

Instructional Designers and Generative AI: A Bibliometric Mapping And Systematic Review of Adoption, Role Transformation, And Entrepreneurial Integration

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Abstract

Generative artificial intelligence (AI) is reshaping instructional design practice across higher education, adult learning, and digital pedagogy. Yet evidence on how instructional designers adopt AI tools, how their roles change, and how they integrate AI strategically remains fragmented across multiple literatures. This paper uses a two-stage review design that combines bibliometric mapping with a systematic review. A VOSviewer co-occurrence analysis of 1,411 deduplicated records from six databases identified five thematic clusters. Guided by this map, a PRISMA-informed review synthesized 65 studies published between 2018 and 2026. Thematic synthesis showed that AI adoption is shaped by organizational readiness, technical usability, and cultural-professional norms; that AI shifts instructional designers from production-oriented tasks toward strategic, evaluative, and collaborative functions; and those entrepreneurial behaviors such as experimentation, adaptability, and calculated risk-taking facilitate strategic integration. The paper proposes a socio-technical and intrapreneurial framework for understanding AI in instructional design and offers implications for learning sciences research.

Introduction

Artificial intelligence (AI) is increasingly shaping the design and delivery of learning environments, particularly within higher education and adult learning contexts. Within the learning sciences, however, the integration of AI remains unevenly conceptualized, often treated as a technological enhancement rather than as a socio-technical and collaborative phenomenon. Research in computer-supported collaborative learning emphasizes that learning emerges through interactions among learners, tools, and institutional structures, rather than through technology alone (Chen et al., 2022; Guan et al., 2024). This perspective highlights the need to examine AI not only as a tool, but as part of a broader system that mediates collaboration, instructional design, and learning processes.

Recent developments in generative AI, including systems such as ChatGPT and AI-based learning assistants, have intensified interest in how instructional design practices are evolving. These technologies are increasingly embedded within collaborative learning environments, where they support communication, feedback, and knowledge construction (Weng & Chiu, 2023; Weng et al., 2024).

Despite growing interest, the literature remains fragmented across domains such as educational technology, instructional design, and innovation studies. Few studies provide a comprehensive synthesis of how AI adoption, workflow transformation, and entrepreneurial practices intersect within instructional design. Addressing this gap is critical for advancing a learning sciences perspective that accounts for collaboration, organizational mediation, and adaptive innovation.

This study responds to this need by combining bibliometric mapping and systematic review methods to examine AI integration in instructional design. By situating AI within a socio-technical and collaborative framework, the study aims to contribute to a more integrated understanding of how learning systems evolve in response to emerging technologies.

Three research questions guide the review:

RQ1: What organizational, technical, and cultural factors influence the adoption or resistance of instructional designers toward AI tools in their workflows?

RQ2: How does the integration of AI tools transform the roles, responsibilities, and collaboration dynamics of instructional designers within their teams and organizations?

RQ3: How can entrepreneurial principles such as innovation, risk-taking, and adaptability facilitate the strategic integration of AI in instructional design workflows?

By addressing these questions, the study contributes to the learning sciences in three ways. First, it centers instructional designers as consequential actors in AI-mediated learning environments. Second, it connects AI adoption to socio-technical and organizational processes rather than treating it as a purely technical question. Third, it introduces an intrapreneurial lens that helps explain why some practitioners move from awareness to strategic experimentation and integration.

Conceptual framing

This review is grounded in an integrative conceptual framework that brings together socio-technical systems theory, professional role theory, and entrepreneurial/intrapreneurial perspectives to explain the complexity of artificial intelligence (AI) integration in educational contexts. These complementary lenses provide a multidimensional understanding of how technological, organizational, and human factors interact to shape adoption and practice.

From a socio-technical systems perspective, AI integration is understood as an outcome of the interaction between technological capabilities and the social environments in which they are embedded. The literature consistently demonstrates that AI tools do not operate in isolation; rather, their effectiveness depends on alignment with institutional policies, instructional workflows, professional norms, and organizational support structures (Chen et al., 2020; Kamalov et al., 2023). Studies on digital transformation further highlight that successful implementation requires coordination across multiple system components, including leadership strategies, infrastructure, and stakeholder engagement (Hashim et al., 2021; Langseth et al., 2022; Dahri et al., 2024).

Professional role theory offers a second lens for understanding how AI reshapes instructional design practice. Research indicates that while AI can automate or accelerate routine functions, it simultaneously elevates the importance of higher-order activities such as evaluation, quality assurance, ethical oversight, and strategic consultation (Bolick & Da Silva, 2023; Parsons & Curry, 2023). As a result, instructional designers are transitioning from content developers to system orchestrators, responsible for ensuring coherence across pedagogical, technological, and institutional dimensions (Baran et al., 2023; Weng & Chiu, 2023). This transformation reflects a reconfiguration of professional identity and practice in response to emerging technological affordances (Kraiger & Ford, 2020; Uzorka et al., 2021).

A third conceptual lens is provided by entrepreneurial and intrapreneurial theory, which helps explain how individuals navigate uncertainty and drive innovation within organizational settings. The literature on entrepreneurial mindset and intrapreneurship emphasizes key constructs such as opportunity recognition, experimentation, adaptability, and calculated risk-taking (Daspit et al., 2021; Hernández-Perlines et al., 2022). These concepts are particularly relevant in the context of AI integration, where implementation rarely follows predetermined pathways. Instead, educators and instructional designers often engage in iterative processes of testing, refinement, and contextual adaptation (Larsen, 2022; Rosenow-Gerhard, 2020). Empirical studies further suggest that successful integration depends on practitioners' ability to identify meaningful applications of AI, experiment within bounded environments, and scale effective practices over time (Ohlert et al., 2024; Reim et al., 2020). In this regard, instructional designers can be conceptualized as institutional intrapreneurs who operate within existing structures while simultaneously introducing innovative practices (Langseth et al., 2023; Zhao et al., 2021).

Together, these three lenses frame AI integration as a socio-technical, professional, and strategic process rather than a linear technology-adoption event.

Method

Overall design

Caption: Two-stage review design linking bibliometric mapping of 1,411 deduplicated records to PRISMA screening and thematic synthesis of 65 included studies

This study employed a two-phase research design that integrated bibliometric analysis with a systematic literature review (see Fig. 1) to provide both breadth and depth in examining artificial intelligence (AI) integration in educational contexts. This combined approach aligns with established methodological practices in review research, where large-scale mapping techniques are used to identify patterns in the literature (Kamalov et al., 2023; Rashid & Kausik, 2024), followed by focused synthesis to generate deeper conceptual insights (Chen et al., 2020; Ayotunde et al., 2023).

In the first phase, bibliometric mapping was used to analyze a broad corpus of scholarly publications, enabling the identification of dominant research trends, keyword co-occurrences, and thematic relationships across the field. This stage provided a macro-level perspective, highlighting the most influential topics and guiding the selection of focal areas for deeper investigation.

The second phase consisted of a systematic literature review of a curated subset of studies that were directly aligned with the research questions. This phase involved structured data extraction, thematic coding, and cross-study comparison to synthesize findings related to AI adoption, role transformation, and entrepreneurial integration. The systematic approach ensured methodological rigor, transparency, and replicability, consistent with best practices in qualitative and mixed methods review research (Alam, 2020; Prosek & Gibson, 2021; Schlunegger et al., 2024).

The sequencing of these two phases reflects a complementary logic, in which bibliometric mapping informs and strengthens the subsequent systematic synthesis. By first establishing a broad overview of the field and then focusing on a targeted set of studies, the design enables both comprehensive coverage and analytical depth. This approach is particularly appropriate for complex and interdisciplinary topics, where understanding both the structure and substance of the literature is essential (Takahashi & Araujo, 2019; Shrestha & Sharma, 2024).

Data sources and search strategy

To ensure comprehensive coverage of the interdisciplinary landscape surrounding artificial intelligence (AI) integration in education, this study employed a multi-database search strategy targeting both educational and innovation-focused scholarship. Searches were conducted across six major academic databases: ProQuest ERIC, Scopus, AISO, EBSCOhost, ProQuest Education, and ProQuest Entrepreneurship. These databases were intentionally selected to capture the convergence of instructional design, educational technology, AI, digital transformation, and entrepreneurial practices, reflecting the multi-dimensional nature of the research problem (Chen et al., 2020; Kamalov et al., 2023).

The search strategy was guided by principles of systematic review design, emphasizing transparency, reproducibility, and conceptual alignment with the research questions (Prosek & Gibson, 2021; Shrestha & Sharma, 2024). To this end, the search was limited to peer-reviewed, English-language publications produced between 2018 and 2026, a period corresponding to the rapid expansion of AI applications in education, particularly the emergence of generative AI technologies (Rashid & Kausik, 2024).

A structured query was developed using four interconnected concept blocks: (1) instructional design roles, (2) artificial intelligence technologies, (3) adoption and workflow processes, and (4) entrepreneurial and adaptive behaviors. These blocks were combined using Boolean operators to ensure both breadth and specificity, as follows:

("instructional designer" OR "learning designer" OR "instructional design")

AND ("generative AI" OR "artificial intelligence" OR ChatGPT OR "AI tools")

AND (adoption OR resistance OR workflow OR integration OR collaboration)

AND (innovation OR adaptability OR "risk-taking")

This multi-layered search structure reflects established practices in systematic literature reviews, where concept-based query design is used to capture complex phenomena spanning multiple domains (Ayotunde et al., 2023; Alam, 2020). The inclusion of both technological and behavioral terms ensured that the search captured not only studies focused on AI tools but also those addressing organizational, pedagogical, and strategic dimensions of integration.

The initial search yielded 1,482 records, which were subsequently screened for duplication. After removing 71 duplicate entries, a total of 1,411 unique records remained. This dataset formed the foundation for both the bibliometric analysis and the systematic review process, enabling the identification of thematic patterns and the selection of studies for in-depth synthesis. The resulting corpus was used to generate the VOSviewer co-occurrence map (see Fig. 2) and to support the PRISMA-guided screening and selection pipeline (see Fig. 3), ensuring methodological rigor and traceability throughout the review process (Takahashi & Araujo, 2019; Schlunegger et al., 2024).

Bibliometric Procedures

The bibliometric phase of this study provided the empirical foundation for identifying dominant themes and structural relationships within the literature on artificial intelligence (AI) in education. This stage relied on keyword co-occurrence analysis and network visualization using VOSviewer (see Fig. 2), a widely recognized tool for mapping scientific knowledge domains and uncovering latent thematic structures (Chen et al., 2020; Ayotunde et al., 2023). By examining the frequency and co-occurrence of keywords across the dataset, the analysis enabled the identification of conceptual clusters as showed in table 1 that informed the subsequent systematic synthesis.

The resulting VOSviewer network map identified five distinct yet interconnected clusters, each representing a thematic concentration within the literature. These clusters were interpreted qualitatively to capture their conceptual significance and were subsequently used to guide the organization of the systematic review. This approach reflects established practices in bibliometric research, where quantitative mapping is combined with qualitative interpretation to generate meaningful insights into the structure of a research field (Takahashi & Araujo, 2019; Schlunegger et al., 2024).

Systematic Review Procedures

Screening and Selection Process

The systematic review phase followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to ensure transparency, rigor, and replicability in study selection (see Fig. 3). This approach is widely recognized as a standard for structuring systematic reviews across interdisciplinary research domains (Prosek & Gibson, 2021; Schlunegger et al., 2024). The screening process was conducted in multiple stages, beginning with title and abstract review and followed by full-text evaluation.

Inclusion criteria were carefully designed to align with the research objectives and to capture studies situated at the intersection of instructional design and artificial intelligence. Specifically, studies were retained if they: (a) focused on instructional designers, learning designers, educational developers, or closely related instructional design roles and workflows; (b) examined generative AI, artificial

intelligence, or AI-enabled tools; and (c) addressed at least one of the following dimensions: adoption, resistance, workflow transformation, role change, collaboration, or entrepreneurial integration. This targeted approach ensured that the selected studies were directly relevant to both the professional and organizational dimensions of AI integration (Ayotunde et al., 2023; Weng & Chiu, 2023).

Studies were excluded if they addressed AI in education only at a highly general or conceptual level without connection to instructional design practice, or if they lacked sufficient empirical or conceptual depth to support thematic coding. This exclusion criterion was particularly important given the rapid expansion of AI-related publications, many of which provide broad overviews without offering actionable insights into practice (Kamalov et al., 2023; Rashid & Kausik, 2024). Following the screening process, 1,346 records were excluded, resulting in a final sample of 65 full-text studies for in-depth analysis. This selection process ensured both relevance and analytical depth, consistent with best practices in systematic review methodology (Takahashi & Araujo, 2019).

Data Extraction and Coding

Data extraction was conducted using a structured thematic extraction table, which served as the primary coding framework at the author level. The use of structured extraction tools is a well-established practice in qualitative and mixed-methods research, enabling systematic comparison across studies while preserving contextual detail (Alam, 2020; Miller et al., 2023). The extraction table included the following fields: author and year, study purpose, adoption factors and barriers, role and workflow transformations, and entrepreneurial or strategic behaviors.

By maintaining author-level distinctions, the extraction process supported both aggregate thematic synthesis and detailed cross-study comparison, allowing for nuanced interpretation of patterns across diverse contexts. This approach also facilitated the integration of findings into manuscript tables and visual representations, enhancing both analytical clarity and reporting transparency (Schlunegger et al., 2024).

The coding process began with open coding, in which key concepts related to AI adoption, workflow transformation, collaboration, and innovation were identified across the dataset. This inductive phase allowed themes to emerge directly from the data, rather than being imposed a priori. Subsequently, these initial codes were grouped into higher-order categories aligned with the three research questions, enabling a structured and theory-informed synthesis (Prosek & Gibson, 2021; Shrestha & Sharma, 2024).

Quality and Synthesis Approach

Given the diversity of study types included in the review—encompassing empirical, conceptual, and review-based research—a qualitative synthesis approach was adopted. Rather than relying on statistical aggregation, the analysis emphasized thematic consistency, conceptual relevance, and explanatory contribution to the research questions. This approach is particularly appropriate for interdisciplinary

fields, where heterogeneity in methods and contexts limits the applicability of purely quantitative synthesis techniques (Chen et al., 2020; Ayotunde et al., 2023).

The synthesis process involved iterative comparison across studies to identify recurring patterns and relationships, followed by the development of integrative themes that captured the underlying dynamics of AI integration. This process aligns with established practices in systematic narrative synthesis, which prioritize depth of understanding and conceptual clarity over numerical generalization (Prosek & Gibson, 2021).

Importantly, the analysis maintained a balance between descriptive accuracy and interpretive insight, ensuring that themes were grounded in the data while also contributing to broader theoretical development. This dual focus enabled the study to move beyond simple categorization toward a more comprehensive understanding of how institutional conditions, professional practices, and entrepreneurial behaviors interact to shape AI integration in educational contexts.

Results

Bibliometric Results

The bibliometric analysis, conducted using VOSviewer, revealed a structured network of five interrelated thematic clusters (see Table 1) that collectively define the intellectual landscape of artificial intelligence (AI) integration in instructional design and educational research. Keyword co-occurrence patterns provided insight into how different domains converge, illustrating that AI-related scholarship is embedded within broader educational, pedagogical, and organizational contexts rather than existing as an isolated field (Chen et al., 2020; Ayotunde et al., 2023).

Caption: VOSviewer keyword co-occurrence map based on 1,411 deduplicated records. Node size reflects keyword frequency and link thickness reflects co-occurrence strength. Five clusters are visible: adult and nontraditional learners (red), AI–instructional design–innovation (green), language learning (yellow), higher education and policy (blue), and methodological/indexing terms (purple)

Table 1
Bibliometric clusters from the VOSviewer analysis

Cluster	Label	Representative keywords
1	Adult and nontraditional learners	adult education; adult students; andragogy; barriers; access to education
2	AI, instructional design, and innovation	artificial intelligence; chatgpt; educational technology; instructional design; entrepreneurs
3	Language learning and computer-assisted instruction	english (second language); second language instruction; feedback; language tests
4	Higher education and policy	higher education; universities; educational policy; educational change
5	Methods and indexing	qualitative research; comparative analysis; correlation; ERIC indexing

Caption: Table presenting the five thematic clusters identified through keyword co-occurrence analysis using VOSviewer. Each cluster represents a distinct area within the research landscape of artificial intelligence (AI) in instructional design and education

Cluster 1: Adult and nontraditional learners in postsecondary and lifelong education

The first cluster, as highlighted in table 1, is centered on concepts related to adult education and nontraditional learner populations, including adult students, adult learning, andragogy, continuing education, and community colleges. The prominence of these terms reflects the strong alignment between AI integration and lifelong learning environments, where flexibility, access, and workforce relevance are critical concerns. Studies within this domain frequently emphasize issues such as educational access, persistence, and barriers to participation, particularly among diverse and underserved populations (Umbar et al., 2024; Wang et al., 2022). The cluster also highlights the importance of designing AI-enabled learning systems that accommodate the needs of adult learners, including self-directed learning and professional upskilling (Lin, 2023).

Cluster 2: Artificial intelligence, educational technology, and instructional design innovation

The second cluster, as underlined in table 1 represents the conceptual core of the present review, bringing together key terms such as artificial intelligence, ChatGPT, educational technology, instructional design, learner engagement, teaching methods, and entrepreneurship. This cluster illustrates that AI is not treated as a standalone technological development but rather as part of an integrated system involving pedagogical design, innovation processes, and organizational change (Bolick & Da Silva, 2023; Kamalov et al., 2023). The inclusion of terms related to qualitative research and case studies further indicates that much of the work in this area is exploratory and practice-oriented, focusing on how AI

tools are implemented and adapted within real-world contexts (Parsons & Curry, 2023; Weng et al., 2024). The presence of entrepreneurship-related terms underscores the growing recognition of innovation and intrapreneurial behavior as key drivers of AI adoption in educational settings (Daspit et al., 2021; Hernández-Perlines et al., 2022).

Cluster 3: Language learning and computer-assisted language instruction

The third cluster, as underscored in table 1, highlights the significance of language education as a major application domain for AI-enabled instructional design. Key terms include English as a second language, second language instruction, language proficiency, language testing, and computer-assisted instruction. This cluster reflects the long-standing integration of technology in language learning, which has been further accelerated by the introduction of AI tools capable of providing personalized feedback, adaptive learning experiences, and automated assessment (Weng & Chiu, 2023; Guan et al., 2024). The prominence of feedback-related terms indicates the importance of formative assessment and learner interaction in AI-supported language environments. Overall, this cluster demonstrates that language education serves as a fertile ground for experimenting with and scaling AI-driven instructional innovations.

Cluster 4: Higher education, outcomes, and policy contexts

The fourth cluster, demonstrated in table 1, situates AI integration within the broader framework of institutional governance, policy, and educational outcomes. It includes terms such as higher education, universities, academic achievement, educational policy, and educational change. This cluster underscores the role of institutional structures in shaping the adoption and impact of AI technologies, highlighting the importance of aligning technological initiatives with strategic priorities and performance metrics (Hashim et al., 2021; Hannan & Liu, 2021). Research within this domain often focuses on the implications of AI for student outcomes, including learning performance, engagement, and self-efficacy (Wang et al., 2022; Chen et al., 2022). The presence of policy-related terms further indicates that AI integration is closely linked to issues of governance, regulation, and institutional change, reinforcing the need for coordinated strategies at the organizational level.

Cluster 5: Methodological and indexing infrastructure

The fifth cluster, showed in table 1, consists of methodological and indexing-related terms, including qualitative research, comparative analysis, correlation, and ERIC indexing labels. While smaller in scope, this cluster reflects the methodological diversity and research infrastructure supporting the field. The prominence of qualitative and case-based approaches suggests a focus on in-depth exploration of complex phenomena, consistent with the emerging and interdisciplinary nature of AI in education (Alam, 2020; Prosek & Gibson, 2021). This cluster also highlights the role of standardized indexing systems in shaping the visibility and categorization of research topics.

Taken together, the five clusters demonstrate that AI-enabled instructional design is deeply embedded within a multifaceted educational ecosystem, encompassing adult learning, language education, institutional policy, and innovation processes. This finding supports the view of AI as a socio-technical phenomenon that intersects with pedagogy, organizational strategy, and professional practice (Kamalov et al., 2023; Rashid & Kausik, 2024). The bibliometric analysis therefore provided a strong empirical justification for focusing the systematic review on the central intersection of AI, instructional design, and innovation, while remaining attentive to adjacent domains that shape its application and impact.

PRISMA Screening Results

The study selection process followed a structured PRISMA-guided screening protocol (see Fig. 3), ensuring transparency and methodological rigor in narrowing the corpus of literature. From an initial pool of 1,482 records, a total of 71 duplicate entries were identified and removed, resulting in 1,411 unique records subjected to title and abstract screening. This phase led to the exclusion of 1,346 records that did not meet the predefined inclusion criteria, primarily due to limited relevance to instructional design practice or insufficient focus on artificial intelligence (AI) integration. The final sample consisted of 65 full-text studies, which were retained for in-depth analysis and thematic synthesis.

This systematic reduction reflects a deliberate effort to balance comprehensiveness with analytical relevance, a key principle in systematic review methodology (Prosek & Gibson, 2021; Schlunegger et al., 2024). The PRISMA framework facilitated a transparent and replicable screening process, enabling the identification of studies that provide substantive contributions to understanding AI adoption, workflow transformation, and entrepreneurial integration in educational contexts (Takahashi & Araujo, 2019).

Caption: PRISMA flow diagram summarizing identification, screening, eligibility, and inclusion for the 65-study systematic review

Characteristics of the Included Studies

The 65 selected studies represent a diverse yet thematically coherent body of research, with a strong concentration in higher education, adult learning, online and blended learning environments, and instructional design workflow contexts. This distribution reflects the central role of postsecondary and professional learning settings as key sites for AI experimentation and implementation, consistent with broader trends in educational technology research (Chen et al., 2020; Ayotunde et al., 2023).

Across the dataset, a range of AI applications was identified, illustrating the breadth of technological approaches currently shaping instructional design practice. Prominent focal points included generative AI tools such as ChatGPT, educational chatbots, AI-driven academic support systems, recommender systems, virtual training environments, and AI-enhanced pedagogical platforms. These technologies are frequently embedded within broader digital transformation initiatives, highlighting their integration into

institutional strategies rather than their use as isolated tools (Kamalov et al., 2023; Rashid & Kausik, 2024).

Thematically, the included studies consistently addressed issues related to implementation readiness, workflow support, trust and ethical considerations, innovation processes, and intrapreneurial behaviors. For instance, several studies examined the conditions under which AI tools are adopted, emphasizing the importance of institutional support, user acceptance, and alignment with pedagogical goals (Dahri et al., 2024; Shahzad et al., 2024). Others focused on how AI reshapes instructional workflows, highlighting changes in collaboration, task distribution, and professional roles (Bolick & Da Silva, 2023; Weng & Chiu, 2023).

In addition, a significant subset of the literature explored innovation and entrepreneurial dynamics, including the ways in which educators and instructional designers experiment with AI tools, adapt them to local contexts, and scale successful practices. These findings align with research on intrapreneurship and innovation in organizational settings, which emphasizes the role of individual agency and iterative learning in driving change (Daspit et al., 2021; Hernández-Perlines et al., 2022).

Overall, the characteristics of the included studies underscore the interdisciplinary and evolving nature of AI integration in education, where technological developments intersect with pedagogical practices, organizational structures, and strategic innovation. This diversity provided a rich foundation for the subsequent thematic analysis, enabling a comprehensive exploration of the factors shaping AI adoption and use within instructional design contexts.

Theme 1: Adoption factors and barriers (RQ1)

The first theme reflected as the first panel of authors concerns organizational, technical, and cultural conditions affecting AI adoption (Charbonneau-Gowdy & Galdames, 2024; He et al., 2023; Lu et al., 2023; McFeeter et al., 2021).

Organizational readiness

Across the studies represented in Panel 1, artificial intelligence adoption is consistently framed as an institutional phenomenon rather than a purely technological decision. A substantial body of work emphasizes that successful integration depends on the presence of coherent policies, strategic alignment, and sustained investment in human and organizational capacity. In higher education contexts, leadership plays a decisive role by articulating clear expectations, embedding AI within institutional priorities, and supporting faculty and staff through targeted professional development initiatives (Alqahtani & Wafula, 2024; Hashim et al., 2021; Lapierre et al., 2021). Complementary research on digital transformation infrastructures further underscores the importance of institutional support units, which function as mediating structures that coordinate resources, facilitate knowledge transfer, and enable localized experimentation (Langseth et al., 2022). Additional studies across the dataset reinforce this perspective by highlighting that without governance clarity, structured implementation pathways, and ongoing training, AI initiatives tend to remain fragmented or underutilized (Larsen, 2022;

Uzorka et al., 2021; Sahin et al., 2022). Collectively, these findings position organizational readiness as a multidimensional construct encompassing leadership vision, policy coherence, and institutional learning capacity.

Workflow fit and usability

Beyond institutional preparedness, the adoption of AI technologies is strongly conditioned by their alignment with instructional workflows and pedagogical practices. The literature demonstrates that educators and instructional designers are more likely to engage with AI tools when these technologies directly enhance existing tasks, reduce cognitive or administrative burdens, and integrate seamlessly into teaching and learning processes. Empirical and conceptual studies examining instructional design workflows, AI-supported recommender systems, classroom analytics, and digital learning environments consistently point to usability, task relevance, and pedagogical value as critical adoption drivers (Bolick & Da Silva, 2023; Kerres & Buntins, 2020; Baran et al., 2023; Liu et al., 2024; Yang et al.). Additional contributions across the panel indicate that when AI tools fail to align with instructional goals or require significant workflow disruption, resistance tends to emerge despite their technical capabilities (Parsons & Curry, 2023). In this sense, adoption is not merely a function of technological sophistication but of the degree to which AI systems are perceived as practically useful within authentic educational contexts.

Trust, ethics, and acceptance

A third, equally critical dimension concerns the socio-cultural conditions under which AI is evaluated and accepted by users. The studies in Panel 1 reveal that perceptions of trust, fairness, and ethical integrity significantly influence whether educators and institutions are willing to adopt AI systems. Research on AI-supported learning environments, leadership in educational technology, and generative AI ethics demonstrates that users assess not only the functional benefits of these tools but also their implications for academic integrity, transparency, and professional responsibility (Dahri et al., 2024; Laufer et al., 2024; Shahzad et al., 2024). This concern is echoed in adjacent scholarship addressing human dignity, ethical decision-making, and attitudes toward automated systems, which collectively suggest that ethical considerations are not peripheral but central to adoption processes (Fowler & Musgrave, 2024; Vveinhardt, 2022; Waliszewski & Warchlewska, 2020). Additional studies within the dataset further highlight that unresolved ethical tensions—such as issues of bias, authorship, and accountability—can significantly hinder adoption, even in technologically advanced environments (Jansen & Delahaij, 2020; Shadkash et al., 2024).

The evidence from Panel 1 demonstrates that AI adoption in educational contexts cannot be reduced to issues of access or technological novelty. Instead, it emerges from the dynamic interaction of three interdependent conditions: (a) institutional readiness and strategic alignment, (b) functional integration within instructional workflows, and (c) socio-cultural legitimacy grounded in trust and ethical acceptability.

Theme 2: Role and workflow changes (RQ2)

The second theme highlighted as the second panel concerns how AI reshapes instructional design work (Jansen & Delahaij, 2020; Lapierre et al., 2021; Luo & Wang, 2024).

Shifting collaboration with faculty and interdisciplinary teams

The body of studies represented in Panel 2 consistently documents a redefinition of instructional design roles in response to artificial intelligence integration. Rather than operating as isolated content developers, instructional designers are increasingly positioned as strategic collaborators who bridge pedagogical intent, technological affordances, and institutional priorities. Evidence across the literature indicates that AI integration amplifies the need for continuous interaction between designers, faculty, and support units, particularly as educational environments become more technologically complex and data-informed (Bolick & Da Silva, 2023; Langseth et al., 2022; Uzorka et al., 2021). In this emerging configuration, designers function as intermediaries who translate faculty needs into implementable technological solutions while simultaneously interpreting AI-generated outputs within pedagogical frameworks. Additional studies further suggest that this collaborative shift is not optional but structurally embedded in digital transformation processes, where alignment across stakeholders is necessary to ensure coherence between instructional goals and technological implementation (Baran et al., 2023; Larsen, 2022). Consequently, instructional design work is increasingly characterized by negotiation, coordination, and shared decision-making across institutional actors.

Expanded responsibility for quality assurance and ethical curation

Alongside these collaborative shifts, the literature highlights a growing expectation that instructional designers assume responsibility for the evaluation and governance of AI-generated content. Studies examining recommender systems, generative AI applications such as ChatGPT, and AI-supported pedagogical tools emphasize that designers must critically assess outputs for accuracy, relevance, pedagogical alignment, and ethical integrity (Kerres & Buntins, 2020; Parsons & Curry, 2023; Liu et al., 2024). This evaluative function extends beyond traditional quality assurance by incorporating considerations of authorship, bias, transparency, and academic integrity. As AI systems increasingly contribute to content generation and decision-making processes, designers are tasked with ensuring that these contributions meet institutional standards and disciplinary expectations. Related research reinforces that such responsibilities cannot be delegated solely to technological systems; instead, they require human oversight informed by pedagogical expertise and ethical judgment (Jansen & Delahaij, 2020; Shadkash et al., 2024). This expanded role intensifies collaboration with faculty and administrative units, as questions surrounding responsibility and legitimacy demand collective deliberation and shared accountability.

From content production to orchestration of complex systems

A further pattern emerging across Panel 2 studies is the transition from task-oriented production models toward system-level orchestration. Rather than focusing exclusively on the development of instructional materials, designers increasingly operate within interconnected ecosystems that include AI tools, data infrastructures, institutional policies, and collaborative networks. Research on digital transformation and innovation in education suggests that AI integration reshapes not only individual tasks but also the broader organization of work, including team structures, communication flows, and decision-making processes (Langseth et al., 2022; Uzorka et al., 2021). In this context, instructional designers act as coordinators who manage the interaction between human and technological components, ensuring that systems function cohesively and adapt to evolving educational needs. This shift reflects a broader movement toward systemic thinking, where the effectiveness of AI integration depends on the alignment of multiple interdependent elements rather than the isolated adoption of tools (Crompton et al., 2021; Baran et al., 2023).

The findings from Panel 2 indicate that AI integration fundamentally transforms instructional design work by redefining roles, expanding responsibilities, and reconfiguring workflows at the system level. Therefore, instructional designers emerge as strategic actors who facilitate collaboration, ensure quality and ethical integrity, and orchestrate complex educational ecosystems.

Theme 3: Entrepreneurial concepts and strategic behaviors (RQ3)

The third theme forming the third panel highlights the relevance of entrepreneurial and intrapreneurial thinking (Luo & Wang, 2024; Uzumcu & Acilmis, 2023).

Experimentation, iterative learning, and innovation

The studies represented in Panel 3 collectively foreground the importance of entrepreneurial thinking as a critical mechanism for navigating the uncertainties associated with artificial intelligence integration in education. Rather than depicting adoption as a linear or policy-driven process, this body of literature emphasizes experimentation, iterative refinement, and context-sensitive innovation as central dynamics (Luo & Wang, 2024; Uzumcu & Acilmis, 2023). Research engaging explicitly with entrepreneurship, intrapreneurship, and innovation frameworks highlights how educational professionals operate as adaptive agents who continuously test, evaluate, and recalibrate AI applications within their local environments (Daspit et al., 2021; Hernández-Perlines et al., 2022; Langseth et al., 2022). In higher education contexts, this often manifests through small-scale pilots, exploratory use cases, and iterative redesign of instructional practices, where learning emerges through cycles of implementation and feedback. Additional studies within the dataset reinforce that such experimentation is not merely technical but deeply pedagogical, requiring alignment with learning objectives, disciplinary norms, and institutional constraints (Larsen, 2022). Consequently, innovation in AI integration is best understood as an ongoing process of situated learning rather than a one-time adoption event.

Risk-taking and opportunity recognition

Complementing this emphasis on experimentation is a consistent focus on the role of risk-taking and opportunity recognition in enabling meaningful AI integration. The literature suggests that successful implementation depends on practitioners' ability to move beyond compliance-oriented approaches and engage proactively with emerging technological possibilities. Studies examining innovation practices, trust dynamics, and strategic decision-making indicate that educators and instructional designers must identify contextually relevant opportunities for AI use, test them within manageable boundaries, and adapt based on observed outcomes (Laufer et al., 2024; Ohlert et al., 2024; Reim et al., 2020). This process inherently involves navigating uncertainty, including potential failures, ethical dilemmas, and institutional resistance. Evidence from research on digital transformation initiatives, innovation labs, and experimental instructional settings further demonstrates that structured environments supporting controlled risk-taking can facilitate the development of scalable and sustainable AI practices (Larsen, 2022; Rosenow-Gerhard, 2020). In this sense, opportunity recognition is not a passive awareness of technological potential but an active, practice-based capability that emerges through engagement, reflection, and adaptation.

Taken together, the findings from Panel 3 position AI integration within an entrepreneurial framework characterized by agency, experimentation, and strategic adaptation. Educational professionals are not merely adopters of externally developed technologies; they act as intrapreneurs who shape, refine, and contextualize AI applications within their institutions. This perspective underscores that sustainable AI integration depends on cultivating environments that support iterative learning, informed risk-taking, and opportunity-driven innovation.

The systematic evidence suggests that AI integration in education is a dynamic and emergent phenomenon that cannot be reduced to any single dimension. Instead, it reflects the convergence of institutional alignment, professional transformation, and strategic agency. This synthesis underscores the need to conceptualize AI adoption as an ongoing process of negotiation and adaptation, where technological, organizational, and human factors are continuously reconfigured in response to changing educational demands.

Discussion

Reconceptualizing AI Integration in Education: A Systemic and Multi-Level Perspective

This study contributes a combined bibliometric and systematic account (see Fig. 1) of AI in instructional design. The bibliometric findings show that AI-related instructional design research is not isolated while the systematic review then clarifies how these field-level patterns are experienced in the professional world of instructional design.

The findings of this systematic analysis provide compelling evidence that artificial intelligence (AI) integration in educational contexts cannot be adequately understood through narrow, technology-centric frameworks. Instead, the synthesis of the three thematic panels reveals a multi-level, dynamic, and interdependent process shaped by institutional readiness, evolving professional practices, and entrepreneurial agency. This integrative perspective aligns with broader conceptualizations of digital transformation, which emphasize the interplay between organizational structures, human actors, and technological systems (Chen et al., 2020; Kamalov et al., 2023). The discussion that follows situates these findings within the existing literature while advancing a more comprehensive understanding of AI adoption as a systemic phenomenon.

Institutional Foundations: Beyond Technological Availability

A central insight emerging from Panel 1 is that AI adoption is fundamentally contingent upon institutional readiness and strategic alignment, rather than mere access to technological tools. This finding reinforces prior research indicating that digital transformation in higher education requires coordinated leadership, policy frameworks, and sustained investment in capacity building (Hashim et al., 2021; Hannan & Liu, 2021). Institutions that articulate clear strategic priorities and align AI initiatives with educational goals are better positioned to achieve meaningful and sustainable implementation (Alqahtani & Wafula, 2024).

The importance of organizational infrastructure is further supported by studies emphasizing the role of institutional support units and digital transformation ecosystems in enabling innovation (Langseth et al., 2022, 2023). These structures function as intermediaries that facilitate knowledge transfer, coordinate resources, and support localized experimentation. In this sense, AI adoption emerges not as an isolated decision but as an outcome of institutional ecosystems that enable or constrain innovation (Chen & Kim, 2023; Rashid & Kausik, 2024).

At the same time, the findings highlight the critical role of trust, ethics, and legitimacy in shaping adoption decisions. Consistent with research on technology acceptance and organizational behavior, users are more likely to engage with AI systems when they perceive them as fair, transparent, and aligned with professional values (Dahri et al., 2024; Shahzad et al., 2024). Ethical concerns—particularly those related to bias, authorship, and accountability—emerge as significant barriers when left unaddressed (Laryeafio & Ogbewe, 2023; Vveinhardt, 2022). This underscores the necessity of integrating ethical considerations into institutional strategies, rather than treating them as secondary concerns.

Taken together, these findings suggest that institutional readiness encompasses not only technical infrastructure but also policy coherence, ethical governance, and organizational culture. This expanded conceptualization aligns with contemporary views of AI as a socio-technical system embedded within complex institutional contexts (Kehoe et al., 2022; Varpio et al., 2019).

Professional Transformation: Redefining Instructional Design Work

The second major contribution of this study lies in its elucidation of how AI integration reshapes professional roles and workflows within educational environments. As demonstrated in Panel 2, instructional designers and educators are increasingly transitioning from task-oriented roles to strategic, collaborative, and system-oriented positions. This shift reflects broader changes in the nature of work associated with digital transformation, where boundaries between roles become more fluid and interdependent (Kraiger & Ford, 2020).

The literature consistently highlights the emergence of instructional designers as mediators between pedagogy, technology, and institutional priorities (Bolick & Da Silva, 2023; Uzorka et al., 2021). Rather than focusing solely on content development, designers now engage in collaborative processes that involve interpreting AI outputs, aligning tools with learning objectives, and supporting faculty in integrating technology into their teaching practices. This finding resonates with research on stakeholder engagement and systems thinking, which emphasizes the importance of coordination and alignment across multiple actors (Baran et al., 2023).

In addition to increased collaboration, the findings point to an expanded emphasis on quality assurance and ethical curation. As AI systems take on a more active role in generating instructional content, the responsibility for evaluating and validating these outputs shifts to human actors. Studies on AI-enhanced learning environments and generative tools such as ChatGPT highlight the need for continuous oversight to ensure accuracy, relevance, and alignment with pedagogical standards (Parsons & Curry, 2023; Liu et al., 2024). This evaluative role is particularly critical in maintaining academic integrity and addressing ethical concerns associated with automated content generation (Sun et al., 2024; Guan et al., 2024).

Furthermore, the findings reveal a broader transition from content production to system orchestration, where instructional designers operate within interconnected ecosystems of tools, data, and institutional structures. This shift reflects the increasing complexity of educational environments and the need for professionals who can manage interactions between human and technological components (Weng & Chiu, 2023; Weng et al., 2024). In this context, instructional design becomes a form of systems engineering, requiring both technical expertise and pedagogical insight.

Entrepreneurial Agency: Innovation Under Conditions of Uncertainty

While institutional and professional factors provide the structural foundation for AI integration, Panel 3 highlights the critical role of individual agency and entrepreneurial behavior in driving innovation. The literature suggests that successful AI adoption depends not only on organizational support but also on the capacity of practitioners to engage in experimentation, iterative learning, and opportunity recognition (Daspit et al., 2021; Hernández-Perlines et al., 2022).

This perspective aligns with research on intrapreneurship and corporate entrepreneurship, which emphasizes the importance of internal actors in initiating and sustaining innovation within established organizations (Burger & Blažková, 2020; Göcke et al., 2021). In educational contexts, instructional designers and faculty members act as institutional entrepreneurs who experiment with new tools, adapt them to local needs, and scale successful practices (Langseth et al., 2023; Zhao et al., 2021).

The role of risk-taking and opportunity recognition is particularly salient in the context of AI integration. Studies indicate that practitioners must navigate uncertainty by testing AI applications in controlled environments, learning from failures, and refining their approaches over time (Ohlert et al., 2024; Reim et al., 2020). This process is inherently iterative and context-dependent, reflecting the evolving nature of both technology and educational practice.

Innovation labs and experimental learning environments emerge as important mechanisms for supporting this process, providing spaces where educators can explore new ideas without the constraints of formal institutional structures (Rosenow-Gerhard, 2020; Larsen, 2022). These environments enable the development of entrepreneurial mindsets, characterized by adaptability, creativity, and a willingness to engage with uncertainty (Bell & Bell, 2020; Bhinekawati et al., 2020).

Importantly, the findings suggest that entrepreneurial behavior is not limited to individual initiative but is influenced by broader organizational conditions. Institutions that foster trust, provide resources, and encourage experimentation are more likely to cultivate innovative practices (Laufer et al., 2024; Chen et al., 2022). This highlights the interconnected nature of the three panels, where institutional, professional, and individual factors collectively shape AI integration outcomes.

Toward a Unified Framework: Integrating Institution, Practice, and Agency

The synthesis of the three panels points to the need for a unified theoretical framework that captures the complexity of AI integration in education. Rather than treating adoption, workflow transformation, and innovation as separate processes, the findings suggest that these dimensions are deeply interconnected and mutually reinforcing as illustrated in Fig. 4.

Caption: A three-level model of AI integration in instructional design showing institutional enablers, practice-level transformations, and agency-driven innovation, connected through causal pathways and feedback loops to produce sustainable, collaborative learning outcomes

At the institutional level, readiness and strategic alignment create the conditions for adoption. At the professional level, evolving roles and workflows enable the effective use of AI tools. At the individual level, entrepreneurial behaviors drive innovation and adaptation. Together, these dimensions form a dynamic system in which changes in one domain influence and are influenced by changes in others.

This integrated perspective represented in Fig. 4 aligns with systems thinking approaches in educational research, which emphasize the importance of understanding interactions between multiple components (Chen et al., 2020; Kehoe et al., 2022). It also resonates with recent work on AI in education, which highlights the need for holistic frameworks that account for technological, organizational, and human factors (Ayotunde et al., 2023; Umbar et al., 2024).

Implications for Research and Practice

The findings of this study have several important implications for both research and practice. First, they suggest that future research should move beyond isolated analyses of AI tools and focus on system-level dynamics that shape integration outcomes. This includes examining interactions between institutional policies, professional practices, and individual behaviors, as well as exploring how these dynamics evolve over time (Acton, 2023; Prosek & Gibson, 2021).

Second, the findings highlight the importance of capacity building and professional development in supporting AI integration. Educational institutions must invest in training programs that equip educators and instructional designers with the skills needed to navigate complex technological environments (Nicole, 2024; Muljana & Luo, 2023). This includes not only technical skills but also competencies related to collaboration, ethical decision-making, and innovation.

Third, the study underscores the need for ethical governance frameworks that address the challenges associated with AI use in education. Institutions must develop policies and practices that ensure transparency, accountability, and fairness, while also fostering trust among users (Laryeafio & Ogbewe, 2023; Shahzad et al., 2024).

Finally, the findings suggest that fostering entrepreneurial cultures within educational institutions can enhance innovation and adaptability. By encouraging experimentation and supporting risk-taking, institutions can create environments where new ideas can emerge and evolve (Larsen, 2022; Rosenow-Gerhard, 2020).

Limitations

Despite the rigor of this systematic synthesis, several limitations should be acknowledged. First, although the extraction table provided a structured and transparent foundation for analysis, the scope of extracted variables remained selective. While key dimensions such as methodology, context, and findings were included, additional variables—such as geographic distribution of studies, institutional types, and the specific categories of generative AI tools employed—could have offered deeper comparative insights. The absence of these elements may limit the granularity of cross-contextual interpretations, particularly given the global diversity of AI implementation in education (Chen et al., 2020; Ayotunde et al., 2023).

Second, the rapidly evolving nature of the AI landscape—especially in relation to generative AI—poses inherent challenges to the stability of thematic conclusions. The emergence of tools such as large

language models and AI-driven learning systems continues to reshape pedagogical practices, institutional policies, and research priorities at an accelerated pace (Kamalov et al., 2023; Rashid et al., 2024). As a result, the patterns identified in this review should be interpreted as temporally situated, reflecting a snapshot of a continuously transforming field. Future studies may reveal new configurations of adoption, workflow transformation, and innovation that extend or challenge the present findings.

Third, the analysis revealed that professional role boundaries within educational institutions are often fluid and overlapping. Distinctions among instructional designers, educational developers, faculty support professionals, and faculty members themselves are not always clearly delineated in the literature. This ambiguity complicates efforts to attribute specific practices or responsibilities to particular roles, especially in contexts where collaborative and interdisciplinary approaches are emphasized (Bolick & Da Silva, 2023; Uzorka et al., 2021). Such overlap, while reflective of real-world practice, introduces analytical complexity and may obscure the precise mechanisms through which AI integration is operationalized.

Finally, as with all systematic reviews, this study is influenced by the selection criteria, database coverage, and methodological approaches employed. Although efforts were made to ensure rigor and comprehensiveness, including structured synthesis and alignment with established qualitative research practices (Alam, 2020; Prosek & Gibson, 2021), the possibility of publication bias and the exclusion of emerging or non-indexed studies cannot be entirely eliminated. This limitation is particularly relevant in a field where innovation often occurs faster than formal publication cycles.

Conclusion

This study combined bibliometric mapping of 1,411 records with an in-depth systematic synthesis of 65 studies to examine the multifaceted dynamics of AI integration in instructional design and educational systems. The findings provide strong evidence that AI adoption is not a purely technological phenomenon but rather a socio-technical process shaped by the interaction of institutional structures, professional practices, and individual agency.

At the institutional level, successful integration is contingent upon strategic alignment, leadership support, and the development of organizational capacity. These factors create the conditions under which AI can be meaningfully adopted and sustained (Hashim et al., 2021; Hannan & Liu, 2021). At the level of professional practice, the findings demonstrate a significant transformation in the role of instructional designers, who increasingly function as collaborators, evaluators, and system orchestrators within complex educational ecosystems (Baran et al., 2023; Weng et al., 2024). This shift reflects broader changes in the nature of work, where the integration of AI requires continuous coordination across pedagogical, technological, and institutional domains.

At the individual level, the study highlights the importance of entrepreneurial and intrapreneurial behaviors, including experimentation, iterative learning, and opportunity recognition. These behaviors enable practitioners to navigate uncertainty, adapt AI tools to local contexts, and drive innovation within

existing institutional frameworks (Daspit et al., 2021; Hernández-Perlines et al., 2022; Ohlert et al., 2024). Together, these findings suggest that sustainable AI integration depends on the alignment of institutional readiness, workflow usability, ethical legitimacy, and strategic experimentation.

Importantly, this study contributes to the learning sciences by repositioning instructional designers and educational professionals as active agents of transformation rather than passive adopters of emerging technologies. The evidence indicates that AI integration reshapes not only tools and processes but also the underlying structures of educational practice, requiring new forms of collaboration, governance, and innovation. This perspective aligns with contemporary research emphasizing the need for holistic and systems-oriented approaches to understanding AI in education (Chen et al., 2020; Kamalov et al., 2023).

Looking forward, the findings suggest that future research should move beyond isolated analyses of AI tools and instead focus on the interdependencies between design practice, organizational mediation, and entrepreneurial change. Such an approach will be essential for developing theoretical frameworks that capture the complexity of AI integration and for informing policies and practices that support equitable, ethical, and effective use of AI in education.

Declarations

Data Availability Statement

The data used in this study were derived from peer-reviewed publications retrieved from six major academic databases: ProQuest ERIC, Scopus, AISO, EBSCOhost, ProQuest Education, and ProQuest Entrepreneurship. As this study is based on published literature, no primary human participant data were collected. The bibliometric dataset and extracted thematic coding framework are available from the corresponding author upon reasonable request.

Ethics Statement

This study involved a systematic review and bibliometric analysis of publicly available peer-reviewed literature and did not involve human participants, human subjects, or identifiable personal data. Therefore, institutional ethics approval and informed consent were not required for this research.

Conflict of Interest Statement

The author declares no conflicts of interest related to this study or its publication.

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Author Contribution

H.N wrote the entire manuscript text, prepared figures and tables and reviewed the manuscript.

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Figures

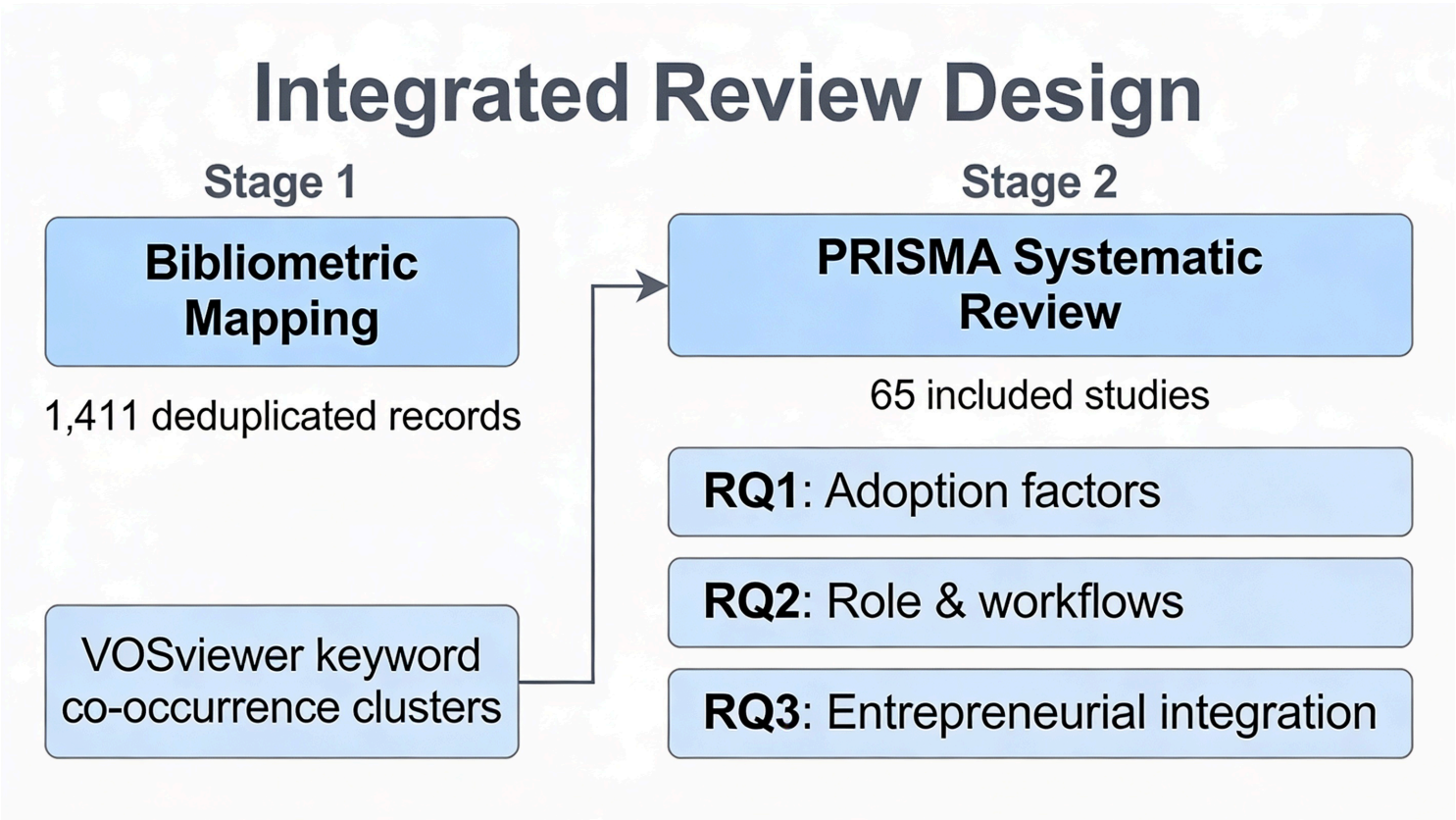


Figure 1

Integrated review design

Caption: Two-stage review design linking bibliometric mapping of 1,411 deduplicated records to PRISMA screening and thematic synthesis of 65 included studies

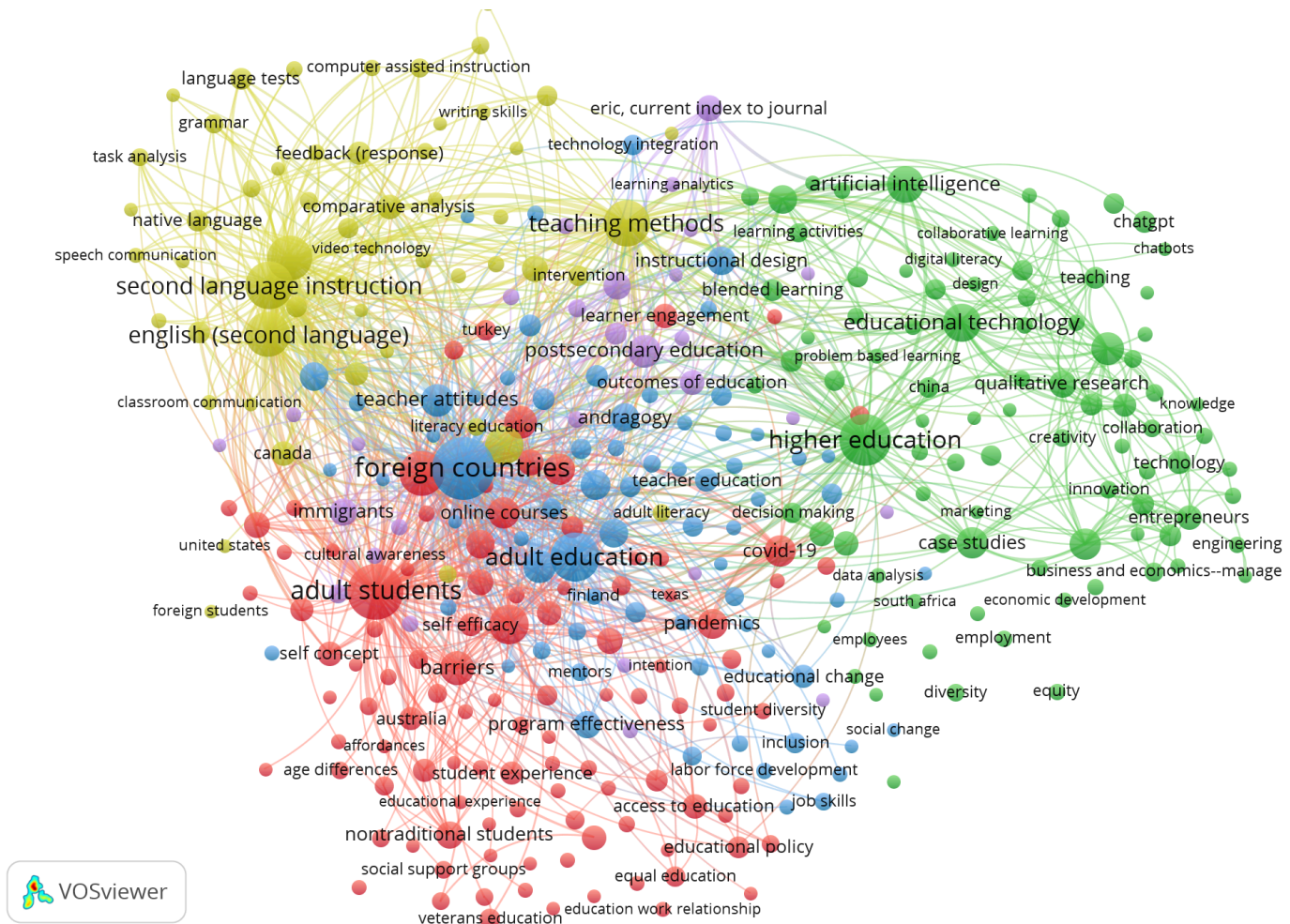


Figure 2

Keyword co-occurrence network for AI and instructional design research

Caption: VOSviewer keyword co-occurrence map based on 1,411 deduplicated records. Node size reflects keyword frequency and link thickness reflects co-occurrence strength. Five clusters are visible: adult and nontraditional learners (red), AI-instructional design-innovation (green), language learning (yellow), higher education and policy (blue), and methodological/indexing terms (purple)

PRISMA 2020

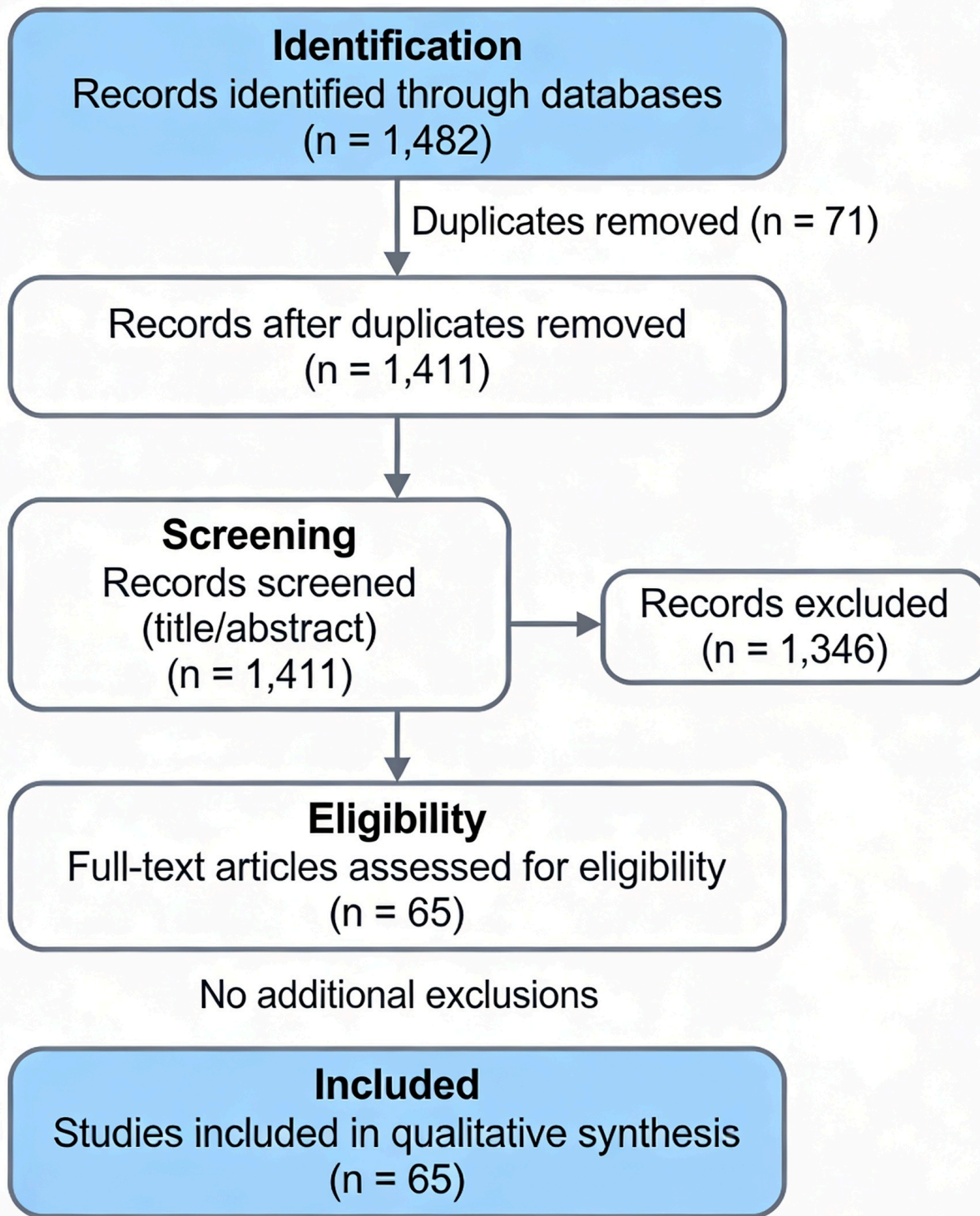


Figure 3

PRISMA screening summary

Caption: PRISMA flow diagram summarizing identification, screening, eligibility, and inclusion for the 65-study systematic review

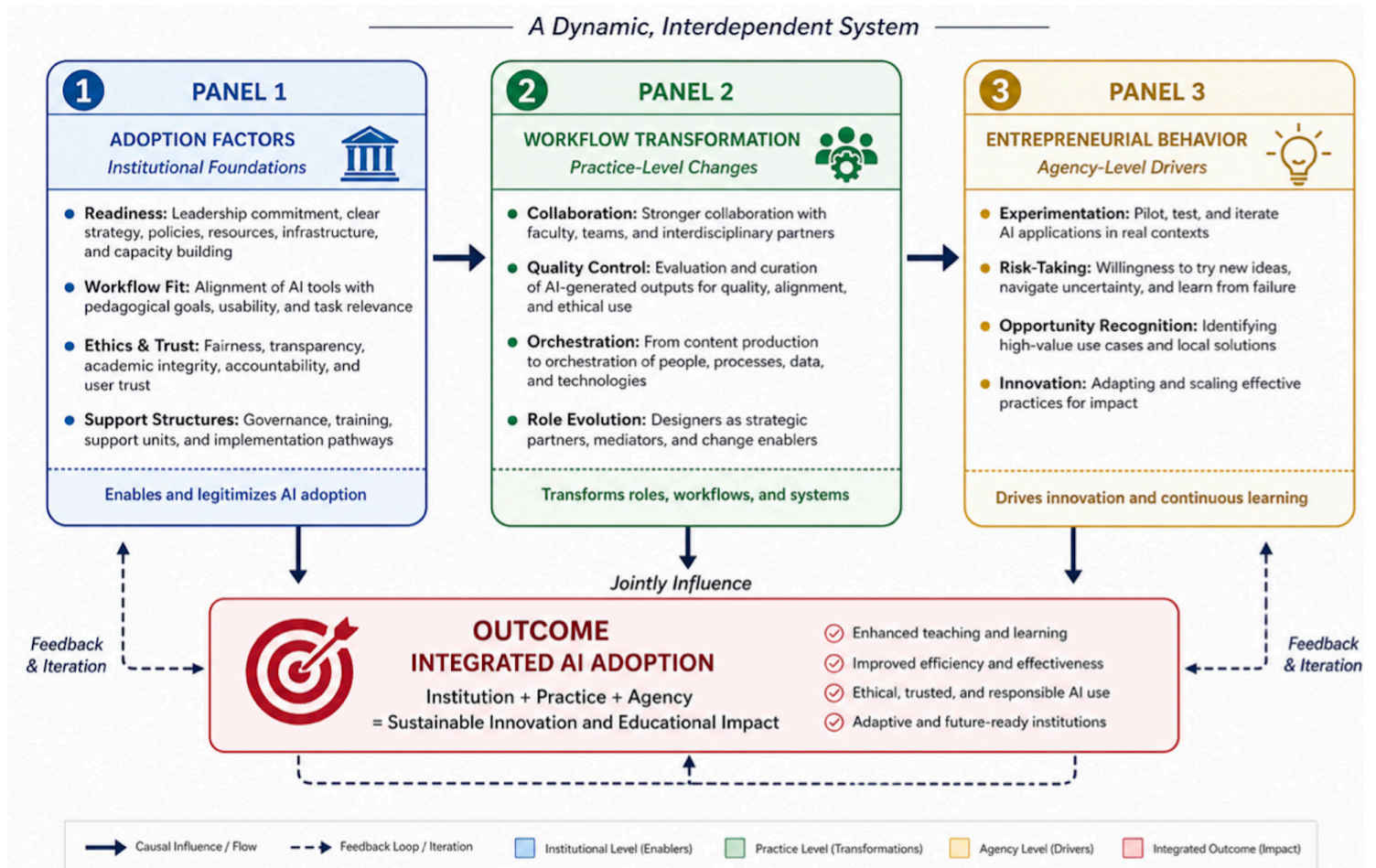


Figure 4

Integrated AI Adoption as a Dynamic, Interdependent System

Caption: A three-level model of AI integration in instructional design showing institutional enablers, practice-level transformations, and agency-driven innovation, connected through causal pathways and feedback loops to produce sustainable, collaborative learning outcomes