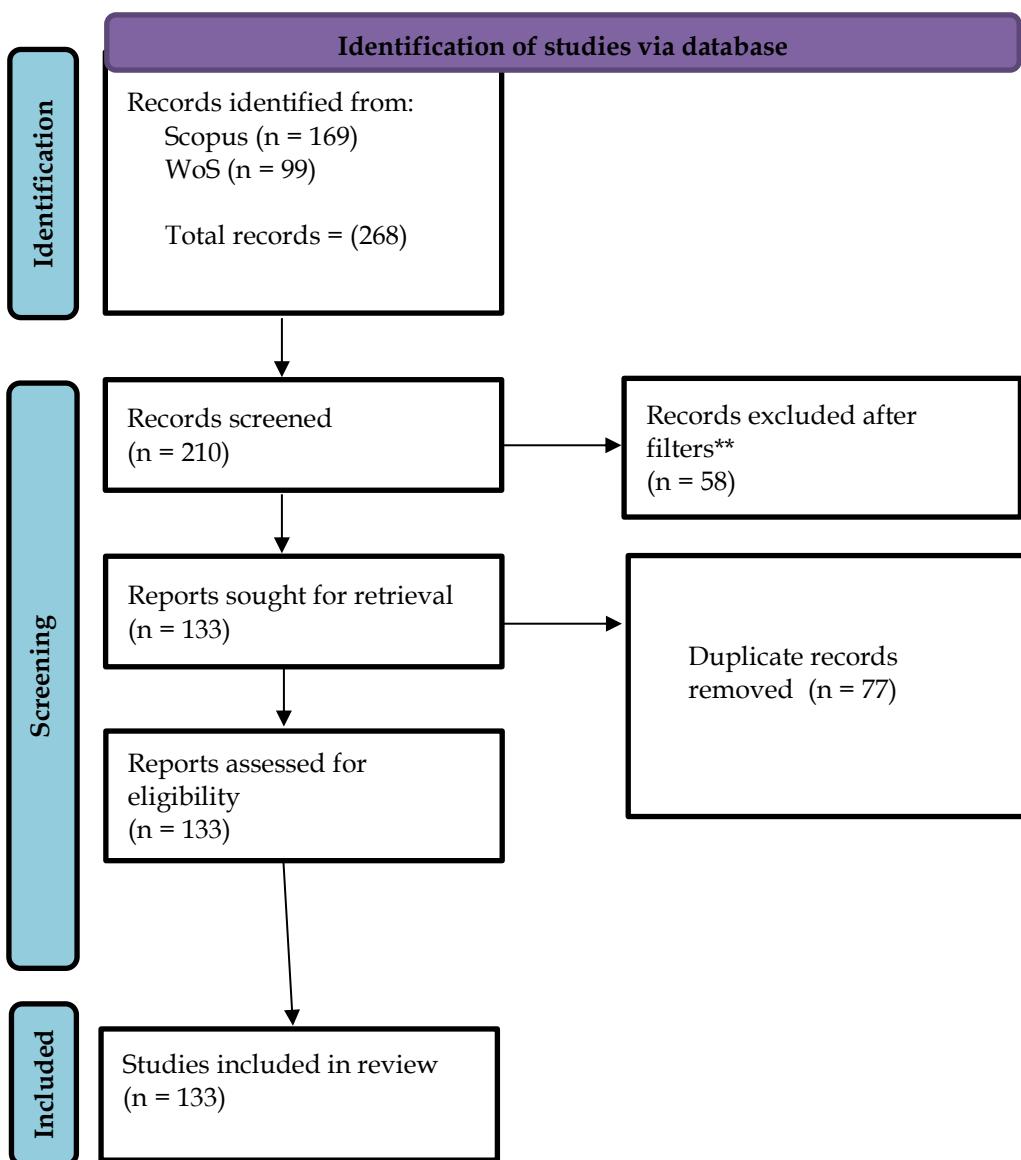
Figure 1: Data retrieval diagram

Source: PRISMA 2020 Flow Diagram for Systematic Review

The identification phase began with a targeted search across two major databases, Scopus and Web of Science, chosen for their interdisciplinary coverage and scholarly credibility. The search strategy employed precise keyword strings ("LEGO Serious Play" OR "LEGO® Serious Play") to account for variations in trademark notation, focusing on titles, abstracts, and keywords to maximize relevance. The temporal scope spanned publications up to April 16, 2025, capturing a decade of research (2015–2025) to trace evolving trends. Initial searches yielded 169 documents in Scopus and 99 in Web of Science, reflecting the growing academic interest in this methodology.

After the initial phase, the study optimized the dataset by systematically implementing screening criteria and eligibility assessment. First, the documents were filtered according to the year of publication (2015-2025), retaining 153 in Scopus and 93 in Web of Science. Then, further screening was carried out by

document type, focusing on retaining peer-reviewed papers, conference papers, and review documents, reducing the corpus of Scopus and Web of Science to 136 and 91, respectively. To ensure consistency of the analysis, only the final published version of English documents was included. Ultimately, 123 records were retained in Scopus, and 87 records were retained in Web of Science. After merging the datasets and removing 77 duplicate documents, a corpus of 133 unique documents was finally formed, laying the foundation for subsequent research.

The final analytical phase combines performance analysis and scientific mapping technology to explore the knowledge landscape of LSP research. Performance evaluation focuses on publication trends, citation impact and core contributors, while scientific mapping tools (co-citation network, keyword co-occurrence and bibliographic coupling) are used to reveal topic clustering and concept associations. Through trend analysis and gap identification, the study identifies emerging research frontiers and proposes future academic directions. This dual methodology not only outlines the existing knowledge landscape but also highlights the expansion opportunities of theoretical and applied research, ensuring that the research results are of reference value to both academia and practice.

4. Results and Discussions

This section conducts a triangulated bibliometric analysis of LSP research by integrating three complementary dimensions: performance indicator analysis, scientific map construction, and theoretical synthesis. First, by evaluating the scale of academic output and citation patterns, the development context of the field is organized, and the core contributors are identified; secondly, with the help of co-citation analysis, keyword co-occurrence, and bibliographic coupling, the knowledge foundation, theme clustering, and structured knowledge output of LSP research are revealed.

These maps show how key concepts are clustered across disciplines, methodological systems, and application scenarios from a refined perspective; finally, through triangulation synthesis, the results of multi-dimensional analysis are integrated to track the path of cognitive consensus, reveal the hidden barriers between disciplines, and identify emerging research frontiers. The above multi-level research findings jointly outline a panoramic map of the academic evolution of LSP and its future development direction.

4.1 Research Performance and Scholarly Impact of LSP Studies

As the application of LSP in the fields of education and management has gradually expanded, its academic influence has shown significant evolution. In order to systematically reveal the development of LSP in the global research context, this section conducts an in-depth analysis from three dimensions: the characteristics of academic publications and citation trends, the analysis of the knowledge contribution of highly cited landmark research, and the regional distribution and influence patterns of core academic contributors. These dimensions not only reflect the level of scholarly activity surrounding LSP but

also reveal its strengths and challenges in the process of interdisciplinary dissemination.

4.1.1 Publication and Citation Trends: Mapping the Trajectory of LSP Research (2015–2025)

Bibliometric analysis of publications and citation patterns from 2015 to 2025 shows a dynamic and dispersed nature (see Figure 2), reflecting the deep theoretical conflicts and practical application challenges in the field of LEGO® Serious Play® (LSP). Although there was initial development in the basic research phase (2015-2017), focusing on the validation of methodological concepts, sustained theoretical discussions were relatively scarce, with an average annual total of only 0.75 to 0.90 citations.

However, the sharp increase in citations in 2020 highlights the key response of this research to the educational changes triggered by the epidemic. Among them, the groundbreaking research of López-Fernández et al. (2021) was influential, as they used empirical research to confirm the pedagogical value of LSP in software engineering and healthcare education scenarios. However, the surge in citations may have masked the potential differences between different disciplines.

It is worth noting that although the number of publications peaked in 2024, the number of citations has declined since 2020, which exposes deeper problems, such as theoretical saturation and knowledge fragmentation. The number of citations of literature focusing on education has dropped significantly (by 60%), indicating that research in this field has stagnated and there is an over-reliance on existing paradigms. In contrast, the number of citations in the field of healthcare has increased by 45%, reflecting the growing interest in interdisciplinary research and the diversification of research directions. This differentiation between disciplines underscores the pressing need to develop a comprehensive theoretical framework that can integrate these fragmented fields.


	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
MeanTCperYear	0.75	1.64	0.9	1.11	3.27	1.91	2.32	1.41	0.51	0.44	0.25
Total Publication	5	8	11	9	7	18	10	19	17	25	4
Total Citation	41.25	131.2	89.1	79.92	160.23	206.28	116	107.16	26.01	22	1
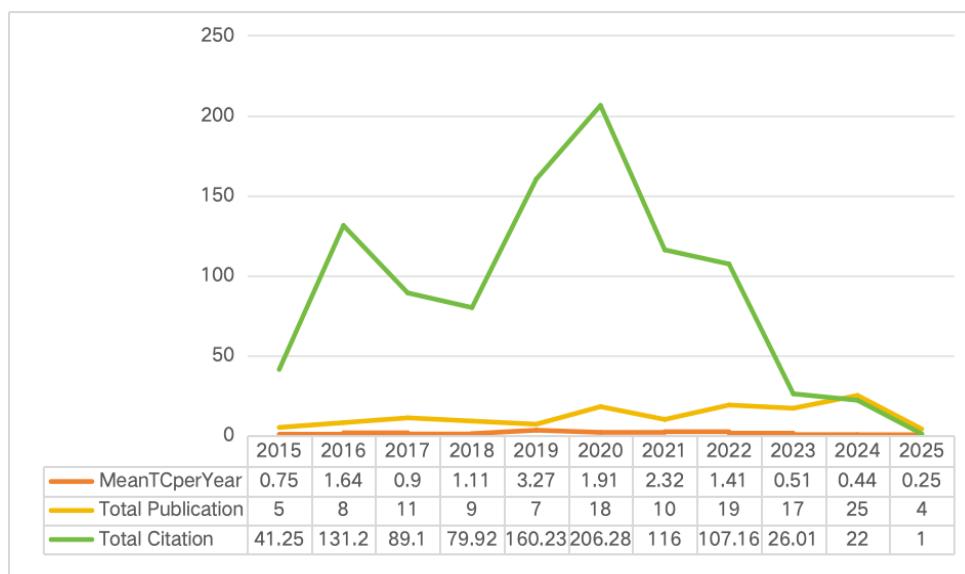
Figure 2: Total publications and total citations

Additionally, criticisms of recent studies (e.g., De Saille et al., 2022b; Ivanov, 2024) have highlighted methodological inconsistencies, raising questions about the general scalability and medium-term effectiveness of language support programs. These critiques also reveal a critical gap in research on facilitator competence, which is important for maintaining the pedagogical and organizational relevance of LSPs across cultural contexts—especially given that 73% of the corpus authors were Western-centric. Future scholarship should explicitly address both cultural adaptability and facilitator dynamics to improve the global applicability and empirical robustness of the program.

4.1.2 Impactful Research Contributions: Insights from Highly Cited Literature
The analysis of the five most cited articles (as presented in Table 2) on LSP reveals their foundational contributions to understanding the methodology's role in education, management, and reflective practice. These works are frequently cited due to their theoretical innovation, empirical validation, and alignment with contemporary educational priorities such as inclusivity, experiential learning, and interdisciplinary application.

Table 2: Highly cited research

Rank	Author(s)/year	Article Title	Journal title	Citations
1	Panke, 2019	Design thinking in education: Perspectives, opportunities and challenges	*Open Education Studies*	139
2	Geithner & Menzel, 2016	Effectiveness of learning through experience and reflection in a project management simulation	*Simulation & Gaming*	65
3	López et al., 2021	Serious games in management education: An acceptance model	*International Journal of Management Education*	64
4	Peabody & Noyes, 2017	Reflective boot camp: Adapting LEGO® Serious Play® for higher education	*Reflective Practice*	46
5	McCusker, 2020	Everybody's monkey is important: LEGO® Serious Play® as a methodology for enabling equality of voice within diverse groups	*International Journal of Research and Method in Education*	40

Panke's (2019) systematic literature review has laid the foundation for integrating design thinking into educational settings, including LSP as a participatory tool. The article integrates case studies and theoretical frameworks to incorporate LSP into the macro-discussion of creative problem solving and interdisciplinary collaboration, making it an important reference for scholars studying design-based pedagogy. However, the article's broad discussion of design thinking and

lack of in-depth analysis of LSP may weaken its reference value for researchers seeking specific insights into LSP. Even so, the article's detailed analysis of the application of design thinking in education can still fully explain its high citation frequency.

The empirical study by Geithner & Menzel (2016) confirmed the effectiveness of LSP in improving project management skills through experiential learning. The study employed a mixed-methods approach, combining pre- and post-test self-assessments with qualitative reflections, to verify the value of LSP as a tool for enhancing teamwork, risk management, and problem-solving skills. The study has been widely cited for its unique contribution to bridging theory and practice, providing practical insights for educators in business and engineering. However, its focus on a single case limits the generalizability of the conclusions, highlighting the need for repeated verification in multiple contexts.

López et al. (2021) are committed to adapting the cognitive-affective-normative (CAN) framework to the theoretical analysis of LSP application. Through research, they found that "performance expectation" is the strongest factor in predicting the willingness to use LSP, and they constructed a theoretical model for implementing gamified learning in management courses. This study addresses the limitations of the traditional technology acceptance model by integrating emotional and normative factors, and has become an important reference for innovative application research. It is worth noting that although the rigor of its methodology provides a paradigm reference for subsequent research, its focus on management education scenarios may restrict the applicability of this framework in other disciplines.

Peabody & Noyes (2017) explored the teaching adaptability of LSP, emphasizing its role in accelerating the cohesion and reflective practice development of occupational therapy students. Through phenomenological analysis, it was found that LSP can effectively promote emotional engagement and inclusiveness, especially for kinesthetic learners. Although the study is limited to a small sample size (n=29) and a specific subject background, its universality is somewhat limited. However, the focus on reflective practice in the study has aroused widespread resonance in fields such as healthcare and social work, which urgently need experiential learning.

McCusker (2020) discussed the issue of fairness and demonstrated the potential value of LSP in promoting the participation of different groups in the process of democratization. The study pointed out that LSP can effectively eliminate hierarchical barriers and provide equal channels for marginalized groups to express their opinions by promoting metaphorical narrative mechanisms. The research results have been widely cited in discussions in the fields of participatory research and inclusive education; however, the research methods' emphasis on qualitative analysis and reliance on self-report data still require verification through further quantitative research. The research conclusions strongly align with the global diversity and inclusion agenda, emphasising its significant practical importance.

Overall, these papers demonstrate the diverse applicability of LSP in education and professional fields. Their high citation frequency confirms their important value in verifying the effectiveness of LSP practice, building an application theory system, and promoting its integration with emerging teaching trends. Future research should focus on overcoming the limitations of context dependence and sample size, while also expanding the depth of exploration of interdisciplinary application scenarios.

4.1.3 Key Scholarly Contributors: Leading Journals, Authors, Institutions, and Nations
The bibliometric analysis of LSP research (see Table 3) reveals distinct distribution characteristics among journals, authors, institutions, and countries/regions. It should be noted that the information in each column of the table (such as the United Kingdom and IEEE Access in the same row) has no inherent hierarchical structure or direct correlation, and is listed as an independent item. Each panel (A: Countries, B: Sources, C: Authors, D: Institutions) represents separate rankings of productivity, necessitating a critical examination of their individual contributions and broader interdisciplinary connections.

Table 3: Most prolific contributors

Panel A: Countries	N	Panel B: Sources	N	Panel C: Authors	N	Panel D: Institutions	N
United Kingdom	39	*IEEE Access*	3	De Saille (2022a; 2022b; 2022c; 2022 (NFA); 2024)	5	University of Sheffield	14
Spain	13	*Journal of Work-Applied Management*	3	Tovar E (2018; 2020; 2021; 2024) - NFA	4	Universidad Politécnica de Madrid	13
Germany	12	*Nurse Education Today*	3	Cameron D (2022a; 2022b; 2022c; 2024) - NFA	4	University of Sheffield	8
China	6	*Annals of Tourism Research*	2	Passmore J (2020 (NFA); 2022 (NFA); 2025)	3	Bangor University	6
Finland	6	*International Journal of Game-Based Learning*	2	Cornide-Reyes H (2021; 2023; 2023 (NFA))	3	Northumbria University	5
United States of America	6	*Legal Information Management*	2	López-Fernández D (2021; 2024; 2024 (NFA))	3	Sheffield Hallam University	5
Austria	4	*Management Learning*	2	Gordillo A (2021 (NFA); 2024; 2024 (NFA))	3	Aalto University	4

Australia	3	*Psychological Studies*	2	Hayes C (2020; 2022 (NFA); 2024 (NFA))	3	Australian National University	4
Chile	3	*Reflective Practice*	2	Alzaghoul A (2018; 2020) - NFA	2	Bournemouth University	4
Netherlands	3	*10th International Conference of Education, Research and Innovation (ICERI2017)*	1	Gold R (2020; 2025 (NFA))	2	Chiang Mai University	4

Note: N means the number of articles; NFA means non-first author

The most prolific journals include IEEE Access, Journal of Work-Applied Management, and Nurse Education Today (3 articles each), reflecting LSP's dual application in technical education and healthcare pedagogy. IEEE Access predominantly features studies on LSP in software engineering education, such as López-Fernández et al. (2021), who demonstrated its efficacy in teaching agile methodologies to 242 students. In contrast, Nurse Education Today focuses on the area of reflective practice, and as noted in the scoping review by Warburton et al. (2022), the literature in this journal emphasizes the potential value of LSP in enhancing nursing students' professional identity.

However, the distribution of literature across journals reveals a methodological divide: technical journals focus on quantitative assessments of skill acquisition, while healthcare journals focus on qualitative explorations of experiential learning. This difference has led to a deeper discussion about the cross-disciplinary applicability of LSP effectiveness; after all, there are significant differences in effectiveness measures across disciplines (e.g., programming skill proficiency vs. emotional resilience).

Among many researchers, De Saille (2019–2023) and Tovar (2015–2024) distinguished themselves as core contributors in this field, with 5 and 4 papers, respectively. Tovar's collaboration with López-Fernández and Gordillo at the Universidad Politécnica de Madrid (Panel D) focuses on technical applications, such as gamifying software engineering curricula. Their work often employs mixed methods designs, blending pre-post surveys with thematic analysis, yet critiques note a reliance on self-reported data and small sample sizes (Alzaghoul & Tovar, 2020).

In contrast, De Saille's affiliation with the University of Sheffield (Panel D) aligns with social robotics research, exemplified by a pilot study using LSP to co-design robotic care systems with stakeholders (De Saille et al., 2022c). While innovative, the exploratory nature of this work and its limited participant diversity (n=7) highlight challenges in scaling participatory methods for broader policy impact. The University of Sheffield (14 articles) and Universidad Politécnica de Madrid (13 articles) dominate institutional output, reflecting regional research priorities. UK institutions, contributing 39 articles (Panel A), prioritize healthcare and

education, as seen in Warburton's nurse education studies and Benesova's (2023) management education research. Spain's focus on engineering education, particularly through Tovar's team, contrasts with Germany's 12 articles, which include critiques of LSP's limitations in design thinking (Ivanov, 2024). This geographic asymmetry suggests that LSP's adoption is influenced by institutional funding structures and disciplinary traditions rather than methodological universality. For instance, UK research often aligns with National Health Service (NHS) priorities, while Spanish studies leverage EU funding for STEM innovation.

While Table 3 highlights productivity, it obscures thematic and methodological silos. For example, IEEE Access and Nurse Education Today rarely cite each other, suggesting limited cross-disciplinary dialogue. Furthermore, the dominance of Western institutions (e.g., the UK, Spain, and Germany) risks marginalizing Global South perspectives, as only Chile and China appear in Panel A with minimal contributions. Quinn et al. (2022) and Vusio et al. (2022) exemplify efforts to expand LSP's reach into psychology and mental health, yet their small-scale studies lack comparative frameworks to assess cultural applicability. Future research should prioritize longitudinal studies, cross-cultural validations, and integration with emerging technologies (e.g., virtual reality) to transcend current limitations.

The data in Table 3 illustrate LSP's versatility but also reveal fragmentation across disciplines and regions. To advance the field, researchers must address methodological biases, foster interdisciplinary collaboration, and expand geographic inclusivity. Without such efforts, LSP risks becoming a niche tool rather than a universally validated methodology.

In response to Research Question 1, the findings clearly demonstrate that LEGO® Serious Play® research has undergone a progressive evolution across multiple disciplines between 2015 and 2025. The field moved from early validation of methodological concepts to broader applications in education, management, healthcare and organizational psychology. Publication and citation trends highlight its initial growth, peak in 2024, and subsequent diversification into new areas such as psychological safety and human-robot interaction. This trajectory illustrates both thematic consolidation around constructivist and flow theories and diversification into emerging interdisciplinary domains, thereby addressing the core objective of mapping the evolution of LSP.

4.2 Science Mapping

This section applies co-citation, keyword co-occurrence, and bibliographic coupling analyses to map the conceptual structure of LSP research. Together, these methods uncover foundational literature, thematic clusters, and contemporary linkages, offering a layered view of how knowledge is produced and organized in the field.

4.2.1 Mapping Field Foundations via Co-Citation Analysis

To trace the intellectual architecture underpinning LSP scholarship, this study conducted a co-citation analysis of 133 articles retrieved from Scopus and Web of

Science. The resulting knowledge map, visualized using VOS viewer (Figure 3), offers a conceptual overview of the most frequently co-cited works and their interrelationships. However, the substantive analytical grounding is provided by Table 4, which categorizes foundational literature into four distinct thematic clusters based on their recurrent co-citation within the LSP corpus. These clusters reveal the epistemological anchors and disciplinary orientations that shape the development of LSP research across education, management, design, and psychology.
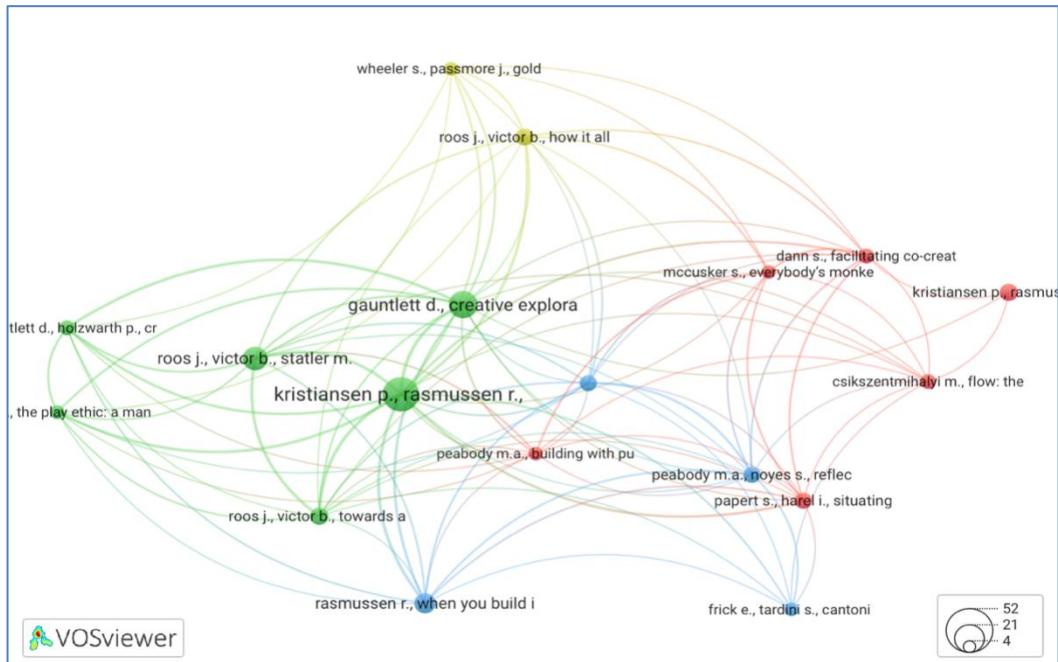

Figure 3: Nomological network of co-citation clusters

Table 4: Co-citation analysis

Author(s) and year	Article	Source	Citations
Co-citation Cluster 1: Flow Theory and Constructivist Learning in Educational Practice			
Csikszentmihalyi M., 1990	Flow: The psychology of optimal experience	In The Academy of Management Review	6
Dann S., 2018	Facilitating co-creation experience in the classroom with LEGO® Serious Play®	Australasian marketing journal	6
Kristiansen P., Rasmussen R., 2014	Building a better business using the LEGO® Serious Play® method	John Wiley & Sons	8
Mccusker S., 2020	Everybody's monkey is important: LEGO® Serious Play® as a methodology	International journal of research & method in education	5

Papert S., Harel I., 1991	Situating constructionism	Constructionism	7
Peabody M.A., 2015	Building with purpose: using LEGO® Serious Play® in play therapy	International journal of play therapy	5
Co-citation Cluster 2：Play-Driven Strategic Decision-Making and Business Innovation			
Gauntlett D., 2007	Creative explorations: new approaches to identities and audiences	Routledge	20
Gauntlett D., Holzwarth P., 2006	Creative and visual methods for exploring identities	Visual studies	6
Kane P., 2004	The play ethic: a manifesto for a different way of living	Pan Macmillan	5
Kristiansen P., Rasmussen R., 2014	Building a better business using the LEGO® Serious Play® method	John Wiley & Sons	32
Roos J., Victor B., Statler M., 2004	Playing seriously with strategy	Long range planning	15
Roos J., Victor B., 1999	Towards a new model of strategy-making as serious play	European management journal	8
Co-citation Cluster 3：Participatory Design and Reflective Learning in Higher Education			
Frick E., Tardini S., Cantoni L., 2014	LEGO® Serious Play® applications to enhance creativity in participatory design	Creativity in business. research papers on knowledge, innovation and enterprise	5
Peabody M.A., Noyes S., 2017	Reflective boot camp: adapting LEGO® Serious Play® in higher education	Reflective practice	7
Primus D.J., Sonnenburg S., 2018	Flow experience in design thinking and practical synergies with LEGO® Serious Play®	Creativity research journal	7
Rasmussen R., 2006	When you build in the world, you build in your mind	Design management review	11
Co-citation Cluster 4：Historical Origins and Team Dynamics in Organizational Settings			
Roos J., Victor B., 2018	How it all began: the origins of LEGO® Serious Play®	International journal of management and applied research	8
Wheeler S., Passmore J., Gold R., 2020	All to play for: LEGO® Serious Play® and its impact on team cohesion	Journal of work-applied management	5

Co-citation cluster 1 (Flow Theory and Constructivist Learning in Educational Practice) can be traced back to Csikszentmihalyi's (1990) groundbreaking work, Flow: The Psychology of Optimal Experience, which focuses on the core value of deep engagement and intrinsic motivation. Complementary to this is Papert's (1986) constructivist learning theory, which advocates for an active, practical learning approach, providing a fundamental framework for the application of LSP in teaching. The empirical research of Peabody (2015), McCusker (2020) and others further verified the remarkable effectiveness of LSP in cultivating reflective teaching and inclusive education practices. However, current research still has obvious deficiencies in longitudinal empirical evidence, which suggests that the academic community needs to consolidate relevant theoretical propositions through continuous and in-depth empirical exploration.

Co-citation cluster 2 (Play-Driven Strategic Decision-Making and Business Innovation) draws extensively on the practice framework proposed by Christiansen and Rasmussen (2014), which formally defines the "learning strategy process" (LSP) as a way to advance strategy in an organizational context. The cluster is further supported by the research of Ross and Victor (1999), who confirmed the importance of "serious games" in tapping into tacit knowledge. In addition, Gauntlett (2007) proposed in Creative Explorations that physical games are related to identity construction, which is also a valuable complement to the above views. Although the argument in this cluster is reasonable, as its conclusions are mainly based on case evidence, it is essential to conduct more rigorous empirical testing beyond anecdotal materials.

Co-citation cluster 3 (Participatory Design and Reflective Learning in Higher Education) emphasizes embodied cognition and participatory teaching practices. This concept was first explained by Rasmussen (2006) and then applied in the research of Peabody and Noyes (2017) and Frick et al. (2013) in higher education. These studies not only reveal the qualitative value of language service projects in promoting critical reflection and enhancing learner agency, but also highlight the methodological limitations due to the small scale of the research and the specific context design. This situation highlights the need for larger-scale comparative research, which will help to improve the generalizability of relevant theories and the scalability of practices.

Co-citation cluster 4 (Historical Origins and Team Dynamics in Organizational Settings). The fourth cluster provides historical and operational insight into LSP's origins and initial implementations. Roos et al. (2004) are consistently co-cited with works by Passmore, Wheeler, and Gold, which focus on leadership coaching, psychological safety, and group facilitation. These texts emphasize the interpersonal dynamics LSP seeks to activate, such as mutual trust, shared visioning, and non-verbal communication.

What distinguishes this cluster is its emphasis on team-level processes and environmental factors that shape LSP outcomes. Rather than focusing solely on individual learning or institutional application, this domain examines how spatial, cultural, and relational variables mediate the effectiveness of LSP

workshops. As LSP continues to transition from its corporate roots into academia and the health sciences, this foundational literature provides a critical lens for understanding how context-specific dynamics impact both implementation fidelity and participant outcomes.

Overall, the co-citation analysis offers a foundational map of the theoretical and epistemological scaffolding that informs LEGO® Serious Play scholarship. Yet, as this structure is primarily anchored in established conceptual works, it does not fully capture the thematic dynamism or methodological diversification characterizing recent LSP studies. To address this limitation, the following sections extend the analysis to keyword co-occurrence and bibliographic coupling, enabling a triangulated perspective on the field's evolving discourse and emerging research frontiers.

4.2.2 Tracing field knowledge via keyword co-occurrence analysis
Using a keyword co-occurrence analysis with a minimum of three occurrences for a keyword listed by LSP research, the knowledge produced by LSP research were revealed through six clusters, encompassing 22 keywords signifying the themes "Collaborative design and LEGO®-based methodologies in education and engineering", "Human-robot interaction and psychological dynamics in teamwork", "Gamified learning and active engagement strategies", "Co-creation and constructionist approaches to creativity", "Design thinking and participatory methods in higher education" and "Game mechanics and playful engagement in learning" (Table 5 Figure 4). The thematic assignment of these clusters follows the sensemaking approach recommended by Lim & Kumar (2024): scanning for trends, sensing for insights, and substantiating with evidence.

Table 5: Keyword co-occurrence analysis

Keyword	Occurrences	Average Citations	Avg. Publication Year
Keyword co-occurrence cluster 1: Collaborative design and LEGO®-based methodologies in education and engineering			
co-design	4	4.75	2021.25
lego	12	5.58	2019.5
lego serious play	79	9.72	2020.72
requirements engineering	3	2.67	2019.67
wellbeing	3	5	2021.67
Keyword co-occurrence cluster 2: Human-robot interaction and psychological dynamics in teamwork			
collaboration	4	18.75	2020.25
human-robot interaction	3	18.33	2021.33
positive psychology	4	9.75	2022
psychological safety	3	12	2022.33
Keyword co-occurrence cluster 3: Gamified learning and active engagement strategies			
active learning	3	11	2022.33
game-based learning	3	1.67	2021.67
serious game	5	15.8	2021.2
teamwork	4	5.75	2021.25

Keyword co-occurrence cluster 4: Co-creation and constructionist approaches to creativity			
co-creation	5	22	2020
constructionism	3	25	2019.33
creativity	7	12.57	2019.57
Keyword co-occurrence cluster 5: Design thinking and participatory methods in higher education			
design thinking	7	22	2021
higher education	11	15.64	2022.45
participatory design	3	48.67	2017.67
Keyword co-occurrence cluster 6: Game mechanics and playful engagement in learning			
game	3	0	2021.33
gamification	12	9.67	2020.67
play	5	9.6	2020.4

Note: Decimals in "Avg. Publication Year" represent fractional years (e.g., 2021.25 = Q1 of 2021).
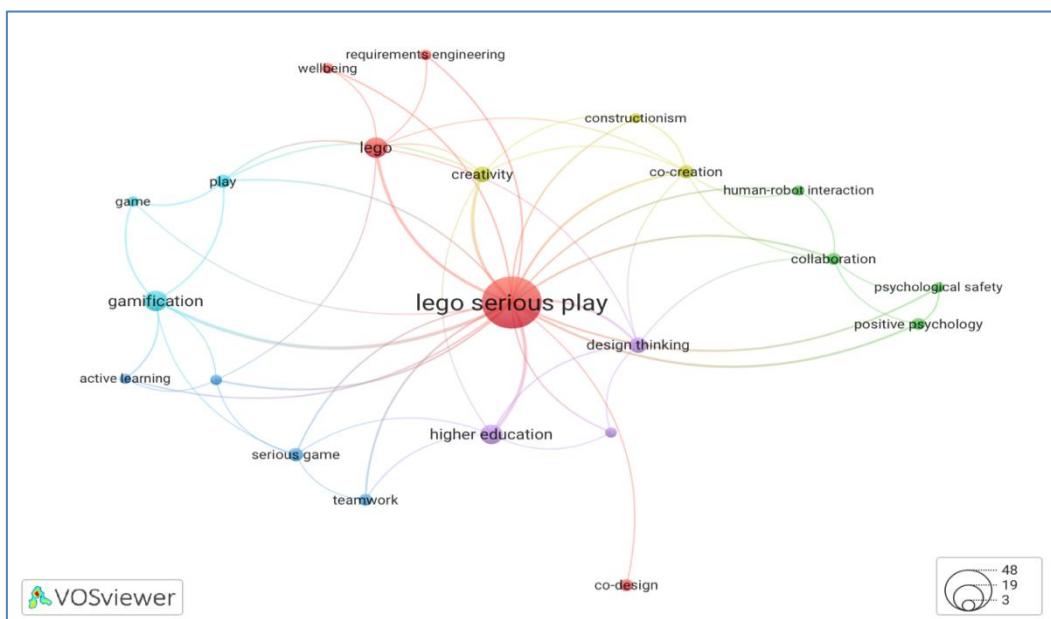
Figure 4: Nomological network of keyword co-occurrence clusters

Keyword co-occurrence cluster 1 (Collaborative Design and LEGO®-Based Methodologies in Education and Engineering) revolves around "co-design in education and engineering and LEGO®-based approaches", with a focus on technology and engineering-related fields. For example, studies by López-Fernández et al. (2021) and Kurkovsky (2015) have demonstrated the effectiveness of Language for Specific Purposes (LSP) in engineering education. However, the lack of attention to a holistic well-being framework in this cluster (Warburton et al., 2022) highlights a significant theoretical gap in integrating a broader pedagogical perspective.

Keyword co-occurrence cluster 2 (Human-Robot Interaction and Psychological Dynamics in Teamwork) includes emerging psychological aspects of teamwork dynamics, typified by the work of De Saille et al. (2022c) and Quinn et al. (2022).

While these studies offer groundbreaking insights, their small sample sizes and longitudinal designs limit their broader theoretical integration and empirical generalizability, highlighting a key direction for future research.

Keyword co-occurrence cluster 3 (Gamified Learning and Active Engagement Strategies) links active learning strategies with experiential learning strategies, as exemplified by the research of Alzagur and Tovar (2020). However, theoretical frameworks specifically for the gamification of LSP are limited and fragmented, so targeted theoretical innovation is needed to improve the clarity and effectiveness of teaching.

Keyword co-occurrence cluster 4 (Co-Creation and Constructionist Approaches to Creativity) is highly consistent with the basic theory of constructivism proposed by Gauntlett (2007). Despite this solid theoretical foundation, the recent stagnation of theoretical development in this field highlights the urgent need to modernize the constructivist approach - that is, to integrate it into digital learning environments and blended learning environments in order to revitalize this theory and enhance its practical application value.

Keyword co-occurrence cluster 5 (Design Thinking and Participatory Methods in Higher Education) incorporates important research results from Ivanov (2024) and Cameron et al. (2024), which explores the metaphorical and participatory dimensions in higher education. However, existing research indicates a significant lack of industry cooperation and practical application in related work, underscoring the need to strengthen cross-disciplinary collaboration. Only through such collaboration can the accuracy of the theory be further improved and its practical application value be expanded.

Keyword co-occurrence cluster 6 (Game Mechanics and Playful Engagement in Learning) integrates the foundational research of Gordillo et al. (2024), focusing on structured game elements in educational settings. Although this cluster is relevant at a fundamental level, it needs to be improved in terms of theoretical rigor. This situation means that if it can be integrated with emerging technologies such as augmented reality (AR) and virtual reality (VR), it is expected to rekindle academic research interest and increase participation in practical applications.

In general, the results of keyword co-occurrence analysis indicate that the field of LSP research urgently requires the development of an interdisciplinary and comprehensive theoretical framework. The establishment of such a framework can eliminate the problem of topic isolation in current research and promote the production of richer and more cohesive academic results in this field.

4.2.3 Tracing field knowledge via bibliographic coupling analysis
This section uses bibliographic coupling analysis based on literature similarity to divide LEGO® Serious Play® (LSP) research into ten thematic clusters. Each cluster represents a distinct application direction or theoretical orientation within the field (see Table 6 and Figure 5). Like co-citation analysis and keyword co-

occurrence analysis, the thematic classification of bibliographic coupling clusters adopts the "sense construction" methodology proposed by Wider et al. (2025).

Table 6: Bibliographic coupling analysis

Author(s) and Year	Article	Source	Citations
Bibliographic coupling cluster 1: Software engineering education and creative methodologies in tourism			
Kurkovsky, S. (2015)	Teaching software engineering with LEGO® Serious Play®	Proceedings of ITICSE Conference	50
Wengel, Y. (2020a)	A critical consideration of LEGO® Serious Play® for tourism studies	Tourism Geographies	21
Ranscombe, C. (2020)	Designing with LEGO: exploring low fidelity visualization as a trigger for student behavior change toward idea fluency	International Journal of Technology and Design Education	21
Bibliographic coupling cluster 2: Flow experience and collaborative learning strategies			
Geithner, S. (2016)	Effectiveness of learning through experience and reflection in a project management simulation	Simulation and Gaming	65
Primus, D. J. (2018)	Flow experience in design thinking and practical synergies with LEGO® Serious Play®	Creativity Research Journal	41
Tuomi, A. (2020b)	Leveraging LEGO® Serious Play® to embrace AI and robots in tourism	Annals of Tourism Research	28
Bibliographic coupling cluster 3: Psychological safety and team cohesion in organizations			
Wheeler, S. (2020)	All to play for: LEGO® Serious Play® and its impact on team cohesion, collaboration and psychological safety in organizational settings using a coaching approach	Journal of Work-Applied Management	23
Quinn, T. (2022)	An exploration into using LEGO® Serious Play® (LSP) within a positive psychology framework in individual coaching: an interpretative phenomenological analysis (IPA)	Coaching	13
Zenk, L. (2021b)	Supporting innovation processes using material artefacts: Comparing the use of LEGO bricks and	Creativity and Innovation Management	9

	moderation cards as boundary objects		
Bibliographic coupling cluster 4: Gamification and active learning in STEM education			
López-Fernández, D. (2021)	LEGO® Serious Play® in software engineering education	IEEE Access	24
Martin-Cruz, N. (2022)	A LEGO® Serious Play® activity to help teamwork skills development amongst business students	International Journal of Research and Method in Education	8
Sońta, M. (2022)	Designing playful employee experience through serious play–reflections from pre-pandemic corporate learning events in Poland	Journal of Work-Applied Management	6
Bibliographic coupling cluster 5: Serious games adoption in management training			
López, F. R. (2021)	Serious games in management education: An acceptance analysis	International Journal of Management Education	64
Dann, S. (2018)	Facilitating co-creation experience in the classroom with LEGO® Serious Play®	Australasian Marketing Journal	39
Hayes, C. (2020)	Understanding the building of professional identities with the LEGO® Serious Play® method using situational mapping and analysis	Higher Education, Skills and Work-Based Learning	12
Bibliographic coupling cluster 6: Reflective practice and healthcare applications			
Peabody, M. A. (2017)	Reflective boot camp: Adapting LEGO® Serious Play® in higher education	Reflective Practice	46
Simon, O. (2020)	Human-robot interaction: Conceptualizing trust in frontline teams through LEGO® Serious Play®	Tourism Management Perspectives	44
Cerezo-Narváez, A. (2019)	Training Competences in Industrial Risk Prevention with LEGO® Serious Play® : A Case Study	Safety	16
Bibliographic coupling cluster 7: Service robotics and social implications			
Kipnis, E. (2022)	Service robots in long-term care: a consumer-centric view	Journal of Service Research	39
Sońta, M. (2023)	"Stop talking about gender:" Toward positive diversity and inclusion experience of female IT professionals in Poland	Equality, Diversity and Inclusion	5
Bibliographic coupling cluster 8: Participatory design for inclusive environments			

McCusker, S. (2020)	Everybody's monkey is important: LEGO® Serious Play® as a methodology for enabling equality of voice within diverse groups	International Journal of Research and Method in Education	40
Hatton, A. L. (2020)	Innovative solutions to enhance safe and green environments for ageing well using co-design through patient and public involvement	Research Involvement and Engagement	8
Bibliographic coupling cluster 9: 3D modeling applications in industrial education			
Deif, A. (2023)	Going from 2D to 3D in supply chain 4.0 education: an LSP approach	International Journal of Industrial Engineering and Operations Management	4
Lear, E. (2020)	Using LEGO® Serious Play® Processes to Build Responsible Professionals	IEEE Global Engineering Education Conference	3
Bibliographic coupling cluster 10: Innovation management through material metaphors			
Zenk, L. (2021a)	Alone but together: flow experience and its impact on creative output in LEGO® Serious Play®	European Journal of Innovation Management	11
Wouters, E. J. M. (2017)	Professionals' views of the sense of home in nursing homes: Findings from LEGO® Serious Play® workshops.	Gerontechnology	9

Note: Column meanings – Author(s) and Year = primary contributor and publication year; Article = study title; Source = journal or conference; Citations = number of citations at time of analysis.
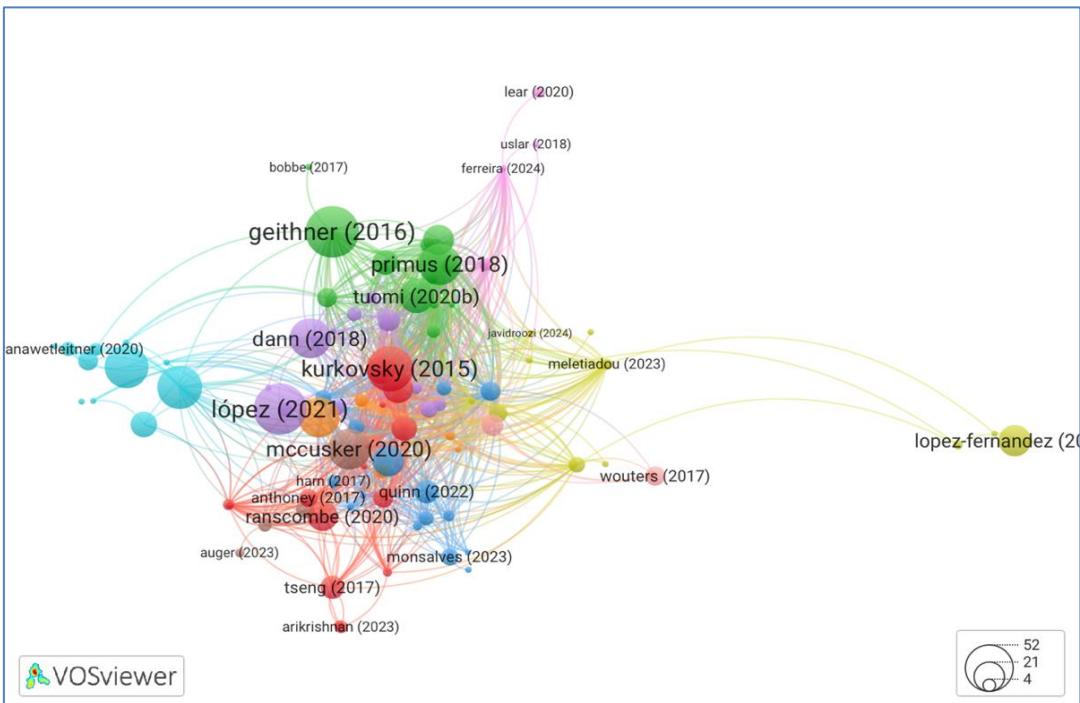
Figure 5: Nomological network of Bibliographic coupling clusters

Cluster 1: Software Engineering Education and Creative Methodologies in Tourism
Kurkovsky (2015) introduced LSP to the field of software engineering as a teaching tool to enable students to make abstract concepts, such as system architecture, concrete. However, the study's validity was limited by its reliance on self-reporting and small sample size (n = 20), and the lack of longitudinal follow-up also constrained impact evaluation. Wenger et al. (2021) extended LSP to the field of tourism to explore host-guest interaction dynamics through the lens of metaphor.

Although the method is based on constructivism, its scalability and cultural adaptability in non-Western contexts remain challenges. Ranscombe et al. (2020) positioned LEGO as a tool in the field of engineering that helps reduce stereotypes; however, the excessive focus on quantity rather than depth, combined with a small sample size (n = 44), limits the reliability of the conclusions. Overall, these studies demonstrate the innovative potential of LSP while also revealing its methodological limitations in terms of generalizability and depth.

Cluster 2: Flow Experience and Collaborative Learning Strategies
In 2016, Geithner and Menzel conducted a study on LSP in project management, highlighting its role in improving self-efficacy and team skills through the "build-share-reflect" cycle. However, the study's transferability to real-world scenarios was limited by the use of an artificially set environment and the lack of a control group. In a 2018 study, Primus and Sonnenburg linked LSP to individual and team flow states and confirmed its correlation with creative output using partial least squares PLS modeling, but this conclusion lacked physiological verification. Tuomi (2020) applied LSP to speculative tourism design to explore the ethical issues of artificial intelligence. Although the study is innovative, it lacks empirical

rigor and the research sample is mainly based on Western groups. All of these studies describe LSP as a factor that promotes flow and collaboration, but they are all limited by issues such as short intervention time and high subjectivity of the data.

Cluster 3: Psychological Safety and Team Cohesion in Organizations
Wheeler et al. (2020) employed importance-performance analysis (IPA) to demonstrate that LSP can mitigate the barriers caused by hierarchy and facilitate the smoother expression of ideas, while also linking tactile games to nervous system responses. Quinn et al. (2022) expanded the application of LSP to the field of personal counseling, emphasizing the importance of emotional safety and introspection, but their research samples lacked diversity. Zenk et al. (2021) compared LSP with adjustment cards and found that LSP had an advantage in engagement; however, they also pointed out that its abstractness may hinder performance. These studies recognize the value of LSP in promoting communication, but also remind people that their role should not be over-generalized in the absence of situational adaptability.

Cluster 4: Gamification and Active Learning in STEM Education
Research by López-Fernández et al. (2021) confirms improved student engagement and a deeper understanding of iteration, but the study was designed in the context of software engineering, and the results were self-reported data only. Martin-Cruz et al. (2022) applied large-scale, open-ended LSP in business classrooms and found that students' collaboration skills improved; however, students also expressed concerns about oversimplification. Sońta (2022) mentioned that, despite some cultural concerns, junior employees' engagement increased in a corporate environment in Poland. Together, these studies validate the alignment of large-scale, open-ended LSP with experiential learning, while also highlighting the need to enhance facilitator capabilities and cultivate cultural awareness.

Cluster 5: Facilitating Co-Creation and Reflective Learning in Educational Contexts
Dann (2018) demonstrated that LSP can serve as a bridge between industry and academia by fostering creativity and promoting shared understanding. Rodríguez López et al. (2021) found that performance expectations were a key factor influencing people's acceptance of this approach. Hayes & Graham (2020) explained how metaphorical narratives help nursing students engage in critical introspection. While these studies recognize the potential of LSP in participatory and reflective learning, they also point out the challenges in balancing freedom of exploration with structured learning outcomes, especially in cross-cultural contexts. Dann (2018) also specifically mentioned that there is a structural contradiction between the open-source concept of LSP and the academic community's demand for quantification.

Cluster 6: Interdisciplinary Applications in Professional Training and Risk Management
Simon et al. (2020) studied trust building in human-robot collaboration and identified robot performance and distance as key influencing factors. Peabody & Noyes (2017) applied LSP to occupational therapy and found that despite initial hesitation, participants' self-awareness and cohesion improved. Cerezo-Narváez

et al. (2019) applied LSP to industrial risk training and found that participants' hazard identification and decision-making abilities were enhanced. However, they also pointed out that the facilitator's ability is a key variable. These studies not only affirm the transformative potential of LSP in various disciplines, but also emphasize the importance of contextual adaptation and structured guidance.

Cluster 7: Reflective practice and healthcare applications
Kipnis et al. (2022) explored people's perceptions of service robots in long-term care. Although their study was not centered on LSP, the findings align with LSP's emphasis on embodied narratives. Sońta (2023) used LSP to study the gendered experiences of information technology professionals in Poland, revealing hidden labor and structural inequalities. LSP made underlying power dynamics visible through symbolic modeling. Both studies acknowledge the role of LSP in tapping marginalized perspectives, but also point out that broader empirical support is needed in such applications.

Cluster 8: Service robotics and social implications
McCaskell (2020) highlighted the ability of LSP to balance the discourses of different stakeholders, allowing a variety of perspectives to be presented in metaphorical and embodied forms. Hatton et al. (2020) demonstrated the role of LSP in age-friendly design workshops, revealing the actual needs of the elderly. Although both studies reflect the advantages of LSP in terms of participation, it is difficult to conclude its long-term effectiveness due to the short-term design. However, these studies still confirm the multiple values of LSP in collaborative public participation, especially in the context of design equity and stakeholder inclusion.

Cluster 9: Participatory design for inclusive environments
Lear et al. (2020) applied LSP to engineering and computer science courses, demonstrating that this approach was effective in improving students' ethical reasoning and teamwork. Deif (2023) compared two-dimensional learning with three-dimensional learning in Supply Chain 4.0 and found that LSP could enhance learners' confidence and systems thinking skills. Although these findings are promising, both studies suffer from the lack of control groups and insufficient generalizability. However, their findings indicate that LSP has the potential to cultivate systems literacy and design creativity in the field of technology, particularly when addressing abstract or complex problems.

Cluster 10: Innovation management through material metaphors
Wouters & van Hoof (2017) utilised LSP in nursing homes to explore emotional concepts such as privacy and belonging. Zenk et al. (2022) conducted a quasi-experiment comparing LSP with traditional meetings and found that the former enhanced emotional engagement and creative output. The former study provided descriptive insights, while the latter pursued experimental rigor. Both studies reinforced the role of LSP in connecting emotion and cognition, but they also emphasized the need for skilled facilitators to guide to avoid superficial results.

Together, these ten research clusters demonstrate the broad prospects of LSP in multi-dimensional applications, and related studies have also confirmed that this

strategy has practical application value in many fields such as engineering, ethics, health, and design. Although the disciplinary backgrounds of these studies vary, they generally share common problems, including small sample sizes, subjective evaluation criteria, and limited scalability. These situations demonstrate the need for research conducted with rigorous methods that consider diverse contexts, thereby further verifying and enhancing the application value of LSP across various fields.

4.3 Integrating Structures and Meanings: A Triangulation

Building upon the co-citation, keyword co-occurrence, and bibliographic coupling analyses, this triangulated synthesis draws from the consolidated mapping in Table 7 to illuminate how conceptual themes, methodological commitments, and disciplinary orientations coalesce in LSP research. This integration reveals not only where thematic and textual clusters intersect but also how they diverge in their theoretical anchoring and real-world applications. This layered reading reveals zones of epistemological convergence, methodological synergy, and underexplored frontiers that warrant further scholarly investigation.

Table 7: Mapping of clusters of research and implications for theory and practice

K-C	B-C	R-T	K-O	F-M-C	T-I	M-I	P-I
Cluster 1	Cluster 1 Cluster 8	Direct methodology alignment	LEGO® Serious Play, co-design in education	Integration of LEGO methods in technical education (e.g., Kurkovsky, 2015) and participatory design (McCusker, 2020)	Supports constructionist learning theory and iterative design frameworks	Enhances cross-disciplinary collaboration in curriculum development	Promotes inclusive education policies and STEM funding
Cluster 2	Cluster 3 Cluster 7	Cross-domain application	Psychological safety, human-robot trust modeling	Psychological safety in teams (Wheeler, 2020) and robotics ethics (Kipnis, 2022)	Links positive psychology to human-AI interaction models	Improves team resilience training and AI ethics guidelines	Informs labor policies for AI integration and workplace safety

Cluster 3	Cluster 4 Cluster 5	Pedagogical reinforcement	Game-based learning, serious games	Active learning in STEM (López-Fernández, 2021) and management training (López, 2021)	Validates gamification as a universal engagement tool across disciplines	Guides training program design for skill development	Supports digital literacy initiatives in education and corporate sectors
Cluster 4	Cluster 2	Conceptual synergy	Co-creation, flow experience in creativity	Flow theory in creativity (Primus, 2018) and material metaphors for innovation (Zenk, 2021a)	Bridges constructionism with flow theory for creative problem-solving	Facilitates innovation workshops and design thinking processes	Encourages public-private partnerships in R&D and innovation hubs
Cluster 5	Cluster 5 Cluster 8	Methodological integration	Participatory design, identity formation	Professional identity building (Hayes, 2020) and inclusive co-design (McCusker, 2020)	Strengthens social constructivism in higher education	Optimizes stakeholder engagement in institutional reforms	Aligns with equity-focused education policies and diversity initiatives
Cluster 6	Cluster 9 Cluster 10	Applied gamification	Playful learning, reflective practice	Gamification in STEM (López-Fernández, 2021) and reflective healthcare training	Reinforces play theory in adult learning and professional development	Enhances training effectiveness through gamified simulations	Supports lifelong learning policies and healthcare workforce development

				(Peabody, 2017)			
No Direct Thematic Correspondence	Cluster 9 Cluster 10	Unmapped/ Partial overlap	Missing keywords: "3D modeling," "gender inclusivity," "material metaphors"	Emerging applications in industrial education (Deif, 2023) and metaphorical innovation (Zenk, 2021a)	Highlights gaps in keyword coverage for technical education and metaphorical design	Suggests expanding LEGO® methods to industrial training and material-driven innovation	Calls for policy attention to vocational education and innovation funding

Note: Codes represent analysis dimensions – K-C = Keyword Cluster; B-C = Bibliographic Coupling Cluster; R-T = Research Theme; K-O = Knowledge Orientation; F-M-C = Framework/Methodological Contribution; T-I = Theoretical Implication; M-I = Managerial Implication; P-I = Policy Implication.

The convergence between co-design and constructionist learning emerges as a dominant axis across all three analytical streams. In keyword co-occurrence cluster 1, terms such as "collaborative design," "pedagogical innovation," and "student-centered learning" appear frequently, mirroring the bibliographic coupling cluster focused on LSP in software engineering education (Kurkovsky, 2015). Theoretical foundations in constructionism reinforce these thematic overlaps (Papert & Harel, 1991) and flow theory (Csikszentmihalyi, 1990), both of which are also central in co-citation cluster 1.

Table 7 explicitly maps this alignment as a "direct methodology correspondence," suggesting a mature and theoretically consistent application of LSP in STEM and design-oriented educational contexts. However, while these overlaps affirm the utility of LSP in fostering reflective and collaborative learning, the saturation of similar pedagogical studies raises concerns about conceptual redundancy and insufficient theoretical diversification.

Another cross-cutting dimension arises at the intersection of psychological safety, team dynamics, and human–robot interaction. Keyword cluster 2 foregrounds terms such as "psychological safety," "trust," and "human-robot collaboration," which align closely with bibliographic coupling cluster 3, where works like Wheeler et al. (2020) and Kipnis et al. (2022) explore how LSP can mediate interpersonal perceptions in technologically mediated or emotionally sensitive environments.

These studies are also mapped in Table 7 as "cross-domain applications," indicating that LSP is increasingly appropriated outside traditional pedagogical settings. Notably, while the theoretical implications are diverse, ranging from

positive psychology to affective computing, the methodological consistency remains tenuous. Most studies in this domain adopt short-term interventions with limited generalizability, raising questions about the scalability and empirical robustness of LSP in complex socio-technical environments. Triangulation also surfaces critical insights regarding the dual role of LSP in both expressive and diagnostic modalities. For instance, bibliographic coupling cluster 8 and keyword cluster 4 emphasize the metaphorical and narrative dimensions of LSP in therapeutic, inclusive, and organizational contexts. McCusker (2020) and Wouters & van Hoof (2017) show how LSP fosters equality of voice and co-constructed meaning in workshops aimed at marginalized groups.

These findings are echoed in Table 7, under themes such as "emotional engagement," "identity construction," and "symbolic participation," indicating a conceptual shift from LSP as a pedagogical tool to LSP as a dialogic and affective interface. This expansion, while promising, is not without critique. Many studies rely heavily on facilitator interpretation, introducing subjectivity and potentially undermining the replicability of insights derived from LSP activities. Lastly, the synthesis reveals an asymmetry in the policy and managerial implications drawn from LSP studies. While bibliographic coupling clusters related to STEM education and organizational change yield well-articulated recommendations for curriculum design and leadership training (Kristiansen & Rasmussen, 2014; Lear et al., 2020), clusters focused on affective or expressive uses of LSP offer limited translation into systemic change.

Table 7 highlights this gap by juxtaposing clusters with "well-defined managerial implications" against those where implications remain speculative or abstract. This discrepancy underscores the need for future LSP research to move beyond small-scale, introspective studies and engage more systematically with institutional structures, especially in policy-sensitive fields such as healthcare, aging, and diversity training. In total, this triangulated mapping validates the multi-functionality of LSP across pedagogical, organizational, and affective domains, but it also reveals fragmentations in methodological rigor, theoretical extension, and translational outcomes. The interplay between structured keyword patterns, bibliographic linkages, and theoretical scaffolds offers a nuanced map of the field's current strengths and latent potential, setting the stage for more integrative and critically engaged scholarship on LSP.

4.4 Unveiling the Future: Strategic Themes and Predictive Trajectories
As the final layer of bibliometric sensemaking, the thematic evolution map in Figure 6 provides critical insight into the intellectual maturity, disciplinary centrality, and developmental momentum of themes associated with LSP research. Situated along axes of relevance (centrality) and development (density), the quadrant analysis offers a foresight-driven lens into which themes are shaping the core of the field, which are specialized or emergent, and which are in potential decline. This visualization functions not only as a snapshot of the current landscape but as a cartographic guide for future inquiry.

Positioned in the upper-right quadrant, motor themes such as "students," "teaching," and "serious play" reflect the field's most developed and central areas. These themes form the backbone of educational LSP scholarship, integrating pedagogical theory, classroom-based interventions, and design-based learning outcomes. Their strong internal cohesion and external linkage suggest a high degree of conceptual maturity; yet, the clustering around conventional settings, such as "education" and "classroom," also signals a degree of saturation. To remain dynamic, future research must expand these constructs into less traditional domains such as informal learning environments, cross-cultural pedagogy, and digital facilitation models.

In contrast, basic themes such as "creativity," "experience," and "work," while broadly connected to the field, exhibit lower density, suggesting that they are underdeveloped despite their conceptual relevance. This misalignment presents a critical opportunity. Although creativity is frequently referenced in LSP-related work (McCusker, 2020; Zenk et al., 2022), few studies rigorously operationalize it or differentiate between types (e.g., divergent vs. convergent) or levels (e.g., individual, group, organizational). Similarly, terms like "experience" and "work" hint at rich affective and organizational layers of LSP that remain superficially explored. Future research should thus interrogate the nuances of creative processes in LSP and examine its intersection with labor studies, emotional design, and professional identity formation.

Niche themes, such as "barriers," "care," and "children," occupy the upper-left quadrant, representing a cluster of topics that are highly specialized, have high internal research density, but are weakly related to the core concepts of the field. These topics often focus on vulnerable groups or ethically sensitive situations. For example, Wouters & van Hoof (2017) confirmed the unique effectiveness of LSP in stimulating deep emotional narratives in elderly care scenarios. However, such research remains rare and exhibits distinct, isolated characteristics. The challenge here is not just to expand the presence of these topics, but to weave them into mainstream theoretical and methodological dialogues. Doing so would elevate their status from niche to foundational, particularly as LSP is increasingly deployed in public health, therapeutic, and inclusive design contexts.

The bottom-left quadrant, representing emerging or declining themes, contains concepts such as "people," "community," and "management." Their low centrality and density suggest that, while these topics are peripheral today, they may signal either a fading relevance or untapped potential. Given the increasing global emphasis on participatory governance, citizen design, and community-based learning, it seems more plausible that these themes are emergent rather than obsolete. Their weak bibliometric footprint likely reflects a lag in formal publication rather than conceptual stagnation. Encouragingly, these terms suggest future directions for embedding LSP in civic innovation, public administration, and bottom-up systems thinking, areas that have been minimally addressed in the literature so far.

Overall, Figure 6 enables a critical synthesis of LSP's present and future trajectories. They show that while educational applications remain dominant, the conceptual terrain is far from exhausted. There is clear potential for cross-pollination between mature pedagogical frameworks and emerging discourses in emotional design, organizational sensemaking, and community co-creation. The next phase of LSP research must not only refine existing knowledge but also venture into interdisciplinary territories where its metaphorical and material affordances can generate novel epistemic contributions.
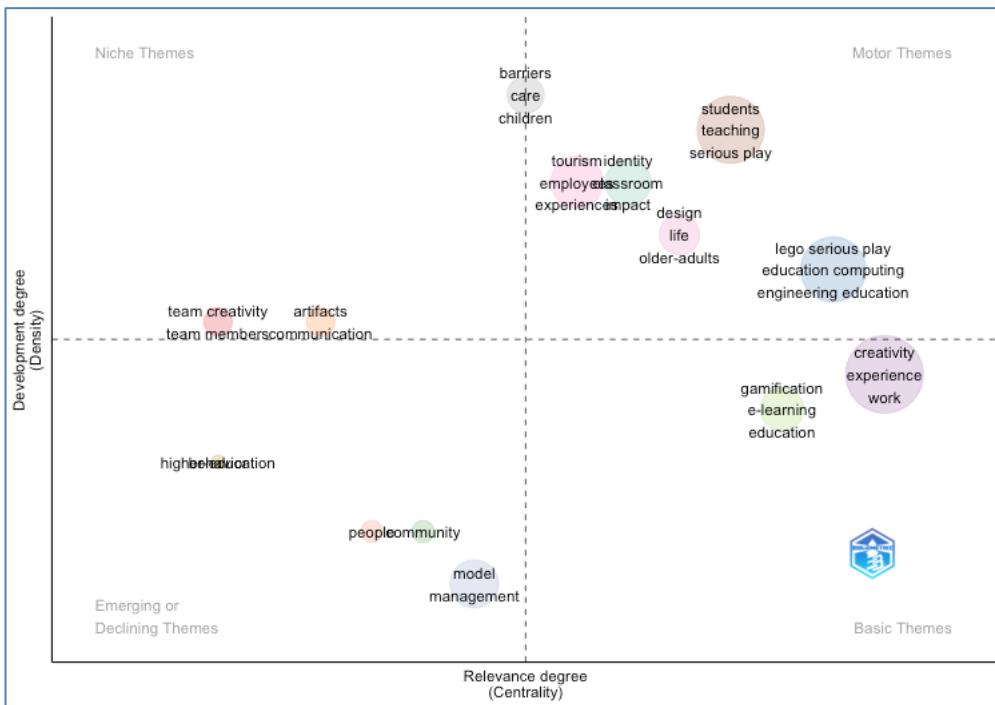
Figure 6: Thematic trends of LSP research

Table 8 presents a summary of the key findings. The critical stance adopted in this study is not intended to diminish the importance of existing studies, but rather to highlight where future work can build upon their insights. By identifying these recurring limitations, this study provides a constructive agenda for researchers to address gaps in theory, method and geographic representation.

Table 8: Summary of the key findings

Research Question	Key Findings
RQ1	LSP research evolved from early validation (2015–2017) to diverse interdisciplinary applications (2018–2025).
RQ2	Emerging frontiers include human–robot interaction, inclusivity, and gamification frameworks.
RQ3	Methodological inconsistencies persist, with heavy reliance on small samples and Western contexts.
RQ4	Cross-disciplinary opportunities lie in digital facilitation, healthcare resilience training, and inclusive design.

5. Conclusion

This bibliometric study maps the development of LSP research over the past two decades, showing its strong foundations in constructivist learning, flow psychology, and creative facilitation while highlighting both its achievements and limitations. The analyses of co-citation, keyword co-occurrence, and bibliographic coupling reveal that LSP has been widely applied in education and organizational change, yet its growth remains fragmented and overly reliant on traditional theories. This bibliometric study has both practical and theoretical implications. The findings suggest that educators and practitioners should move beyond traditional theories and adopt more rigorous, comparative methods to explore emerging themes like gamification and inclusivity, thereby strengthening the empirical foundation of LSP. They should also explore cross-cultural applications to foster creativity and resilience across diverse contexts.

Summarizing this study, this bibliometric study relies on the comprehensive coverage of Scopus and Web of Science, ensuring that its analysis is rooted in a credible and transparent academic base. At the same time, by critically appraising the weaknesses of the cited literature, its theoretical saturation, methodological fragmentation, and Western bias, this study positions itself as a bridge between established knowledge and future directions. Recognizing these limitations is not self-critical but constructive, offering future scholars a roadmap to expand the LSP research agenda through more inclusive, rigorous, and globally representative contributions.

6. Theoretical and Practical Contributions

Theoretically, this study enriches constructivist and flow-based perspectives by demonstrating their continued dominance, while also pointing to saturation, which highlights the need for theoretical innovation. Practically, the findings underscore the importance of cross-disciplinary collaboration, improved facilitator training, and integration of LSP into digital and inclusive learning environments. Together, these contributions provide a roadmap for researchers and practitioners to extend the relevance and rigor of LSP applications.

7. Data availability, Conflict of interest, Ethical statements and Author contributions

Data availability: All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflict of interests: The author(s) declare no competing interests.

Ethical statements: Ethics approval is not required.

Author contributions: All authors contributed to the development of this manuscript. Author 1 conceptualized the study, designed the methodology, and led the writing process. Authors 2 and 3 contributed to data collection, analysis, and interpretation. Author 4 supported the literature review and data visualization. Author 5 was involved in reviewing and editing the manuscript. Authors 6 and 7 provided general academic support and reviewed the final draft. All authors read and approved the final manuscript.

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