




Educational Design Models in Transition: A Comparative Review

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Abstract

A persistent gap between educational theory and classroom practice underscores the need for methodological approaches that are reflective, participatory, and context responsive. This study provides a comparative review of four major educational design models, including research and development (R&D); Analysis, Design, Development, Implementation, and Evaluation (ADDIE); design-based research (DBR); and educational design research (EDR), to examine their theoretical orientations and contemporary applications. A systematic literature synthesis and bibliometric mapping were conducted on 80 peer-reviewed journal articles indexed in Scopus between 2020 and 2025. The findings reveal that ADDIE remains the most frequently applied framework due to its procedural clarity and practical utility, whereas EDR demonstrates steady growth in studies emphasizing contextual inquiry, collaboration, and reflective design practices. Keyword co-occurrence analyses indicate a gradual methodological transition from technocratic models toward more participatory and theory-integrated paradigms. Overall, EDR emerges as a promising framework that unites theoretical advancement with practical innovation, offering a sustainable bridge between educational research and classroom implementation. These findings provide conceptual and empirical insights to inform scholars, educators, and policymakers in selecting design approaches that are both context sensitive and theoretically robust.

Keywords: *instructional design, educational design research, ADDIE, design-based research, bibliometric mapping, synthesis*

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Introduction

The persistent disconnection between educational theory and classroom practice remains a fundamental challenge in the field. Many instructional innovations, defined here as new teaching methods, learning technologies, or curriculum frameworks introduced to improve educational practice, are often grounded in academic research but fail to address the complexities of real teaching contexts. This shortcoming largely stems from limited practitioner involvement in design and decision-making processes. The resulting gap reflects not only issues in content or technology but also the methodological frameworks researchers employ when developing educational solutions. The assumption that research findings can be universally applied without attending to local social, cultural, and pedagogical dynamics has been increasingly contested in recent studies (Laurillard, 2012; McKenney & Reeves, 2019; Nieveen & Folmer, 2013; Voogt et al., 2015).

Development models, such as research and development (R&D) and Analysis, Design, Development, Implementation, and Evaluation (ADDIE), have long dominated educational research, particularly in graduate-level academic work. Both models offer systematic and replicable structures; however, they often conceptualize learning as a linear, controlled system. Procedural patterns embedded within these approaches tend to overlook opportunities for critical reflection, contextual adaptation, and active user engagement (Branch, 2009; Gall et al., 2003). Recent evidence shows that solutions generated through these models frequently lack the responsiveness required for meaningful change in diverse learning environments, particularly when applied across different cultural and institutional settings (Al-Fraihat et al., 2021).

Emerging critiques of technocratic design models point toward the need for more iterative and reflective methodological approaches. Current educational problems demand processes that integrate design and evaluation in continuous, revisable cycles. This need has brought renewed attention to design approaches that yield not only final products but also conceptual principles that extend theoretical understanding (Anderson & Shattuck, 2012; Reeves, 2006; Van den Akker et al., 2006). Educational design research (EDR), sometimes referred to as design research in education, has gained traction as an approach that integrates theoretical contributions and practical problem-solving within a single, dynamic process.

EDR repositions researchers not as sole creators but as reflective partners working collaboratively with teachers, designers, and other stakeholders. The EDR process typically follows three interrelated and iterative phases—exploration, design and construction—as well as evaluation and reflection, which enable continuous refinement between theory and practice. The flexible and iterative nature of this approach aligns with the complexity, contextuality, and dynamism of contemporary educational challenges. Moreover, the concept of contextual inquiry within EDR emphasizes collaborative problem analysis rooted in authentic educational settings, ensuring that interventions remain directly relevant to the needs of both learners and educators. Consequently, EDR facilitates the development of empirically grounded design principles that can be tested and validated in real-world contexts while simultaneously contributing to broader theoretical and scholarly discourse (Barab & Squire, 2004; McKenney & Reeves, 2019; Philipsen et al., 2019).

The bibliometric analysis in this study was conducted using the Scopus database, selected for its broad and multidisciplinary coverage of peer-reviewed journals in the social sciences and educational technology domains. The search strategy employed Boolean operators to combine general instructional design terms with specific model-related keywords, ensuring comprehensive retrieval of relevant literature. The search was executed on July 15, 2025, applying the following filters: document type (journal articles), language (English), year range (2020–2025), and subject area (social sciences).

The retrieved records were screened through several stages based on predefined inclusion and exclusion criteria. Articles were included if they explicitly referenced at least one instructional development model—ADDIE, design-based research (DBR), EDR, or R&D—and were excluded if they were conference papers, book chapters, non-peer-reviewed publications, or non-English sources. Duplicate and irrelevant records were also removed.

In total, 80 journal articles met the final inclusion criteria. Each article was examined to identify its methodological orientation and coded into categories corresponding to the four instructional design models or “unspecified/other” when no explicit model was indicated.

To ensure transparency and replicability, the complete Scopus search string, inclusion and exclusion criteria, and the full list of analyzed studies, including the journal source, publication year, DOI, and coding classification, are provided in this article tables and appendices.

The novelty of this study lies in its synthesis of conceptual insights with academic trend visualization, an approach rarely adopted in similar literature. Rather than presenting EDR as a methodological substitute, this article frames it as a reflective and context-sensitive paradigm that integrates theoretical development and practical impact. As such, it seeks to inform and guide researchers in making conscious choices about educational design approaches that are responsive to context, grounded in theory, and oriented toward meaningful change.

Literature Review

Research and Development

The R&D model remains one of the earliest and most recognized approaches to educational development, particularly influential in graduate research traditions. Rooted in experimental and product-development paradigms, R&D seeks to produce instructional tools or materials that can be empirically tested and implemented across varied educational contexts (Gall et al., 2003; Nieveen & Folmer, 2013). Its strength lies in its structured and systematic process, which appeals to many researchers, especially graduate students, because of its clarity, sequential logic, and predictability (Gall et al., 2003). However, this linearity often promotes what critics have termed a technocratic assumption, the notion that education operates as a controllable and closed system fully managed by the designer, thus limiting contextual responsiveness and reflection (McKenney & Reeves, 2019). Consequently, while R&D contributes significantly to the empirical rigor of instructional product development, it is often critiqued for neglecting sociocultural dynamics and for focusing on procedural rather than transformative educational innovation (Philipsen et al., 2019).

By offering a sequence of predetermined phases, R&D has been perceived as academically safe and relatively easy to implement. However, this linearity promotes what critics have termed a technocratic assumption: the notion that education is a closed, controllable system fully managed by the designer (McKenney & Reeves, 2019). Such an assumption discourages practitioner participation, neglects cultural and social dynamics, and limits contextual responsiveness. Moreover, the R&D process seldom encourages deep theoretical reflection, leaving contributions largely procedural or practical rather than conceptual (Barab & Squire, 2004; Van den Akker et al., 2006).

Analysis, Design, Development, Implementation, and Evaluation (ADDIE)

The ADDIE model, comprising five sequential phases of analysis, design, development, implementation, and evaluation, is among the most widely used instructional design frameworks in education and professional training. ADDIE provides a systematic structure that guides practitioners in the creation, implementation,

and evaluation of instructional materials (Branch, 2009; Molenda, 2003). Its structured sequence and clear deliverables make ADDIE particularly appealing to educators and instructional designers who value replicable processes and efficient workflows (Branch, 2009).

The model's adaptability across diverse sectors, including industry, the military, and higher education, has established ADDIE as a default framework for curriculum development and technology-enhanced learning environments (Allen & Sites, 2012). In practice, ADDIE underpins the design of e-learning platforms, technology-based training, and certification systems, supporting a broad range of instructional development efforts (Abuhassna et al., 2024). Nevertheless, its linear orientation has been increasingly criticized for limited responsiveness to dynamic, context-dependent learning environments and for underemphasizing iterative reflection and stakeholder collaboration (McKenney & Reeves, 2019). Learners in ADDIE-based designs are often positioned as passive recipients rather than co-designers, restricting opportunities for collaboration, contextual sensitivity, and reflective engagement. Consequently, in higher education settings that emphasize adaptability and metacognitive engagement, ADDIE appears insufficiently flexible to support complex, participatory, and theory-integrated instructional approaches (Philipsen et al., 2019).

Design-Based Research

DBR emerged in the early 2000s as a response to the limitations of traditional experimental methodologies when applied in authentic educational contexts. Its central aim is to co-develop contextually grounded interventions while simultaneously advancing theoretical understandings of learning processes (Barab & Squire, 2004; Wang & Hannafin, 2005). The strength of DBR lies in its proximity to practice, where researchers and practitioners collaboratively design, enact, and refine interventions that address real problems of learning and instruction (Anderson & Shattuck, 2012; McKenney & Reeves, 2019). Such interventions are considered sustainable when they can be iteratively improved and maintained in authentic educational environments over time (Design-Based Research Collective, 2003).

Learning within DBR is viewed not as a fixed variable but as a situated, dynamic, and contextually embedded process that evolves through iterative cycles of design and enactment (Brown, 1992; Collins, 1992). Despite these strengths, DBR has been critiqued for methodological ambiguity, lack of standardization, and limited replicability across settings (Bell, 2004; Sandoval, 2014). In research domains not directly centered on technology or instructional product development, DBR studies sometimes exhibit inconsistent application of design principles and theoretical grounding, resulting in fragmented or diffuse contributions to educational theory (McKenney & Reeves, 2019; Philipsen et al., 2019).

Moreover, DBR's theoretical contributions are not always clearly articulated or transferable. Many studies have described iterative design and development cycles but failed to distill generalizable design principles or establish coherent epistemological frameworks (e.g., Amiel & Reeves, 2008; Bell, 2004; McKenney & Reeves, 2019; Philipsen et al., 2019; Sandoval, 2014). While DBR shares foundational values with EDR, it has not consistently evolved into a paradigm that balances problem solving and robust theory building. Recent meta-analyses and reviews reinforce this concern, indicating that DBR often prioritizes tool creation or localized intervention over theoretical clarity and scalability (Anderson & Shattuck, 2012; Wang & Hannafin, 2005).

Educational Design Research

EDR emerged as an enhancement of DBR with explicit attention to the systematic integration of theory and practice. EDR conceptualizes design as a reflective and iterative research process that simultaneously produces practical solutions and theoretical insights into teaching and learning (McKenney & Reeves, 2019; Reeves, 2006; Van den Akker et al., 2006).

The structure of EDR typically involves three interconnected and recurring cycles, analysis and exploration, design and construction, and evaluation and reflection, which guide the progressive refinement of both design products and theoretical propositions (McKenney & Reeves, 2019; Nieveen & Folmer, 2013). These dynamic cycles promote continuous improvement through empirical validation and stakeholder collaboration while concurrently shaping design principles and theoretical frameworks that contribute to broader educational understanding (Reeves, 2011). This dual orientation, balancing pragmatic relevance with academic rigor, positions EDR as a hybrid model that advances both applied knowledge and scholarly inquiry (Bakker, 2019; Nieveen & Folmer, 2013).

EDR is its participatory ethos. Researchers, educators, and practitioners co-create interventions from the outset, ensuring that solutions address real-world challenges while incorporating sociocultural and pedagogical dimensions often overlooked in linear or technocratic models (McKenney & Reeves, 2019; Nieveen & Folmer, 2013; Van den Akker et al., 2006). This collaborative orientation enhances both the ecological validity, the degree to which findings remain relevant in authentic contexts, and the scholarly significance of interventions (Bakker, 2019; Nieveen & Folmer, 2013). By engaging multiple stakeholders throughout the design process, EDR bridges the divide between theory and practice, ensuring that research outcomes are simultaneously context responsive and theoretically informed.

Recent scholarship underscores the growing relevance and robustness of EDR in addressing contemporary educational challenges. For example, McKenney and Reeves (2019) identify EDR as a key methodology for producing conceptually rigorous and practice-oriented scholarship in computing and higher education. Similarly, Moore et al. (2025) argue that educational technology research increasingly requires methodologies oriented toward solving authentic problems, a need that EDR is uniquely positioned to meet.

Methods

This study employed a systematic literature analysis integrated with bibliometric mapping to examine the distribution and conceptual trajectory of instructional development models in recent educational research. The design supported both longitudinal and thematic exploration, focusing on the methodological positioning of EDR in comparison with ADDIE, DBR, and R&D. The analytic orientation was grounded in interpretive qualitative inquiry, emphasizing conceptual synthesis and meaning-making rather than purely numerical description (Cooper, 1998; Jesson et al., 2011).

Source Selection and Criteria

A comprehensive search was conducted in the Scopus database on July 15, 2025, chosen for its broad coverage of peer-reviewed publications in education and the social sciences. The Boolean search string combined multiple keywords—EDR, DBR, ADDIE model, R&D in education, and instructional design model—and was applied to titles, abstracts, and keywords (see Table 1). Results were filtered to include only peer-reviewed journal articles published in English between 2020 and 2025 within the subject area of social sciences.

Table 1. Search String Used in Scopus Query

Component	Keywords/Operators	Notes
Population/ Domain	“instructional design” OR “educational design” OR “instructional development”	Ensures broad coverage of design-related research

Specific Models	“ADDIE” OR “Analysis Design Development Implementation Evaluation” OR “R&D in education” OR “Research and Development in education” OR “Design-Based Research” OR “DBR” OR “Educational Design Research” OR “EDR”	Captures the four major models under review
Connector	AND	Combines general instructional design with specific models
Applied Filters	- Document type: <i>Journal Articles (peer-reviewed)</i> - Language: <i>English</i> - Year range: <i>2020–2025</i> - Subject area: <i>Social Sciences</i>	Restricts to relevant and comparable sources
Final Boolean String	TITLE-ABS-KEY(“instructional design” OR “educational design” OR “instructional development”) AND TITLE-ABS-KEY(“ADDIE” OR “Analysis Design Development Implementation Evaluation” OR “R&D in education” OR “Research and Development in education” OR “Design-Based Research” OR “DBR” OR “Educational Design Research” OR “EDR”) AND (LIMIT-TO(DOCTYPE,“ar”)) AND (LIMIT-TO(LANGUAGE,“English”)) AND (PUBYEAR > 2019 AND PUBYEAR < 2026) AND (LIMIT-TO(SUBJAREA,“SOCI”))	Complete search string used in Scopus advanced search on July 15, 2025

Notes for non-expert readers: Boolean string refers to a combination of keywords with logical operators (AND, OR) used to precisely retrieve articles from the database, and TITLE-ABS-KEY means that Scopus searches for the keywords in the title, abstract, or author keywords of the articles.

The inclusion criteria required that studies (1) were published between 2020 and 2025, (2) explicitly referenced one of the four development models, (3) appeared in peer-reviewed journals, and (4) were written in English (see Table 2). Exclusion criteria eliminated conference proceedings, book chapters, and editorials, as well as non-English publications, duplicates, and articles not directly engaging with instructional design frameworks (see Table 2). The initial search yielded 130 records. After duplicate removal and abstract screening, 80 articles were retained for full-text analysis, while 50 were excluded (23 were not focused on design models, 16 were not peer reviewed, and 11 were outside the language and year scope).

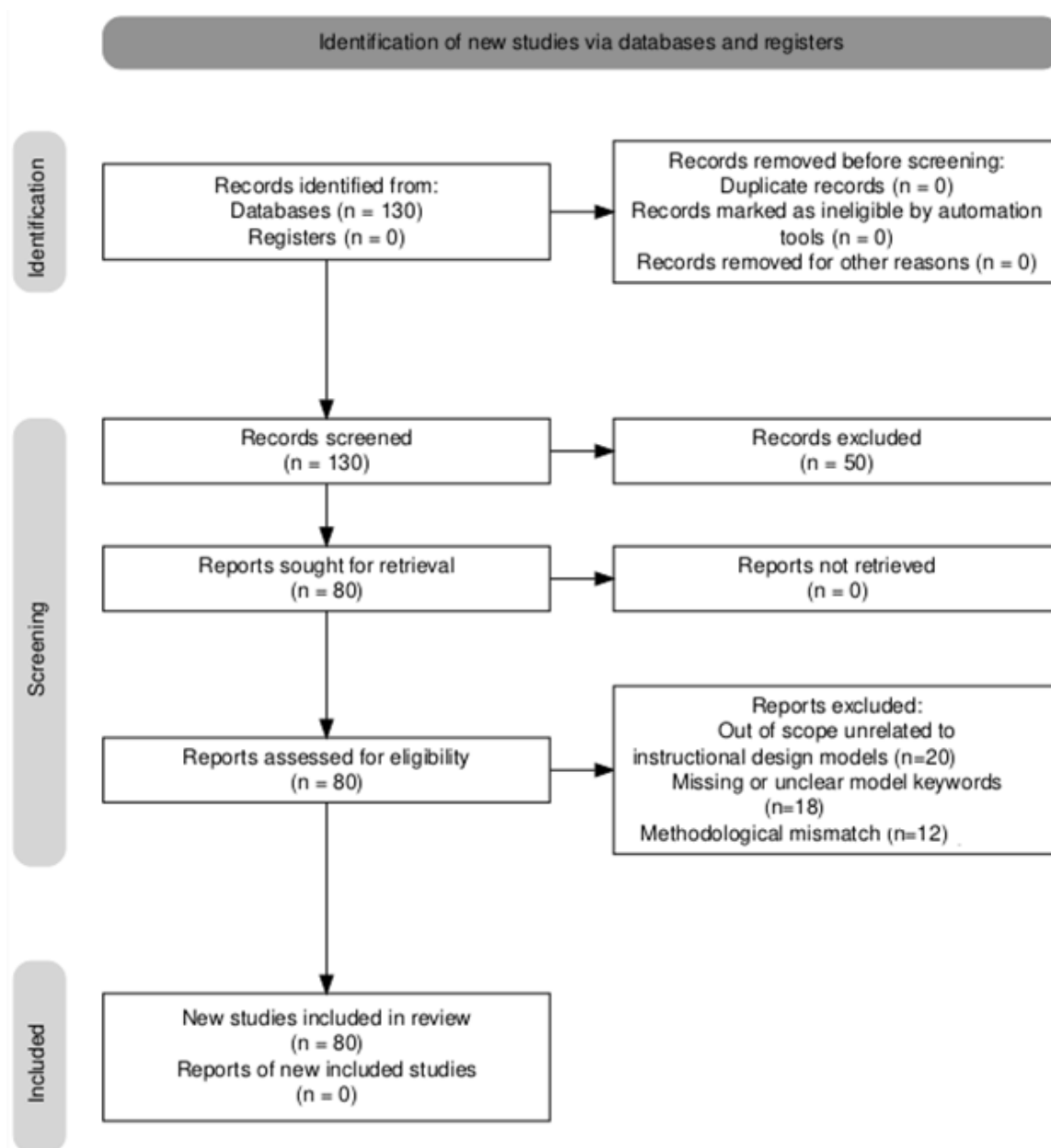
Table 2. *Inclusion and Exclusion Criteria*

Category	Rationale	Criteria
Inclusion	Published between 2020 and 2025	Focuses on the most recent 6-year period
	Peer-reviewed journal articles	Ensures academic credibility and quality
	Written in English	Allows for consistent comparison across studies
	Explicit reference to at least one instructional development model (ADDIE, DBR, EDR, or R&D).	Ensures relevance to the research aim
Exclusion	Conference proceedings, book chapters, editorials, or non-peer-reviewed sources	Excludes materials lacking peer review or formal validation
	Articles not directly focused on instructional design models	Removes studies only tangentially related to the topic
	Non-English publications	Avoids linguistic inconsistency in analysis
	Studies published before 2020 or after 2025	Keeps timeframe consistent with bibliometric mapping
	Duplicate records	Prevents double-counting of the same study

In Figure 1, the process of identification, screening, eligibility, and inclusion is summarized in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. This diagram lists the final set of analyzed articles and summarizes the identification, screening, and inclusion process for the reviewed studies.

A total of 130 records were identified from Scopus and other academic databases. After removing duplicates and ineligible items, 80 records were screened and assessed for eligibility (see Figure 1). Fifty records were excluded, 20 for being out of scope (not related to instructional design models), 18 for missing or unclear model keywords, and 12 for methodological mismatch, resulting in 80 peer-reviewed studies included in the final synthesis.

Figure 1. PRISMA Flow Diagram



Data Extraction and Coding Procedures

Titles and abstracts were independently reviewed by two trained coders using a rubric comprising three dimensions: explicit mention of the model, methodological orientation, and conceptual alignment. Articles were grouped into five categories: ADDIE, EDR, DBR, R&D, and Other/Unspecified. Inter-coder reliability was assessed using Cohen's $\kappa = 0.81$, indicating substantial agreement (Landis & Koch, 1977). Any discrepancies were resolved through consensus meetings to ensure transparency and consistency. The complete coding table is presented in Appendix A: List of Selected Studies and Coding Classification.

Bibliometric Mapping

Bibliographic metadata were exported from Scopus in comma-separated values (CSV) format, a universal spreadsheet type that stores data in rows and columns, similar to a Microsoft Excel file. This format was selected because it is compatible with bibliometric software. The dataset was then processed using VOSviewer version 1.6.20 (van Eck & Waltman, 2010), a widely used application for visualizing bibliometric networks.

VOSviewer generated keyword co-occurrence maps, overlay visualizations, and density maps that illustrate how terms cluster together across publications. For example, if “ADDIE” frequently appeared with “training” and “evaluation,” they formed a conceptual cluster. Parameter settings included a minimum keyword co-occurrence of 5, full counting as the counting method, association strength for normalization, and a clustering resolution of 1.0. Both the raw CSV files and the processed outputs are available in the supplementary materials.

Analytical Approach

The analysis was conducted in four interconnected stages. First, a frequency analysis tabulated the distribution of models across the sample, highlighting their relative prominence. Second, a temporal analysis mapped publication patterns between 2020 and 2025, revealing trends in model use over time. Third, a geographical and thematic analysis identified the countries of origin and disciplinary orientations of the studies. Finally, a conceptual analysis employed bibliometric clustering to detect epistemological orientations and conceptual linkages, showing how the models were positioned within broader scholarly discourses.

Validation of results was strengthened through cross-checking of categorizations and bibliometric outputs by both coders. This interpretive approach ensured that the findings extended beyond descriptive reporting, offering conceptual reflection on the epistemological positioning of each model and the contemporary relevance of EDR in educational research.

Results

Distribution of Development Models in Educational Research (2020–2025)

Analysis of the final sample of 80 peer-reviewed articles revealed a diverse distribution of instructional development models (see Appendix B). The ADDIE model appeared in 37 studies (46.3%), making it the most frequently applied framework. EDR was identified in 20 studies (25.0%), while DBR was present in 7 studies (8.8%). Only one study (1.3%) explicitly referenced the R&D model; 15 studies (18.8%) used general instructional design terminology without specifying a formal model. This pattern underscores the persistent dominance of ADDIE, reflecting its appeal due to procedural clarity and linear sequencing. At the same time, the rising proportion of EDR indicates an emerging methodological movement toward reflective, participatory, and context-sensitive approaches. The full distribution is illustrated in Figure 1.

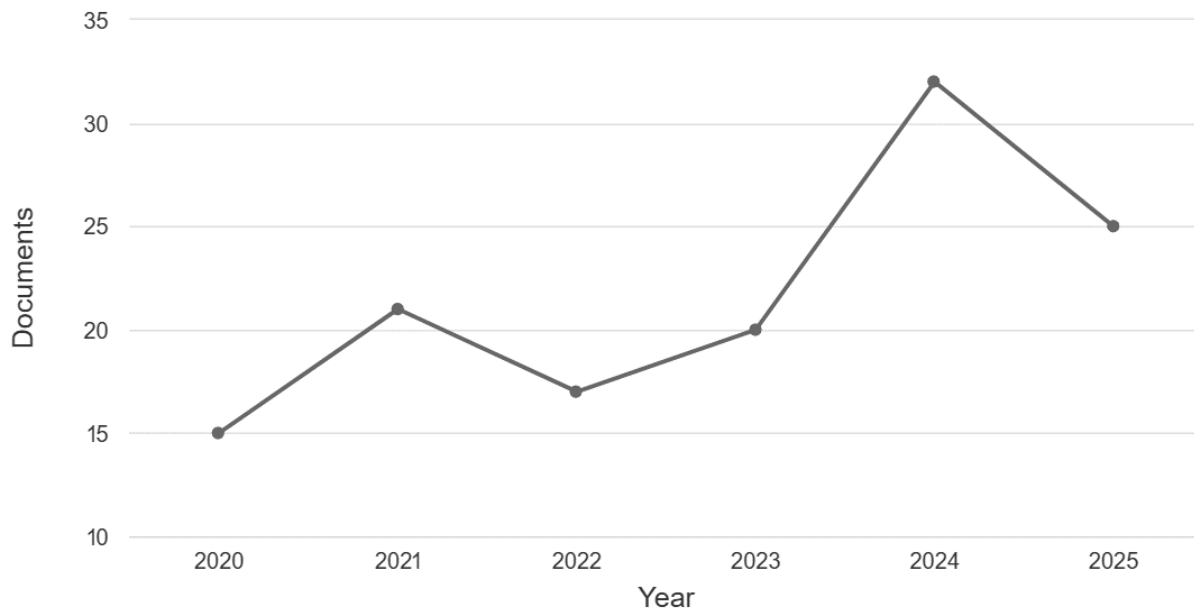
Temporal Trends in Educational Design Research

Publication patterns between 2020 and 2025 demonstrate an overall increase in research outputs, with a peak in 2024 of 32 publications, followed by a modest decline in 2025, likely attributable to indexing delays rather than an actual reduction in output. Model-specific trends indicate that ADDIE dominated in the early years (2020–2022) but began declining after 2023, while EDR showed steady growth and surpassed DBR and R&D by 2024. DBR remained underrepresented, and R&D appeared only once across the 6-year span. These temporal dynamics are depicted in Figure 2.

Figure 2 illustrates the annual distribution of publications included in the review between 2020 and 2025. Research output shows a steady increase from 2020 to 2021, followed by a slight dip in 2022. Publication activity then rose sharply, peaking in 2024 with 32 studies, before a moderate decline in 2025, likely due to indexing delays and ongoing publication processing. Overall, the trend indicates a growing scholarly interest in instructional design models during this 6-year period, particularly toward reflective and participatory frameworks.

Figure 2. Annual Publication Counts (2020–2025)

Documents by year



Geographical and Subject Distribution

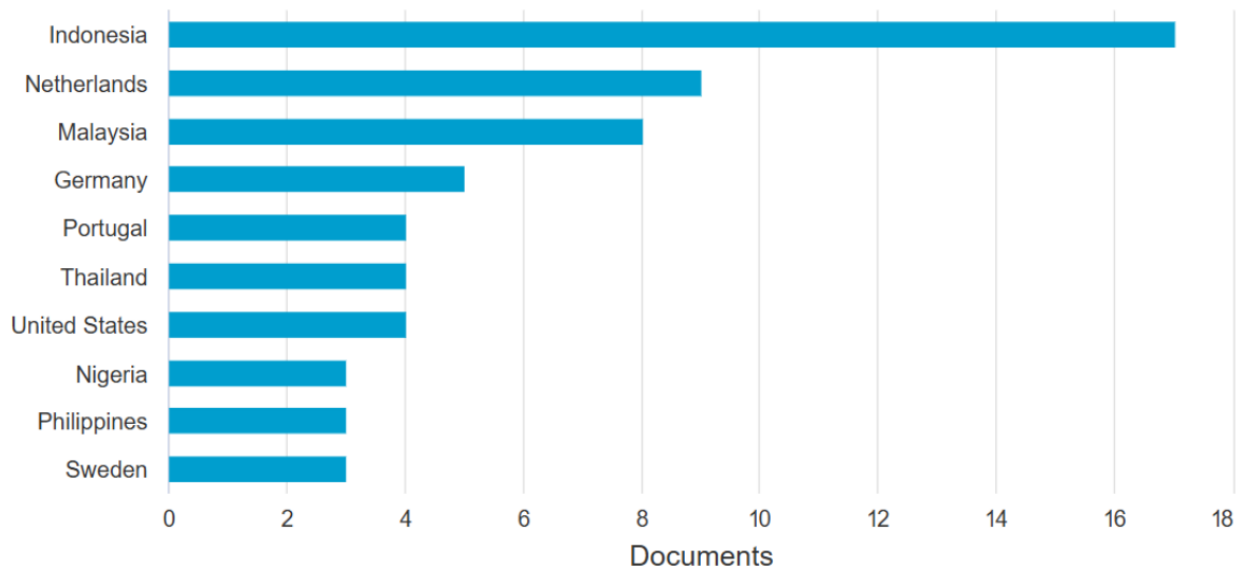
To test whether the observed increase of EDR over time represented a significant trend, a chi-square test of independence compared the distribution of models across early (2020–2022) and later (2023–2025) periods. Figure 3 provides a stacked bar chart illustrating the gradual shift from linear models, such as ADDIE, toward more iterative and theoretically engaged frameworks. Results indicated a statistically significant increase in the relative frequency of EDR publications in the later period, $\chi^2(1, N = 80) = 4.72, p = .03$. This supports the interpretation of an ongoing methodological transition from procedural frameworks toward reflective and participatory approaches.

Geographical mapping revealed that Indonesia contributed the largest share with 26 articles, followed by the Netherlands (15), Malaysia (13), and the United States (11). Indonesia's high output reflects its institutional reliance on ADDIE and R&D, combined with increasing adoption of EDR in recent years. The Netherlands' prominence aligns with its established tradition in design research, particularly influenced by scholars, such as Plomp (2013), Nieveen (2010), and McKenney (2019). European research, especially from the Netherlands, shows greater adoption of EDR. These results highlight regional methodological orientations shaped by national research cultures and policy priorities. The country-level distribution is presented in Figure 3.

Figure 3. *Geographic Distribution of Studies*

Documents by country or territory

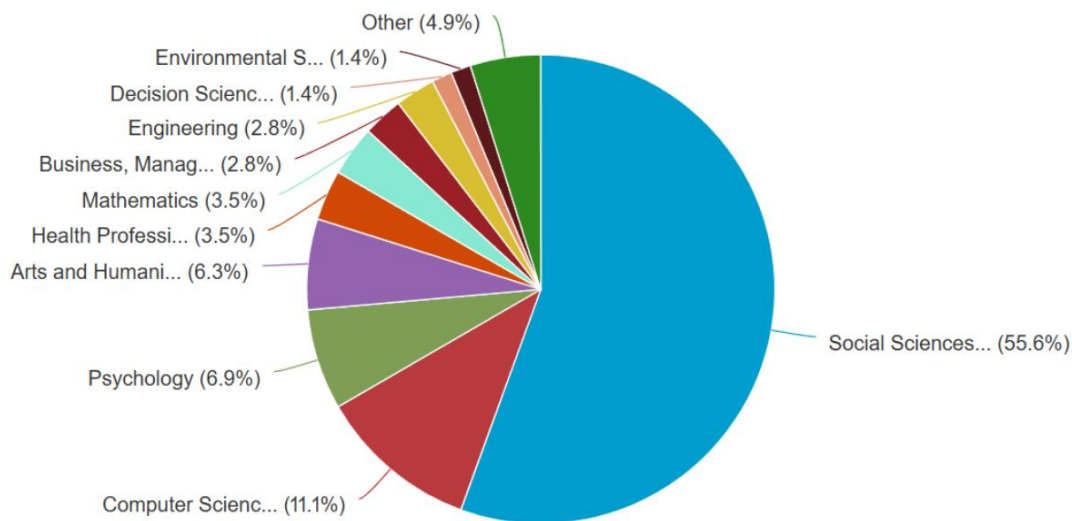
Compare the document counts for up to 15 countries/territories.



Regarding subject-area classification, 56.3% of the publications originated from the social sciences, with additional contributions from computer science (13.0%), psychology (6.1%), and arts and humanities (5.2%). Smaller proportions originated from health, mathematics, business, and engineering. This spread highlights the interdisciplinary reach of instructional design research, as shown in Figure 4, which presents the disciplinary distribution of the 80 analyzed studies, as classified by Scopus subject areas.

Figure 4. *Subject-Area Classification of Studies*

Documents by subject area



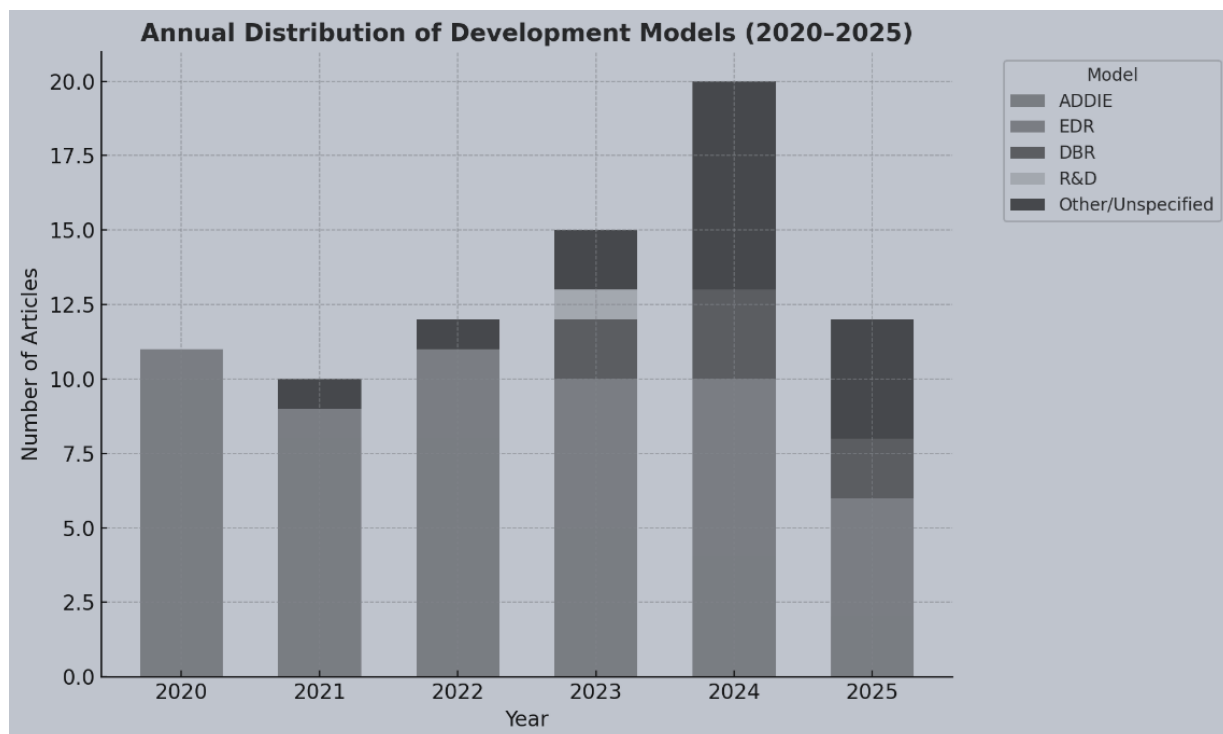
The social sciences dominate (56.3%), followed by computer science (13.0%), psychology (6.1%), and arts and humanities (5.2%). Smaller contributions emerge from engineering, health professions, mathematics, and business management, indicating that instructional design research increasingly spans interdisciplinary fields, with growing integration of technology and learning sciences.

Thematic Clustering and Conceptual Convergence

Bibliometric keyword co-occurrence mapping identified two dominant conceptual clusters. The first is anchored in ADDIE, linked with terms such as *module*, *training*, *effectiveness*, and *questionnaire*, emphasizing its procedural and evaluative orientation. The second cluster centers on EDR, associated with *collaboration*, *reflection*, *framework*, *practice*, and *co-design*, underscoring its participatory and iterative character. The keyword network is displayed in Figure 5, which visualizes bibliometric keyword co-occurrences extracted from Scopus data (2020–2025). Data were generated using VOSviewer version 1.6.20.

Two dominant clusters are displayed in Figure 5: one anchored in ADDIE, emphasizing procedural and evaluative terms (training, effectiveness, module, questionnaire), and another anchored in EDR, emphasizing participatory and reflective terms (collaboration, reflection, framework, co-design). Node size reflects keyword frequency, while color indicates cluster grouping. A grayscale version of this figure is provided in the supplementary materials for accessibility and online replication.

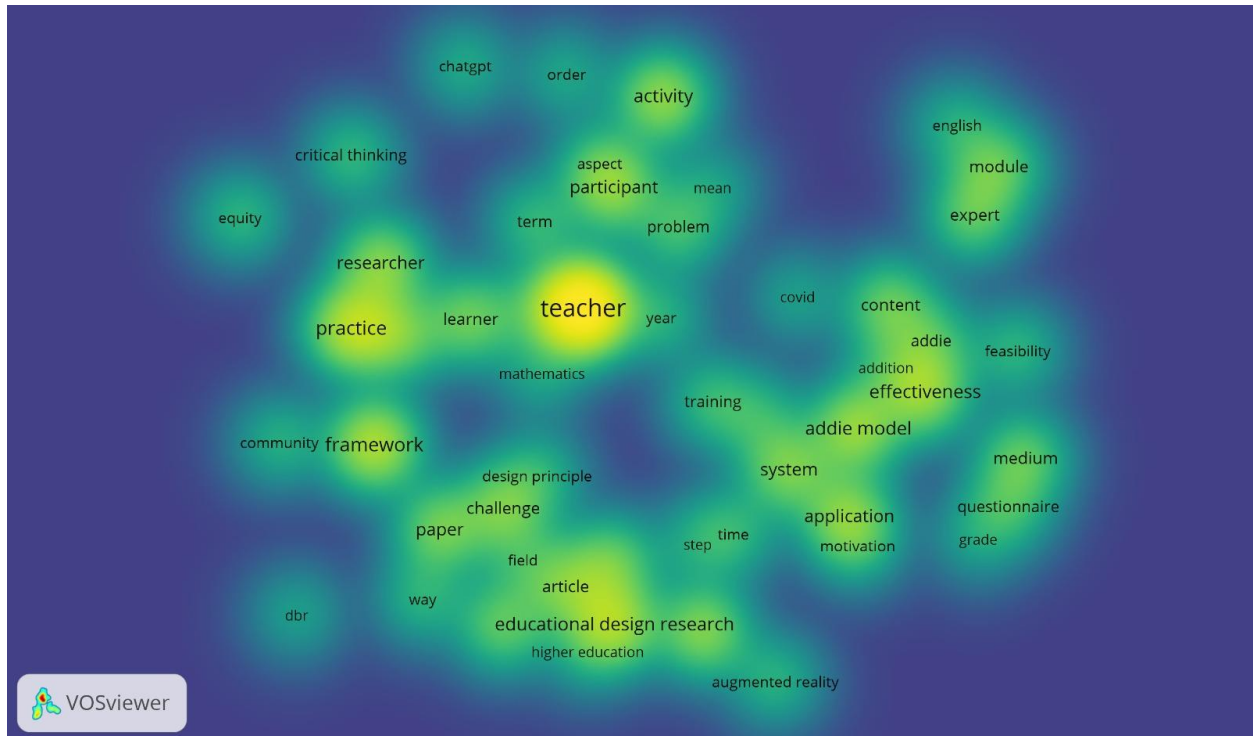
Figure 5. *Keyword Co-Occurrence Map of Instructional Design Models*



Temporal overlay analysis further revealed that procedural terms connected to ADDIE were most frequent between 2020 and 2022, while reflective and collaborative terms associated with EDR gained prominence after 2023. Density mapping reinforced this shift, with high-intensity nodes forming around both ADDIE and EDR, illustrating the ongoing methodological tension between technocratic and theory-informed approaches. Additional supporting visualizations are presented in Figures 6 and 7.

In Figure 8, the visualization, generated using VOSviewer (version 1.6.20), depicts the co-occurrence density of author keywords from all 80 studies. Warmer colors (yellow to red) represent higher keyword frequency. Central nodes, such as teacher, practice, framework, and EDR, indicate thematic cores, linking procedural design models like ADDIE with emergent reflective paradigms, such as EDR. The map reveals two conceptual clusters: one focused on procedural terms (training, evaluation, module) and another emphasizing reflective practices (collaboration, framework, co-design).

Figure 8. *Keyword Density Map*



Discussion

Reframing Educational Design Through Empirical Trends

The bibliometric results confirmed the dominance of the ADDIE model in instructional design research during the 2020–2025 period. Its popularity is largely attributable to procedural clarity and structured sequencing, which facilitate adoption in thesis projects and institutional training programs (Branch, 2009). As a standardized framework, ADDIE appeals to outcome-driven instructional development, although its rigidity and limited sensitivity to contextual dynamics have been consistently noted (Allen, 2006; Molenda, 2003).

In contrast, the increasing presence of EDR signals an epistemological shift. Unlike ADDIE, which frames design as a linear product, EDR positions design as an iterative and dialogic process shaped by contextual needs and theoretical validation (McKenney & Reeves, 2019; Nieveen & Folmer, 2013). Bibliometric keyword mapping (Figures 5–7) revealed that terms such as *reflection*, *collaboration*, and *pedagogical innovation*

gained centrality between 2022 and 2025, reinforcing the position of EDR as a reflective and participatory paradigm.

These bibliometric patterns are further substantiated by statistical testing. A chi-square analysis comparing early (2020–2022) and later (2023–2025) periods indicated a significant increase in the relative frequency of EDR publications, $\chi^2(1, N = 80) = 4.72, p = .03$. Taken together, these findings provide both descriptive and inferential evidence that instructional design scholarship is undergoing a gradual yet measurable transition from technocratic approaches toward more flexible and theory-informed methodologies.

Model Suitability: Between Procedural Efficiency and Reflective Design

Comparative analysis highlights the dual role of ADDIE: While widely used for its procedural simplicity and clarity (Branch, 2009; Gustafson & Branch, 2002), ADDIE's quantitative dominance comes at the cost of conceptual depth and socio-pedagogical responsiveness. Prior critiques emphasize its deterministic and linear orientation, which constrains participatory reflection and co-design (Allen, 2006; Molenda, 2003).

DBR emerged to counteract the limitations of ADDIE by embedding design processes within authentic contexts. This enables iterative testing and empirical refinement, particularly in technology-oriented interventions (Design-Based Research Collective, 2003; Wang & Hannafin, 2005). However, its heavy emphasis on tool-based or digital applications limits broader adaptability.

By contrast, EDR occupies an integrative position. It combines iterative cycles, participatory engagement, and explicit theoretical contribution, producing both practical interventions and conceptual principles (McKenney & Reeves, 2019). The results suggest that future methodological choices should consider not only procedural efficiency but also epistemological depth and pedagogical impact.

The Role of Context in Methodological Selection

The geographical distribution of this study (as previously illustrated in Figure 3) underscores the contextual dimension of methodological choice. Indonesia's dominance within the dataset reflects institutional traditions that privilege structured models, such as ADDIE and R&D, whereas European contributions, particularly from the Netherlands, have advanced EDR as a theoretically grounded and design-oriented approach (Nieveen & Folmer, 2013). This regional variation demonstrates how academic traditions, institutional priorities, and educational demands shape the adoption and preference of instructional design models.

Within higher education, contextual demands also help explain the growing prominence of EDR. Universities increasingly require adaptive and collaborative frameworks rather than rigid procedural models, particularly when addressing metacognitive learning, academic literacy, and interdisciplinary integration. Although DBR appears less frequently overall, it remains valuable in digital learning contexts where rapid prototyping and long-term iterative refinement are feasible. Consequently, the selection of a methodological approach should be informed not only by disciplinary conventions but also by institutional resources, pedagogical objectives, and problem-specific needs.

Toward a Reflective-Responsive Paradigm in Instructional Design

The combined bibliometric and conceptual findings point toward a gradual realignment from linear, procedural models to reflective and participatory frameworks. EDR represents the clearest manifestation of this transition, embedding inquiry into the design process itself and positioning researchers and practitioners as co-constructors of meaningful interventions (Kelly et al., 2008). This orientation aligns with constructivist epistemologies that privilege dialogue, inclusivity, and transformation (Gravemeijer & Cobb, 2006).

Adopting a reflective-responsive paradigm not only enhances theoretical rigor but also strengthens practical relevance in dynamic, post-pandemic educational contexts. EDR's dual orientation, linking theory and practice, offers a robust methodology for addressing contemporary challenges such as learner diversity, interdisciplinarity, and the demand for collaborative knowledge creation.

Conclusion

Building on these empirical and conceptual insights, this comparative review of four instructional development models clarifies distinct methodological trajectories in recent educational research. The ADDIE model continues to dominate due to its structured and replicable procedures, yet its linear orientation and limited contextual adaptability reduce its relevance in complex and participatory educational environments (Branch, 2009; Molenda, 2003). In contrast, EDR is gaining prominence as a reflective and theory-integrated approach, a trend demonstrated by its growing frequency across the dataset (McKenney & Reeves, 2019; Nieveen & Folmer, 2013). Although DBR and R&D appeared only sparingly, their presence indicates a continued but marginal role in supporting experimental and iterative traditions.

The bibliometric evidence and statistical testing jointly indicate a measurable methodological shift. While ADDIE still accounted for nearly half of the reviewed studies, EDR represented approximately one quarter of the sample. A chi-square analysis confirmed a statistically significant increase in the relative frequency of EDR publications over time, $\chi^2(1, N = 80) = 4.72, p = .03$. These findings support the interpretation of an emerging transition from outcome-focused proceduralism toward more reflective, participatory, and context-responsive design practices. However, the relatively small representation of DBR and R&D models suggests that this statistical evidence should be viewed as indicative rather than conclusive, warranting further longitudinal research to validate the observed trend.

The results carry significant practical implications for both research and professional training. Graduate programs should integrate EDR into curricula to balance procedural competence with theory-driven and contextually responsive design. Supervisors are encouraged to foster iterative and dialogic mentorship rather than checklist-oriented guidance, supporting students in developing reflective inquiry skills that are essential for contemporary design research. Likewise, institutions should promote interdisciplinary collaboration and evaluation systems that reward theory-practice integration, ensuring that design outcomes contribute to both scholarly advancement and practical innovation.

Beyond pedagogical training, embedding EDR principles into institutional research culture can nurture sustainable cycles of reflection, innovation, and improvement. By aligning curriculum development, faculty supervision, and institutional assessment with the reflective, collaborative ethos of EDR, universities can cultivate environments where educators become co-designers of knowledge rather than mere implementers of prescribed procedures. Such a paradigm fosters methodological agility and adaptive expertise, preparing researchers to navigate the complexities of 21st-century educational ecosystems with critical insight, ethical sensitivity, and transformative intent.

Several methodological constraints limit the generalizability of the findings. The reliance on the Scopus database excluded non-indexed or regionally published work, while the restriction to English-language articles reduced linguistic diversity. The search strategy, based on exact keyword filtering, may have favored studies using established terminology, potentially underrepresenting hybrid or emergent approaches. Geographic concentration, with a notable proportion of studies from Indonesia, reflects regional methodological traditions and may have skewed perceptions of global trends. The classification of studies, conducted by two independent coders with substantial agreement ($\kappa = .81$), ensured consistency, yet the interpretation of hybrid cases remains challenging. Bibliometric analyses also relied on specific VOSviewer

parameters, which, while suitable for detecting major clusters, may have overlooked smaller or emerging conceptual patterns.

Despite these constraints, this study provides meaningful insights into methodological developments in instructional design research. The rising prominence of EDR underscores its potential as a reflective and participatory paradigm capable of bridging theory and practice, advancing scholarship, and addressing the evolving challenges of contemporary higher education.

Because the search was limited to English-language, Scopus-indexed journals, scholarship published in regional or non-English databases, particularly from developing contexts, may be underrepresented, potentially narrowing the observed methodological and cultural range. Future updates should incorporate multilingual and regionally indexed databases to provide a more inclusive and globally representative synthesis.

As a form of sensitivity analysis, the dataset was restricted to publications from 2020 to 2024 to mitigate potential indexing lag for 2025 entries. The directional pattern remained consistent, showing an increasing relative proportion of EDR, and the chi-square test remained significant at the .05 level, leaving the interpretation of the emerging methodological transition unchanged.

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Appendix A

Entries in this appendix list the first author (surname, given name), article title, source, year, and DOI/URL exactly as indexed. Model Classified (Auto) was generated by keyword rules and verified during coding: ADDIE (mentions “ADDIE” or “Analysis Design Development Implementation Evaluation”), DBR (contains “design-based research”), EDR (contains “educational design research”), and R&D (explicit “research and development model,” often linked to Borg & Gall). When multiple models appeared in one article, coders selected the dominant methodological frame described in Methods/Design; disagreements were resolved by consensus.

Coding Category definitions include: Explicit model use = the model is named and operationalized in the study design; Procedural (unspecified model) = procedural steps are described without naming a formal model; Unspecified/Other = design activity reported but not classifiable under the four focal models; Iterative intervention = multi-cycle design reported but not tied to DBR/EDR labels; Contextual/participatory alignment = aims and procedures emphasize stakeholder participation/contextual inquiry consistent with EDR values but without model naming.

DOIs are preferred; a URL is shown only when a DOI is unavailable. Titles/venues are kept in the language of publication; diacritics are preserved. Author strings follow the source record and may include initials as indexed. Sorting follows the table order and does not imply study quality. The corpus was drawn from Scopus (2020–2025) per inclusion criteria described in the Methods; full bibliographic references appear in the References section.

List of Selected Studies and Coding Classification

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Alaoui, Siham	(Re)Designing an Online Course in Archival Science Using the ADDIE Model: Lessons Learned and Future Directions	<i>Journal of Education for Library and Information Science</i> https://doi.org/10.3138/jelis-2023-0060	2025	ADDIE	Explicit model use
Artman, Nicholas	Applying the Cognitive Theory of Multimedia Learning: Using the ADDIE Model to Enhance Instructional Video	<i>Explorations in Media Ecology</i> https://doi.org/10.1386/eme_00054_1	2020	ADDIE	Explicit model use
Karthikeyan, P., A.M., Abirami, A. M., T., Murugan, Thangavel	Enhancing Learner Engagement in Online Education Through ADDG9E Model	<i>Journal of Engineering Education Transformations</i> https://doi.org/10.16920/jeet/2024/v37is2/24022	2024	ADDIE	Explicit model use
Lai, Liqi, L., Wang, Luyao, R., Huang, Rui, Z.L., Jiang, Zoe Lin, J., Huang, Junbo, W., Shi, Wenyue, B., Zhou, Bin, R., Chen, Renzhang, B., Lei, Bin, J. B., Fang, Junbing Bin	Task-Driven ADDIE-Twist Model With a Teach-Study Double-Helix Structure	<i>IEEE Transactions on Education</i> https://doi.org/10.1109/TE.2023.3296975	2024	ADDIE	Explicit model use
Maxnun, Lu'luil, K., Kristiani, Kristiani, C. D. S., Indrawati, Cicilia Dyah Sulistyaningrum	Development of Hots-Based Cognitive Assessment Instruments: ADDIE Model	<i>Journal of Education and Learning</i> https://doi.org/10.11591/edulearn.v18i2.21079	2024	ADDIE	Explicit model use

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Nwizu, Ucheoma, C. N., Sariem, Comfort Nanbam, J. V., Malhotra, Jodie V.	Training Nigerian Pharmacy Interns for Leadership and Clinical Pharmacy Advancement Using the ADDIE Method of Instructional Design	<i>Pharmacy Education</i> https://doi.org/10.46542/ pe.2022.224.143149	2022	ADDIE	Explicit model use
Salas-Rueda, Ricardo Adán, É. P., Salas-Rueda, Érika Patricia, R. D., Salas-Rueda, Rodrigo David	Analysis and Design of the Web Game on Descriptive Statistics Through the ADDIT Model, Data Science and Machine Learning	<i>International Journal of Education in Mathematics, Science and Technology</i> https://doi.org/10.46328/ IJEMST.V8I3.759	2020	ADDIE	Explicit model use
Shahat, Hussein Ahmed, S. A., Gaber, Sherif Adel, H. K., Aldawsari, Hussam Khalifah	Using the ADDIE Model to Teach Creativity in the Synthesis of Raw Materials	<i>International Journal of Learning, Teaching and Educational Research</i> https://doi.org/10.26803 /ijlter.22.6.15	2023	ADDIE	Explicit model use
Tu, Juiche, X., Zhang, Xu, X., Zhang, Xiuyue	Basic Courses of Design Major Based on the ADDIE Model: Shed Light on Response to Social Trends and Needs	<i>Sustainability</i> (Switzerland) https://doi.org/10.3390/s u13084414	2021	ADDIE	Explicit model use
Yu, Shih Jou, Y., Hsueh, Yuling, J. C. Y., Sun, Jerry Chih Yuan, H., Liu, Haoze	Developing an Intelligent Virtual Reality Interactive System Based on the ADDIE Model for Learning Pour-Over Coffee Brewing	<i>Computers and Education: Artificial Intelligence</i> https://doi.org/10.1016/j. caesai.2021.100030	2021	ADDIE	Explicit model use
Azimi, Esmaeil, L., Jafari, Leila, Y., Mahdavinassab, Yousef	Using a Design-Based Research Methodology to Develop and Study Prompts Integrated Into Geogebra to Support Mathematics Learning of Gifted Students	<i>Education and Information Technologies</i> https://doi.org/10.1007/s 10639-023-11632-9	2023	DBR	Explicit model use
Dermentzi, Eleni, M., Zotou, Maria, E., Tambouris, Efthimios, K. A., Tarabanis, Konstantinos A.	Using the Problem Based Learning Method and Educational Technologies to Teach Open Data: A Design- Based Research Approach	<i>Education and Information Technologies</i> https://doi.org/10.1007/s 10639-022-10995-9	2022	DBR	Explicit model use
Fahd, Kiran, S. J., Jahan Miah, Shah Jahan, K. E. U., Ahmed, Khandakar Entenam Unayes, S., Venkatraman, Sitalakshmi, Y., Miao, Yuan	Integrating Design Science Research and Design Based Research Frameworks for Developing Education Support Systems	<i>Education and Information Technologies</i> https://doi.org/10.1007/s 10639-021-10442-1	2021	DBR	Explicit model use
Fowler, Samuel, S. N., Leonard, Simon N.	Using Design Based Research to Shift Perspectives: A Model for Sustainable Professional Development for the Innovative Use of Digital Tools	<i>Professional Development in Education</i> https://doi.org/10.1080/1 9415257.2021.1955732	2024	DBR	Explicit model use
Peschl, Rosalynn, H., Peschl, Houston, L., Bortolin, Leah, V., Reid, Victoria	A Case of Design Based Research Methodology to Create Curriculum for an Entrepreneurial Thinking Course.	<i>International Journal of Management Education</i> https://doi.org/10.1016/j. ijme.2023.100838	2023	DBR	Explicit model use
Zydney, Janet Mannheimer, Z. B., Warner, Zachary B., L., Angelone, Lauren	Learning Through Experience: Using Design Based Research to Redesign Protocols for Blended	<i>Computers and Education</i> https://doi.org/10.1016/j. compedu.2019.103678	2020	DBR	Explicit model use

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
	Synchronous Learning Environments				
Ang, Jayden Wei Jie, Y., Ng, Yinni, L.H.W., Lee, Lynette Hui Wen, J. Y., Yong, Jia Ying	Exploring Students' Learning Experience and Engagement in Asynchronous Learning Using the Community of Inquiry Framework Through Educational Design Research	<i>Education Sciences</i> https://doi.org/10.3390/educsci14030215	2024	EDR	Explicit model use
Ge, Xun, J.C., Liu, Juhong Christie, Z., Li, Zhe	Guest Editorial: Educational Design Research for Digital Learning Technologies to Promote Inclusion, Equity, and Accessibility	<i>Educational Technology and Society</i> https://doi.org/10.30191/ETS.202410_27(4).SP01	2024	EDR	Explicit model use
Gül, Muhammet Davut, B., Coştu, Bayram	Improving a Multimodal Based Teacher Training Program for Teachers of Gifted: An Educational Design Research; Unaprjedenje Programa za Edukaciju Učitelja Darovitih Učenika Temeljenoga na Multimodalnosti: Istraživanje Obrazovnoga Dizajna	<i>Croatian Journal of Education</i> https://doi.org/10.15516/cje.v26i4.5856	2024	EDR	Explicit model use
Jacobsen, Michele, S. E., Mckenney, Susan E.	Educational Design Research: Grappling With Methodological Fit	<i>Educational Technology Research and Development</i> https://doi.org/10.1007/s11423-023-10282-5	2024	EDR	Explicit model use
João, Patrícia, M. H., Henriques, M. H., A.V., Rodrigues, Ana V., P., Sá, Patrícia	In-Service Teacher Education Program Through an Educational Design Research Approach in the Framework of the 2030 Agenda	<i>Education Sciences</i> https://doi.org/10.3390/educsci13060584	2023	EDR	Explicit model use
Kartoğlu, Ümit H., R.C., Siagian, Ria Christine, T. C., Reeves, Thomas Charles	Creating a “Good Clinical Practices Inspection” Authentic Online Learning Environment Through Educational Design Research	<i>TechTrends</i> https://doi.org/10.1007/s11528-020-00509-0	2020	EDR	Explicit model use
Mckenney, Susan E., T. C., Reeves, Thomas Charles	Educational Design Research for Relevant & Robust Scholarship	<i>Journal of Computing in Higher Education</i> https://doi.org/10.1007/s12528-025-09456-2	2025	EDR	Explicit model use
Meeuwssen, Bert	Thematic Paper on Ethics in Higher Business Education—Educational Design Research Need	<i>Caritas et Veritas</i> https://doi.org/10.32725/cetv.2022.028	2022	EDR	Explicit model use
Mirattanaphrai, Pantechat, S., Srikoon, Sanit	Design and Development of Innovator Self-Assessment Questionnaire for Students in Grade 6: Utilizing Educational Design Research	<i>Social Sciences and Humanities Open</i> https://doi.org/10.1016/j.ssaho.2025.101414	2025	EDR	Explicit model use
Pumyoch, Natthiya, S., Srikoon, Sanit	Executive Function Training Curriculum to Enhance Emotional Intelligence in Early Childhood: Theory Adaptation in Educational Design Research	<i>Thinking Skills and Creativity</i> https://doi.org/10.1016/j.tsc.2024.101673	2024	EDR	Explicit model use
Sá, Patrícia, P. C., Silva, Patrícia Christine, J., Peixinho, Joana, A.,	Sustainability at Play: Educational Design Research for the Development of a Digital	<i>Social Sciences</i> https://doi.org/10.3390/ocsci12070407	2023	EDR	Explicit model use

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Figueiras, Ana, A. V., Rodrigues, Ana V.	Educational Resource for Primary Education				
Schat, Esther, E., van der Knaap, Ewout, R. D., de Graaff, Rick D.	Key Principles for an Integrated Intercultural Literary Pedagogy: An Educational Design Research Project on Arts Integration for Intercultural Competence	<i>Language Teaching Research</i> https://doi.org/10.1177/13621688211045012	2023	EDR	Explicit model use
Silva, Patrícia Christine, A. V., Rodrigues, Ana V., P. N., Vicente, Paulo Nuno	An Evaluation of the Experimental Science Teaching Program for Primary Education from the Teachers' Perspective: An Educational Design Research Journey	<i>Education Sciences</i> https://doi.org/10.3390/educsci14070782	2024	EDR	Explicit model use
Silva, Patrícia Christine, P. N., Vicente, Paulo Nuno, A. V., Rodrigues, Ana V.	Development of Serious Games for Science Assessment Using Educational Design Research	<i>International Journal of Serious Games</i> https://doi.org/10.17083/ijsg.v12i2.854	2025	EDR	Explicit model use
Uusiutti, Satu, S., Hyvarinen, Sanna, H., Kangastie, Helena, S., Kari, Sofia, J., Löf, Jonna, M., Naakka, Moona, K., Rautio, Krista, N., Riponiemi, Netta	Character Strengths in Higher Education: Introducing a Strengths-Based Future Guidance (SBFG) Model Based on an Educational Design Research in Two Northern Finnish Universities	<i>Journal of Psychological and Educational Research</i>	2022	EDR	Explicit model use
Vos, Pauline, P., Frejd, Peter	Grade 8 Students Appropriating Sankey Diagrams: The First Cycle in an Educational Design Research	<i>Journal on Mathematics Education</i> https://doi.org/10.22342/jme.v13i2.pp289-306	2022	EDR	Explicit model use
Wotring, Anthony	Contextualising Dialogic Teaching Through Educational Design Research: Evolving Teaching Principles With EFL Teachers and Students	<i>TESL-EJ</i> https://doi.org/10.55593/ej.28112a3	2025	EDR	Explicit model use
Abdurrahman, Muhammad Sani, A. H., Abdullah, Abdul Halim, S. B., Osman, Sharifah Binti	Design and Development of Linear Algebra Peer Tutoring Strategy to Develop Students Mathematical Thinking Processes Based on Experts' Evaluation	<i>Universal Journal of Educational Research</i> https://doi.org/10.13189/ujer.2020.080836	2020	Others/Unspecified	Procedural (unspecified model)
Ahmed, Md Meraz, A., Rahman, Anika, M. K., Hossain, Md Kamal, F. B., Tambi, Fatimah Binti	Ensuring Learner-Centred Pedagogy in an Open and Distance Learning Environment by Applying Scaffolding and Positive Reinforcement	<i>Asian Association of Open Universities Journal</i> https://doi.org/10.1108/AOUJ-05-2022-0064	2022	Others/Unspecified	Unspecified/Other
Ahmed, Md Meraz, H. A., Haroon, Harshita Aini, M. K., Hossain, Md Kamal, F. B., Tambi, Fatimah Binti	Implementing Learning Management System-Integrated Blended Learning in Teacher Training Programme at Bangladesh Open University	<i>Open Learning</i> https://doi.org/10.1080/02680513.2024.2385345	2025	Others/Unspecified	Procedural (unspecified model)
Ahmed, Taghread Elsayed, H., Ibrahim, Heba, G. M. Y., Elsayed, Ghada Mohamed Youssef, N. T., Ebrahim Housen, Nour Taha, M. A. A., Ebrahim, Mona Abdelmoneim	Promoting Students' Health Awareness and Higher Order Thinking Skills Using E Projects Strategy in Learning Physical and Health Education	<i>Journal of Education and Health Promotion</i> https://doi.org/10.4103/jehp.jehp_1701_22	2023	Others/Unspecified	Unspecified/Other

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Abdelmabood, N., El-Tanahi, Nagla, N. M. R., Sofy, Naglaa Mohamed Roby, S. N., Housny Elshltawy, Sara Nashat					
Alghazzawi, Daniyal M., S. H., Hasan, Syed Hamid, G. A., Aldabbagh, Ghadah Abdullah, M. J., Alhaddad, Mohammed Jaffer, A. A., Malibari, Areej Abbas, M. Z., Asghar, Muhammad Zubair, H. M., Aljuaid, Hanan M.	Development of Platform Independent Mobile Learning Tool in Saudi Universities	<i>Sustainability</i> (Switzerland) https://doi.org/10.3390/su13105691	2021	Others/Unspecified	Procedural (unspecified model)
Alkhateeb, Mohammad Ahmad	Correcting Misconceptions in Fractions Using Interactive Technological Learning Activities	<i>International Journal of Learning, Teaching and Educational Research</i> https://doi.org/10.26803/ijlter.19.4.17	2020	Others/Unspecified	Unspecified/Other
Alvarez, Joel I., S. M. A., Galman, Sheena Mai A.	Massive Open Online Course in Elementary Statistics: From Analysis to Evaluation	<i>Educational Process: International Journal</i> https://doi.org/10.22521/edupij.2025.14.86	2025	Others/Unspecified	Procedural (unspecified model)
Arnilla, Arvin Kim A.	Print-Based Storybook in the Mother Tongue for Teaching COVID-19 Prevention in the Philippines	<i>Cypriot Journal of Educational Sciences</i> https://doi.org/10.18844/cjes.v17i8.7381	2022	Others/Unspecified	Unspecified/Other
Azizan, Suzana Ariff, N. A., Abu Shamsi, Nurulaini Abu	Design-Based Learning as a Pedagogical Approach in an Online Learning Environment for Science Undergraduate Students	<i>Frontiers in Education</i> https://doi.org/10.3389/feduc.2022.860097	2022	Others/Unspecified	Procedural (unspecified model)
Bak-Piard, Maxy, S., Kroon, Sjaak	The Implementation and Evaluation of a Program for Dutch Language Proficiency for Teacher Education in Curaçao; De Implementatie en Evaluatie van een Programma Voor Nederlandse Taalvaardigheid Voor de Lerarenopleiding in Curaçao	<i>Pedagogische Studien</i> https://doi.org/10.59302/ps.v100i2.14222	2023	Others/Unspecified	Procedural (unspecified model)
Björklund, Camilla, H., Palmér, Hanna	Preschoolers' Reasoning About Numbers in Picture Books	<i>Mathematical Thinking and Learning</i> https://doi.org/10.1080/10986065.2020.1741334	2020	Others/Unspecified	Unspecified/Other
Bose, Arindam	Fostering Meaning in a Trilingual Mathematics Classroom by Connecting Everyday and School Mathematical Ways of Talking: A Design Approach	<i>ZDM - International Journal on Mathematics Education</i> https://doi.org/10.1007/s11858-021-01254-1	2021	Others/Unspecified	Procedural (unspecified model)
Cacciamani, Stefano, G. R., Mangione, Giuseppina Rita, M., Pieri, Michelle	The Teachers' Reflective Activity for the Development of an Innovative Model for Small Schools: The Case of "Classi In Rete"	<i>Querty</i> https://doi.org/10.30557/QW000087	2024	Others/Unspecified	Procedural (unspecified model)

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Choi, Heeseung, U., Lee, Ujin, T., Gwon, Taekyun	Development of a Computer Simulation-Based, Interactive, Communication Education Program for Nursing Students	<i>Clinical Simulation in Nursing</i> https://doi.org/10.1016/j.ecns.2021.04.019	2021	Others/Unspecified	Procedural (unspecified model)
Clement, Mieke, I., Op de Beeck, Ilse, K., Rajagopal, Kamakshi	Towards the Mainstreaming of Online Mobility at KU Leuven	<i>Education Sciences</i> https://doi.org/10.3390/educsci13010014	2023	Others/Unspecified	Unspecified/Other
de Jong, Nivja H., S.A., Raaijmakers, Stephan A., D. E. H., Tigelaar, Dineke E. H.	Developing high-quality, practical, and ethical automated L2 speaking assessments	System https://doi.org/10.1016/j.system.2025.103796	2025	Others/Unspecified	Unspecified/Other
de Witt, Annick, M. C., Bootsma, Margien C., B. J., Dermody, Brian J., K. T., Rebel, Karin T.	Designing Transformative Interventions for a World in Crisis: How the “Worldview Journey” Invites for Personal, Cultural, and Systems Transformation	<i>Environmental Science and Policy</i> https://doi.org/10.1016/j.envsci.2024.103896	2024	Others/Unspecified	Procedural (unspecified model)
de Witt, Annick, M.C., Bootsma, Margien C., B. J., Dermody, Brian J., K. T., Rebel, Karin T.	The Seven-Step Learning Journey: A Learning Cycle Supporting Design, Facilitation, and Assessment of Transformative Learning	<i>Journal of Transformative Education</i> https://doi.org/10.1177/15413446231220317	2024	Others/Unspecified	Iterative intervention
Dirgayasa, I. Wy, S. J., Lubis, Safrida J., A., Sari, Asrita	Developing Worksheet Through Socrative to Improve Students’ English Writing Skill	<i>World Journal of English Language</i> https://doi.org/10.5430/wjel.v13n1p405	2023	Others/Unspecified	Unspecified/Other
Esteve-Mon, Francesc M., A., Sánchez-Caballé, Anna, M. Á., Llopis-Nebot, Maria Ángeles	Social Networking From a Transmedia Perspective: The Development of Reflective and Digital Competencies of Student-Teachers	<i>Journal of Educational Multimedia and Hypermedia</i>	2021	Others/Unspecified	Procedural (unspecified model)
Fadhli, Rahmat, A., Suharyadi, Aris, F. M., Firdaus, Fery Muhamad, M., Bustari, Meilina	Developing a Digital Learning Environment Team-Based Project to Support Online Learning in Indonesia	<i>International Journal of Evaluation and Research in Education</i> https://doi.org/10.11591/ijere.v12i3.24040	2023	Others/Unspecified	Unspecified/Other
Falaahudin, Ardhika, Suharjana, Sumarjo, D., Tirtawirya, Devi, D. T., Iwandana, Dody Tri, P., Padli, Padli, Y., Ockta, Yovhandra, M. I., Sabillah, Muhamad Ichsan	Development and Practicality of Android-Based Application to Assess the Physical Condition of Young Swimmers	<i>International Journal of Human Movement and Sports Sciences</i> https://doi.org/10.13189/saj.2025.130116	2025	Others/Unspecified	Procedural (unspecified model)
Fink, Maximilian Christian, A., Radkowsch, Anika, E. B., Bauer, Elisabeth B., M., Sailer, Michael, J., Kiesewetter, Jan, R., Schmidmaier, Ralf, M., Siebeck, Matthias, F., Fischer, Frank, M. R., Fischer, Martin R.	Simulation Research and Design: A Dual-Level Framework for Multi-Project Research Programs	<i>Educational Technology Research and Development</i> https://doi.org/10.1007/s11423-020-09876-0	2021	Others/Unspecified	Procedural (unspecified model)
Fred, Huijboom, P., van Meeuwen, Pierre, R.,	How to Enhance Teachers’ Professional Learning by Stimulating the Development of	<i>Professional Development in Education</i>	2020	Others/Unspecified	Procedural (unspecified model)

Authors	Title	Journal/ DOI (URL)	Year	Model Classified (Auto)	Coding Category
Ellen, Rusman, V., Marjan, Vermeulen	Professional Learning Communities: Operationalising a Comprehensive PLC Concept for Assessing its Development in Everyday Educational Practice	https://doi.org/10.1080/19415257.2019.1634630			
Gök, Ahmet, A., Karamete, Ayşen	Designing a Mathematical Modeling Activity for Students with Mild Intellectual Disabilities: Google Maps Example; Haff Düzeyde Zihinsel Yetersizliği Olan Öğrencilere Yönelik Matematiksel Modelleme Etkinliği Geliştirilmesi: Google Haritalar Örneği	<i>Milli Egitim</i> https://doi.org/10.37669/milliegitim.1605632	2025	Others/Unspecified	Procedural (unspecified model)
Gusti, Wahyu Ramadhani, F., Arifin, Fatchul	Embedded System Training Kit for Artificial Intelligence	<i>International Journal of Information and Education Technology</i> https://doi.org/10.18178/ijiet.2024.14.1.2026	2024	Others/Unspecified	Unspecified/Other
Hadriana, Hadriana, M., Adanan, Mahdum, T., Herawan, Tutut	M-WebQuest Development: Reading Comprehension of Senior High School Students in Indonesia	<i>International Journal of Emerging Technologies in Learning</i> https://doi.org/10.3991/ijet.v15i03.10628	2020	Others/Unspecified	Procedural (unspecified model)
Hamdani, Aam I. S., A., Suherman, Amay	Self-Design Project Based Learning: An Alternative Learning Model for Vocational Education	<i>Journal of Technical Education and Training</i> https://doi.org/10.30880/jtet.2021.13.03.007	2021	Others/Unspecified	Procedural (unspecified model)
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Hamid, Siti Nurshuhada Mohd, T. T., Lee, Tien Tien, H. B., Taha, Hafsa Binti, N. A., Rahim, Nurulsaidah Abdul, A. M., Sharif, Aisyah Mohamad	E-Content Module For Chemistry Massive Open Online Course (MOOC): Development And Students' Perceptions	<i>Journal of Technology and Science Education</i> https://doi.org/10.3926/jotse.1074	2021	Others/Unspecified	Procedural (unspecified model)
Hijriyah, Umi, R. N., Edi, Relit Nur, Erlina, G.C., Kesuma, Guntur Cahaya, T. S. I., Khodr, Tamer Sa'Ad Ibrahim	Innovative Approaches To Arabic Vocabulary Learning For Islamic Senior High School Students With Lectora Inspire	<i>Jurnal Pendidikan Islam</i> https://doi.org/10.15575/JPI.V10I2.28754	2024	Others/Unspecified	Unspecified/Other
Hirshfield, Laura J., M.D., Koretsky, Mílo D.	Cultivating Creative Thinking in Engineering Student Teams: Can a Computer-Mediated Virtual Laboratory Help?	<i>Journal of Computer Assisted Learning</i> https://doi.org/10.1111/jcal.12509	2021	Others/Unspecified	Unspecified/Other

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Insani, Marzius, E. Y., Haenilah, Een Yayah, H., Hariri, Hasan, R. M., Sinaga, Risma Margaretha	Audio-Visual-Based History Learning Media Materials About Human Life in the Literary Age	<i>Journal of Education and Learning</i> <a href="https://doi.org/10.11591/
edulearn.v17i3.20730">https://doi.org/10.11591/ edulearn.v17i3.20730	2023	Others/Unspe cified	Unspecified/Other
Kalyoncu, Furkan, H., Kara, Hasan	Design And Development of Augmented Reality Application for Basic Concepts of Computer Systems	<i>Education and Information Technologies</i> <a href="https://doi.org/10.1007/s
10639-024-12971-x">https://doi.org/10.1007/s 10639-024-12971-x	2025	Others/Unspe cified	Procedural (unspecified model)
Kaminski, Julius Josef, A., Franz, Anne, Y., Holzhausen, Ylva, H. H., Wedenic, Hans Hellfried, F., Sporn, Fabrice, H., Peters, Harm	Establishing TELLme—An Online Platform for Self-Directed, Formative Assessment of Knowledge Acquisition Across an Undergraduate Medical Curriculum	<i>Medical Teacher</i> <a href="https://doi.org/10.1080/
0142159X.2024.2362896">https://doi.org/10.1080/ 0142159X.2024.2362896	2025	Others/Unspe cified	Unspecified/Other
Karademir Coşkun, Tuğra Karademir, A., Alper, Ayfer, A. F., Soğuksu, Asuman Fulya, Z.C., Karababa, Z. Canan	The Development and Evaluation of Self-Directed Digital Learning Material Development Platform for Foreign Language Education	<i>Interactive Learning Environments</i> <a href="https://doi.org/10.1080/1
0494820.2019.1593199">https://doi.org/10.1080/1 0494820.2019.1593199	2021	Others/Unspe cified	Procedural (unspecified model)
Kazakova, Julia Konstantinovna, E. M., Shastina, Elena Mikhailovna, I. I., Gibadulina, Ilzira Ilsurovna	Implementing an Online Course in the MOOC Environment With a Focus on Science and Mathematics Education	<i>International Journal of Evaluation and Research in Education</i> <a href="https://doi.org/10.11591/i
jere.v13i6.28161">https://doi.org/10.11591/i jere.v13i6.28161	2024	Others/Unspe cified	Procedural (unspecified model)
Keiller, Lianne, C. N., Nyoni, Champion N., C., van Wyk, Chante	A Model for Design of Online Health Professions Education Faculty Development Courses in Sub-Saharan Africa	<i>BMC Medical Education</i> <a href="https://doi.org/10.1186/s
12909-023-04039-0">https://doi.org/10.1186/s 12909-023-04039-0	2023	Others/Unspe cified	Procedural (unspecified model)
Keiller, Lianne, C.N., Nyoni, Champion N., C., van Wyk, Chantel	Online Faculty Development in Low- and Middle-Income Countries for Health Professions Educators: A Rapid Realist Review	<i>Human Resources for Health</i> <a href="https://doi.org/10.1186/s
12960-022-00711-6">https://doi.org/10.1186/s 12960-022-00711-6	2022	Others/Unspe cified	Procedural (unspecified model)
Khoshnoodifar, Mehrnoosh, M., Zangiabadian, Moein, M., Ilaghi, Mehran	Design, Implementation and Evaluation of a Systematic Review Course for Medical Students	<i>Strides in Development of Medical Education Journal</i> <a href="https://doi.org/10.22062
/sdme.2023.198835.1254">https://doi.org/10.22062 /sdme.2023.198835.1254	2023	Others/Unspe cified	Procedural (unspecified model)
Kirwan, Collette, E., Costello, Eamon, E., Donlon, Enda	ADAPTTTER: Developing a Framework for Teaching Computational Thinking in Second-Level Schools by Design Research	<i>TechTrends</i> <a href="https://doi.org/10.1007/s
11528-022-00735-8">https://doi.org/10.1007/s 11528-022-00735-8	2022	Others/Unspe cified	Procedural (unspecified model)
Kosim, Muhammad, M., Kustati, Martin, W. R., Sirait, Wahida Raihan, S., Fajri, Suryadi, S. R., Febriani, Suci Ramadhanti, Mufti, D. D., Perrodin, David D.	Developing a Religious Moderation-Based Curriculum Module for Laboratory Madrasah Tsanawiyah in Islamic Higher Education	<i>Jurnal Pendidikan Islam</i> <a href="https://doi.org/10.15575/j
pi.v10i2.39163">https://doi.org/10.15575/j pi.v10i2.39163	2024	Others/Unspe cified	Unspecified/Other
Kumar, Vishesh, P. S., Wardrip, Peter	Design Tensions in Developing and Using Observation and Assessment Tools in Makerspaces	<i>Educational Technology Research and Development</i>	2024	Others/Unspe cified	Procedural (unspecified model)

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Samuelson, R., Millerjohn, Rebecca		https://doi.org/10.1007/s11423-023-10330-0			
Lantz-Andersson, Annika, E., Skantz- Åberg, Ewa, A., Roka, Apostolia, M., Lundin, Mona, P., Williams, Pia	Teachers' Collaborative Reflective Discussions on Technology- Mediated Teaching: Envisioned and Enacted Transformative Agency	<i>Learning, Culture and Social Interaction</i> https://doi.org/10.1016/j.lcsi.2022.100645	2022	Others/Unspe cified	Contextual/particip atory alignment
Lanz, Julie J., J.S., Rodefer, Joshua S., B., Rokusek, Blase, S.S., Synek, Sarah S.	Assessing the Implementation of a Short Psychological Critical Thinking Intervention in Traditional and Online Courses	<i>Scholarship of Teaching and Learning in Psychology</i> https://doi.org/10.1037/s110000339	2025	Others/Unspe cified	Procedural (unspecified model)
Lasica, Ilona Elefteryja, M., Meletiou- Mavrotheris, Maria, K., Katzis, Konstantinos	Augmented Reality in Lower Secondary Education: A Teacher Professional Development Program in Cyprus and Greece	<i>Education Sciences</i> https://doi.org/10.3390/educsci10040121	2020	Others/Unspe cified	Procedural (unspecified model)
MacNeil, Ryan T., S., Ochoa Briggs, Santana, A.E., Christie, Alisha E., C., Sheehan, Connor	Dorm-Preneurship as Entrepreneurial Living and Learning: An Educational Design Ethnography	<i>Entrepreneurship Education and Pedagogy</i> https://doi.org/10.1177/25151274241232356	2025	Others/Unspe cified	Procedural (unspecified model)

Appendix B

Appendix B lists the final, corrected APA 7 information needed for citations and references used in the manuscript and documents the specific enhancements made during verification. Enhancements include standardizing sentence case for article titles, italicizing journal and book titles, removing duplicate DOIs/URLs, converting DOIs to the <https://doi.org/...> format, restoring author diacritics, correcting author order and initials, and reconciling publication details (year, volume, issue, page range). Each entry maps one to one to an in-text citation in the paper and to the main References section. DOIs were validated via Crossref; citation–reference matches were checked with ReciteWorks. This table is provided for transparency only and is not a substitute for the reference list.

Enhanced References

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1	Alaoui, Siham	(Re)designing an online course in archival science using the ADDIE model: Lessons learned and future directions	<i>Journal of Education for Library and Information Science</i>	2025	https://doi.org/10.3138/8/jelis-2023-0060
2	Artman, Nicholas	Applying the cognitive theory of multimedia learning: Using the ADDIE model to enhance instructional video	<i>Explorations in Media Ecology</i>	2020	https://doi.org/10.1386/eme_00054_1
3	Karthikeyan, P., A.M., Abirami, A. M., T., Murugan, Thangavel	Enhancing learner engagement in online education through ADDG9E model	<i>Journal of Engineering Education Transformations</i>	2024	https://doi.org/10.16920/jeet/2024/v37is2/24022
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5	Maxnun, Lu'luil, K., Kristiani, Kristiani, C. D. S., Indrawati, Cicilia Dyah Sulistyanningrum	Development of hots-based cognitive assessment instruments: ADDIE model	<i>Journal of Education and Learning</i>	2024	https://doi.org/10.11591/edulearn.v18i2.21079
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10	Yu, Shih Jou, Y., Hsueh, Yuling, J. C. Y., Sun, Jerry Chih Yuan, H., Liu, Haoze	Developing an intelligent virtual reality interactive system based on the ADDIE model for learning pour-over coffee brewing	<i>Computers and Education: Artificial Intelligence</i>	2021	https://doi.org/10.1016/j.caeai.2021.100030
11	Azimi, Esmaeil, L., Jafari, Leila, Y., Mahdavinassab, Yousef	Using a design-based research methodology to develop and study prompts integrated into GeoGebra to support mathematics learning of gifted students	<i>Education and Information Technologies</i>	2023	https://doi.org/10.1007/s10639-023-11632-9
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13	Fahd, Kiran, S.J., Jahan Miah, Shah Jahan, K. E. U., Ahmed, Khandakar Entenam Unayes, S., Venkatraman, Sitalakshmi, Y., Miao, Yuan	Integrating design science research and design based research frameworks for developing education support systems	<i>Education and Information Technologies</i>	2021	https://doi.org/10.1007/s10639-021-10442-1
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25	Mirattanaphrai, Pantechat, S., Srikoon, Sanit	Design and development of innovator self-assessment questionnaire for students in grade 6: Utilizing educational design research	<i>Social Sciences and Humanities Open</i>	2025	https://doi.org/10.1016/j.ssaho.2025.101414
26	Pumyoch, Natthiya, S., Srikoon, Sanit	Executive function training curriculum to enhance emotional intelligence in early childhood: Theory adaptation in educational design research	<i>Thinking Skills and Creativity</i>	2024	https://doi.org/10.1016/j.tsc.2024.101673
27	Sá, Patrícia, P. C., Silva, Patrícia Christine, J., Peixinho, Joana, A., Figueiras, Ana, A. V., Rodrigues, Ana V.	Sustainability at play: Educational design research for the development of a digital educational resource for primary education	<i>Social Sciences</i>	2023	https://doi.org/10.3390/socsci12070407
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	Alhaddad, Mohammed Jaffer, A. A., Malibari, Areej Abbas, M. Z., Asghar, Muhammad Zubair, H. M., Aljuaid, Hanan M.				
39	Alkhateeb, Mohammad Ahmad	Correcting misconceptions in fractions using interactive technological learning activities	<i>International Journal of Learning, Teaching and Educational Research</i>	2020	https://doi.org/10.26803/ijlter.19.4.17
40	Alvarez, Joel I., S. M. A., Galman, Sheena Mai A.	Massive open online course in elementary statistics: From analysis to evaluation	<i>Educational Process: International Journal</i>	2025	https://doi.org/10.22521/edupij.2025.14.86
41	Arnilla, Arvin Kim A.	Print-based storybook in the mother tongue for teaching COVID-19 prevention in the Philippines	<i>Cypriot Journal of Educational Sciences</i>	2022	https://doi.org/10.18844/cjes.v17i8.7381
42	Azizan, Suzana Ariff, N. A., Abu Shamsi, Nurulaini Abu	Design-based learning as a pedagogical approach in an online learning environment for science undergraduate students	<i>Frontiers in Education</i>	2022	https://doi.org/10.3389/feduc.2022.860097
43	Bak-Piard, Maxy, S., Kroon, Sjaak	The implementation and evaluation of a program for Dutch language proficiency for teacher education in Curaçao [De implementatie en evaluatie van een programma voor Nederlandse taalvaardigheid voor de lerarenopleiding in Curaçao]	<i>Pedagogische Studien</i>	2023	https://doi.org/10.59302/ps.v100i2.14222
44	Björklund, Camilla, H., Palmér, Hanna	Preschoolers' reasoning about numbers in picture books	<i>Mathematical Thinking and Learning</i>	2020	https://doi.org/10.1080/10986065.2020.1741334
45	Bose, Arindam	Fostering meaning in a trilingual mathematics classroom by connecting everyday and school mathematical ways of talking: a design approach	<i>ZDM - International Journal on Mathematics Education</i>	2021	https://doi.org/10.1007/s11858-021-01254-1
46	Cacciamani, Stefano, G. R., Mangione, Giuseppina Rita, M., Pieri, Michelle	The teachers' reflective activity for the development of an innovative model for small schools: The case of "Classi in rete"	<i>Qwerty</i>	2024	https://doi.org/10.30557/QWo00087
47	Choi, Heeseung, U., Lee, Ujin, T., Gwon, Taekyun	Development of a computer simulation-based, interactive,	<i>Clinical Simulation in Nursing</i>	2021	https://doi.org/10.1016/j.ecns.2021.04.019

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48	Clement, Mieke, I., Op de Beeck, Ilse, K., Rajagopal, Kamakshi	Towards the mainstreaming of online mobility at KU Leuven	<i>Education Sciences</i>	2023	https://doi.org/10.3390/educsci13010014
49	de Jong, Nivja H., S. A., Raaijmakers, Stephan A., D. E. H., Tigelaar, Dineke E. H.	Developing high-quality, practical, and ethical automated L2 speaking assessments	<i>System</i>	2025	https://doi.org/10.1016/j.system.2025.103796
50	de Witt, Annick, M. C., Bootsma, Margien C., B. J., Dermody, Brian J., K. T., Rebel, Karin T.	Designing transformative interventions for a world in crisis: How the 'Worldview Journey' invites for personal, cultural, and systems transformation	<i>Environmental Science and Policy</i>	2024	https://doi.org/10.1016/j.envsci.2024.103896
51	de Witt, Annick, M. C., Bootsma, Margien C., B. J., Dermody, Brian J., K. T., Rebel, Karin T.	The seven-step learning journey: A Learning cycle supporting design, facilitation, and assessment of transformative learning	<i>Journal of Transformative Education</i>	2024	https://doi.org/10.1177/15413446231220317
52	Dirgayasa, I. Wy, S. J., Lubis, Safrida J., A., Sari, Asrita	Developing worksheet through socratic to improve students' english writing skill	<i>World Journal of English Language</i>	2023	https://doi.org/10.5430/wjel.v13n1p405
53	Esteve-Mon, Francesc M., A., Sánchez-Caballé, Anna, M. Á., Llopis- Nebot, Maria Ángeles	Social networking from a transmedia perspective: The development of reflective and digital competencies of student- teachers	<i>Journal of Educational Multimedia and Hypermedia</i>	2021	
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55	Falaahudin, Ardhika, Suharjana, Sumarjo, D., Tirtawirya, Devi, D. T., Iwandana, Dody Tri, P., Padli, Padli, Y., Ockta, Yovhandra, M. I., Sabillah, Muhamad Ichsan	Development and practicality of android-based application to assess the physical condition of young swimmers	<i>International Journal of Human Movement and Sports Sciences</i>	2025	https://doi.org/10.13189/saj.2025.130116

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57	Fred, Huijboom, P., van Meeuwen, Pierre, R., Ellen, Rusman, V., Marjan, Vermeulen	How to enhance teachers' professional learning by stimulating the development of professional learning communities: operationalising a comprehensive PLC concept for assessing its development in everyday educational practice	<i>Professional Development in Education</i>	2020	https://doi.org/10.1080/19415257.2019.1634630
58	Gök, Ahmet, A., Karamete, Ayşen	Designing a mathematical modeling activity for students with mild intellectual disabilities: Google Maps example [Hafif düzeyde zihinsel yetersizliği olan öğrencilere yönelik matematiksel modelleme etkinliği geliştirilmesi: Google Haritalar örneği]	<i>Milli Egitim</i>	2025	https://doi.org/10.37669/milliegitim.1605632
59	Gusti, Wahyu Ramadhani, F., Arifin, Fatchul	Embedded system training kit for artificial intelligence	<i>International Journal of Information and Education Technology</i>	2024	https://doi.org/10.18178/ijiet.2024.14.1.2026
60	Hadriana, Hadriana, M., Adanan, Mahdum, T., Herawan, Tutut	M-WebQuest development: Reading comprehension of senior high school students in Indonesia	<i>International Journal of Emerging Technologies in Learning</i>	2020	https://doi.org/10.3991/ijet.v15i03.10628
61	Hamdani, Aam I. S., A., Suherman, Amay	Self-design project based learning: An alternative learning model for vocational education	<i>Journal of Technical Education and Training</i>	2021	https://doi.org/10.30880/jtet.2021.13.03.007
62	Hamid, Mustofa Abi, P., Sudira, Putu, M.B., Triyono, Mochamad Bruri, M. A., Rizqillah, Muhamad Aqil, N., Irwanto, D.,	Variable frequency drive trainer kits for electronic control system subjects in vocational secondary schools	<i>International Journal of Evaluation and Research in Education</i>	2024	https://doi.org/10.11591/ijere.v13i5.29333

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63	Hamid, Siti Nurshuhada Mohd, T. T., Lee, Tien Tien, H. B., Taha, Hafsah Binti, N. A., Rahim, Nurulsaidah Abdul, A. M., Sharif, Aisyah Mohamad	E-content module for chemistry massive open online course (MOOC): Development and students' perceptions	<i>Journal of Technology and Science Education</i>	2021	https://doi.org/10.3926/jotse.1074
64	Hijriyah, Umi, R. N., Edi, Relit Nur, Erlina, G. C., Kesuma, Guntur Cahaya, T. S. I., Khodr, Tamer Sa'Ad Ibrahim	Innovative approaches to Arabic vocabulary learning for Islamic senior high school students with Lectora inspire	<i>Jurnal Pendidikan Islam</i>	2024	https://doi.org/10.15575/JPI.V10I2.28754
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66	Insani, Marzius, E. Y., Haenilah, Een Yayah, H., Hariri, Hasan, R. M., Sinaga, Risma Margaretha	Audio-visual-based history learning media materials about human life in the literary age	<i>Journal of Education and Learning</i>	2023	https://doi.org/10.11591/edulearn.v17i3.20730
67	Kalyoncu, Furkan, H., Karal, Hasan	Design and development of augmented reality application for basic concepts of computer systems	<i>Education and Information Technologies</i>	2025	https://doi.org/10.1007/s10639-024-12971-x
68	Kaminski, Julius Josef, A., Franz, Anne, Y., Holzhausen, Ylva, H.H., Wedenig, Hans Hellfried, F., Sporn, Fabrice, H., Peters, Harm	Establishing TELLme—an online platform for self-directed, formative assessment of knowledge acquisition across an undergraduate medical curriculum	<i>Medical Teacher</i>	2025	https://doi.org/10.1080/0142159X.2024.2362896
69	Karademir Coşkun, Tuğra Karademir, A., Alper, Ayfer, A. F.,	The development and evaluation of self-directed digital learning	<i>Interactive Learning Environments</i>	2021	https://doi.org/10.1080/10494820.2019.1593199

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	Soğuksu, Asuman Fulya, Z. C., Karababa, Z. Canan	material development platform for foreign language education			
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71	Keiller, Lianne, C. N., Nyoni, Champion N., C., van Wyk, Chante	A model for design of online health professions education faculty development courses in sub- Saharan Africa	<i>BMC Medical Education</i>	2023	https://doi.org/10.1186/s12909-023-04039-0
72	Keiller, Lianne, C. N., Nyoni, Champion N., C., van Wyk, Chantel	Online faculty development in low- and middle-income countries for health professions educators: A rapid realist review	<i>Human Resources for Health</i>	2022	https://doi.org/10.1186/s12960-022-00711-6
73	Khoshnoodifar, Mehrnoosh, M., Zangiabadian, Moein, M., Ilaghi, Mehran	Design, implementation and evaluation of a systematic review course for medical students	<i>Strides in Development of Medical Education Journal</i>	2023	https://doi.org/10.22062/sdme.2023.198835.1254
74	Kirwan, Collette, E., Costello, Eamon, E., Donlon, Enda	ADAPTER: Developing a framework for teaching computational thinking in second- level schools by design research	<i>TechTrends</i>	2022	https://doi.org/10.1007/s11528-022-00735-8
75	Kosim, Muhammad, M., Kustati, Martin, W. R., Sirait, Wahida Raihan, S., Fajri, Suryadi, S. R., Febriani, Suci Ramadhanti, Mufti, D. D., Perrodin, David D.	Developing a religious moderation- based curriculum module for laboratory madrasah Tsanawiyah in Islamic higher education	<i>Jurnal Pendidikan Islam</i>	2024	https://doi.org/10.15575/jpi.v10i2.39163
76	Kumar, Vishesh, P. S., Wardrip, Peter Samuelson, R., Millerjohn, Rebecca	Design tensions in developing and using observation and assessment tools in makerspaces	<i>Educational Technology Research and Development</i>	2024	https://doi.org/10.1007/s11423-023-10330-0
77	Lantz-Andersson, Annika, E., Skantz- Åberg, Ewa, A., Roka, Apostolia, M.,	Teachers' collaborative reflective discussions on technology- mediated teaching: Envisioned and enacted transformative agency	<i>Learning, Culture and Social Interaction</i>	2022	https://doi.org/10.1016/j.lcsi.2022.100645

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79	Lasica, Ilona Elefteryja, M., Meletiou- Mavrotheris, Maria, K., Katzis, Konstantinos	Augmented reality in lower secondary education: A teacher professional development program in Cyprus and Greece	<i>Education Sciences</i>	2020	https://doi.org/10.3390/educsci10040121
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