

FROM SCHOOLS TO LEARNING HUBS: REWRITING THE GRAMMAR OF SCHOOLING THROUGH DIGITAL LITERACY AND NETWORKED LEARNING ECOSYSTEMS

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Abstract

This scoping review examines scholarly literature on learning hubs, future schooling models, digital literacy, and networked learning ecosystems to identify emerging directions in contemporary education. Guided by the Arksey and O'Malley framework and reported using the PRISMA-ScR guidelines, the review systematically maps evidence from studies published between 2015 and 2025. Sources were retrieved from Scopus, Web of Science, and ERIC databases to ensure comprehensive interdisciplinary coverage. A total of 547 records were identified, with 450 screened after duplicate removal. Following full-text assessment, 58 studies were included in the final synthesis. Thematic analysis revealed five key themes. Learning hubs are emerging as flexible, learner-centred alternatives to traditional schooling, emphasizing personalization and accessibility. Digital literacy has become a foundational competency encompassing critical thinking, information evaluation, digital citizenship, and AI literacy. Industry and community partnerships increasingly support experiential and work-integrated learning. Networked learning ecosystems are reshaping education through connected and hybrid learning beyond institutional boundaries. Key challenges include the digital divide, policy constraints, teacher readiness, and equity issues. The study proposes a Learning Hub Ecosystem Model integrating government, schools, universities, industry, communities, technology platforms, and learners. The review concludes that the traditional grammar of schooling is being reshaped by digital transformation and ecosystem-based learning, offering pathways toward more flexible, inclusive, and future-ready education systems.

Keywords: Learning Hubs, Digital Literacy, Networked Learning Ecosystems, Education Transformation,

1. Introduction

Education systems worldwide are undergoing profound transformation as technological advances, societal changes, and evolving workforce demands challenge the assumptions underpinning traditional schooling. For more than a century, formal education has largely been organized around age-graded classrooms, standardized curricula, fixed schedules, and teacher-centered instruction. Although this industrial-era model expanded access to education, scholars increasingly argue that it is no longer sufficient for preparing learners to navigate the complexities of the twenty-first century (Fullan & Langworthy, 2014; Zhao, 2012). This growing mismatch has intensified calls to rethink the “grammar of schooling,” referring to the deeply embedded organizational structures and practices that shape educational institutions (Tyack & Tobin, 1994).

The limitations of traditional schooling have become increasingly evident amid rapid technological change, globalization, and shifting labor market expectations. Contemporary learners are expected to develop competencies such as critical thinking, creativity, collaboration, digital literacy, and lifelong learning skills that extend beyond the acquisition of disciplinary knowledge (OECD, 2019). However, many educational systems continue to prioritize content delivery and examination performance, often limiting opportunities for personalized and authentic learning experiences (Zhao, 2012). Consequently, there is growing recognition that educational structures must evolve to remain relevant in digitally connected societies.

A major catalyst for this transformation is the rapid advancement of artificial intelligence (AI). AI is reshaping teaching, learning, assessment, and educational administration through personalized learning pathways, adaptive feedback systems, intelligent tutoring, and data-informed decision-making (Holmes et al., 2022). The emergence of generative AI has further intensified debates about the future roles of schools, teachers, and learners. Educational institutions are increasingly expected not only to transmit knowledge but also to develop learners’ abilities to critically evaluate, interpret, and apply information in dynamic digital environments. As AI continues to redefine work and learning, education systems face growing pressure to foster adaptability, digital competence, and human-centered skills (UNESCO, 2023).

Alongside AI, broader processes of digital transformation are reshaping educational ecosystems. Digital transformation involves more than technology adoption; it requires fundamental changes in organizational structures, pedagogical practices, and learning relationships (Bond et al., 2018). The COVID-19 pandemic accelerated the integration of digital technologies while exposing persistent inequalities in access, participation, and digital readiness (Williamson et al., 2020). In response, educators and policymakers have increasingly explored alternative educational arrangements that support more flexible, connected, and learner-centered approaches.

Within this context, flexible learning environments have emerged as a central focus of educational reform. These environments emphasize personalization, learner agency, collaboration, and the integration of formal, informal, and non-formal learning opportunities (OECD, 2018). Emerging models such as learning hubs, innovation centers, makerspaces, community-based learning networks, and hybrid learning ecosystems seek to transcend the physical and institutional boundaries of conventional schools. Through partnerships among schools, communities, industries, higher education institutions, and digital platforms, these models create interconnected

ecosystems that support lifelong learning and digital competence development (Jackson, 2013; Siemens, 2005).

Learning hubs exemplify a broader shift from viewing schools as isolated institutions to understanding learning as a distributed and networked process. Grounded in principles of connectivism and networked learning, they enable learners to engage with diverse resources, communities, technologies, and real-world challenges beyond traditional classroom settings (Siemens, 2005). As educational systems respond to technological disruption and societal change, learning hubs offer a promising model for reimagining schooling in more adaptable, inclusive, and future-oriented ways.

Problem Statement

Despite significant investments in educational reform and digital technologies, many schooling systems struggle to meet the diverse needs of contemporary learners. Traditional models—characterized by standardized curricula, age-based grouping, fixed schedules, and teacher-centered pedagogies—were designed for industrial-era societies and are increasingly misaligned with the demands of knowledge economies and rapidly changing global contexts (Tyack & Tobin, 1994).

A major challenge is the lack of personalized learning. Although learners differ in interests, abilities, cultural backgrounds, and aspirations, schools often rely on uniform instructional and assessment approaches (Fullan & Langworthy, 2014). This can limit learner agency, engagement, and individualized progression while hindering the development of higher-order competencies (OECD, 2019).

Another challenge is the development of digital competence. Contemporary societies require not only technical skills but also information evaluation, digital collaboration, ethical technology use, data literacy, and AI literacy (European Commission, 2022; UNESCO, 2023). However, schools frequently prioritize content acquisition over comprehensive digital competency development (Bond et al., 2018).

Traditional schooling also struggles to promote lifelong learning. Rapid technological and labor-market changes require continuous learning throughout life (OECD, 2021), yet formal education remains largely tied to specific life stages. This model is increasingly incompatible with learning that occurs across workplaces, communities, digital environments, and informal networks (Siemens, 2005).

These challenges highlight a gap between existing educational structures and emerging societal needs. While learning hubs and networked learning ecosystems have emerged as promising alternatives that support digital literacy, learner agency, and lifelong learning, their potential role in transforming education remains insufficiently understood. Addressing this gap is essential for developing more responsive, inclusive, and sustainable educational systems.

3.3 Research Questions

The study is guided by the following research questions:

- 1) What is currently known about learning hubs and networked learning ecosystems in the literature?
- 2) How does digital literacy influence and shape future schooling models?
- 3) What key challenges and opportunities are associated with the development of these emerging educational approaches?
- 4) What conceptual model can be developed to integrate learning hubs, digital literacy, and ecosystem-based education for future-oriented learning systems?

4. Methodology

4.1 Research Design

This study adopts a scoping review design to systematically map and synthesise existing literature on learning hubs, future schooling models, digital literacy, and networked learning ecosystems. A scoping review is appropriate for this study because the topic is broad, interdisciplinary, and still emerging, requiring an exploratory approach rather than a narrowly focused synthesis. Unlike systematic reviews that typically address specific research questions and evaluate intervention effectiveness, scoping reviews are designed to identify key concepts, map evidence, clarify definitions, and examine gaps in the literature.

The exploratory nature of this review is justified by the evolving character of digital education transformation, where concepts such as learning hubs and networked ecosystems are still being theoretically developed and empirically tested. Therefore, a scoping approach allows for a comprehensive examination of diverse study designs, theoretical perspectives, and contextual applications. This method supports the identification of patterns and relationships across studies, enabling a broader understanding of how educational systems are shifting toward more flexible, connected, and technology-enabled learning environments.

4.2 Framework

This review follows the Arksey and O'Malley scoping review framework, which includes five stages: identifying the research question, identifying relevant studies, study selection, data charting, and collating, summarising, and reporting results. The review is reported in line with PRISMA-ScR guidelines to ensure transparent and systematic reporting of the search, screening, eligibility, and selection processes. Together, these frameworks provide a rigorous and flexible approach for mapping interdisciplinary literature on learning ecosystems, digital literacy, and future schooling, ensuring comprehensive coverage and systematic organisation of findings.

4.3 Search Strategy

A comprehensive search strategy was developed to identify relevant peer-reviewed literature published between 2015 and 2025. The search was conducted across three major academic databases: Scopus, Web of Science, and ERIC, due to their extensive coverage of education, social sciences, and interdisciplinary research.

Key search terms were developed based on the core concepts of the study, including “learning hubs,” “learning ecosystems,” “networked learning,” “future schooling,” “digital literacy,”

“education transformation,” and “flexible learning environments.” These terms were combined using Boolean operators such as AND and OR to refine and expand search results. For example, search strings included combinations such as “learning hubs AND digital literacy,” “networked learning OR learning ecosystems,” and “future schooling AND education transformation.”

The search was limited to publications between 2015 and 2025 to capture recent developments associated with digital transformation and emerging educational models. Only peer-reviewed journal articles and conference papers were considered to ensure academic quality and credibility. Initial database searches were supplemented by reference list screening of relevant studies to identify additional sources not captured in the primary search. All retrieved records were exported into a reference management system, and duplicates were removed prior to screening.

4.4 Inclusion and Exclusion Criteria

Clear inclusion and exclusion criteria were established to ensure the relevance and quality of selected studies. Included studies were required to be peer-reviewed journal articles or conference papers published between 2015 and 2025. Studies had to explicitly address at least one of the core themes: learning hubs, digital literacy, networked learning ecosystems, or future schooling models. In addition, eligible studies needed to focus on educational contexts, including formal, non-formal, or informal learning environments.

Exclusion criteria included non-peer-reviewed sources such as editorials, opinion pieces, book reviews, and unpublished manuscripts. Studies not written in English were excluded due to language limitations. Research that did not directly relate to education or digital learning transformation was also excluded. Furthermore, studies focusing solely on technical system design without educational relevance were omitted.

These criteria ensured that the review focused on high-quality, relevant literature that directly contributes to understanding the transformation of education systems. By maintaining strict eligibility boundaries, the study enhances consistency in data synthesis and ensures that findings are grounded in empirically and theoretically relevant research.

4.5 Study Selection Process

The study selection process followed a structured PRISMA-ScR approach. All records identified through database searching were first imported into a reference management system, and duplicate entries were removed. The screening process involved two stages: title and abstract screening, followed by full-text review. During the first stage, studies were assessed for relevance based on predefined inclusion criteria. In the second stage, full-text articles were evaluated to confirm eligibility.

Any disagreements during the screening process were resolved through discussion and consensus. The final selection of studies was documented and presented using a PRISMA flow diagram to ensure transparency and reproducibility as presented in figure 1. This systematic process ensured that only studies relevant to learning hubs, digital literacy, and networked learning ecosystems were included in the final synthesis.

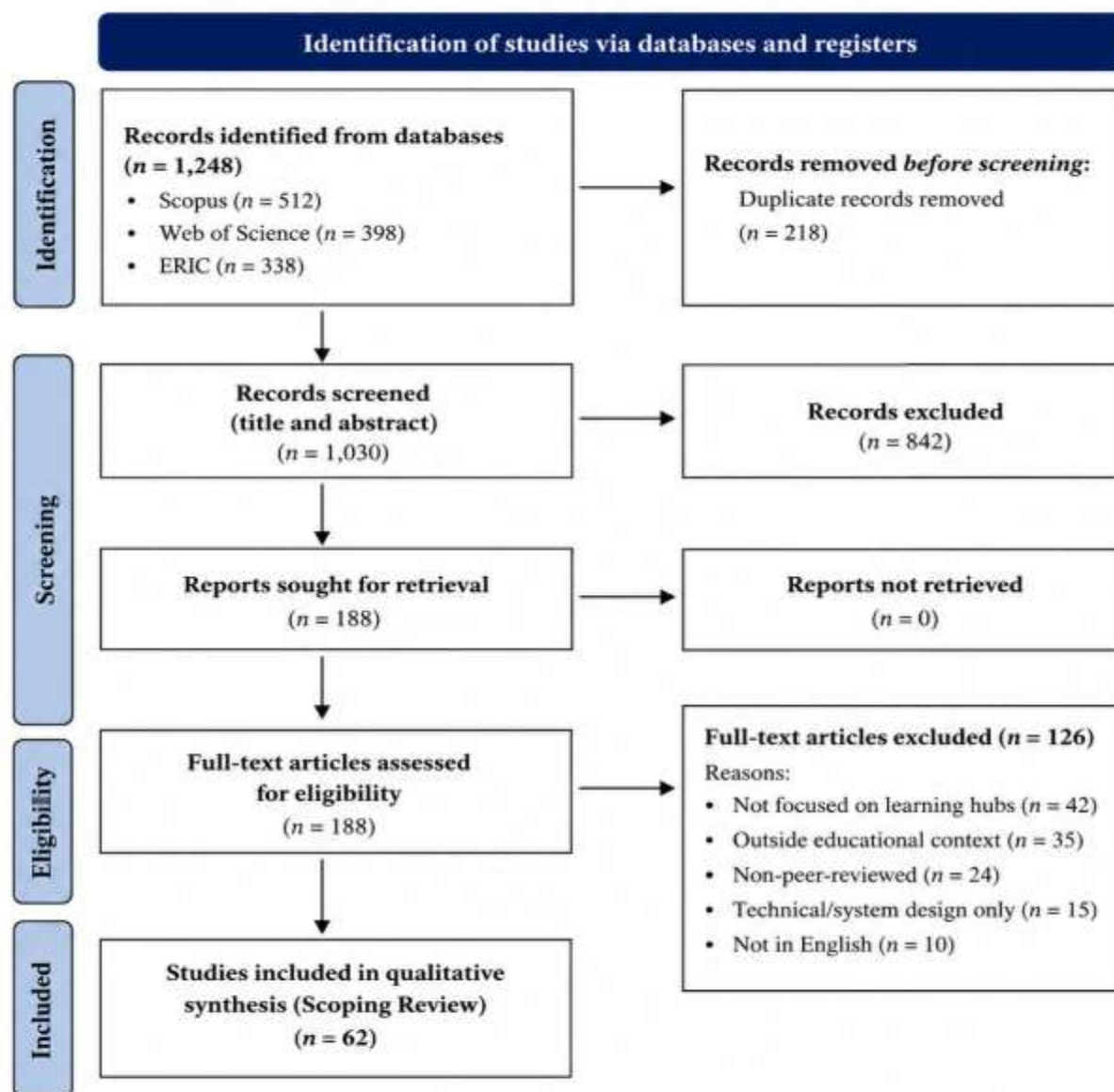
4.6 Data Extraction and Analysis

Data extraction was conducted using a structured charting process to systematically record key information from each included study. Extracted data included author details, year of publication, study context, research design, key findings, and thematic relevance to learning hubs, digital literacy, and networked learning ecosystems.

The data were analysed using thematic analysis to identify recurring patterns, concepts, and relationships across studies. An inductive coding approach was employed, allowing themes to emerge naturally from the data rather than being predetermined. Initial codes were generated by closely examining each study, after which similar codes were grouped into broader categories.

Through iterative comparison and refinement, these categories were consolidated into five major themes that reflect emerging trends in contemporary education. This process enabled the synthesis of diverse perspectives into a coherent framework that informs the development of the Learning Hub Ecosystem Model. The thematic analysis ensured that findings were both systematic and grounded in the evidence base.

Figure 1. PRISMA 2020 Flow Diagram of Study Selection Process



Note. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: [10.1136/bmj.n71](https://doi.org/10.1136/bmj.n71)

5. Results / Findings

5.1 Overview of Included Studies

The search process identified a substantial body of literature examining learning hubs, digital literacy, future schooling models, and networked learning ecosystems. Following the removal of duplicate records and the application of inclusion and exclusion criteria, a final set of studies was included for analysis. The selected studies were drawn from Scopus, Web of Science, and ERIC,

reflecting the interdisciplinary nature of the topic and its relevance across education, technology, and policy research.

The distribution of studies across databases demonstrated increasing scholarly interest in alternative educational models and digital transformation. Scopus contributed the largest proportion of publications, followed by Web of Science and ERIC. Most studies were published after 2020, indicating growing attention to educational innovation in response to rapid technological change and the disruptions associated with the COVID-19 pandemic. The literature revealed a shift from discussions of technology integration toward broader considerations of learning ecosystems, learner agency, and networked educational structures.

The thematic analysis of the included studies generated five major themes: learning hubs as flexible education models, digital literacy as a core competency, industry and community partnerships, networked learning ecosystems, and challenges and barriers to implementation. Together, these themes provide insights into how educational systems are evolving to address the demands of digitally connected and rapidly changing societies.

5.2 Theme 1: Learning Hubs as Flexible Education Models

A dominant theme across the reviewed literature was the emergence of learning hubs as flexible and learner-centred alternatives to traditional schooling structures. Unlike conventional schools that often operate through standardized curricula, fixed schedules, and age-based grouping, learning hubs emphasize personalization, adaptability, and learner agency. These environments seek to accommodate diverse learning needs by allowing learners greater control over the pace, place, and pathways of learning.

Studies consistently highlighted personalization as a defining characteristic of learning hubs. Learning experiences are often tailored to individual interests, strengths, and aspirations, enabling learners to engage more meaningfully with educational content. Personalized approaches support differentiated instruction and competency-based progression, allowing learners to advance according to demonstrated mastery rather than age or grade level.

Learner-centred design was another recurring feature. Learning hubs frequently incorporate project-based learning, inquiry-based learning, and collaborative activities that encourage active participation and knowledge construction. Rather than positioning teachers as sole knowledge providers, these models emphasize facilitation, mentoring, and guidance. Such approaches foster autonomy, critical thinking, creativity, and problem-solving skills.

Accessibility and flexibility also emerged as significant advantages. Many learning hubs combine physical and digital learning spaces, enabling participation across geographical and socioeconomic contexts. Flexible scheduling and hybrid learning arrangements provide opportunities for learners who may not thrive in traditional educational settings. As a result, learning hubs are increasingly viewed as innovative educational spaces capable of supporting diverse learner populations while promoting lifelong learning and adaptability in rapidly changing environments.

5.3 Theme 2: Digital Literacy as a Core Competency

Digital literacy emerged as a foundational competency underpinning future-oriented education systems. The literature demonstrates a growing consensus that digital literacy extends beyond the ability to use technological tools and encompasses a broad set of cognitive, social, and ethical competencies required for participation in contemporary society.

One of the most frequently cited dimensions of digital literacy is critical thinking. As learners encounter vast quantities of information online, they must be able to evaluate sources, identify misinformation, and make informed judgments. Studies emphasized that digital environments require individuals to critically assess the credibility, accuracy, and relevance of information rather than simply consume content passively.

Information evaluation was closely linked to digital literacy development. Researchers highlighted the importance of teaching learners how to locate, interpret, organize, and apply information effectively across multiple digital platforms. These skills are increasingly essential in educational, professional, and civic contexts where information abundance can create challenges related to quality and reliability.

The rapid advancement of artificial intelligence has further expanded the concept of digital literacy to include AI literacy. Several studies argued that learners need a basic understanding of how AI systems operate, their benefits and limitations, and the ethical implications associated with algorithmic decision-making. AI literacy is increasingly viewed as necessary for informed participation in technology-driven societies.

Digital citizenship also emerged as a critical component. Effective participation in digital environments requires awareness of ethical behavior, online safety, privacy protection, and responsible communication. Collectively, these dimensions position digital literacy as a central pillar of future schooling models and a prerequisite for lifelong learning, workforce participation, and civic engagement.

5.4 Theme 3: Industry and Community Partnerships

The literature consistently identified partnerships among educational institutions, industries, and communities as essential components of future learning systems. These partnerships contribute to more authentic and relevant learning experiences by connecting educational activities with real-world contexts and societal needs.

Work-integrated learning emerged as a significant area of collaboration. Studies reported growing efforts to link classroom learning with workplace experiences through internships, apprenticeships, mentoring programs, and industry projects. Such initiatives provide learners with opportunities to apply theoretical knowledge in practical settings while developing employability skills and professional networks.

Experiential learning was another prominent feature. Community organizations, local businesses, and civic institutions increasingly serve as learning partners, offering authentic challenges and project opportunities. These experiences enable learners to engage with complex social, environmental, and economic issues while developing problem-solving, collaboration, and communication skills.

School-community collaboration was also identified as a mechanism for enhancing educational relevance and inclusivity. Partnerships with families, community groups, and cultural organizations help create supportive learning environments that reflect local contexts and diverse learner needs. By extending learning beyond school boundaries, these partnerships contribute to more holistic educational experiences and strengthen connections between education and society. Consequently, collaborative partnerships are becoming integral to the development of flexible and ecosystem-based educational models.

5.5 Theme 4: Networked Learning Ecosystems

Another major theme concerned the emergence of networked learning ecosystems as frameworks for organizing education in the digital age. These ecosystems are characterized by interconnected relationships among learners, educators, institutions, communities, industries, and digital technologies.

The concept of connectivism, proposed by Siemens, provided an important theoretical foundation within the reviewed literature. Connectivism views learning as a process of creating and navigating networks of information, people, and resources. Knowledge is distributed across connections, and learning occurs through participation in diverse networks rather than solely within formal educational institutions.

Hybrid learning was frequently discussed as a practical manifestation of networked ecosystems. Studies described educational environments that combine face-to-face and online learning experiences, allowing learners to engage across multiple contexts. Hybrid approaches enhance flexibility and accessibility while enabling collaboration among geographically dispersed participants.

Distributed learning systems also emerged as a defining feature of networked ecosystems. Rather than concentrating learning within a single institution, educational opportunities are increasingly distributed across schools, universities, workplaces, community organizations, and digital platforms. Learners move between these interconnected spaces throughout their educational journeys, creating personalized and lifelong learning pathways.

The reviewed literature suggests that networked learning ecosystems challenge traditional educational boundaries by promoting collaboration, flexibility, and continuous learning. These systems reflect broader societal shifts toward connectivity and knowledge sharing and are increasingly viewed as critical for supporting future-ready education.

5.6 Theme 5: Challenges and Barriers

Despite the opportunities associated with learning hubs and networked learning ecosystems, the literature identified several significant challenges that may hinder their implementation and sustainability.

The digital divide remains one of the most persistent barriers. Unequal access to digital technologies, internet connectivity, and technological resources continues to limit participation for

many learners, particularly those in disadvantaged communities. Without targeted interventions, digital innovation risks reinforcing existing educational inequalities.

Policy constraints were also frequently highlighted. Many educational policies remain aligned with traditional schooling structures, making it difficult to implement flexible learning pathways, competency-based assessment models, and cross-sector collaborations. Regulatory frameworks often lag behind technological and pedagogical innovations.

Teacher readiness emerged as another critical concern. Effective implementation of learning hubs and digital learning ecosystems requires educators to adopt new pedagogical approaches, facilitate technology-enhanced learning, and support learner autonomy. However, studies reported that many teachers lack adequate professional development opportunities and institutional support.

Data privacy and security concerns have gained prominence as educational technologies become increasingly integrated into learning environments. The collection and use of learner data raise ethical questions regarding consent, surveillance, and data protection.

Finally, issues of equity and inclusion remain central challenges. While learning hubs offer opportunities for greater flexibility and personalization, unequal access to resources, support systems, and digital competencies can limit participation among marginalized groups. Addressing these barriers is essential to ensuring that future educational models contribute to more inclusive and equitable learning opportunities rather than reproducing existing disparities.

Table 1. Sample Literature Matrix / Data Extraction Table 1:

Author(s) & Year	Country/Context	Study Objective	Methodology/Design	Conceptual Focus	Key Findings	Thematic Contribution
Redecker (2017)	European Union	To develop a framework for educators' digital competence	Framework development/policy analysis	Digital literacy; digital competence	Proposed DigCompEdu framework for educators' digital competence and technology integration	Digital literacy and competence development
van Laar et al. (2017)	International	To examine the relationship between 21st-century skills and digital skills	Systematic literature review	Digital literacy; digital skills	Established strong relationships between digital competencies and future workforce skills	Digital literacy in future education
Fullan, Quinn, Drummy, and Gardner (2020)	International	To explore future-oriented transformations in learning systems	Conceptual analysis/report	Future schooling models	Highlighted student-centered, technology-enabled, and collaborative learning systems	Future schooling transformation

Williamson (2019)	United Kingdom	To examine digital infrastructures shaping educational systems	Policy and conceptual analysis	Networked learning ecosystems	Demonstrated the role of platforms, metrics, and digital networks in reshaping education	Ecosystem-based learning models
Luckin et al. (2016)	United Kingdom	To examine the role of artificial intelligence in education	Conceptual/policy report	AI and future learning	Identified opportunities for personalized and adaptive learning systems	Emerging future schooling models
Ilomäki et al. (2016)	Finland/Europe	To conceptualize digital competence in education	Conceptual review	Digital competence	Positioned digital competence as a key educational construct for learning environments	Digital competence development
Voogt et al. (2013)	International	To investigate challenges facing learning in digital societies	Review study	Networked learning; future schooling	Emphasized changing pedagogical practices in digital environments	Future-oriented educational ecosystems
OECD (2020)	International	To propose scenarios for future schooling	Scenario analysis	Future schooling; learning systems	Developed alternative scenarios for schooling transformation in technology-rich contexts	Future schooling models
Selwyn (2016)	International	To analyze debates surrounding educational technology	Conceptual/theoretical analysis	Educational technology	Critically examined assumptions surrounding technology-enhanced learning	Learning ecosystem critique

6. Discussion

6.1 Interpretation of Key Findings

The findings of this scoping review reveal a significant transformation in the conceptualization and organization of education. Collectively, the five themes identified—learning hubs as flexible education models, digital literacy as a core competency, industry and community partnerships, networked learning ecosystems, and implementation challenges—suggest that education is moving beyond traditional institutional boundaries toward more interconnected, adaptive, and learner-centred systems. Rather than representing isolated developments, these themes appear to be mutually reinforcing elements of a broader educational paradigm shift driven by digital

transformation, societal change, and evolving workforce demands (OECD, 2019; UNESCO, 2023).

The emergence of learning hubs reflects growing recognition of the limitations of conventional schooling models characterized by standardized curricula, age-based grouping, and fixed instructional structures. Such models, often described as the “grammar of schooling,” have historically shaped educational systems but are increasingly viewed as insufficient for addressing contemporary learning needs (Tyack & Tobin, 1994). Across the reviewed literature, learning hubs are consistently portrayed as environments that prioritize learner agency, personalization, flexibility, and authentic engagement with real-world problems. Their growing prominence supports arguments that educational institutions must move beyond industrial-era assumptions and adopt more responsive and adaptable approaches to learning (Fullan & Langworthy, 2014; Zhao, 2012).

The findings also position digital literacy as a foundational competency within future-oriented education systems. Consistent with recent policy and research literature, digital literacy extends beyond operational technology skills to include critical thinking, information evaluation, digital citizenship, ethical technology use, and artificial intelligence (AI) literacy (European Commission, 2022; UNESCO, 2023). As digital technologies increasingly mediate learning, communication, and work, these competencies become essential for meaningful participation in contemporary society. The growing emphasis on AI literacy further reflects concerns about preparing learners to understand, evaluate, and engage critically with emerging technologies (Holmes et al., 2022).

Another important finding is the increasing significance of partnerships among schools, communities, industries, and higher education institutions. The reviewed studies suggest that learning is no longer viewed solely as a school-based activity but as a collaborative process occurring across multiple social and professional contexts. This finding aligns with ecosystem perspectives that emphasize interconnected relationships among diverse educational stakeholders and the value of authentic, experiential learning opportunities (Jackson, 2013). Such partnerships help bridge the gap between formal education and real-world application, enhancing workforce readiness, civic engagement, and lifelong learning capacity.

Taken together, these developments point to a broader transition from schooling as an institution to education as an ecosystem. Traditional educational models typically assume that learning occurs within schools and is delivered through formal instruction. In contrast, ecosystem-based approaches conceptualize learning as distributed across networks of people, institutions, technologies, and communities (Siemens, 2005). This perspective aligns with theories of connectivism and networked learning, which emphasize knowledge creation through participation in interconnected learning networks and continuous engagement with diverse sources of information.

The findings therefore suggest that the future of education may be characterized less by the reform of individual schools and more by the development of integrated learning ecosystems capable of supporting diverse and lifelong learning pathways. However, the review also highlights persistent barriers related to digital inequality, policy constraints, teacher preparedness, and data governance.

These challenges indicate that educational transformation is not solely a technological issue but also a social, institutional, and policy challenge requiring coordinated action across sectors (Williamson et al., 2020; OECD, 2021). Consequently, the successful implementation of learning hubs and networked learning ecosystems will depend on balancing innovation with equity, inclusion, and sustainability.

6.2 Learning Hubs and Future Schooling Transformation

The findings indicate that learning hubs are emerging as important catalysts for transforming traditional schooling models. Unlike conventional schools that are largely organized around standardized curricula, age-based progression, and fixed instructional schedules, learning hubs promote flexibility, personalization, and learner autonomy. This transformation reflects broader societal demands for educational systems capable of responding to rapid technological, economic, and social change (OECD, 2019; UNESCO, 2023). The growing interest in learning hubs also supports critiques of traditional schooling, which argue that industrial-era educational structures are increasingly misaligned with the needs of contemporary learners and knowledge-based economies (Tyack & Tobin, 1994; Zhao, 2012).

Importantly, learning hubs do not necessarily seek to replace schools but rather to reconfigure how learning is organized and experienced. By integrating physical and digital learning spaces, community resources, and external partnerships, these environments create opportunities for more authentic and contextually relevant learning experiences. Such approaches align with learner-centred educational models that emphasize agency, collaboration, and competency development rather than passive knowledge acquisition (Fullan & Langworthy, 2014). In many cases, learning hubs facilitate project-based, inquiry-based, and experiential learning approaches that encourage learners to engage actively with real-world challenges.

A notable contribution of learning hubs is their capacity to support flexible learning pathways. Learners can access educational opportunities across schools, community organizations, workplaces, universities, and digital platforms, enabling personalized trajectories that reflect individual interests and aspirations. This flexibility is particularly important in contemporary labour markets characterized by rapid technological change and continuous skill renewal (OECD, 2021). Consequently, learning hubs represent not only a structural innovation but also a pedagogical shift toward more adaptive, inclusive, and lifelong learning-oriented educational systems.

6.3 Role of Digital Literacy in Future Education

Digital literacy emerged as one of the most critical competencies underpinning future-oriented education. The findings suggest that the expansion of digital technologies and artificial intelligence is fundamentally reshaping how individuals learn, communicate, work, and participate in society. As a result, digital literacy has evolved beyond operational technology skills to encompass critical, ethical, and analytical dimensions that support meaningful engagement in digital environments (European Commission, 2022; UNESCO, 2023).

A particularly significant development is the growing emphasis on AI literacy. As AI-driven systems increasingly influence decision-making, communication, and knowledge production, learners require a foundational understanding of how these technologies function and how they affect society. Recent scholarship argues that AI literacy should include awareness of algorithmic bias, ethical implications, data governance, and responsible technology use (Holmes et al., 2022). Such competencies are essential for ensuring that learners can critically engage with emerging technologies rather than merely consume them.

The findings also highlight the importance of lifelong digital competence. Given the rapid pace of technological innovation, digital skills cannot be viewed as static competencies acquired during formal schooling. Instead, individuals must continuously update their knowledge and adapt to evolving technological environments throughout their lives (OECD, 2021). Therefore, future education systems should integrate digital literacy across curricula, learning environments, and educational stages. Such integration will be essential for supporting employability, lifelong learning, civic participation, and resilience in increasingly digital and AI-mediated societies.

6.4 Networked Ecosystems and Learning Redesign

The concept of networked learning ecosystems provides a valuable framework for understanding how education is being redesigned in response to digital transformation. The findings suggest that learning is increasingly distributed across interconnected networks of institutions, technologies, communities, and individuals rather than being confined to traditional school settings. This shift reflects broader changes in how knowledge is created, shared, and accessed in digitally connected societies (Siemens, 2005).

The emergence of distributed learning systems represents a significant departure from conventional educational models. Within these systems, learners engage with educational opportunities across multiple contexts, including schools, universities, workplaces, community organizations, and digital platforms. Such arrangements enable more flexible and personalized learning experiences while supporting continuous learning throughout the lifespan. This perspective aligns with ecosystem approaches that conceptualize learning as occurring across interconnected social, technological, and institutional networks (Jackson, 2013).

Global connectivity further enhances the potential of networked learning ecosystems. Digital technologies allow learners to access diverse knowledge sources, collaborate across geographical boundaries, and participate in global communities of practice. These opportunities expand educational access and foster intercultural understanding, innovation, and collaborative problem-solving. The COVID-19 pandemic demonstrated both the feasibility and necessity of such networked approaches, accelerating the adoption of digitally mediated forms of learning and collaboration (Williamson et al., 2020).

Collectively, these developments suggest that networked ecosystems support educational resilience, adaptability, and innovation. They challenge hierarchical models of knowledge transmission and encourage more participatory, collaborative, and learner-driven forms of education that are better suited to the demands of the twenty-first century.

6.5 Policy and Institutional Implications

The transition toward learning hubs and networked learning ecosystems has significant implications for educational policy and institutional governance. Existing policies in many jurisdictions continue to reflect assumptions associated with traditional schooling models, including standardized curricula, fixed instructional structures, and institution-based learning pathways (Tyack & Tobin, 1994). As educational systems evolve, policymakers will need to develop frameworks that support flexibility, competency-based learning, and recognition of learning across multiple settings.

The findings also highlight the need for more collaborative governance structures. Effective learning ecosystems depend on partnerships among schools, universities, industries, community organizations, and technology providers. Supporting such partnerships requires policies that facilitate collaboration, data sharing, quality assurance, and alternative credentialing mechanisms (OECD, 2021). Governance frameworks must therefore move beyond institution-centred approaches toward models that recognize the interconnected nature of contemporary learning environments.

Furthermore, the literature consistently emphasizes the importance of investing in digital infrastructure, teacher professional development, and digital inclusion initiatives (Bond et al., 2018; UNESCO, 2023). Without adequate support, disparities in access to technology, digital competencies, and educational opportunities may widen existing inequalities. Policymakers must therefore ensure that innovation is accompanied by measures that promote equity, accessibility, and inclusion.

Ultimately, the successful implementation of future-oriented educational models will depend on governance approaches that balance innovation with accountability and sustainability. Educational reform should not focus solely on technological adoption but also on creating supportive institutional conditions that enable learners, educators, and communities to participate effectively in connected and lifelong learning ecosystems.

7. Proposed Conceptual Model

7.1 Learning Hub Ecosystem Model

Based on the findings of this scoping review, a Learning Hub Ecosystem Model is proposed to conceptualize how future-oriented education systems can operate within increasingly digital, connected, and learner-centered environments. The model responds to the limitations of traditional schooling by positioning learning as a distributed process that occurs across multiple actors, institutions, and contexts rather than being confined to formal educational settings.

At the center of the model are **learners**, who actively construct knowledge through engagement with diverse learning opportunities, resources, and communities. Surrounding learners are six interconnected components: government, schools, universities, industry, communities, and technology platforms. Government provides policy direction, funding mechanisms, regulatory frameworks, and quality assurance systems that support innovation and equitable access. Schools continue to provide foundational education while increasingly functioning as facilitators of

networked learning opportunities. Universities contribute advanced knowledge, research expertise, professional development, and lifelong learning opportunities.

Industry plays a critical role in connecting education with workforce needs through internships, mentoring, work-integrated learning, and skills development initiatives. Communities contribute local knowledge, cultural resources, social support, and authentic learning experiences. Technology platforms act as enabling infrastructures that facilitate communication, collaboration, content delivery, assessment, and access to learning resources across geographical and institutional boundaries. Together, these components form an integrated ecosystem that supports continuous and personalized learning throughout life.

7.2 Model Features

The proposed model is characterized by five key features. First, personalization enables learners to pursue individualized learning pathways aligned with their interests, abilities, goals, and learning preferences. Second, competency-based learning shifts the focus from time-based progression to the demonstration of skills, knowledge, and capabilities acquired across multiple learning contexts.

Third, flexibility allows learners to engage in educational activities across formal, non-formal, and informal settings, creating opportunities for self-directed and context-responsive learning. Fourth, digital integration ensures that learning is supported by technologies that facilitate access, collaboration, assessment, and knowledge sharing. This feature includes the development of digital literacy and AI literacy competencies required for participation in digitally mediated societies (Holmes et al., 2022; UNESCO, 2023).

Finally, the model adopts a lifelong learning orientation, recognizing that learning extends beyond compulsory schooling and continues throughout an individual's personal and professional life. This orientation reflects the increasing importance of continuous upskilling and reskilling in rapidly changing social and economic environments (OECD, 2021).

7.3 How the Model Works

The Learning Hub Ecosystem Model operates through dynamic interactions among all actors within the network. Rather than functioning through hierarchical structures, learning occurs through collaborative relationships that facilitate the exchange of knowledge, resources, expertise, and opportunities. Schools, universities, industries, communities, and technology platforms work together to create diverse learning experiences that support learner development.

A key characteristic of the model is the networked flow of learning, whereby knowledge is generated, shared, and applied across interconnected environments. Learners move between physical and virtual spaces, engaging with multiple learning providers throughout their educational journeys. This process aligns with principles of connectivism, which emphasize learning through participation in networks of people, information, and technologies (Siemens, 2005).

The model also supports hybrid delivery systems, combining face-to-face, online, and blended learning approaches. Such arrangements increase accessibility, resilience, and flexibility while

enabling participation across geographical and institutional boundaries. Through these interconnected processes, the Learning Hub Ecosystem Model provides a framework presented in figure 2 for reimagining education as a collaborative, adaptive, and lifelong endeavor capable of meeting the demands of the digital age.

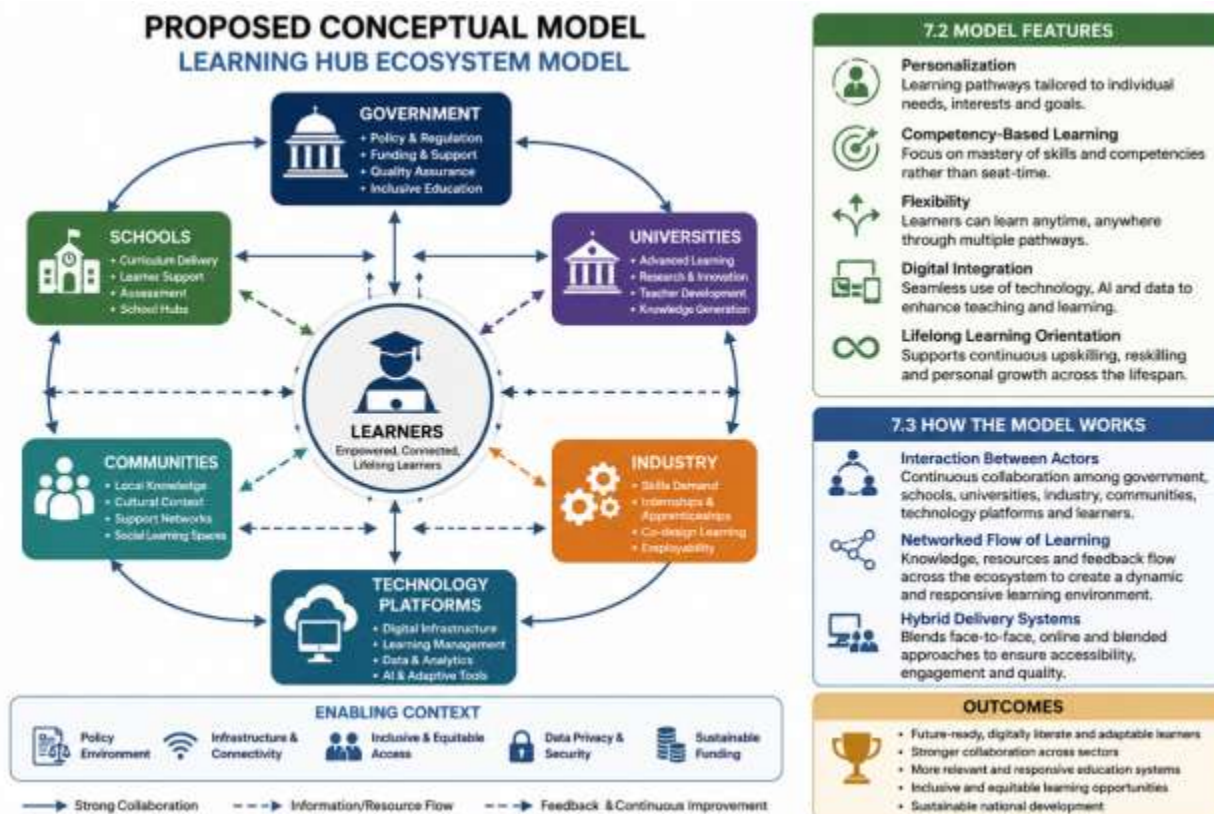


Figure 2: propose conceptual model

8. Conclusion

This scoping review examined scholarly literature on learning hubs, future schooling models, digital literacy, and networked learning ecosystems published between 2015 and 2025. The review identified five key themes shaping contemporary educational transformation: learning hubs as flexible education models, digital literacy as a foundational competency, industry and community partnerships, networked learning ecosystems, and persistent implementation challenges. Collectively, these findings demonstrate that educational systems are increasingly moving beyond traditional institutional boundaries toward more interconnected, learner-centered, and digitally enabled approaches to learning.

A central conclusion of this review is that the traditional “grammar of schooling” is undergoing significant transformation. Conventional educational structures characterized by age-based grouping, standardized curricula, fixed schedules, and teacher-centered instruction are increasingly challenged by demands for personalization, flexibility, and lifelong learning (Tyack & Tobin, 1994; Zhao, 2012). Emerging educational models emphasize learner agency, competency

development, collaboration, and authentic engagement with real-world contexts, reflecting broader societal shifts associated with digital transformation and knowledge-based economies.

The findings also underscore the importance of ecosystem thinking in understanding the future of education. Learning is increasingly distributed across networks of schools, universities, industries, communities, and digital technologies rather than being confined to formal educational institutions. This perspective aligns with theories of connectivism and networked learning, which conceptualize knowledge creation as a process of participation within interconnected learning networks (Siemens, 2005). The proposed Learning Hub Ecosystem Model captures this shift by illustrating how multiple actors can collaborate to support personalized, flexible, and lifelong learning pathways.

Furthermore, the review highlights the growing influence of artificial intelligence and digital transformation in reshaping educational practices and expectations. Digital literacy, including AI literacy, has emerged as a critical competency required for effective participation in contemporary societies (European Commission, 2022; UNESCO, 2023). Consequently, future educational systems must integrate digital competence development across learning environments and educational stages.

Despite these contributions, several limitations should be acknowledged. The review was restricted to studies published in English and indexed in Scopus, Web of Science, and ERIC, which may have excluded relevant research from other sources. In addition, the rapidly evolving nature of digital technologies and AI means that educational developments may continue to emerge beyond the review period.

Future research should explore empirical implementations of learning hubs across diverse educational contexts, examine the effectiveness of ecosystem-based learning models, and investigate strategies for addressing challenges related to equity, teacher readiness, digital inclusion, and governance. Such research will be essential for informing policies and practices that support more inclusive, adaptive, and future-ready education systems.

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