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Teaching Micro-credentials through Learning Management Systems: A Systematic Review of Pedagogical Designs, Assessment Practices, and Learner Outcomes

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Abstract

Micro-credentials are increasingly positioned as flexible, competency-based responses to rapid skills change, yet their educational value depends on how learning is designed, facilitated, assessed, and evidenced through digital platforms. This systematic title-and-abstract review examines pedagogical designs, assessment practices, LMS affordances, learner support, and reported outcomes in LMS-enabled micro-credentials. Following PRISMA 2020, 49 records from five Scopus result sets were merged; eight duplicates were removed, 41 unique titles and abstracts were screened, and 12 studies were included in narrative synthesis. The evidence comprised higher education, engineering, vocational education, professional learning, laboratory science, information literacy, sustainability, and MOOCs. Assessment and feedback were the most frequent pedagogical features (9/12), followed by modular or self-paced pathways (7/12), analytics or progress tracking (6/12), credential visibility (5/12), personalisation or remediation (4/12), and active learning, applied tasks, and learner scaffolding (3/12 each). Canvas, Moodle, MOOC platforms, institutional LMSs, and virtual learning environments were represented, although three abstracts did not name the platform. Positive findings concerned engagement, confidence, self-efficacy, preparedness, and perceived credential value; however, causal and longitudinal evidence remained scarce. Effective provision combined bounded competencies, modular pathways, applied evidence, feedback, remediation, human support, and transparent credential criteria. The review proposes an LMS-enabled micro-credential pedagogy framework and identifies priorities for vocational and engineering education, including authentic performance assessment, accessible support, interoperable evidence, and longitudinal evaluation of workplace transfer.

1 Introduction

Micro-credentials have moved from the margins of alternative certification into mainstream debates about lifelong learning, employability, modular curricula, and the responsiveness of higher education. UNESCO defines a micro-credential as a record of focused learning achievement that is assessed against transparent standards, awarded by a trusted provider, and capable of standing alone or contributing to larger credentials [1, 2]. This definition is pedagogically consequential, a micro-credential is not merely a shortened course or an electronic certificate. Its legitimacy rests on a chain of alignment among intended competence, learning activity, assessment evidence, and the claim communicated by the credential.

The expansion of micro-credentials has been accelerated by digitalisation, demand for upskilling and reskilling, and policy interest in flexible pathways [3–6]. However, flexibility can become educationally hollow when institutional attention concentrates on catalogue growth, badge technology, or market signalling while neglecting how learners actually acquire and demonstrate competence. Existing reviews have mapped definitions, opportunities, governance, accreditation, and implementation challenges [4–8]. They consistently note fragmented terminology, uneven quality assurance, uncertain employer recognition, and limited evidence of impact. Far less is known about the instructional mechanisms through which an LMS converts a short unit of learning into credible competence.

This gap is especially important in vocational and engineering education, where competence is situated, performative, and frequently dependent on authentic tools, standards, constraints, and judgement. An LMS can distribute content efficiently, but content delivery alone cannot establish occupational capability. To function as a pedagogical infrastructure, the LMS must support diagnostic entry, modular progression, deliberate practice, interaction, timely feedback, authentic evidence, reassessment, and transparent credential issuance. These functions connect competency-based education, constructive alignment, adult learning, self-regulated learning, and assessment for learning.

Empirical studies already suggest that design matters. LMS-based teacher micro-credentials have combined baseline assessment, topic modules, reflection, summative performance standards, self-pacing, and access to coaching [9]. Faculty designers distinguish micro-credentials that merely mark participation from those that integrate defensible assessment and portable credential value [10]. Multi-case evidence on digital badges further indicates that unclear purpose, usability problems, and faculty workload can obstruct adoption [11]. Recent institutional cases show the potential of Canvas Credentials and open platforms for progress visibility and stackability, while also exposing problems of cross-unit coordination and consistent quality [12]. These findings are informative but dispersed across higher education, professional learning, teacher education, and digital-badge research.

Accordingly, this review shifts the unit of analysis from the credential as an object to the teaching-learning system that produces the credential. Its purpose is to identify what educators do, what LMS affordances are mobilised, how competence is assessed, which support structures are provided, and what outcomes are reported. This orientation also addresses a gap identified by prior reviews: the relationship among micro-credential delivery, instruction, motivation, engagement, and learning remains underexamined [4].

1.1 Conceptual boundaries

The review distinguishes four related but non-equivalent constructs. A micro-credential is an assessed and quality-assured record of focused learning; a digital badge is a visual and metadata-bearing representation that may indicate competence, completion, participation, or affiliation; microlearning concerns the granularity and duration of learning activities; and an LMS is the digital environment used to organise content,

interaction, assessment, progression, and learner data. Digital-badge studies are included only when the badge represents or scaffolds assessed learning relevant to micro-credential pedagogy. Purely promotional badges, attendance certificates, blockchain architecture without learning design, and policy papers without implemented instruction are excluded.

1.2 Theoretical orientation

The synthesis uses constructive alignment as its principal organising logic: intended competencies should determine learning activities, assessment tasks, feedback, and credential claims [13]. Competency-based education adds mastery progression and performance evidence; self-determination theory clarifies how autonomy, competence, and relatedness shape engagement [14]; and adult-learning perspectives foreground relevance, prior experience, flexibility, and immediate application [15]. The LMS is treated through an affordance lens: its value is not inherent in technical features but emerges when educators enact those features for specific learning purposes. This prevents technological determinism and enables critical comparison between nominal platform use and pedagogically consequential platform orchestration.

1.3 Research questions

RQ1. What educational contexts, learner groups, credential types, delivery modes, and LMS/platform configurations characterise the literature?

RQ2. Which pedagogical designs and learning activities are used to teach LMS-enabled micro-credentials?

RQ3. How are competencies assessed, evidenced, verified, and connected to credential issuance?

RQ4. Which LMS affordances, facilitation practices, and learner-support mechanisms enable or constrain participation and mastery?

RQ5. What learner, instructional, institutional, and employment-related outcomes are reported, and how robust is the evidence?

RQ6. What design principles and research priorities follow for vocational and engineering education?

2 Methods

2.1 Review design and reporting standard

The review was designed in accordance with PRISMA 2020 [16]. Because the evidence includes qualitative studies, mixed-methods research, implementation cases, design reports, and quantitative evaluations, a convergent narrative synthesis was used rather than meta-analysis. The review protocol was not prospectively registered; the absence of registration is reported as a transparency limitation.

2.2 Information sources and search strategy

Scopus was the sole bibliographic source. Five saved Scopus result sets supplied by the author were exported in RIS format on 18 August 2026. The exports contained titles, abstracts, authors, years, sources, DOI or Scopus links, affiliations where available, keywords, publication type, and citation metadata. All five files were merged before deduplication. DOI was used as the primary duplicate key and a normalised title was used when DOI was absent. Screening was deliberately limited to the complete Scopus title and abstract fields supplied by the author; no claims in the synthesis extend beyond those fields.

The RIS files preserve the retrieved records but do not embed the exact Scopus query strings. Accordingly, the five exported sets and their record counts constitute the auditable corpus for this review, while absence of the original query histories limits exact search replication and is acknowledged as a methodological limitation.

Table 1
Scopus result sets used in the review

Source	Records
Scopus result set 1	10
Scopus result set 2	10
Scopus result set 3	9
Scopus result set 4	10
Scopus result set 5	10
Total before deduplication	49

2.3 Eligibility criteria

Table 2
Inclusion and exclusion criteria

Domain	Include	Exclude
Population/ context	Learners in higher education, TVET, professional education, workplace learning, or teacher professional development.	K-12 pupil-only interventions unless the participants are educators; informal badge use without organised learning.
Intervention	Implemented micro-credential or competence-representing digital badge taught substantially through an LMS or comparable online platform.	Policy commentary, credential registry, blockchain verification, marketing, or badge architecture with no teaching-learning process.
Evidence	Reports learning design, teaching activity, assessment, facilitation, learner experience, engagement, completion, learning, transfer, or implementation outcomes.	Editorials and purely conceptual papers without empirical or sufficiently detailed design evidence.
Publication	Peer-reviewed journal article or full conference paper; English; 2015-search date.	Abstract-only records, dissertations, non-peer-reviewed promotional material; duplicates.
Credential quality	A discrete learning outcome and identifiable completion or assessment criterion.	Attendance-only certificate where no learning criterion is described.

2.4 Study selection

The 49 exported records were deduplicated algorithmically and checked by title. The remaining 41 records were screened using titles and abstracts. A record was retained when it (a) described a micro-credential or competence-representing digital badge as a learning intervention; (b) located delivery in an LMS, MOOC, virtual learning environment, or sufficiently described online platform; and (c) reported pedagogical design, assessment, implementation, learner experience, or outcomes. Twenty-nine records were excluded under one primary reason. The largest exclusion classes were absence of an implemented LMS teaching intervention, technical credential architecture or repository without pedagogy, and secondary or conceptual evidence. Twelve records met the criteria for narrative synthesis. The screening-decision file retains the decision and reason for every unique record.

2.5 Quality appraisal

A formal study-level risk-of-bias appraisal was not undertaken because the review was intentionally restricted to titles and abstracts, which do not provide sufficient methodological detail for defensible MMAT ratings [17]. Instead, confidence in each synthesis statement was qualified according to the evidence reported: measured outcome, association, participant perception, implementation feasibility, or design proposition. Causal language was avoided where abstracts reported uncontrolled observations or correlations. A subsequent full-text extension should apply MMAT to empirical studies and explicit credibility criteria to design and implementation reports.

2.6 Data extraction and synthesis

The extraction form captured bibliographic data, country, educational context, LMS or platform, study design, pedagogical features, assessment approach, and outcomes stated in the abstract. Pedagogical features were coded as modular/self-paced learning, authentic or applied tasks, assessment and feedback, analytics or progress tracking, active/social learning, credential visibility, personalisation/remediation, and scaffolding/support. Multiple codes could be assigned to one study. Missing information was coded as not reported rather than inferred.

The synthesis proceeded in three stages. First, descriptive mapping addressed publication year, platform, context, and method. Second, intervention and findings statements were coded for pedagogical mechanisms, platform affordances, assessment, learner support, barriers, and outcomes. Third, codes were organised into descriptive and analytical themes using thematic synthesis [18]. A recurrent practice was not automatically interpreted as effective: implementation descriptions were distinguished from measured outcomes, and association was distinguished from causation.

3 Results

3.1 Study selection and characteristics

The five Scopus result sets contained 49 records. Eight duplicate occurrences were removed, leaving 41 unique titles and abstracts. Twenty-nine records were excluded and 12 were retained, corresponding to 29.3% of unique records. Included studies were published from 2021 to 2026: one study appeared in each year from 2021 to 2024, three in 2025, and five in 2026. This distribution indicates an accelerating but still immature evidence base, with two thirds of the included literature published in 2025–2026.

The studies represented the United States (n = 3), Greece, Brazil, Bulgaria, Italy, and cross-national settings involving Belgium-Viet Nam, Pakistan-Malaysia, Argentina-Spain, and a European multi-country course corpus. One abstract did not report affiliation. Contexts included

higher-education faculty development, undergraduate laboratory science, sustainability education, academic leadership MOOCs, electrical and computer engineering, engineering-educator certification, TVET, health-workforce learning, information literacy, and lifelong online learning. Engineering/TVET was therefore visible, but no included abstract evaluated hands-on workshop competence or direct workplace performance.

Table 3
Evidence extraction matrix for final included studies

Study	Context	Credential	Platform	Pedagogical design	Method	Contribution
Goldberg et al. [23]	HE faculty; country NR	GenAI literacy	Online platform, unnamed	Self-paced modules; experiential tasks; artefacts	Pre-post case evaluation	Significant gains in GenAI use and self-efficacy
Bartha & Kele [24]	US laboratory science	Mock micro-credentials	Institutional LMS	Weekly pre-lab badges; readiness monitoring	Survey and LMS participation	20% rise in mean pre-lab involvement; confidence increased
Gallagher & Tóth [25]	100 European university courses	Sustainability competencies	Platform NR	GreenComp mapping; active learning analysis	Content and thematic analysis	< 50% used active learning; active learning related to competence breadth (r = 0.43)
Cheng et al. [26]	Leadership MOOCs	Digital badges	Canvas MOOCs	Badges as motivator, credential and instruction	Mixed methods	Value shaped by motivation, issuer, visual design and difficulty
Shaheen et al. [27]	MOOC learners/stakeholders	MOOC micro-credentials	Multiple MOOC platforms	Data-driven course selection and adoption	Data mining and survey	Certification, organisation, rating, difficulty and price predicted adoption
Amoruso et al. [28]	US electrical/computer engineering	Skill-specific badges	Canvas/AchieveUp	Quiz diagnosis; tutoring; remediation; automation	Quantitative evaluation/survey	Achievement correlation; moderate learner benefit; 87% high instructor UX
Stamatakis et al. [29]	Greek engineering HE	Learning-objective micro-credentials	Greek LMS ecosystem	Hackathons; blended and differentiated learning	Design/implementation	Engagement and autonomy proposed; causal evidence absent
Da Silva et al. [30]	Brazilian health workforce	Digital skill pathways	Virtual learning environment	Short modules; personalisation; continuous evaluation	Pilot implementation	Feasible; certification integration and regional access challenged
Palmieri et al. [31]	Engineering educator certification	Open badges/micro-accreditation	Moodle	Competence recognition and engagement	Implementation case	Teaching-practice and engagement effects reported without effect sizes

Study	Context	Credential	Platform	Pedagogical design	Method	Contribution
Petkov [32]	Bulgarian TVET	ECVET and micro-credentials	Team-developed LMS	Small learning units; achievement measurement	Design examples	Dynamic design illustrated; learner outcomes not reported
Gaylor et al. [33]	US information literacy	Research-skill micro-credentials	Institutional LMS	20 + interactive asynchronous modules	Implementation case	Scalable embedded hub; measurable outcomes absent from abstract
Borrelli & Tateo [34]	Italian lifelong online learning	Gamified badge pathway	University LMS	Badge criteria; materials; scaffolding; support	Design research/model	Plugin-only deployment rejected; pedagogy and support required

Four studies used other institution-specific LMS configurations, two used Canvas, one used Moodle, one examined multiple MOOC platforms, and one used a virtual learning environment. Three abstracts described online delivery or a digital micro-credential but did not identify the platform. This reporting gap is substantively important: without platform identification and feature-level description, the mechanism linking technology to learning cannot be replicated or compared.

3.2 Pedagogical design patterns (RQ2)

3.2.1 Competency-first modularisation

Modular or self-paced organisation appeared in seven of the 12 studies (58.3%). The clearest example was the faculty GenAI micro-credential, which combined self-paced modules with experiential practice and required participants to create usable artefacts such as syllabus statements and GenAI interaction transcripts [23]. The information-literacy hub embedded more than 20 interactive asynchronous modules inside an institutional LMS [33], while the Brazilian health initiative organised short pathways around digital foundations, automation, innovation, and leadership [30]. In TVET, Petkov used small learning units to connect content design with ECVET and micro-credential achievement [32]. Across these studies, modularity functioned as more than brevity: it supported sequencing, flexible entry, visible progression, and the isolation of assessable competencies. Nevertheless, most abstracts did not report workload, prerequisite logic, mastery thresholds, or rules for stacking modules, limiting conclusions about optimal granularity.

3.2.2 Practice, reflection, and workplace relevance

Authentic or applied tasks were explicit in three studies (25.0%), although several others implied workplace relevance. The GenAI course asked faculty to produce artefacts directly transferable to teaching practice [23]. AchieveUp linked digitised assessment to skill-specific remediation in an electrical and computer engineering course [28], and the information-literacy hub embedded research and scholarly-writing activities within students' academic workflow [33]. Social or active learning also appeared in three studies. The Greek LMS incorporated collaborative hackathons and blended learning to reposition the platform as an open learning ecosystem [29], while the Italian design model combined gamification, badge criteria, scaffolding, and learner support [34]. The sustainability analysis offers a critical counterpoint: fewer than half of 100 European micro-credentials communicated active-learning pedagogies, and active learning showed a moderate positive relationship with the number of sustainability competencies addressed ($r = 0.43$) [25]. Thus, short-format delivery does not inherently produce active or transformative learning; pedagogical compression can instead reinforce transmissive instruction.

3.2.3 Personalisation and mastery progression

Personalisation or remediation was identifiable in four studies (33.3%), while analytics or progress tracking appeared in six (50.0%). AchieveUp provided the most explicit closed-loop model: Canvas quiz responses were mined to diagnose knowledge gaps, undergraduate tutors supported targeted remediation, and scripts issued skill-specific badges [28]. The Brazilian virtual environment combined personalised pathways, continuous evaluation, secure certification, and performance monitoring [30]. MOOC adoption modelling further showed that certification type, course organisation, rating, difficulty, and price influenced participation [27], demonstrating that learner choice is structured by platform and course attributes rather than flexibility alone. However, no abstract compared adaptive and standard pathways experimentally, and no study reported whether personalisation reduced or amplified subgroup inequities.

3.3 Assessment, evidence, and credential issuance (RQ3)

Assessment or feedback was the most frequent feature, coded in nine studies (75.0%). The evidence nevertheless ranged from completion-oriented badging to applied performance. Weekly pre-laboratory micro-credentials were used to verify preparation and give faculty an overview of readiness [24]. The GenAI programme required applied artefacts and detected pre-post gains in self-efficacy [23]. AchieveUp combined diagnostic quizzes, targeted tutoring, remediation, and automated badge issuance [28]. The Brazilian pilot used continuous evaluation and formal competency recognition [30], while the engineering-educator programme integrated open badges and micro-accreditation into Moodle [31]. These examples show that the credential can function as feedback during learning, evidence at completion, or both.

The synthesis exposes an important validity gradient. At the lowest level, badges indicate participation or completion. Knowledge checks establish conceptual readiness but not performance under authentic conditions. Applied artefacts provide stronger evidence when assessed against transparent criteria. Observed, simulated, laboratory, or workplace performance provides the strongest basis for occupational claims, yet this level was rarely visible in the abstracts. Even the engineering and TVET studies focused mainly on digital assessment architecture, course-level achievement, or engagement rather than direct demonstration in workshops or workplaces [28, 29, 31, 32]. Accordingly, the literature supports the feasibility of LMS-based assessment more strongly than it supports the validity of claims about workplace competence.

Credential visibility or recognition appeared in five studies (41.7%). Canvas leadership learners interpreted badges simultaneously as motivators, credentials, recognition devices, and instructional tools; perceived value varied with issuer, visual design, difficulty, and learner motivation [26]. Moodle-based engineering micro-accreditation and the Italian badge model similarly emphasised criteria and recognition [31, 34]. These findings indicate that assessment quality and signalling value are analytically distinct: rigorous assessment can remain invisible to external audiences, whereas visually attractive badges can overstate weak evidence. High-integrity design must therefore align criteria, task, feedback, evidence, and badge metadata.

Table 4
Assessment hierarchy for LMS-enabled micro-credentials

Level	Typical LMS evidence	Claim supported	Design implication
1: Participation	Login, attendance, content view, discussion post	Effort or exposure only	Do not claim competence
2: Knowledge	Quiz, short answer, concept test	Recall and conceptual understanding	Suitable for foundational knowledge; guard against item leakage
3: Application	Project, design artefact, lesson plan, code, portfolio	Application to a realistic task	Use explicit rubric, feedback and revision
4: Performance	Observed practice, simulation, workplace demonstration	Integrated competence under authentic constraints	Strongest claim; requires trained judgement and evidence governance

3.4 LMS affordances, facilitation, and learner support (RQ4)

Platform evidence was heterogeneous. Four studies used institution-specific LMS configurations, two used Canvas, one used Moodle, one examined multiple MOOC platforms, and one used a virtual learning environment; three did not identify the platform in the abstract. Across platforms, six affordances were recurrent: modular sequencing, progress visibility, embedded assessment, analytics, remediation workflows, and credential integration. Canvas supported both motivational badges in leadership MOOCs [26] and a more tightly coupled diagnostic-remediation system in engineering [28]. Moodle integrated open badges into international engineering-educator certification [31]. Institution-specific LMSs supported pre-laboratory preparation [24], collaborative hackathons and blended learning [29], vocational content design [32], and asynchronous information-literacy modules [33].

The evidence indicates that platform affordances are pedagogically conditional. Analytics can inform instruction when data lead to feedback or remediation, as in AchieveUp [28], but progress monitoring without intervention merely documents participation. Similarly, badge automation reduces administrative friction but does not establish assessment validity. Borrelli and Tateo make this point explicitly: installing a badge plug-in cannot compensate for weak learning materials, unclear criteria, or absent scaffolding [34]. The Brazilian pilot adds an institutional dimension, showing that technically feasible learning pathways can still encounter certification-integration and regional-access problems [30].

Human facilitation was less frequently described than automation. Only three abstracts explicitly foregrounded scaffolding or support. AchieveUp used undergraduate tutors for remediation [28], the Italian model treated scaffolding as a necessary design component [34], and the information-literacy hub was built as a community-oriented learning landscape [33]. This under-reporting is consequential because self-paced adult learners may require orientation, assessment clarification, motivational contact, peer critique, and technical assistance. The evidence therefore favours a hybrid support model: automate low-stakes diagnosis and routine progress communication, but retain human judgement and dialogue for complex performance and reassessment.

3.5 Reported outcomes and evidential strength (RQ5)

The most concrete positive outcomes concerned engagement, preparedness, confidence, self-efficacy, and perceived value. Weekly laboratory badging was associated with a 20% increase in mean pre-laboratory involvement and improved confidence [24]. Faculty completing the GenAI course reported statistically significant gains in GenAI use and self-efficacy [23]. Canvas leadership learners valued badges as motivational, credentialing, and instructional devices [26]. AchieveUp found that students receiving grades of A obtained 62.2% of issued badges, compared with an average of 16.9% for students in the B range; however, this association does not demonstrate that badges caused higher achievement [28]. Instructor experience with AchieveUp was positive, with 87% rating the system nine or ten, while learners judged support for internships, self-efficacy, and professional identity only to a moderate extent [28].

Several studies offered feasibility or design evidence rather than quantified learning effects. The Greek LMS described mechanisms for collaboration, differentiated learning, and autonomy but did not report causal outcomes in the abstract [29]. The Brazilian pilot demonstrated feasibility while identifying institutional-system integration and vulnerable-region access as constraints [30]. The Moodle engineering programme reported effects on engagement and teaching practice without abstract-level effect sizes [31]. The Bulgarian TVET, information-literacy, and Italian studies contributed design principles but did not report measurable learner outcomes in their abstracts [32–34].

Taken together, the evidence is suggestive rather than conclusive. It supports the proposition that well-designed LMS micro-credentials can strengthen proximate outcomes, but it does not establish durable competence transfer, employment gains, wage effects, or equity. Threats to inference include self-selection, small or unspecified samples, post-course perceptions, lack of comparison groups, correlation between achievement and badging, heterogeneous definitions, and incomplete platform reporting. Strong claims about employability or workforce capability therefore exceed the current title-and-abstract evidence.

3.6 Integrative framework

The framework represents micro-credential pedagogy as a recursive mastery cycle rather than a linear content pipeline. Competency architecture determines the LMS pathway; the pathway provides opportunities to practise and produce evidence; authentic assessment generates feedback and, where necessary, reassessment; human facilitation sustains engagement and judgement; and the trusted credential communicates verified achievement. Credential use in employment or further study then informs revision of competencies and assessment. Failure at any link weakens the entire claim.

4 Discussion

4.1 From platform delivery to pedagogical orchestration

The central finding is that an LMS does not teach a micro-credential merely by hosting it. Educational value emerges when the platform orchestrates a sequence of competence-oriented decisions. This distinction explains why superficially similar online offerings can produce different outcomes. A repository model foregrounds access to content and automates completion. An orchestration model aligns entry diagnosis, activity, social interaction, feedback, mastery evidence, and credential issuance. The latter demands greater learning-design expertise and institutional coordination but offers a more defensible basis for claiming competence.

This interpretation extends prior implementation reviews. Ahsan et al. separated operational/technology issues from the wider micro-credential ecosystem and identified technology as a necessary enabler, while also noting limited evidence on its influence [4]. The present framework specifies the pedagogical mechanisms through which technology may matter. It also supports Reed et al.'s argument that positive outcomes are not automatic and that assessment and credential design must be integrated [10].

4.2 A design proposition for vocational and engineering education

Vocational and engineering micro-credentials should be designed backwards from occupational performance. Each credential should identify a work function or engineering capability, specify standards and constraints, map prerequisite knowledge, and define acceptable evidence. The LMS can support conceptual preparation, simulation, data capture, peer critique, portfolio assembly, and feedback, but some competencies require laboratories, workshops, field settings, or supervised workplace demonstration. Accordingly, hybrid assessment is not a weakness; it is often a validity requirement.

A defensible sequence is: diagnose prior competence; present an authentic challenge; provide concise resources and worked examples; scaffold deliberate practice; require an artefact or performance; apply an analytic rubric aligned with industry or professional standards; provide feedback and reassessment; verify identity and evidence; issue an interoperable credential; and create a documented pathway to credit, further learning, or employment. Industry participation should improve task authenticity and recognition, but academic providers must protect educational coherence and avoid reducing curricula to transient employer demands.

4.3 Motivation, agency, and the risk of credentialism

Badges can make progress visible and support goal setting [22], yet external symbols may also narrow attention to accumulation. Self-determination theory suggests that motivation is more sustainable when learners experience autonomy, growing competence, and relatedness [14]. Therefore, badges should not function as isolated rewards detached from meaningful feedback. Learners need choice within bounded pathways, credible evidence of improvement, and interaction with instructors or peers. Stackability should likewise represent cumulative capability rather than a collection of loosely related tokens.

4.4 Equity, accessibility, and data ethics

Flexibility does not guarantee inclusion. Short online courses can reproduce exclusion through fees, inaccessible media, unreliable connectivity, platform complexity, English-only resources, compressed schedules, or assumed digital fluency. Equity-sensitive design requires accessible documents and multimedia, low-bandwidth alternatives, predictable workload, mobile compatibility, explicit orientation, flexible evidence formats where construct-irrelevant, and timely human support. LMS analytics and credential evidence also raise questions of consent, retention, privacy, algorithmic bias, and the right to contest decisions. These matters should be incorporated into quality assurance rather than treated as downstream technical compliance.

4.5 Institutional and policy implications

- Governance: establish a cross-functional approval process linking academic standards, learning design, registry, IT, accessibility, careers, and industry engagement.
- Curriculum: require constructive alignment, bounded workload, stackability rules, and explicit recognition-of-prior-learning pathways.
- Assessment: distinguish participation, knowledge, application, and performance claims; mandate rubrics, feedback, reassessment, and moderation proportional to risk.
- Technology: integrate the LMS, credential platform, identity management, portfolio, and student-record systems while maintaining data minimisation and interoperability.
- Faculty capability: provide workload, design templates, assessor calibration, analytics literacy, and communities of practice rather than expecting individual enthusiasts to sustain provision.
- Evaluation: report enrolment, participation, completion, mastery, learner experience, subgroup equity, transfer, progression, and employer or professional recognition using transparent denominators.

4.6 Limitations of the review

This review is restricted to five Scopus result sets and may omit studies indexed elsewhere, professional reports, and rapidly evolving institutional practice. More importantly, eligibility and synthesis were based only on titles, abstracts, keywords, and bibliographic metadata. Abstracts compress intervention detail, may selectively emphasise positive findings, and rarely report complete assessment rubrics, LMS configurations, attrition, subgroup outcomes, or methodological limitations. Consequently, the review is best interpreted as a systematic title-and-abstract evidence map and narrative synthesis rather than a full-text effectiveness review.

Terminological instability also created sensitivity and specificity problems: rigorous micro-credentials may be described as digital badges, certificates, or short courses, whereas some uses of micro-credential refer only to blockchain or recognition technology. Three included abstracts did not identify the platform, and several described design intent without quantified outcomes. No independent full-text quality appraisal was possible. Publication concentration in 2025–2026 further means that the evidence is recent, citation-light, and potentially vulnerable to publication bias. These limitations require cautious interpretation of apparent pedagogical patterns.

4.7 Future research

Future research should move beyond descriptive adoption and short post-course surveys. Priority designs include multi-site comparative studies of LMS pathways; quasi-experimental or randomised comparisons of feedback, social presence, and mastery features; learning-analytics studies grounded in theory and privacy safeguards; longitudinal tracking of workplace transfer and educational progression; cost-effectiveness analysis; and realist evaluations asking what works, for whom, under which conditions. Vocational and engineering education particularly needs studies comparing LMS-only, simulated, laboratory, and workplace evidence and examining inter-rater reliability, authenticity, safety, and recognition by employers and professional bodies.

5 Conclusion

Micro-credentials derive educational legitimacy from the learning and assessment system behind the award. Across 12 Scopus-indexed studies, LMS-enabled provision was most defensible when five functions were aligned: a clear competency architecture, a modular mastery pathway, authentic assessment, sustained human facilitation, and a trusted, evidence-bearing credential. Assessment and feedback dominated the literature, but authentic tasks, active learning, and scaffolding were much less frequently reported. Positive evidence concerned

engagement, confidence, preparedness, self-efficacy, and perceived value; evidence of workplace transfer, employability, equity, and sustained performance remained insufficient. The LMS can connect learning, evidence, and credentials at scale, but it can also conceal weak pedagogy behind smooth enrolment and automated certification. For vocational and engineering education, the decisive standard should be whether learners can demonstrate transferable performance under authentic constraints. Institutions should therefore evaluate micro-credentials not by catalogue size or badge issuance, but by constructive alignment, evidential validity, human support, accessibility, and recognised progression.

Declarations

Author contributions

B.T.C: Conceptualization, methodology, formal analysis, first draft writing, project administration, review & editing.

S.A.H.N.: Data curation, review & editing, supervision.

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Data availability

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Ethics approval

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Consent to participate

Not applicable.

Consent to publish

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Figures

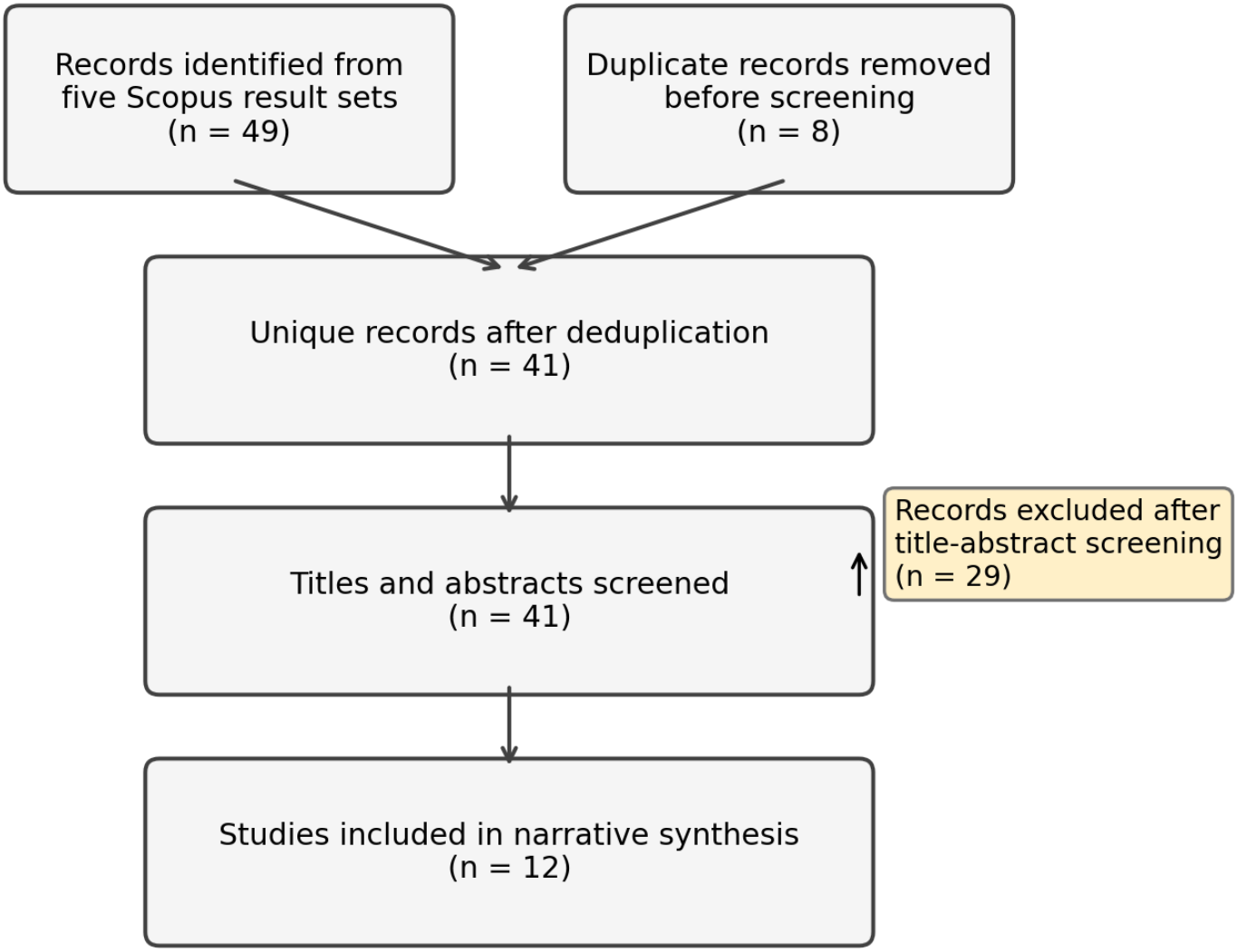


Figure 1

PRISMA 2020 flow diagram for the Scopus title-and-abstract review

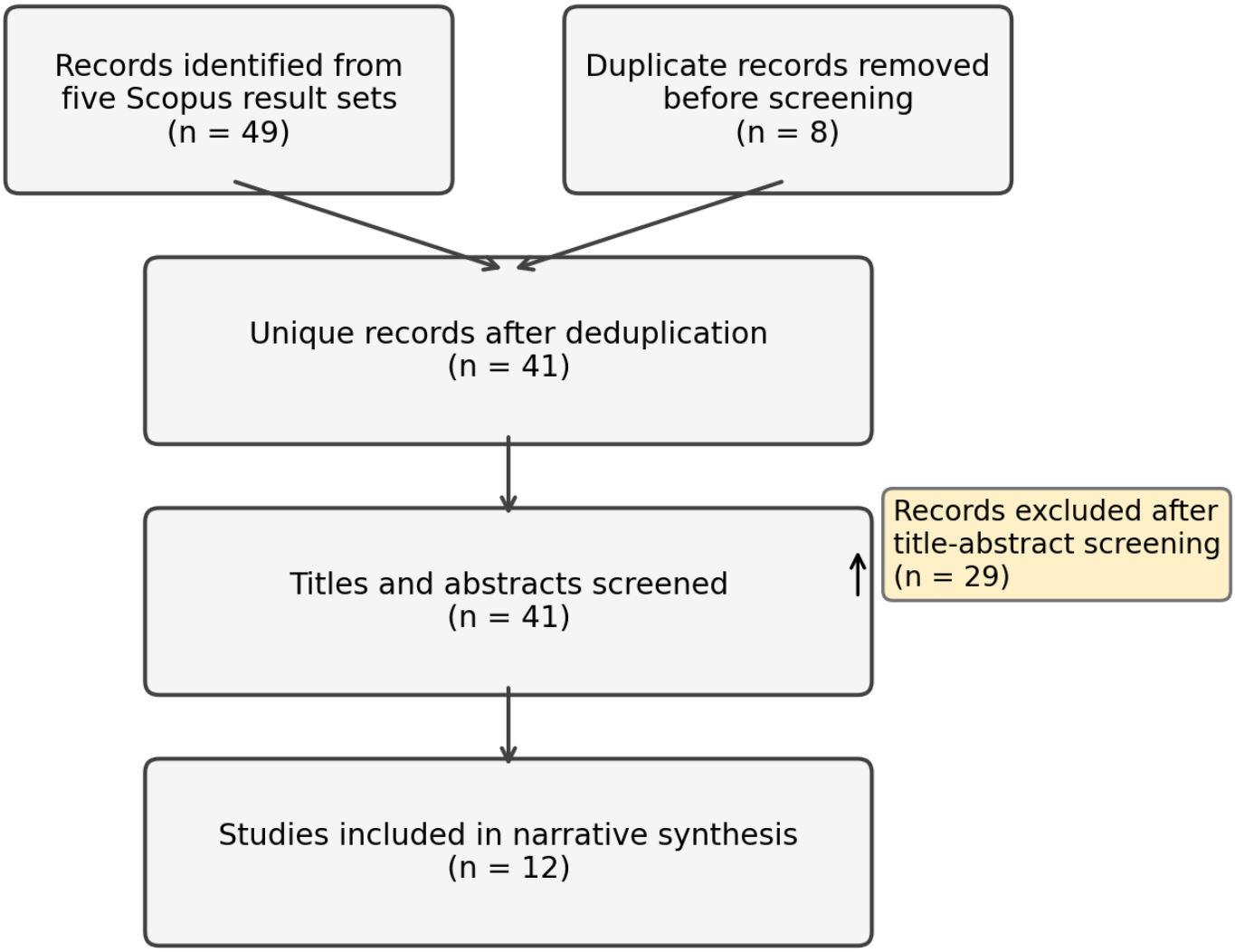


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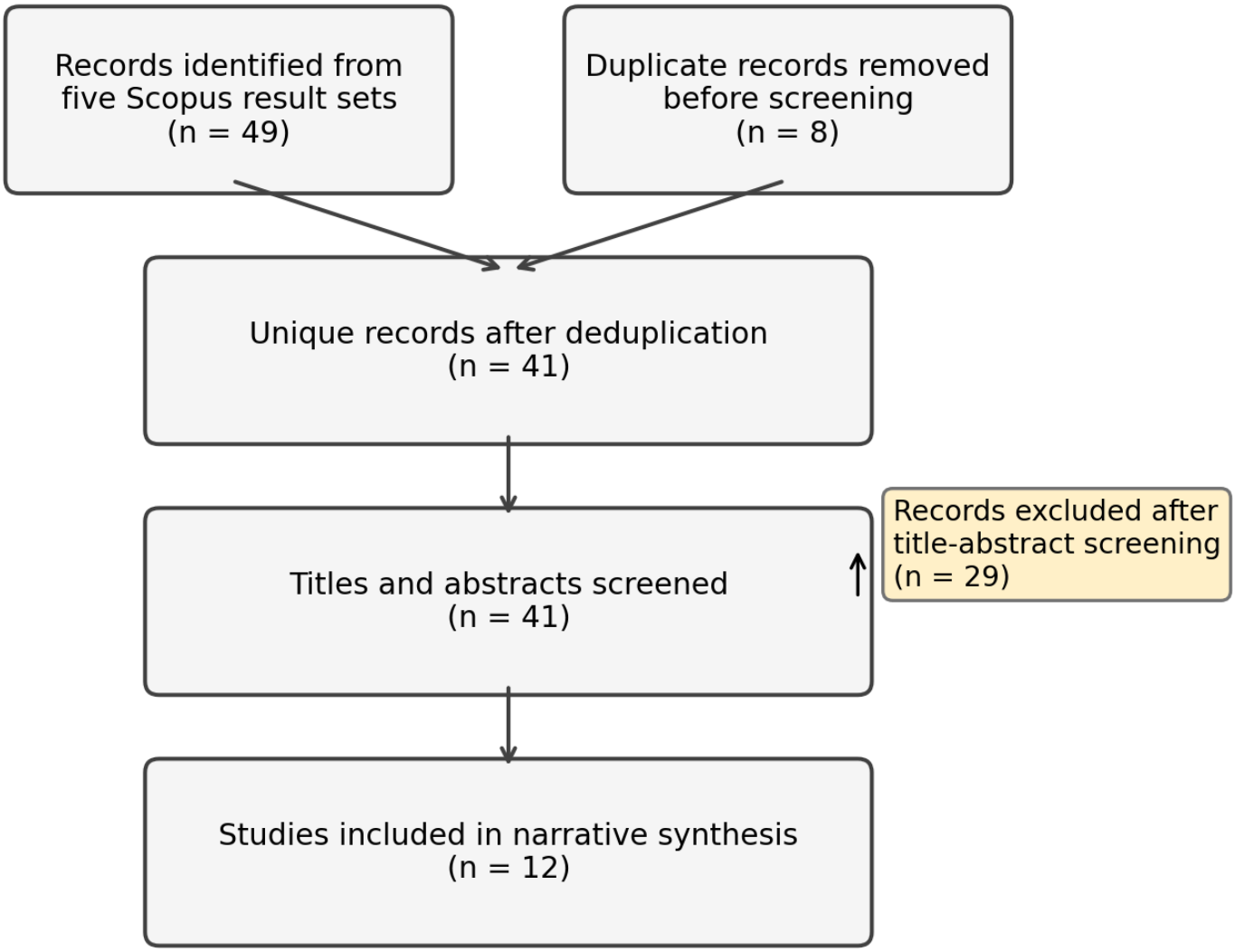


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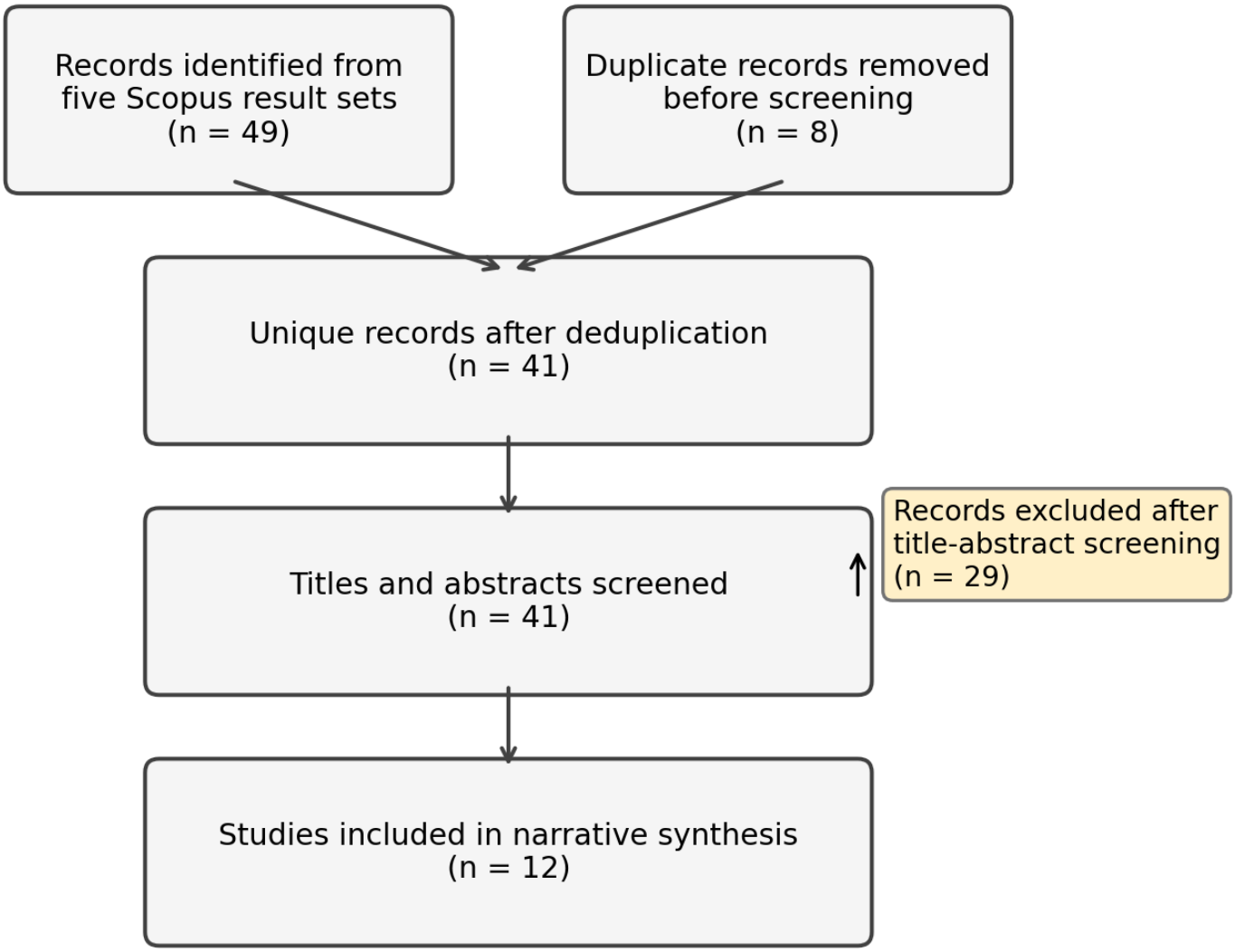


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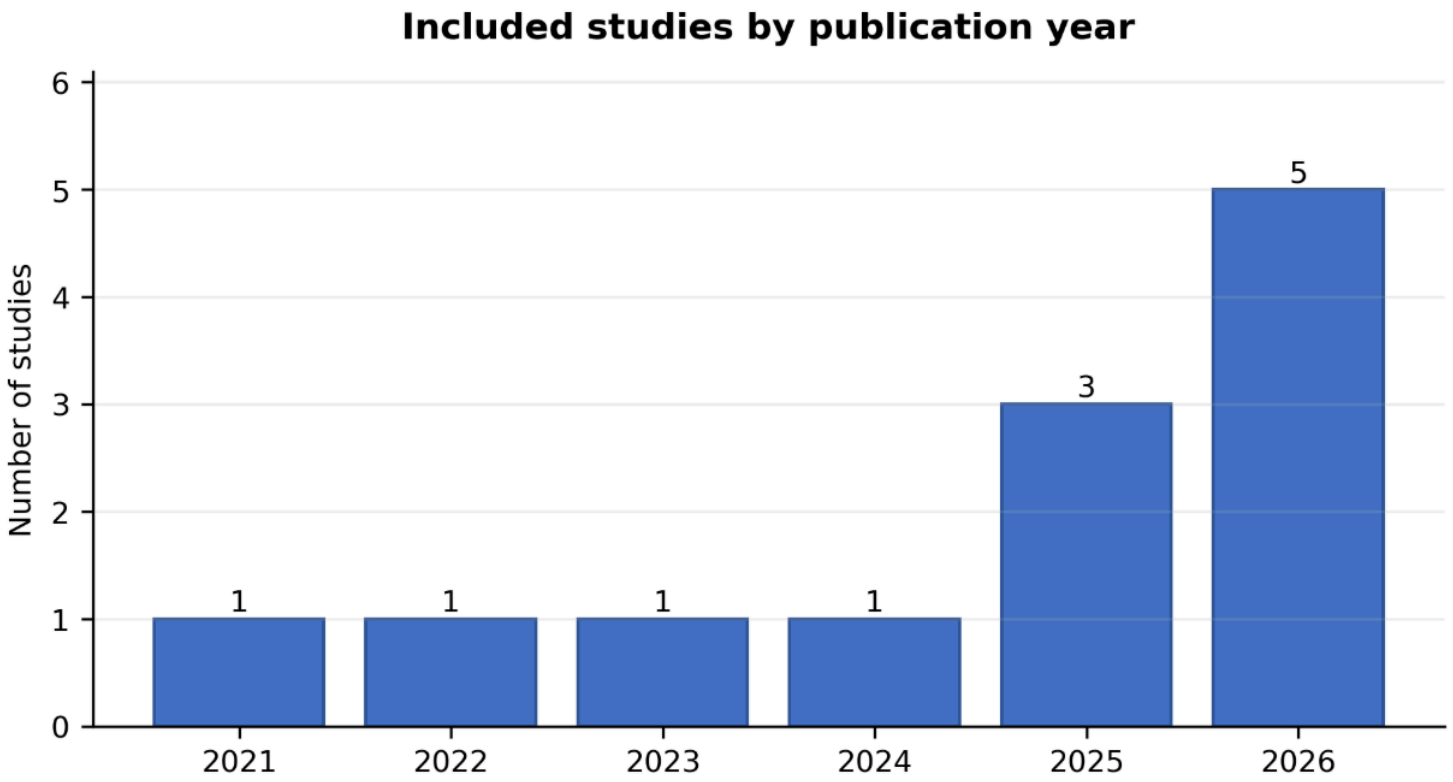


Figure 2

Distribution of the 12 included studies by publication year

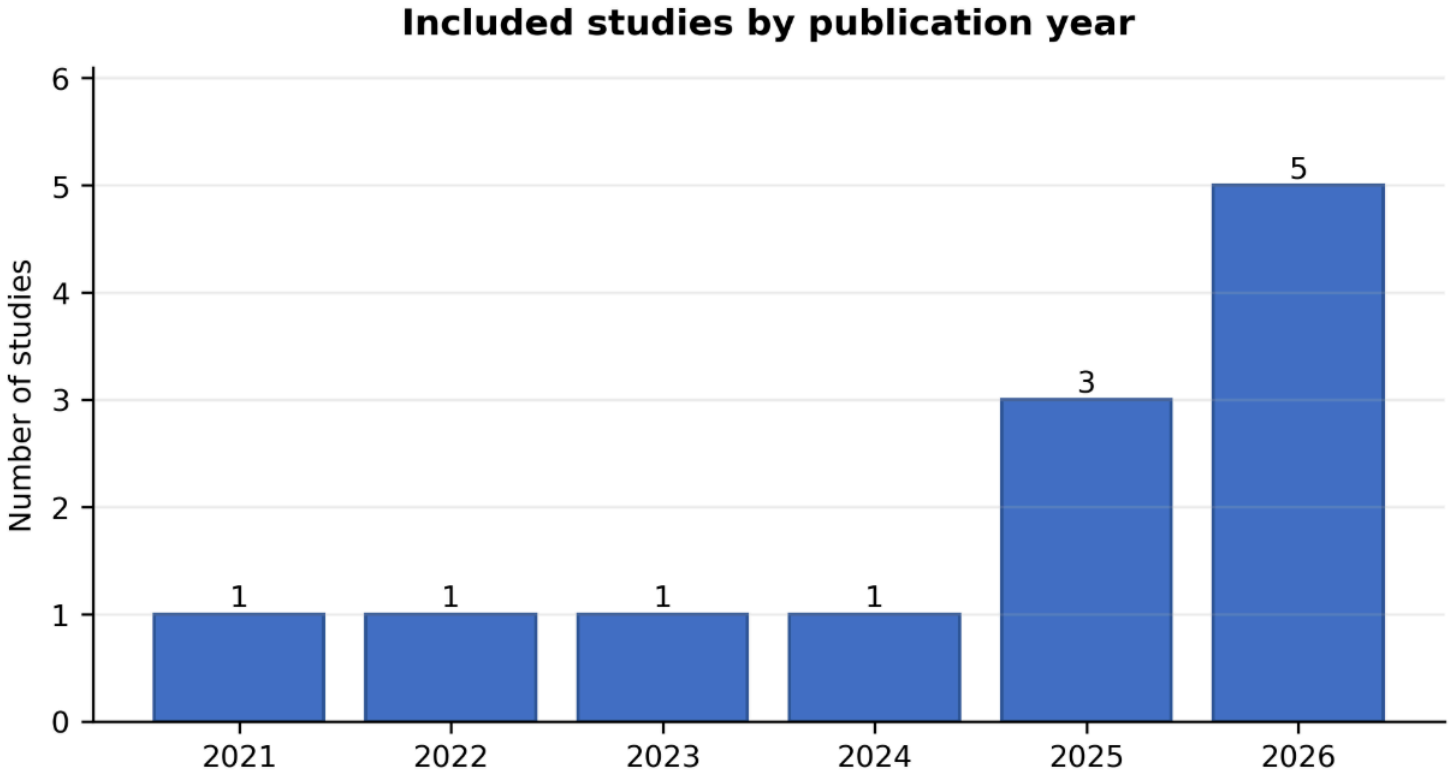


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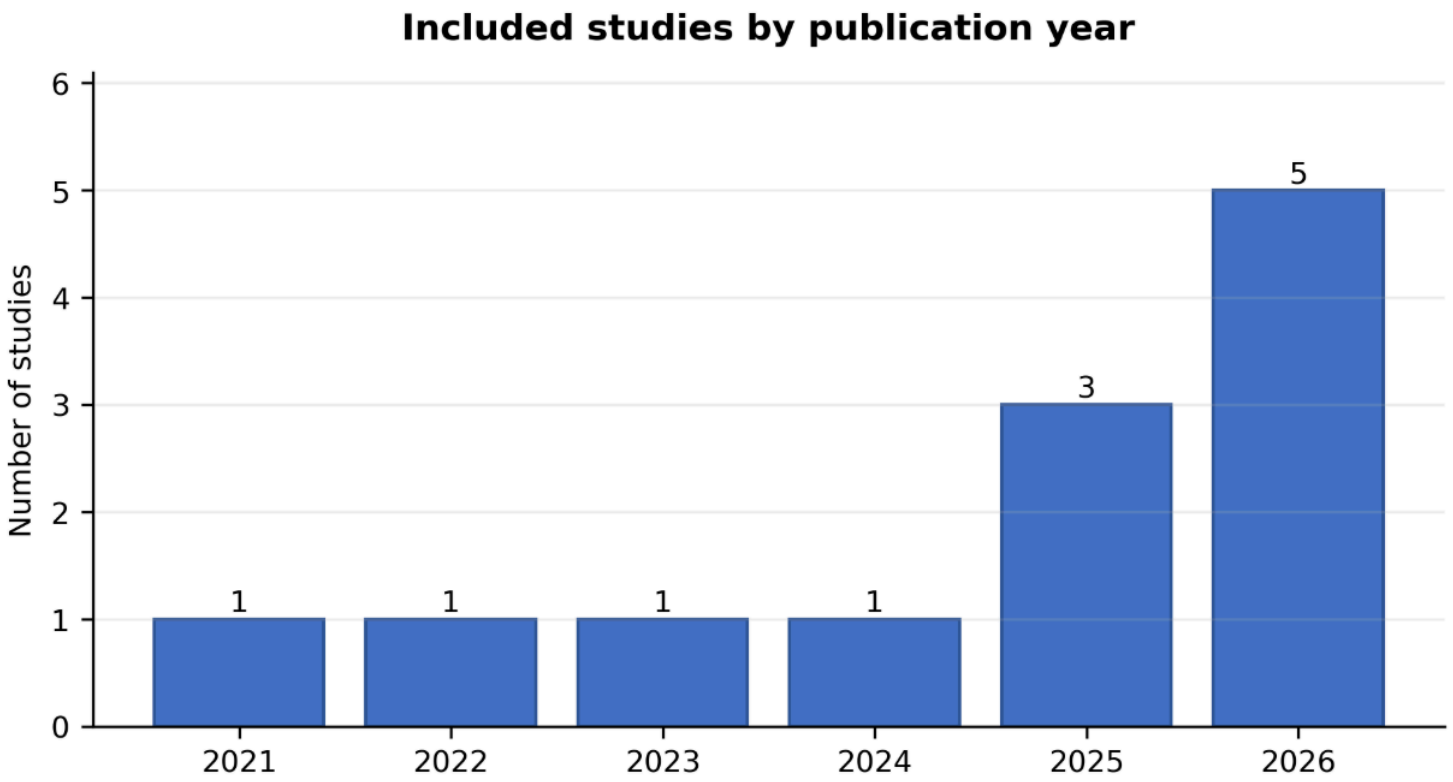


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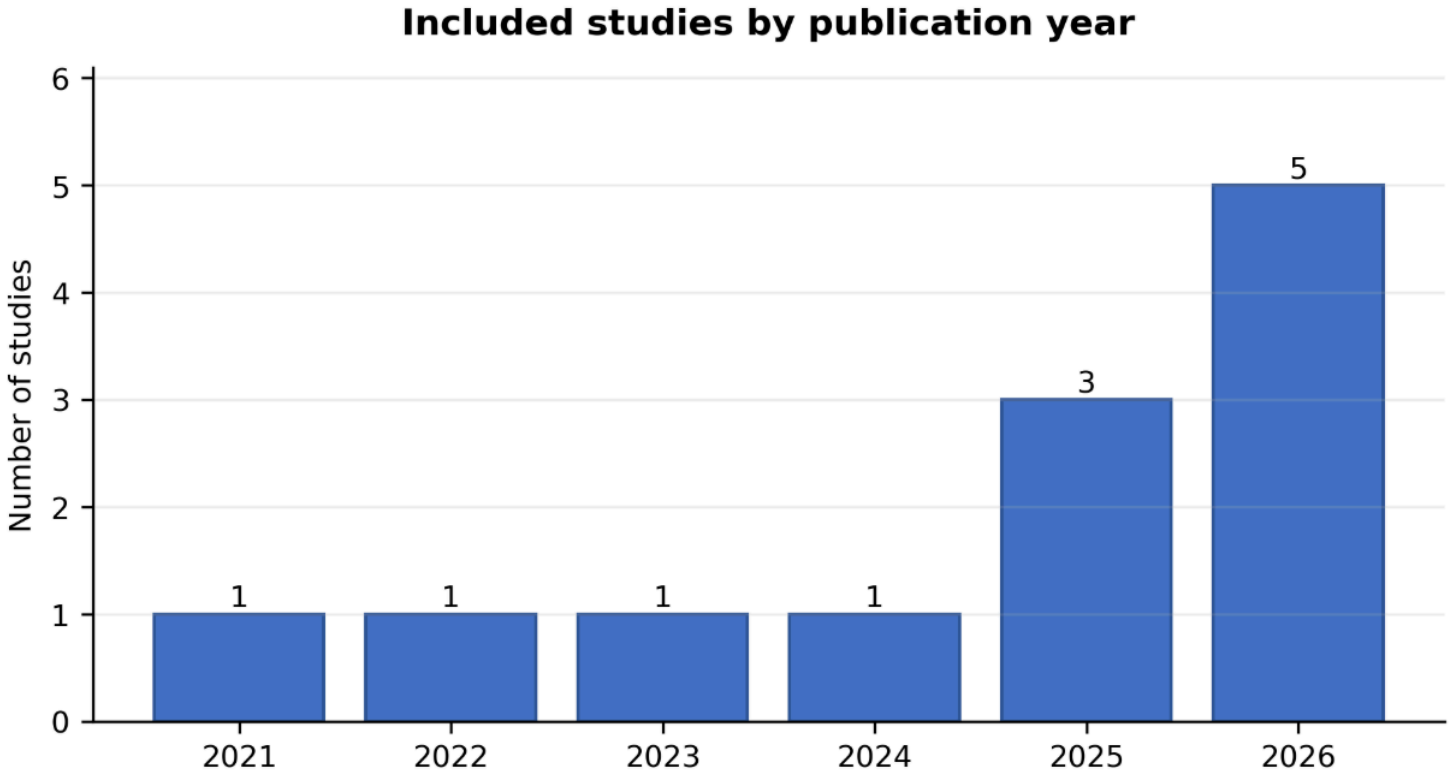


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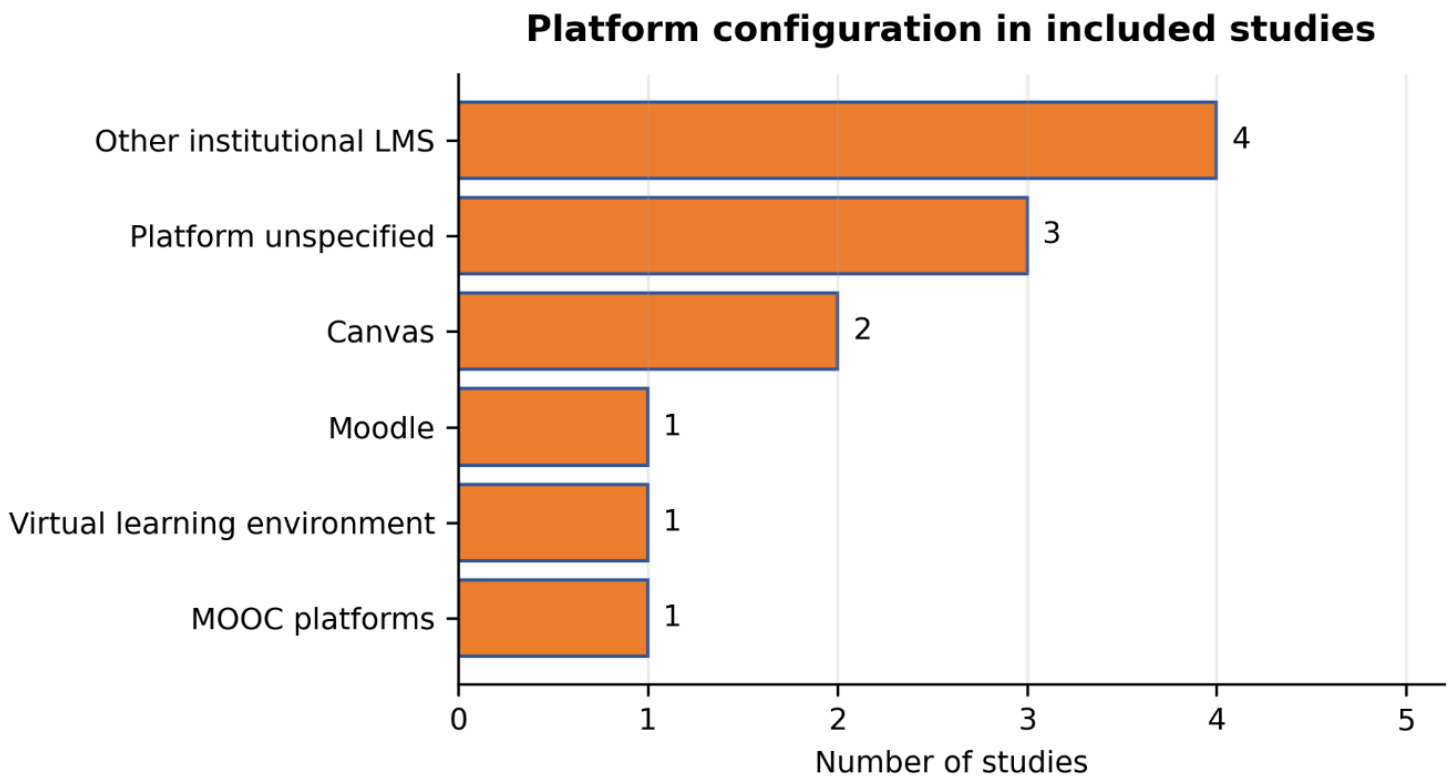


Figure 3

LMS and platform configuration reported in included titles and abstracts

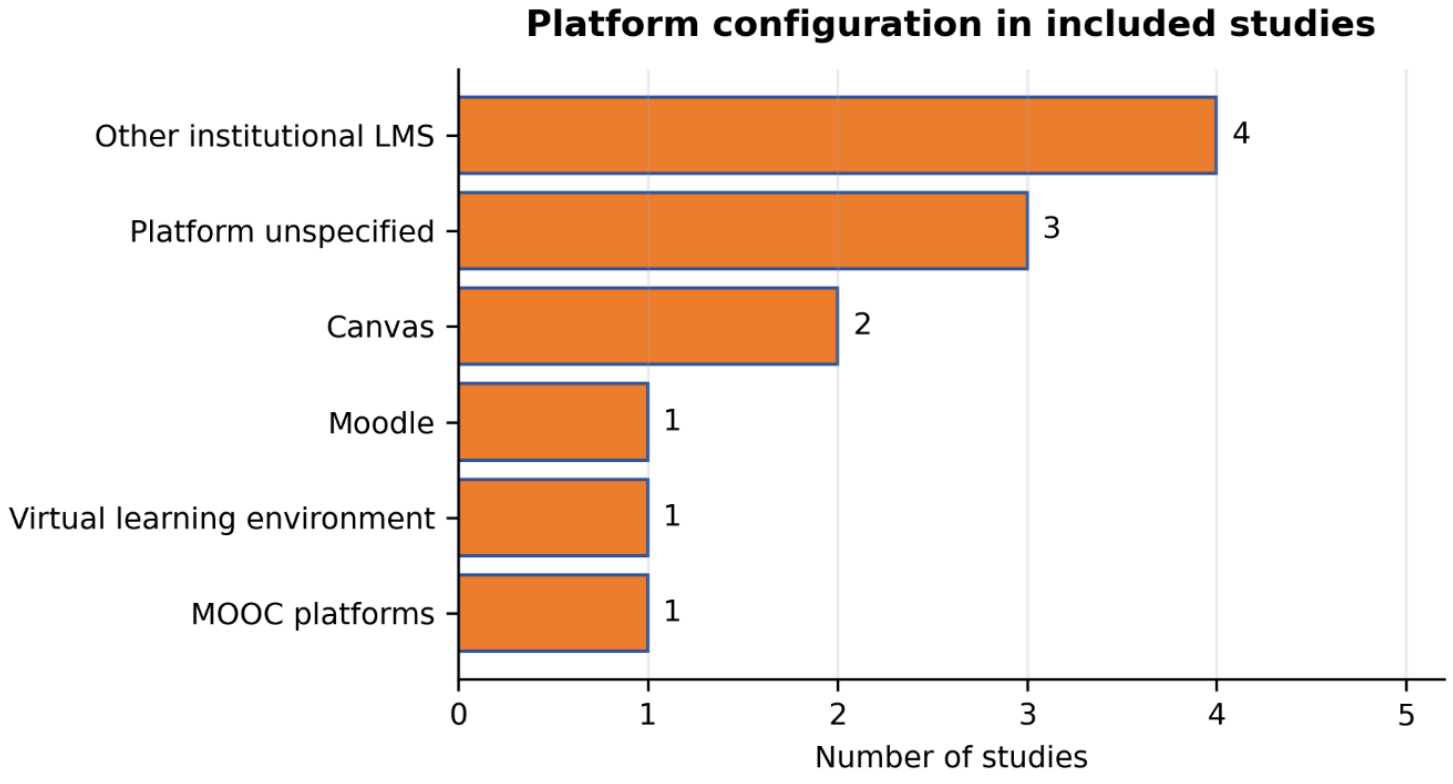


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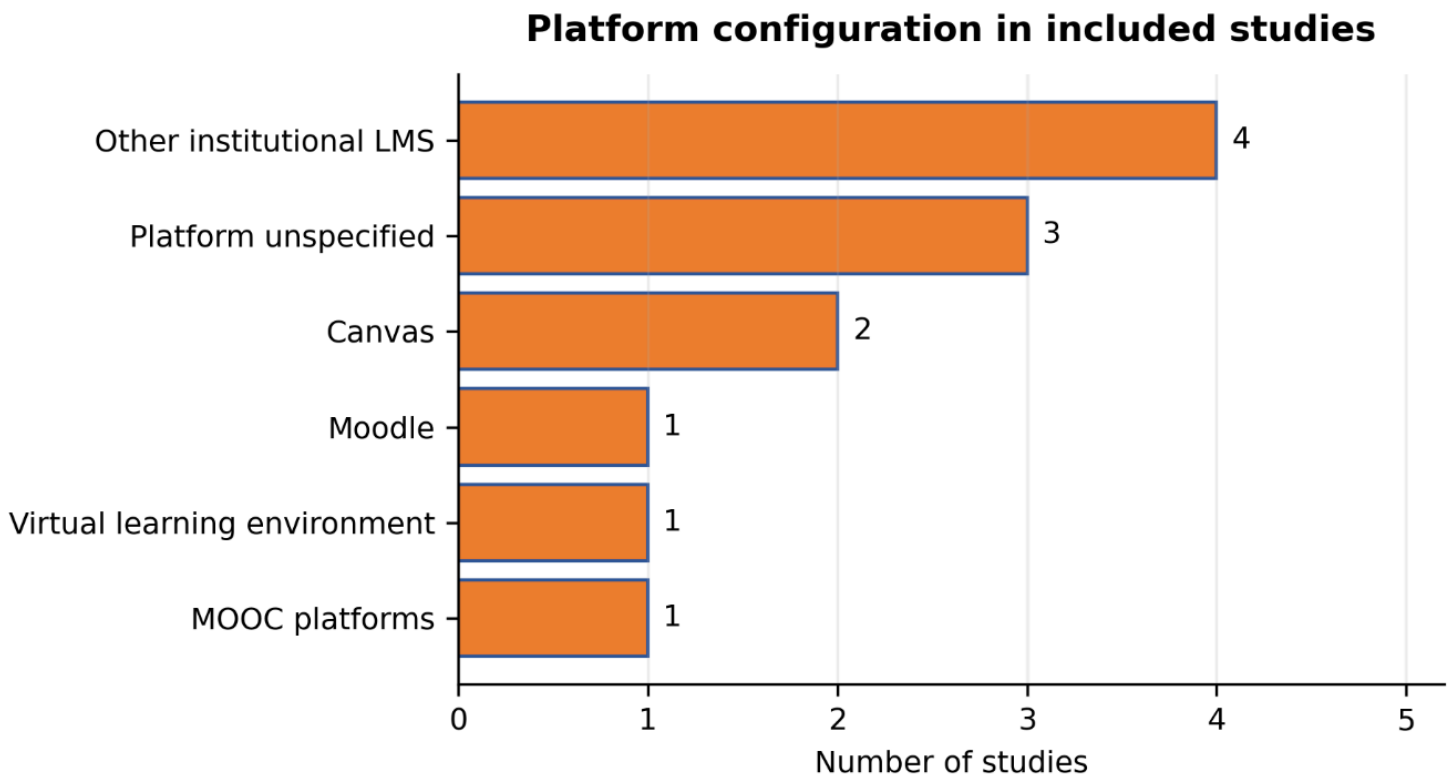


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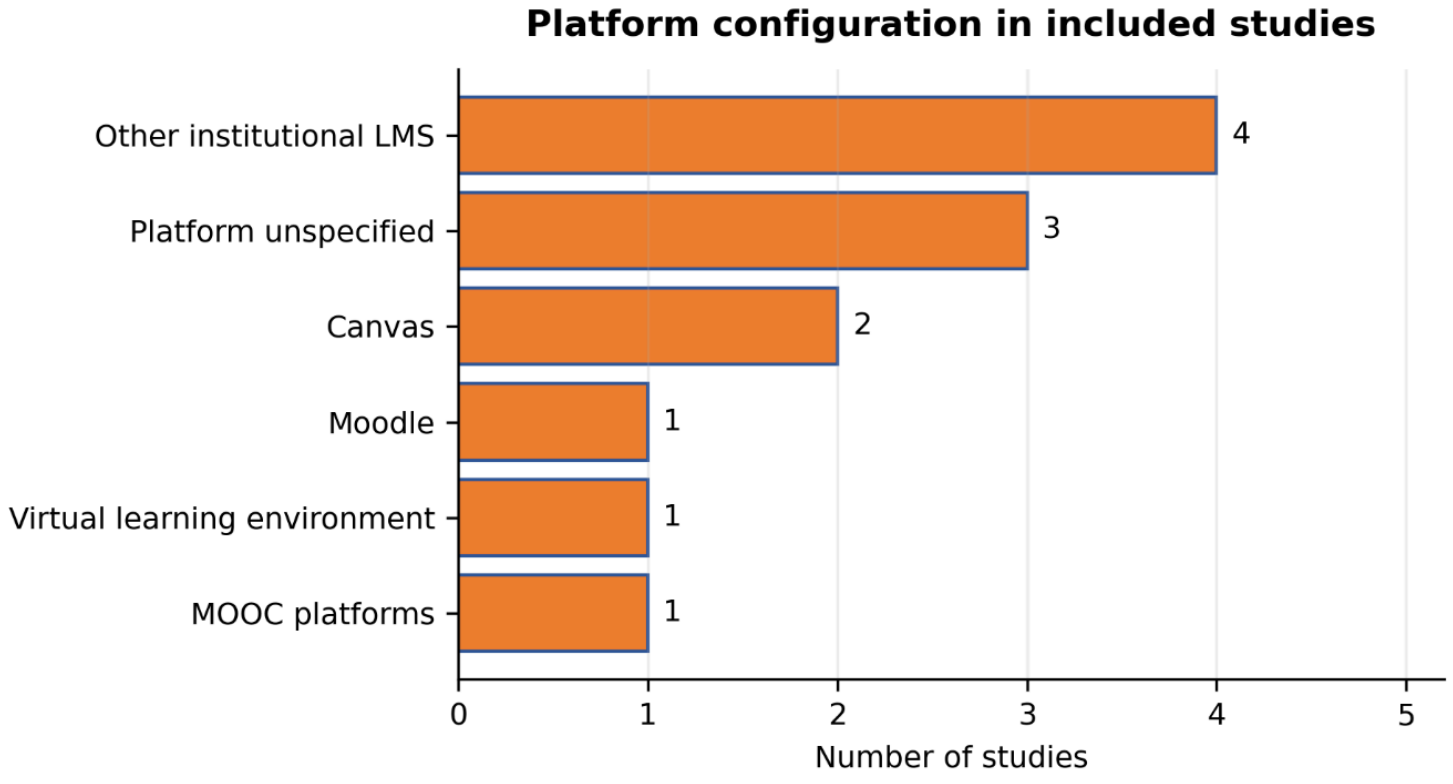


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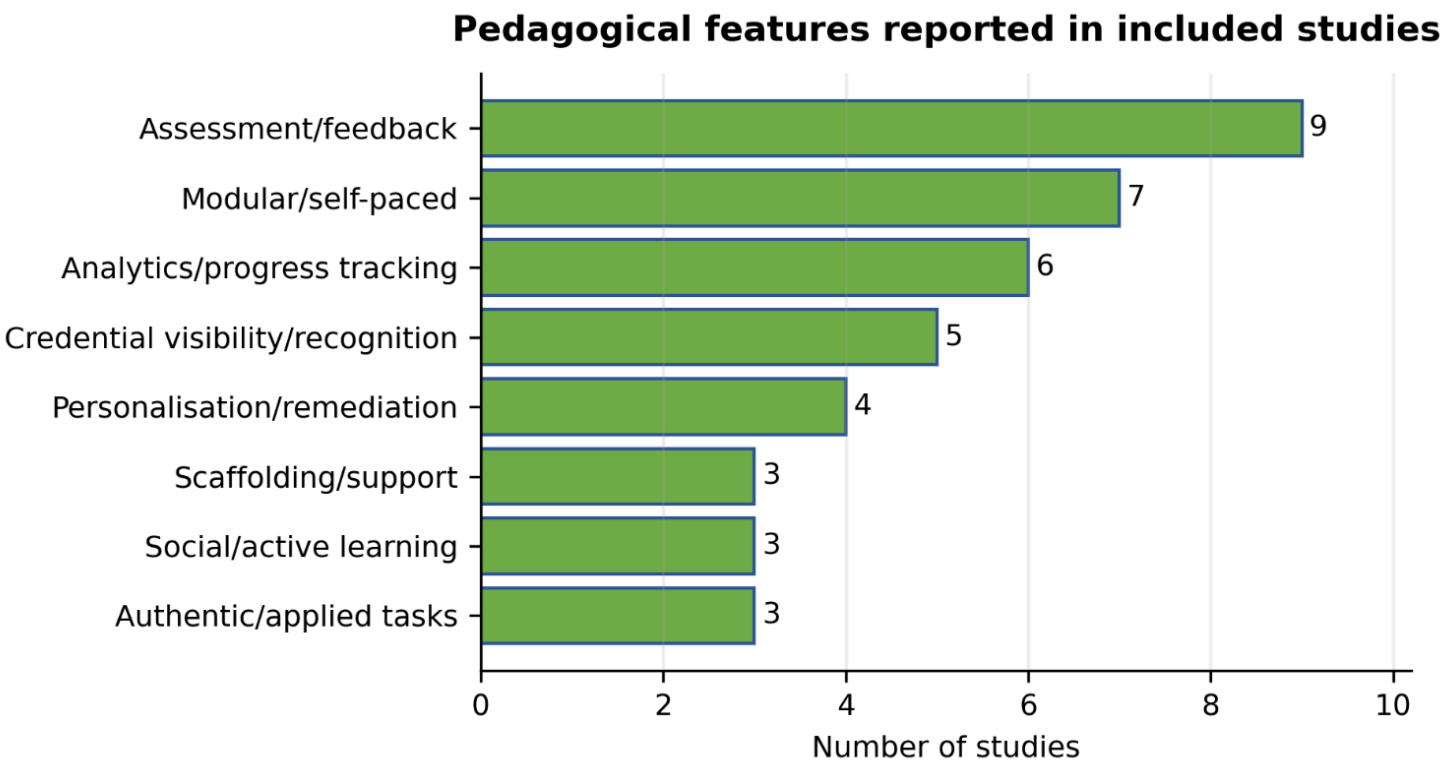


Figure 4

Frequency of pedagogical features coded across the 12 included studies. Multiple features could be coded per study

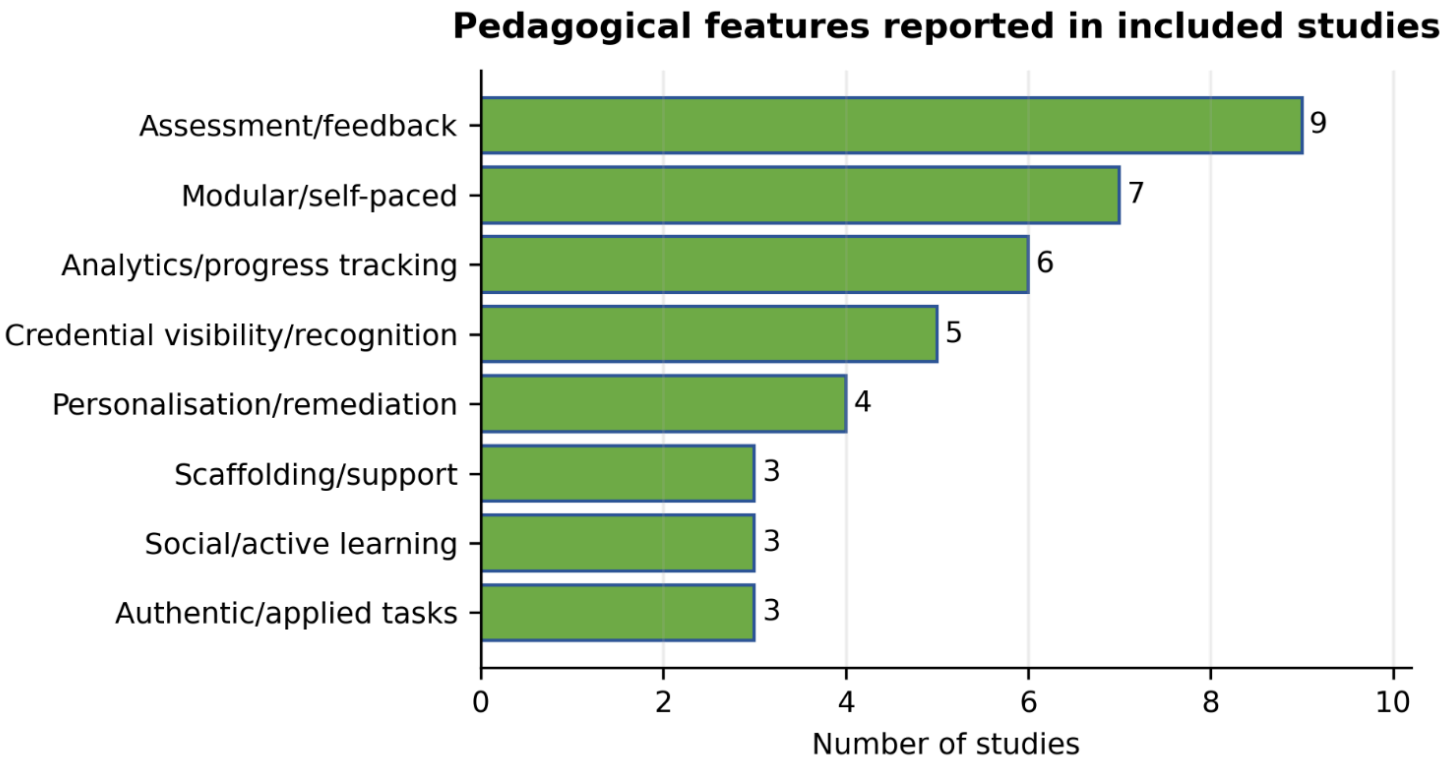


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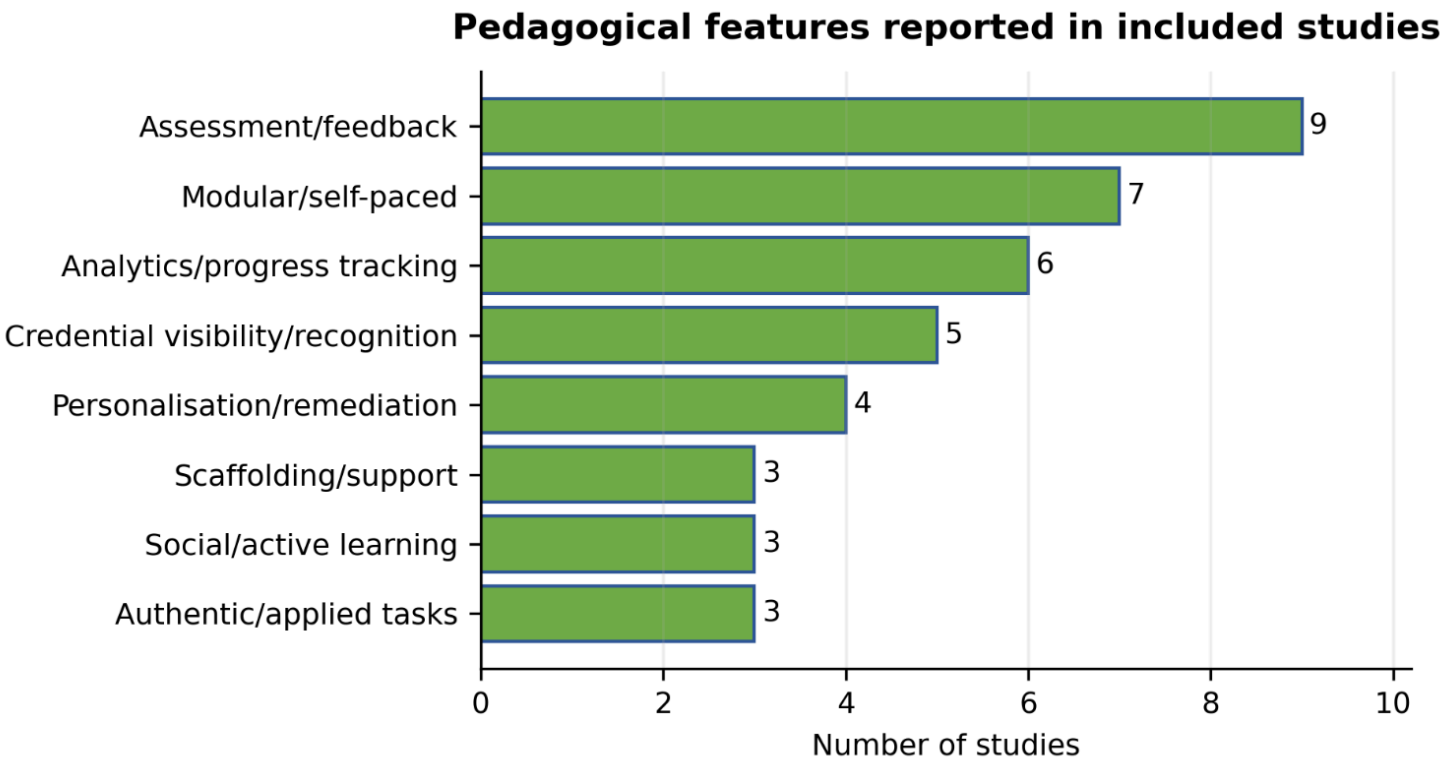


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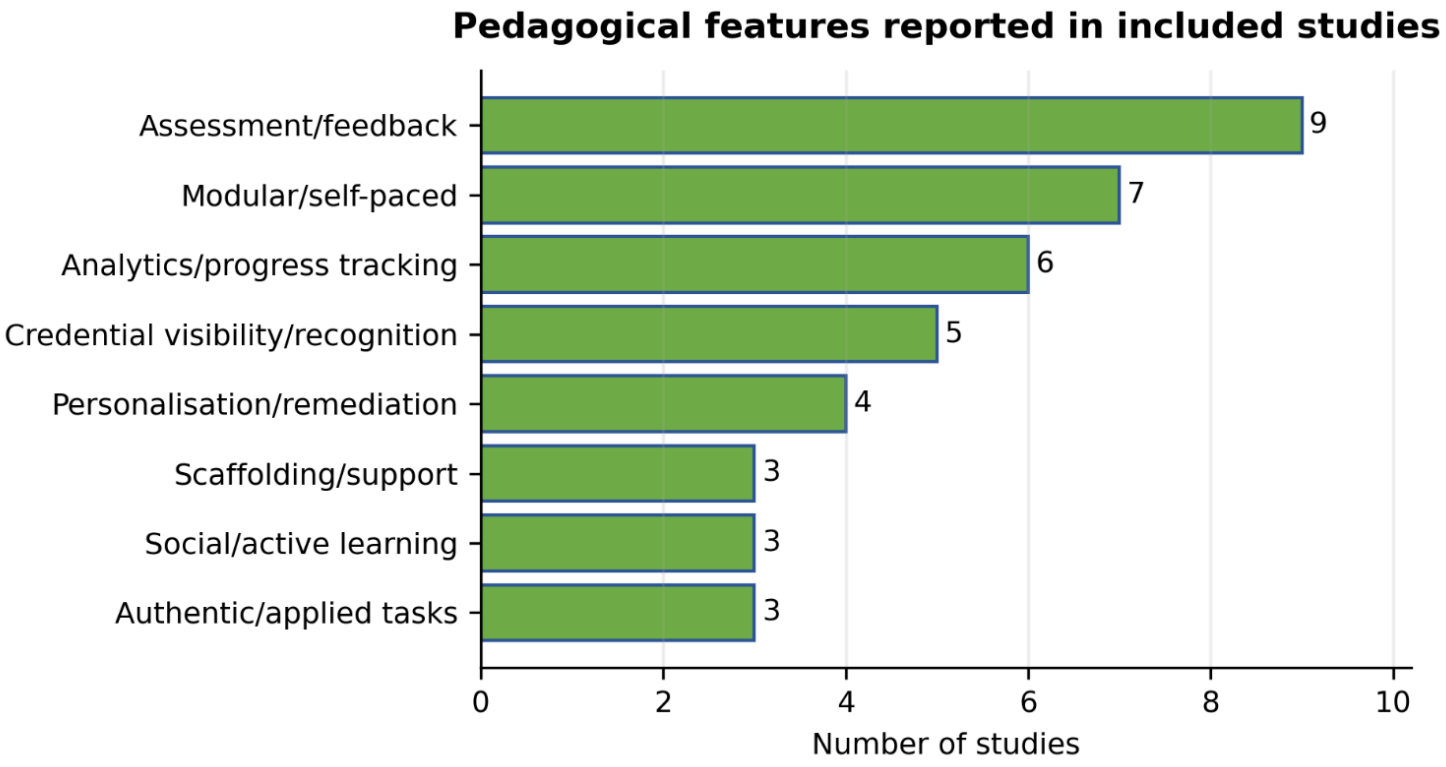


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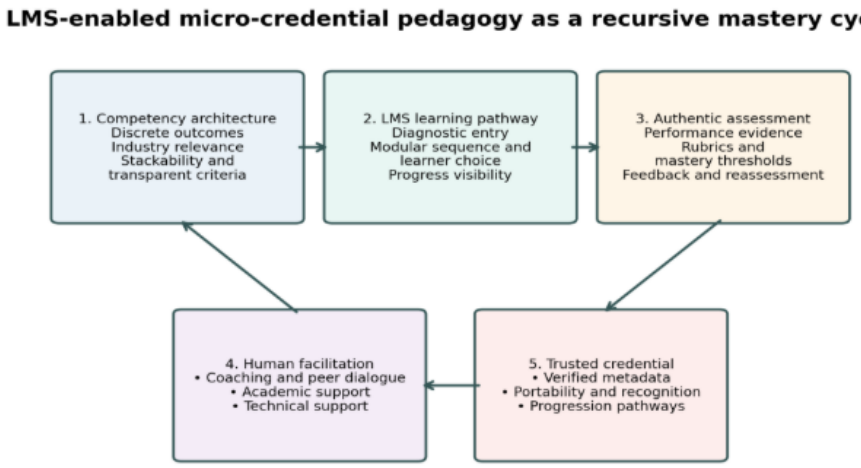


Figure 5

LMS-enabled micro-credential pedagogy framework derived from the thematic synthesis

LMS-enabled micro-credential pedagogy as a recursive mastery cycle

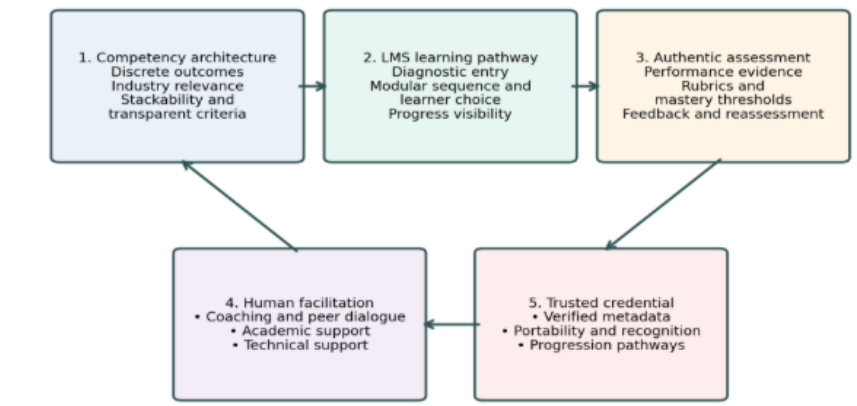


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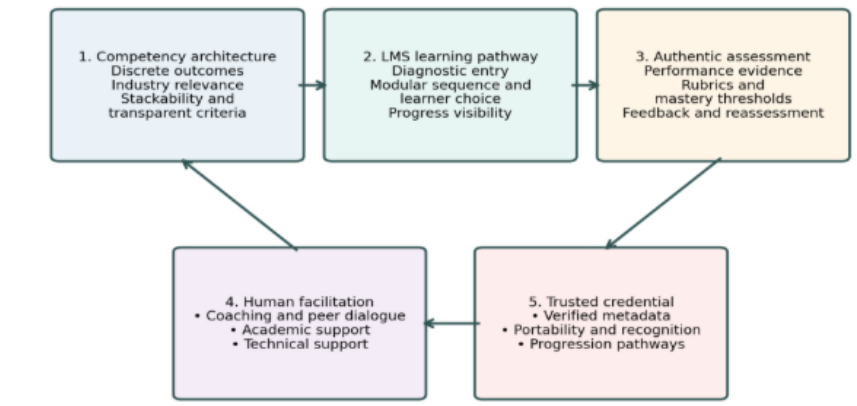


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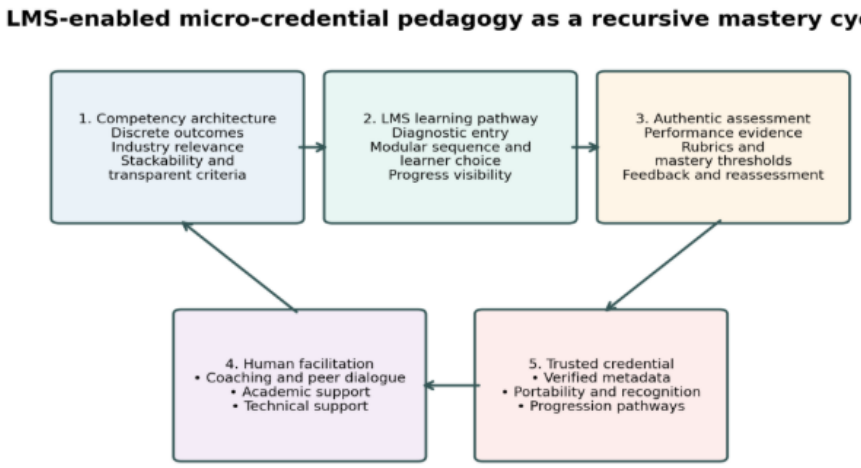


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