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REVIEW

From Pedagogy to Heutagogy: A Systematic Scoping Review of Digitalization of Pedagogies to Foster Self-Determined Learning (2010–2024)

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ABSTRACT

The fourth industrial revolution technologies are primarily characterized by digitalization. Regardless of the underlying premise, i.e., pedagogical or andragogical, digitalization is the key to heutagogy. The present scoping review was conducted to 1) differentiate foundational learning paradigms of pedagogy, andragogy, and heutagogy as conceptualized in digital learning contexts, 2) classify digital technologies supporting digital learning, 3) classify digital platforms used in teaching and learning, 4) investigate drivers of technology-enhanced learning design in terms of financial support, infrastructure availability, and teacher preparedness, 5) investigate epistemological concerns arising from technology-enhanced learning design, and 6) investigate equity concerns of digital divide for learners from rural and low-bandwidth environments, as well as for female, disabled, and refugee learners. The scoping review followed the process of Arksey and O'Malley and aligned with PRISMA-ScR guidelines. The number of studies included in the review was 36. The findings suggest that the progression from pedagogy to heutagogy underscores the importance of digital technologies for self-directedness. The digital platforms redefine the boundaries of learning - where, when, and how learning occurs. However, this evolution remains uneven across contexts. Financial support, infrastructure availability, and teacher preparedness are decisive factors in digital transformations. The digital divide persists and constrains the realization of heutagogical potential by learners from rural and low-bandwidth environments, as well as by female, disabled, and refugee learners. Epistemologically, digital

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pedagogy is moving toward connectivism and co-created knowledge systems, challenging traditional notions of knowledge ownership, knowledge validation, authenticity, ethical governance, and learner assessment.
Keywords: Digitalization; Pedagogy; Andragogy; Heutagogy; Teaching; Learning; Education; Digital Divide

1. Introduction

The term digitalization refers to the adoption of digital technologies to transform the way of doing things, which denotes modernization and progression. The term *digitalization of pedagogies* refers to the enrichment of pedagogies to enable the mediation of knowledge and skills in digital ways. The developments in the Fourth Industrial Revolution (4IR) and its innovative technologies are primarily characterized by digitalization. The emergence of digital technologies promotes an organizational context that is inevitably becoming digital savvy. This equally applies to education institutions. Education institutions must introduce a new learning environment that is more active, personalized, and collaborative. That is, education institutions must shift their teaching and learning approaches in kind by making fundamental shifts in pedagogies to replace the existing approaches to offer more enriched and flexible learning options [1–4]. Hence, the digitalization of pedagogies has a colossal impact on the dynamics of teaching and learning [5]. Further, the technology-enhanced learning design implies to stakeholders, especially students and industry, what constitutes (or does not constitute) good teaching, making them more aware of quality in education offerings. Today, the digitalization of pedagogies is high on the agenda, and its importance is emphasized by different international bodies that have interest in the field of education and employment, such as the World Bank Group [6] and the World Economic Forum [7]. With more emphasis on and opportunities for digitalization, the discussions on how the principles of heutagogy contribute to the teaching and learning process have received much attention [5, 8]. Heutagogy is a learning theory when delivering instruction with digital technologies [5]. Regardless of the underlying premise, i.e., pedagogical or andragogical, digitalization is the key to heutagogy. Although steps are taken to digitalize the teaching and learning process, the application of pure heutagogy may be impractical [5]. Still, the principles of heutagogy can be incorporated into the teaching and learning process for the optimal learning experience and learner engagement, as well as to support learners' transition to the workplace.

However, higher education institutions find difficulties in responding to the rapid pace at which technological changes are happening in the world [1, 6]. The initial impact of digital technology on pedagogies is to move existing classes and curricula online without proper centrally planned initiatives, coordination, or national standardization [1, 9, 10]. The learners all over the world experienced the use of digital technologies for education purposes during the COVID-19 pandemic. Even though the COVID-19 pandemic and subsequent lockdowns have accelerated technology-enhanced learning design, in most instances, proper planning, coordination, or standardization were not seen [11]. Further, it is evident that the epistemological foundations of pedagogy have been reshaped by the digitalization of pedagogies [12–14]. Pedagogical paradigm is expected to shift from teacher-centered to learner-centered teaching and learning process with several benefits as well as some risks [14, 15].

Further, the discourse on technology-enhanced learning design remains incomplete if it fails to capture digital inequalities, particularly in the Global South. Gender disparities in internet access are well-documented in the literature, where women enjoy less access that is more pronounced in low-income countries [16–18]. The gender digital divide is further exacerbated by gender norms and socio-cultural factors that also restrict women's access to education and technology [16]. Individuals with disabilities face barriers in fully participating in digital learning due to impairments and usability challenges caused by poor inclusive design in digital technological products [19]. Refugees are another marginalized group with limited access to education via digital technological products due to factors such as a lack of infrastructure, legal restrictions, and socio-economic challenges [20]. Last but not least, communities living in rural and low-income areas experience digital exclusion due to inadequate infrastructure [21, 22]. Therefore, the scoping review presented in this paper is conducted to better understand the complexities of the digitalization of pedagogies.

1.1. Objectives of the Scoping Review

1) To differentiate foundational learning paradigms of pedagogy, andragogy, and heutagogy as conceptualized in digital learning contexts,
2) To classify digital technologies supporting digital learning,
3) To classify digital platforms used in teaching and learning,
4) To investigate drivers of technology-enhanced learning design in terms of financial support, infrastructure availability, and teacher preparedness,
5) To investigate epistemological concerns arising from the technology-enhanced learning design,
6) To investigate equity concerns of digital divide for learners from rural and low-bandwidth environments, as well as for female, disabled, and refugee learners.

1.2. Conceptual Framework

The review follows Pedagogy–Andragogy–Heutagogy (PAH) continuum of Blaschke[5] (p. 60). This continuum conceptualizes the evolution of learning from teacher-centered pedagogical instruction through andragogical self-directed learning to heutagogical self-determined learning.

1.3. Research Questions of the Scoping Review

1. How have pedagogy, andragogy, and heutagogy been conceptualized and differentiated in the digital learning literature?
2. Which digital technologies support effective digital learning?
3. Which digital platforms are used in teaching and learning?
4. What drives technology-enhanced learning design in terms of financial support, infrastructure availability, and teacher preparedness?
5. What epistemological concerns have arisen from technology-enhanced learning design?
6. What equity concerns have emerged from the digital divide for learners from rural and low-bandwidth environments, as well as for female, disabled, and refugee learners?

2. Methodology

2.1. Research Design

The study adopted a systematic scoping review to achieve the above-mentioned objectives. The review followed the five-stage process proposed by Arksey and O'Malley[23] and aligned with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Review) guidelines[24].

2.2. Search Strategy

A systematic search strategy was employed to identify relevant studies published between 2010 and 2024. This period witnessed a rapid expansion of digital learning technologies and increased scholarly interest in self-determined learning approaches. Searches were conducted across multiple scholarly databases, i.e., IEEE Xplore, Web of Science Core Collection, ERIC (Education Resources Information Center), Scopus, SpringerLink, Taylor & Francis Online, Sage, Wiley, and ScienceDirect, as well as Google Scholar for credible gray literature. In addition, searches were conducted in conference databases of Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) and International Conference on Education and New Learning Technologies (EDULEARN).

2.3. Inclusion Criteria and Search Strings

The studies included were empirical or conceptual papers published in English language between 2010 and 2024 as peer-reviewed journal articles or conference papers on learners or educators in higher education (also known as post-secondary or tertiary). Hence, early childhood education and K-12 were excluded. Further, the studies should at least cover one of the objectives of the scoping review, which are mentioned above. Truncation was used to broaden the search, with the asterisk (*) serving as the symbol of truncation. The following search strings were used.

- ('pedagogy' OR 'andragogy' OR 'heutagogy' OR 'self-determined learn*' OR 'self-directed learn*' OR 'autonomous learn*').
- ('digital learn*' OR 'online learn*' OR 'virtual learn*' OR 'blended learn*' OR 'hybrid learn*' OR

'technology-enhanced learn*').

- ('digital technolog*' OR 'digital platform' OR 'educational technolog*').
- ('epistemology of digital learning' OR 'digital learning epistemology' OR 'connectivism' OR 'digital education epistemic agency' OR 'learner autonomy epistemology' OR 'learner control epistemology').
- ('teacher preparation', OR 'teacher training' OR 'continuous professional development' OR 'institutional support' OR 'faculty professional development' OR 'teacher willingness').
- ('digital pedagogy infrastructure' OR 'infrastructure', OR 'finance' OR 'funding' OR 'investment' OR 'digital infrastructure').
- ('gender' OR 'disability' OR 'refugee' OR 'rural' OR 'low bandwidth' OR 'low income' OR 'digital divide' OR 'access' OR 'inclusion').
- Filters were ('higher education' OR 'post-secondary education' OR 'tertiary education' OR 'adult education' OR 'vocational'), published 2010–2024, peer-reviewed, English.

Search results were screened to remove duplicates using *EndNote*. Thereafter, screened the titles and abstracts against the inclusion criteria; reviewed the full texts for eligibility. **Figure 1** shows PRISMA-ScR flow. The scoping review objectives were used as the parameters for data extraction and synthesis.

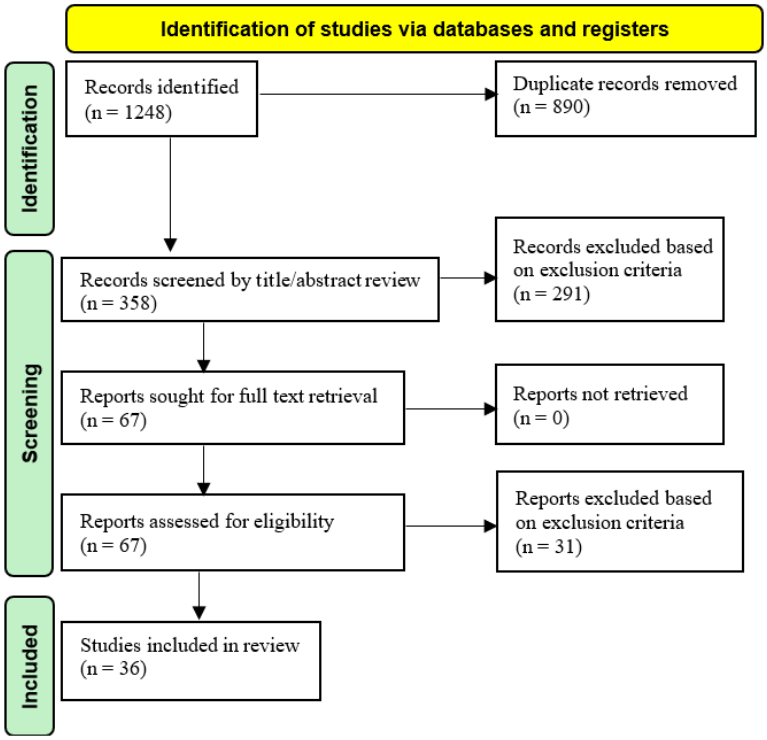


Figure 1. PRISMA-ScR flow for study selection.

3. Findings

3.1. Description of Studies Included in the Scoping Review

Table 1 shows the summary of 36 studies included in the scoping review. The outcomes of included studies are also mapped against the objectives of the present scoping review as shown in **Table 1**.

3.2. Pedagogy, Andragogy, and Heutagogy

The pedagogy involves teacher-centered learning; andragogy involves facilitating autonomous and learner-centered learning; heutagogy involves the management of learning for self-managed learners[5, 25, 27, 47]. While pedagogy leads to the development of knowledge and skills, andragogy leads to the development of competencies, and heutagogy leads to the development of capabili-

ties [26–28]. **Table 2** is created by the author to distinguish the approaches of pedagogy (teacher-directed learning) through andragogy (self-directed learning) to heutagogy (self-determined learning).

Table 1. Included studies.

Study	Location	Outcomes of Included Studies Mapped Against the Objectives of Present Scoping Review					Implications for
		Obj. 1	Obj. 2 and 3	Obj. 4	Obj. 5	Obj. 6	
1. McLoughlin and Lee [25]	Australia	P to H	Web 2.0; Blogs; Wiki	Funding; faculty training	Digital identity; ownership	-	Faculty development
2. Blaschke [5]	Global	H vs. A	Digital media; communities	Infrastructure	Knowledge co-creation	-	Co-creation design
3. Wedasinghe and Wicramaarchchi [19]	Sri Lanka	H	Mobile apps	Infrastructure; teacher training	Learning autonomy; adaptive technology	Disabled; accessibility; low-resource settings	Disabled; low-resource; accessible apps; teacher training
4. Blackley and Sheffield [26]	Australia	A vs. P	LMS; discussion boards	Infrastructure; teacher readiness	-	-	Teacher education
5. Halupa [27]	United States	P to A to H	LMS; simulations; collaboration tools	Faculty resistance; digital competence; institutional support	Learning autonomy; epistemic authority; assessment validity	Low-resources; limited access	Educator adaptability; inclusive instructional design
6. Blackley and Walker [28]	Australia	A to H	Moodle; e-Portfolio	Technical barriers	Learner autonomy in digital spaces	-	Heutagogy adoption
7. Dahya and Dryden-Peterson [29]	Kenya	H	Open-source/web-based platforms	Infrastructure; devices; teacher preparation	-	Refugees; inequality; culture	Digital literacy; data costs; teacher training; content localization; resource sharing
8. Yot-Domínguez and Marcelo [30]	Spain	A; H	LMS; e-portfolios	Teacher feedback	Data ownership	-	Learning strategies and autonomy
9. Ally and Wark [31]	Canada	A to H	MOOCs; LMS; blended	Infrastructure; teacher readiness	Autonomy	Infrastructure for access	Staff; infrastructure; flexible/digital models
10. Blaschke and Hase [32]	Germany	H	Digital media; networked learning spaces	Teachers' facilitation skills	Learner autonomy	-	Heutagogical course design; lifelong learning
11. Kamrozzaman et al. [33]	Malaysia	H	Mobile Learning	Infrastructure	Quality assurance	-	Mobile learning policies
12. Mallillin et al. [34]	Philippines	P	LMS; video conferencing	Infrastructure; finance	-	Infrastructure for access	Online learning policy
13. Al Lily et al. [35]	Saudi Arabia	A	LMS/video conferencing; digital classrooms	Infrastructure; culture; institutional support	Cultural/policy/epistemo-logical framing of 'equal access'	Gendered access; sociocultural; women; adult learners	Gender digital divide; infrastructure; awareness campaigns; policy reforms
14. France et al. [9]	United Kingdom and Canada	P; A	Smartphones; GPS	Mobile phone policies; access to apps; devices; teacher readiness	Leaner autonomy: learners constructing knowledge vs simply consuming digital data	Low-income; devices; bring your own devices	Shift from teacher-led to learner-device led
15. Hizam et al. [36]	Malaysia	P	Virtual Learning	Teacher training;	-	Infrastructure for access	Teacher skills
16. Nwajiuba and Ukwandu [18]	Nigeria	P	Computers; e- learning; social media; smartphones; internet-based tools	Financing; devices; infrastructure	Digital inequality	Gendered access; digital gap	Infrastructure
17. Olasunkanmi [37]	Nigeria	P	-	Digital literacy	Privileged knowledge forms	Digital literacy; tech advancement in Africa	"Being educated vs learned" in contexts of limited technological advancement
18. Vinayan and Harikirishanan [38]	India	H	MOOCs	Policy; infrastructure	Learner agency	-	National policy on heutagogy; digital autonomy
19. Whalley et al. [11]	United Kingdom	P to H	Mobile device; personal learning environments; blended	Flexible devices; PLEs; institutional willingness; learner readiness; infrastructure	Learner control; digital knowledge production and mediation	device/connectivity	Devices; infrastructure
20. Yoto et al. [39]	Indonesia	H	Digital simulation; LMS	Infrastructure	Knowledge agency	-	Teacher competence
21. Czerniewicz et al. [16]	South Africa	A	Computers; mobile devices; broadband internet; Lecture recording; podcasts; LMS; social media	Infrastructure; affordability of data; institutional preparedness; teacher adaptation; teacher workload/roles	Digital inequity; digital knowledge access; digital knowledge production and mediation	Access inequities; racial; gender; rural connectivity; inclusivity and systemic barriers	Sustainable digital inclusion; social justice in technology use
22. Pepito and Acledan [40]	Philippines	H	LMS; Zoom	Infrastructure	Digital inequality	Infrastructure for access	ICT training
23. Segara et al. [41]	Indonesia	H	LMS; E-learning	Teacher facilitation	-	-	Learners' digital skills

Table 1. *Cont.*

Study	Location	Outcomes of Included Studies Mapped Against the Objectives of Present Scoping Review					Implications for
		Obj. 1	Obj. 2 and 3	Obj. 4	Obj. 5	Obj. 6	
24. Sumarni and Sudira [42]	Indonesia	H	LMS	Infrastructure; teacher skills	Digital epistemic reflection	-	Digital readiness; self-concept
25. Wijewickrama and Wickramasinghe [43]	Sri Lanka	A; H	Webinars; LMS; video conferencing	Teachers' acceptance; platforms; connectivity; teacher digital competency; infrastructure	Teacher beliefs of learning; digital epistemic shifts	-	Teacher training; digital literacy
26. Dhakal [44]	Nepal	P	LMS; MOOCs	Government funding	Digital epistemic shifts		Digital infrastructure
27. Jensen et al. [45]	India	A	E-learning; LMS.	Institutional funding	Trust issue	Infrastructure for access	Local capacity
28. Williamson et al. [14]	United Kingdom	A; H	AI; digital platforms	Infrastructure; policy	AI-mediation: knowledge construction/validation; algorithmic bias; digital power relations	Digital divide; discrimination; commercialization; governance	AI in education
29. Amare et al. [46]	Ethiopia	A	-	Faculty belief/attitude	Tech use does not equal improved learning	Resource-constrained environments.	Understand educators' beliefs/attitudes
30. Anuar et al. [47]	Malaysia	H	LMS; social media; interactive multimedia tools	Teachers' openness; digital pedagogical skills; institutional training; peer collaboration; ICT infrastructure	Depth of learning; authenticity of assessment	Digital access; urban and rural institutions; inclusion; women; low income	Digital pedagogy; Inclusive instructional design
31. Bitar and Davidovitch [48]	Israel	P to H	-	Digital infrastructure;	Traditional cultural practices intersecting with digital methods	Less-resourced learners	Technological adaptation; cultural integration; knowledge construction
32. Getenet et al. [49]	Australia	H	LMS; video conferencing tools	Digital literacy; staff attitudes; institutional support	Self-regulation and confidence	Rural; digital self-efficacy; gender; digital confidence	Digital literacy; self-efficacy, technical difficulties
33. Kaddouri et al. [50]	Morocco	P; H	Mobile apps; collaborative platforms; VR/AI	Infrastructure	Relational/emotional components of learning	Low resources; isolated contexts; digital divide	Emotional/relational dimension; knowledge construction; digital mediation
34. Ntim [51]	Ghana	A	LMS; assessment tools; institutional e-learning systems	Institutional policy; training; peer learning.	Knowledge transmission	Urban and rural universities; women; disabled	Connectivity, digital fatigue, instructional design; contextual pedagogy.
35. Wickramasinghe and Wickramasinghe [10]	Indo-Pacific, 15 countries	A; H	Industry 4.0 digital tools; LMS; simulation	Staff training; supportive culture; resource availability	Digital mediation; digital inequality	Digital divide; developing/low-income countries; weaker education institutions	Weaker education institutions; low GDP growth countries
36. Zuhri et al. [52]	Indonesia	P	Blended learning; flipped classroom	Teachers' willingness, comprehensive preparation; adaptation	Superficial 'device use'; deep learning; assessment; workload	Infrastructure for access	Digital literacy

Note: P: Pedagogy, A: Andragogy, H: Heutagogy.
Table is created by the author.

Table 2. Pedagogy, andragogy, and heutagogy.

Feature	Pedagogy →	Andragogy →	Heutagogy
Reasons for learning	Required to advance to the next stage	Learners experience that they should learn the content, which is more relevant or need to become more efficient	Learning is not planned. Learning occurs when the potential to learn prevails.
	The need for learning is external—from parents or qualification to compete in job market	The need for learning is internal	The need for learning is internal—comes with self-efficacy.
Dependence	Teacher decides what, when, and how academic subjects should be taught	Learner-centered; learner is more independent. Learning is more relevant to life experience	The learner decides how to negotiate the learning process, manages his/her own learning.
Learning process	Teacher-led	Autonomous and learner-centered	Self-directed and self-determined. Learning is not linear. The focus is on the learning process rather than learning content.

Table 2. *Cont.*

Feature	Pedagogy →	Andragogy →	Heutagogy
Learning process	Learns theory and practice of an academic subject	Learning may be life/process-centered for future potential, or task/problem-centered with a short-term focus	Learning is experiential and lifelong—not a means to an end; more holistic approach; learners gain capabilities to succeed in their chosen path
Program/ course design	Prescribed curriculum, planned logical sequence of academic subjects; step-by-step progression	Learning is experiential. Learners use their own and others' experiences	Design is non-linear; holistic. Intention is to create self-determined and empowered learners to succeed in their chosen path
	Lectures, video, or reading about the subject matter. Learning is not experiential unless deliberate actions are taken by the teacher	Activities vary—group work, field studies, and simulations. Still, pedagogical approaches are needed to effectively respond to learning requirements	Action learning/research, and reflective journaling of real-life occurrences while interacting with others. Learners are expected to go beyond problem-solving and develop capability to respond to new/diverse situations proactively. However, pedagogical/andragogical approaches are still needed to respond effectively to learning requirements. Flexible learning contracts may be used.
	Evaluated by objective testing; formative and summative testing methods, which may be digitalized	Evaluated using formative and summative testing methods, which may be digitalized	Learning is evaluated using a variety of formative and summative testing methods, which may be digitalized.
Learning resources	The learner mainly relies on teacher-provided learning resources	Teacher provides learning resources. Learners' own and others' experiences, too, play a greater role in learning	The teacher provides learning resources. Digitalization can provide access to more learning resources and make learning self-directed. Learners may need some guidance on choosing digital resources Learners' own and others' experiences play a greater role in learning.
Role of the teacher	Teacher is an expert on subject content and classroom management skills	Teacher's role is passive and acts as a facilitator	Teacher's role is to assist learners on how to learn, manage learning, and develop capabilities.
	Designs learning process and delivers	Create a learning environment that promotes trust, respect, collaboration, and openness; promotes inquiry, data/information gathering, analysis, and decision-making capacities in learners	Create a learning environment that promotes trust, respect, collaboration, and openness. Promotes inquiry, data/information gathering, analysis, and decision-making capacities in learners with more focus on the learning process.
	Assesses learners and provides feedback to learners	Assesses learners and provides feedback to learners	Assesses learners and provides constant feedback to learners.

Note: Table is created by the author.

Some scholars [5] support the identification of pedagogy, andragogy, and heutagogy in a continuum. However, some other scholars [27, 53] identified the possibilities of applying principles of each approach simultaneously. In this regard, Halupa [27] (p. 143) states that principles of pedagogy, andragogy, and heutagogy 'can be exhibited at any time during the educational experience, particularly with the advent of more advanced educational technologies'. Regardless of the standing, scholars agree that selected learning principles of all three approaches may be incorporated into a single course to provide an optimal learning experience and learner engagement [5, 27, 31, 52]. Still, when heading for heutagogy, irrespective of whether the underlying premise is pedagogical or andragogical, digitalization is the key.

The digital technologies that make heutagogy possible are discussed in the section *technologies for digital peda-*

gogy. These digital technologies support co-learning and co-creation as well as the self-directedness of learners in information discovery and deciding ways to negotiate the learning process and manage their own learning. Concerning co-learning and co-creation, the literature identifies the importance of peeragogy (also known as paragogy) and cybergogy with the digitalization of the teaching and learning process. Peeragogy is identified as peer-to-peer learning that emphasizes co-learning and co-creating content for self-directed learning, especially using digital tools [47, 54]. Cybergogy is identified as 'learner-centered autonomous, and collaborative learning in a virtual environment' [8, 55]. Therefore, in today's learning context with digitalization, peeragogy and cybergogy are also receiving much importance in learning and learner engagement.

3.3. Technologies for Digital Pedagogy

Technologies that make technology-enhanced learning design happen can be grouped into five. First, ubiquitous computing infrastructure, i.e., broadband, mobile broadband, and cloud computing, is a prerequisite to making most digital learning applications happen [19, 25, 28, 56]. For example, on the one hand, mobile learning could make computer suites of educational institutions largely redundant when learners are not required to travel to the educational institution [11]. On the other hand, mobile learning devices (smartphones and tablets) as adaptational and companion devices in the teaching and learning environment of Bring Your Own Devices (BYOD) enable ubiquitous computing infrastructure to be used effectively in any learning space with the capacity to improve learner experience [9, 57]. The COVID-19 pandemic showed the importance of ubiquitous computing infrastructure for teaching and learning [11].

Second, collaboration technologies are "technologies with a 'social' element incorporated qualify as collaboration technologies" [56] (p. 32). Ubiquitous computing infrastructure facilitates collaboration technologies to deliver possibilities to communicate, collaborate, and exchange data and information across space and time.

Third, extended reality technologies, which include virtual reality (VR), augmented reality (AR), and mixed reality (MR), bring real-world elements and digital elements together to facilitate a rich teaching and learning environment. Extended reality technologies help to bridge the division between theory in the classroom and practical application at work by allowing learners to practice the operation and control of equipment/machines in virtual environments [6, 58, 59].

Fourth, the applications of artificial intelligence (AI) can be seen in the teaching and learning process. For example, AI plays a major role in search engines and help forums, translating educational materials, natural language processing, recommender systems, and grading-assist systems [56]. Finally, blockchain offers opportunities for the issuance of certificates and the management of student information systems [60].

3.4. Digital Platforms for Teaching and Learning

The above-mentioned digital technologies drive technology-enhanced learning design. The digital platforms connected to these digital technologies are five folds. Social media platforms provide the ability for collaboration, conversation, and exchange of information 'across space and time' [56]. Always-on and easy-to-access social media platforms allow learners not only to stay in close and constant contact with fellow learners but also with teachers. The very nature of social media platforms bridges gaps between learning periods, which are archetypal in the traditional teaching and learning environment.

Video conferencing platforms allow learners to learn a course entirely over the Internet without moving out of their physical place of stay [38, 39]. With the effective incorporation of email, forums, chat, or LMS with video conferencing platforms, teachers and students can interact only online, even if they live on the same physical premises.

Open online educational resources reside in the public domain and allow access to teaching and learning materials for 'use, adaptation and redistribution by others with little or no restrictions' [58]. The main features of open online educational resources are not having built-in courses with specific start and end dates and not having teachers/tutors to review coursework or learning progress [28]. Cloud computing permits the storage of open online educational resources at a lower cost.

The model of massive open online courses (MOOCs) is almost similar to the process in physical schools but delivered online with the distance mode [61]. Hence, these are

within a defined study area, have predefined learning outcomes and specific start/end dates, delivered by teachers, and students' homework is reviewed and progress is assessed. Although completion rates are questionable [6], MOOCs address specific knowledge and skill needs of learners, provide certification for jobs, and a completion of a course may provide opportunities for further academic pursuits.

Learning management systems (LMS), such as Moodle and Google Classroom, allow to perform a combination of tasks in one place, such as creating and delivering a subject content, managing courses/modules, managing discussion forums, monitoring student participation, evaluating student progress, exchanging feedback, maintaining student records, and obtaining reports on learning analytics. An LMS can deliver and manage video conferencing and learning material content, which incorporates AR, VR, and AI. Learning via LMS can be individual or collaborative. Furthermore, LMS allows asynchronous learning, i.e., self-paced and on-demand through prepared material, as well as synchronous learning, i.e., teachers and students engage in the teaching and learning process at the same time through Webinars.

3.5. Drivers of the Digitalization of Pedagogies

Support mechanisms are decisive in the adoption of andragogical and heutagogical teaching and learning practices when heading for heutagogy [62]. The main support mechanisms are identified as financial support, infrastructure availability, and the preparation of teachers for digital delivery [21, 22, 27–29, 35].

When financial support is taken into consideration, the cost of (or investments in) training delivery in digital ways is a function of the complexity and sophistication of training offerings [16, 18, 63]. Hence, technology-enhanced learning design calls for regular funding mechanisms for the digitalization process that include the development, maintenance, and upgrade of systems. Many developing countries expect the support of donor agencies [6].

Infrastructure availability involves ICT infrastructure and services, computing facilities and equipment, digital networks, and cloud storage services. All countries do not have access to reliable electricity and internet connectivity for teaching and learning [16, 18, 21, 22, 55]. Further, one-time upgrades are not sufficient to keep pedagogies digitalized [64]. Rapid technological advances tend to be much faster compared to advances in education systems [6].

Teachers possessing sufficient digital skills for teaching is important [47, 51, 52]. Teachers' digital skill requirements involve both capabilities to use digital technologies and capabilities to teach with digital technologies [43, 64–66]. One of the barriers to the digitalization of pedagogies is the lack of preparedness of teachers to integrate digital technologies into the teaching and learning process. However, in many countries, digital competencies are not a mandatory component in teacher education, which makes teachers to acquire these through continuous professional development [11]. Their willingness could be influenced by their own value systems towards pedagogies and their proficiency in digital technologies, the level of enjoyment they have by integrating digital technologies, as well as the influence they get from the education institutions for the use of digital technologies [64–66]. However, in general, education institutions find it difficult to catch up with the latest pedagogical developments, which the industry expects their recruits to be accustomed to, mainly due to financial and infrastructure challenges [34, 36, 51, 52, 67].

Access to financial support, the availability of digital technologies for the teaching and learning process, the capabilities of teachers to use digital technologies and teach using digital technologies are decisive factors when heading for heutagogy. When support is inadequate, education institutions might find difficulties in facilitating andragogical and heutagogical learning practices. This may compel institutions/teachers to rely more on pedagogical learning practices.

3.6. Epistemological Concerns of the Digitalization of Pedagogies

Epistemological beliefs on the nature of knowledge and learning (knowing) and pedagogical beliefs on teaching and learning require some attention [12, 13, 68]. Epistemological beliefs are primarily concerned with the study of knowledge [37]. As per the epistemological inquiry, learners must learn above and beyond the facts taught in the subjects of a course. Hence, education should provide a breadth of understanding, think clearly, appreciate and respect others, and so forth.

Technology-enhanced learning design has reshaped the epistemological foundations of pedagogy. When ped-

agogical paradigm shifts from teacher-centered to learner-centered models when heading for heutagogy, emphasis is on constructivist and connectivist approaches [15]. Pedagogical paradigm shift can empower learners, but with some risks and concerns.

The advocates of technology-enhanced learning design argue for the strengths of digital pedagogies, some of which are as follows.

- Increased flexibility: the digital platforms allow learners to learn anytime, anywhere [5, 6, 27, 30]. The effects of geographical barriers as well as other individual-specific characteristics, such as an individual's physical disabilities or care responsibilities on access to education can be minimized while providing more flexibility to engage in learning;
- Use of interactive tools: the digital technologies discussed above make learning more engaging and interactive, which eventually increases learners' engagement and motivation to learn [25, 26, 32, 59];
- Personalized learning environment: teachers are better equipped with adaptive learning systems and data analytics to individualize the learning content and teaching delivery to suit individual learners [9, 27, 47];
- Collaborative learning: the digital platforms allow learners to contact teachers and fellow learners in real time beyond the physical location, anywhere across the world [9, 25, 30];
- Facilitate continuous assessment and the provision of feedback: the digital platforms allow teachers to use various continuous assessment methods and provide real-time performance feedback to learners [11].

However, the opponents of technology-enhanced learning design identify several risks and associated concerns. Some of these are as follows.

- High emphasis on technology leading to superficial learning: digital tools might lead to learners' superficial engagement without critical pedagogical grounding [10, 15, 37, 52]. The argument is that the digital interactivity facilitated by the digitalization of pedagogies may not provide deeper engagement in the learning process. Further, Williamson [69] suggests that 'valuable' knowledge has increasingly been mediated by systems that prioritize efficiency over criticality;
- Risk of decreasing teacher-student relationship: in a digitalized classroom, teachers' role could become a facilitator compared to the traditional learning context [5, 27, 43, 70]. Further, this might obscure affective and relational dimensions in the teaching and learning process [50];
- Effect of digital divide on learning: digitalization often reinforces existing educational inequities. Access to reliable internet, digital devices, and private learning spaces is unevenly distributed, both within and across the countries [9, 16–19, 29, 71]. The digital divide between societies or across countries may not provide equal access to digitalized services for all citizens [16, 17, 22]. Learners from marginalized communities are more likely to experience digital exclusion, leading to what Warschauer [72] identified as the 'second-level digital divide'—not merely of access, but of meaningful usage;
- Level of digital literacy: for effective digital pedagogy, both teachers and learners must possess a high level of digital literacy, which they might not possess [12]. Hence, previous studies suggest that without substantial investment in digital literacy education and teacher training, digital platforms and tools risk amplifying educational stratification rather than resolving it [43, 73]. Further, both teachers and learners must accept continuous learning to enhance digital literacy to be especially effective in andragogical and heutagogical contexts;
- Invisible labor associated with digital teaching: online content creation and delivery demand additional academic workload from teachers that are often underacknowledged and poorly compensated [16, 74];
- Ethical concerns around surveillance, student data, and privacy: the vast amount of student data might raise concerns about student surveillance and data privacy unless a transparent governance system is in place [14, 75, 76].

When building on the strengths and risks of the digitalization of pedagogies, the core concern is whether technology-enhanced learning design leads to enhancing pedagogy and not to replacing it. Technology must be applied with sound educational principles, where technology is a tool and not a substitute.

Further, the proliferation of digital technologies and platforms is embedded within neoliberal logics that consider education as a market rather than a public good. Digital plat-

forms are increasingly becoming commercial, subscription-based, and driven by venture capital. This commodification reshapes the purpose of education by shifting the attention away from holistic, critical, and transformative pedagogies toward productivity and quantifiable outcomes, such as efficiency[14]. In this regard, Selwyn et al.[77] wrote that technology in education is often driven more by institutional pressures and market logics than by educational needs or research-based practices, which reinforces neo-liberal ideals of meritocracy.

3.7. Digital Divide in Diverse Contexts: Gender, Disability, Refugee, Rural, and Low-Bandwidth

The digitalization of pedagogies has been instrumental in fostering learner autonomy. Despite the advancements in the digitalization of pedagogies, significant disparities persist in learners' access to digital technologies to engage in self-paced and collaborative learning even after the COVID-19 pandemic, across geographical boundaries and societies[17, 21, 22]. The concept of the "digital divide" remains salient and takes various forms, such as gender, disability, refugee, rural, and low-bandwidth[16–20, 78]. For instance, Czerniewicz et al.[16] provides evidence for failures to incorporate the needs and experiences of women when designing digital platforms marginalizing women. Further, Wedasinghe and Wicramaarchchi[19] provide evidence for failures to incorporate the needs and experiences of individuals with disabilities when designing assistive features in digital platforms marginalizing learners with disabilities. In rural and low-bandwidth environments, limited internet connectivity and a lack of infrastructure are significant obstacles[21, 22]. Hence, inequities in digital access hinder the realization of self-directed and self-determined learning opportunities for marginalized groups. However, effectively designed and accessible digital platforms not only bridge the resource gap but also allow learners to be more aligned with the principles of heutagogy. Inclusive learning environments can be created when digital platforms are capable of providing access to educational content for learners with disabilities in low-bandwidth contexts[19]. Similarly, Dahya and Dryden-Peterson[29] showed the efficacy of digital products in supporting refugee learners, who often face challenges such as limited access to physical resources and unstable internet connections.

3.8. Summary of Main Themes Emerged in Line With the Scoping Review Objectives

Table 3 provides the summary of main themes that emerged in line with the scoping review objectives. Across the studies reviewed, the evolution from pedagogy through andragogy to heutagogy was consistently articulated. This evolution implies an important shift from traditional pedagogy to more learner-centered approaches. Further, the progression from pedagogy to heutagogy underscores the importance of digital technologies for self-directedness. Various digital platforms facilitate learners to reflect, collaborate, and co-create knowledge, aligning with heutagogical principles. Most importantly, digital platforms have redefined the boundaries of learning in terms of where, when, and how learning occurs. Both digital technologies and platforms have evolved supporting the transition towards self-determined learning. Hence, digital technologies as well as digital platforms built on these technologies are instrumental in transiting from pedagogy to heutagogy enabling learners to experience personalized, flexible, and collaborative learning environments. However, this evolution remains uneven across contexts. Financial support, infrastructure, and teacher preparation were identified as decisive factors in digital transformation, i.e., these continue to constrain the full realization of heutagogical potential. Further, the digital divide persists, which is a significant barrier to equitable education. Persistent digital inequities hinder digital access for rural, low-income, low-bandwidth, female, disabled, and refugee learners. The design and accessibility of digital platforms are vital to provide equitable learning opportunities addressing the needs of learners belonging to various groups, such as women, the disabled, and refugees, as well as learners from rural, low-bandwidth, and low-income environments. Furthermore, the epistemological consequences of the digitalization of pedagogies have not been fully understood. Epistemologically, digital pedagogy is moving toward connectivism and co-created knowledge systems, challenging traditional notions of knowledge ownership, knowledge validation, authenticity, ethical governance, and learner assessment.

Table 3. Summary of main themes emerged aligned with scoping review objectives.

Obj.	Main Themes Identified	Synthesis
1	Theme 1.1: Transition from teacher-centered to learner-centered education Theme 1.2: Heutagogy as an extension of andragogy emphasizing learner autonomy and capability development Theme 1.3: Contextual application of each paradigm (pedagogy: guided learning; andragogy: self-directed; heutagogy: self-determined)	Paradigm shift from pedagogical to heutagogical approaches.
2	Theme 2.1: Integration of LMS as a foundational platform Theme 2.2: Use of Web 2.0 tools for collaborative learning Theme 2.3: Emergence of AI, adaptive learning systems, and immersive technologies in post-2020 studies	Digital pedagogical ecosystem has evolved from static LMS to dynamic AI-enabled environments.
3	Theme 3.1: LMS becomes the backbone of digital learning infrastructure Theme 3.2: Mobile learning and social media integration to foster engagement, motivation, and self-directed learning Theme 3.3: MOOCs and open platforms democratize access but raise quality concerns	Blended ecosystems that integrate LMS with digital platforms; Scalability and interactivity drive adoption.
4	Theme 4.1: Infrastructure availability is a critical enabler/barrier Theme 4.2: Teacher digital competence and continuous professional development Theme 4.3: Financial investment and policy support for sustainability Theme 4.4: Inclusive infrastructure (accommodating platforms for disabilities)	Technological innovation without adequate investment; cannot sustain without teacher digital competency and institutional.
5	Theme 5.1: Shift from content transmission to knowledge co-construction; networked epistemology Theme 5.2: Issues of digital identity, data privacy, and academic integrity Theme 5.3: 'knowledge' in AI-mediated environments	Concerns about authenticity, assessment validity, and ethical governance in digital learning.
6	Theme 6.1: Persistent inequalities for women Theme 6.2: Persistent inequalities for disabled learners Theme 6.3: Persistent inequalities for refugee learners Theme 6.4: Persistent inequalities for learners from rural, low income, and/or low-bandwidth environments Theme 6.5: Usability is critical for inclusion; technological innovations must account for gender, disability, rural, and low-bandwidth constraints to maximize participation	Accessibility and usability remain inconsistent across countries/ regions; concerns about persistent inequalities.

Note: Table is created by the author.

4. Synthesis

The digitalization of pedagogies has assumed an important place on the agenda of higher education systems across countries. The present systematic scoping review from 2010 to 2024 underscores six interrelated dimensions. First, conceptual clarity is required to differentiate pedagogy, andragogy, and heutagogy to understand the evolution in educational paradigms that moved away from traditional pedagogy toward andragogy and, more recently to heutagogy reflecting a progressive shift toward more learner autonomy and self-determined learning. The findings from this scoping review reaffirm the progressive transformation of educational paradigms along the PAH continuum. The review also indicates that heutagogy in digital education is not merely an instructional method but a philosophical reorientation toward self-determined learning, where technology functions as both an enabler and mediator of agency. However, the progress made in digital technology-based delivery in teaching and learning is not uniform. ILO[56] reports that not only in developing countries but also in advanced economies, basic pedagogies that can be enabled by digital technologies have not yet been mainstreamed, covering the entire spectrum of the education system. The adoption of digital technology-based delivery in teaching and learning can be viewed as an implementation of innovation. Then, the diffusion of innovation becomes important. A society's acceptance or rejection, as well as the level of adoption are important to understand the diffusion of an innovation. For instance, the digitalization of pedagogies could be dependent on the extent of technological advancement expected to be experienced by the education system of a country and internal stakeholders' preparedness to adopt the digitalization of pedagogies. In this regard, the exposure of students during the COVID-19 pandemic to use digital technologies may lead to an increase in their maturity level towards heutagogy,

as well as an increase in the positive evaluations of teachers of digital technologies and their willingness to incorporate heutagogical principles into their course designs. Further, conditions created during the COVID-19 pandemic could have provided opportunities for the institutions to secure digital technologies for the teaching and learning process. All these could accelerate education institutions' journey towards heutagogy. Therefore, heading for heutagogy may not be utopian.

Second, the review identified an array of digital technologies that facilitate the transition, and these have, over the years, fundamentally and gradually expanded the pedagogical repertoire. The digital technologies align particularly well with heutagogical principles, allowing learners to set their own goals, choose resources, reflect on progress, and adjust strategies fostering self-determined learning. With regard to the types of digital platforms used for teaching and learning, the use of social media platforms remains useful for persistent learning, where learners can stay in close contact with each other. Concerning the evolution, LMS serves as a foundational infrastructure enabling course management and asynchronous learning. It is, over time, supplemented by Web 2.0 tools promoting collaboration and peer feedback, embodying social constructivist and connectivist principles [15]. This is important to bridge gaps between learning periods in the traditional teaching and learning environment. However, the ecological perspective emphasizes that digital pedagogy must be a networked constellation of tools and interactions. This implies the need for alignment across platforms, ensuring accessibility, interoperability, and pedagogical coherence. The literature also suggests that countries have more reliance on low-level digital technologies, and low-level digital technologies hold the highest potential for digitalization in the short run globally [56]. The ILO [56] further states that the highest growth can be observed in the adoption of relatively simple platforms such as video conferencing. It is possible to expect more implementations of digitalization of pedagogies in the post-COVID era. However, the cost of digitalization of pedagogies increases dramatically when a digital platform's complexity and sophistication increase. This raises the question: do education institutions have support mechanisms for investment, infrastructure, and teacher development for such endeavors?

Third, the digitalization of pedagogy is deeply connected to systemic support structures. All publications reviewed consistently identified financial support, infrastructure, and teacher competency as critical determinants that accelerate the digitalization of pedagogies. Regarding financial and infrastructure support, more low- and middle-income countries are inclined to use online learning and extended reality technologies [6]. Still, whether these countries could implement and use these for the teaching and learning process effectively needs careful consideration. Evidence raises serious concerns over the availability of funding, and inadequate access to reliable broadband internet and hardware [21, 22]. Regarding support for teacher development, obstacles in teacher development for the use of new pedagogical approaches have been well documented [6, 22, 56]. Without adequate funding, investment in infrastructure, and targeted teacher professional development, the potential of digital technologies to facilitate self-determined learning remains unrealized. Still, some previous studies, such as Mahdum et al. [65] showed the importance of people attached to education institutions in different capacities having the right attitudes towards digitalization since a significant segment viewed it with skepticism. Further, recent empirical studies report significant differences across countries in the use of digital technologies for teaching and learning in the Global South [10, 62, 64, 66]. The priorities given by higher education institutions on which types of digital technologies to adopt could stem from the digital technologies to which teachers were exposed to during their training as well as support received from the education regulatory bodies of respective countries [10, 62, 64, 66].

Fourth, the epistemological implications of the digitalization of pedagogies are another recurring theme. The review highlights profound epistemological and ethical considerations involving learners' engagement with knowledge as well as reflective, critical, and responsible practices. Knowledge is increasingly co-constructed, distributed, and networked in the heutagogical context rather than centrally transmitted in the pedagogical context. Hence, the digitization of pedagogies alters how knowledge is constructed, accessed, and validated [15, 16]; the teacher should assume the role of facilitator, aligning with connectivist epistemology [15]. However, this shift raises new ethical and philosophical questions, as reviewed in detail in the above section (3.6). Issues concerning data privacy, intellectual ownership, digital identity,

and authenticity become integral parts of the learning process. These transitions necessitate a rethinking of educational practices to ensure the promotion of critical thinking, creativity, and ethical engagement. Hence, frameworks for ethical governance are essential to safeguard academic integrity and learner agency in increasingly self-determined learning environments.

Fifth, the findings of the review highlight persistent inequities as learners from marginalized groups—female, disabled, and refugee learners, and learners from rural and low bandwidth environments—may be systematically excluded from being educated unless digital pedagogies are intentionally designed for accessibility and equity [16, 35]. The digital divide disproportionately affects these marginalized groups hindering equitable access to digital learning. This disparity emphasizes the need for targeted technological solutions and policy interventions to bridge the digital divide by ensuring that digital technologies are accessible, affordable, and relevant to the digital learning needs of marginalized groups.

Sixth, the education institutions must aim to prepare students for the workplace and to make them lifelong learners. The preparation of students for the workplace has two meanings. One is inclusivity and the other is bridging the boundary between theory and practice. The digitalization of pedagogies could provide the required leap to minimize the gap between theory and hands-on practice. This directly improves labor market outcomes. When fulfilling the aims of preparing students for the workplace and making them lifelong learners, pedagogical or even andragogical learning approaches adopted by education institutions before the COVID-19 pandemic may not be sufficient in the post-COVID-19 era, in the wake of 4IR technologies. The digitalization of pedagogies not only impacts inclusivity but also impacts what, where, and how students learn. First, delivery through digital means can reach a wider learner population, i.e., inclusivity or access to education. Alternative participation modes allow learners/intended learners to 'choose between participation modes in space and time' [11] (p. 89). This may lead to higher enrolments for some groups of the population, who otherwise would not be included in higher education. Second, education institutions provide skills in the domains of cognitive, technical, and socio-emotional. Digitalization can successfully integrate cognitive and technical components by reducing the boundary between theory and practice; learning can become more interactive and real-time. The use of learning activities on different digital platforms and the provision of diverse learning experiences and assessments increase the quality of learning experiences. Hence, the use of digital technologies for the teaching and learning process leads toward heutagogical practice, which opens opportunities to better prepare students for the world of work and to make them lifelong learners.

Overall, the digitalization of pedagogies brings a paradigm shift in the way education is conceived and delivered. The pedagogical approach is largely teacher-centered, while leaning towards heutagogical approach offers more learner-centered, personalized, and collaborative learning supported by digital technologies and platforms. Technology-enhanced learning design emphasizes innovative transformations to how knowledge is delivered and consumed, with offering personalized learning, more accessibility and flexibility, as well as more interactions and collaborations. In a digitalized learning context, the role of the teacher is transitioning from knowledge distributor to a facilitator, who helps learners to navigate digital resources while encouraging inquiry-based learning. Technology-enhanced learning design is reshaping the teaching and learning context and the roles of teachers and learners. For an effective teaching and learning process, significant improvements are needed in digital infrastructure and continuous teacher training, demanding higher investments as well as a shift in mindset on how to participate in the teaching and learning process for the maximum benefit when moving from pedagogy through andragogy to heutagogy. While digitalization offers opportunities for innovation and flexibility, it also brings risks and their associated pedagogical, social, and ethical concerns. Hence, the narrative offered for technology-enhanced learning design could become challenging. When looking ahead, the digitalization of pedagogies is expected to enhance pedagogical effectiveness. Still, education policies, standardization, and infrastructure must evolve to support a sustainable digitalization of pedagogies. Therefore, stakeholder participation is vital to ensure that the teaching and learning process is not only innovative but also inclusive, ethical, and pedagogically sound to reap higher benefits from the digitalization of pedagogies.

5. Implications for Policy, Practice, and Research

5.1. For Policy

- Policies must be introduced to address the epistemic and ethical dimensions of digital learning, including data protection and equitable participation.
- The digitalization of pedagogies must be recognized as an infrastructural imperative, not an optional enhancement. National and institutional strategies should prioritize investment in infrastructure development and teacher capacity building, promoting digital inclusion.
- National policy frameworks must support foundational digital literacy training to marginalized groups.
- All policies targeting the digital divide require multidimensional strategies to achieve equitable outcomes.

5.2. For Practice

- Governments must encourage the development of low-bandwidth and offline-capable platforms for rural and resource-constrained areas.
- Education institutions must prioritize fund generation and critical infrastructure development.
- Countries must promote inclusive design that integrate accessibility features for learners with disabilities.
- Teacher preparation and readiness must include heutagogical approaches, technology integration, and inclusive pedagogy.
- Education institutions could establish cross-sector collaborations that support lifelong learning.
- Institutional quality assurance and accreditation frameworks must include criteria for ethical data use, digital literacy, learner autonomy, and inclusion to sustain credibility in digital learning.
- Education institutions must encourage continuous professional development for building confidence and pedagogical innovation of teachers.
- Education institutions could establish communities of practice for teachers to foster peer mentoring and collective problem-solving surrounding digital teaching and learning.

5.3. For Research

- The operationalization of heutagogy with measurable self-determined learning outcomes needs more research attention.
- Longitudinal and mixed-method research designs may offer deeper insights into whether learners sustain heutagogical practices beyond their formal education.
- Future studies could explore the evolution of andragogy and heutagogy practices across disciplines, i.e., engineering, medicine, and humanities and social sciences, over time.
- Research could explore how the epistemological implications of algorithmic personalization influence knowledge creation, autonomy, and equity in digital learning.
- Future research should investigate whether digital technologies such as simulations, game-based learning, AR/VR foster higher-order thinking skills of learners or whether these are just for content delivery.
- Research could investigate whether systems are available for continuous professional development of teachers to effectively train them to design, implement, and evaluate digital pedagogies.
- Future research should investigate what digital platforms work and/or do not work as well as how digital platforms interact with a particular country's context.
- Future research could investigate views towards the adoption of digital technologies for teaching and learning held by people engaged in the higher education system in different capacities.

6. Conclusions

The present scoping reviews underscore the need for conceptual clarity to distinguish pedagogy, andragogy, and heutagogy to provide a foundation for instructional design. From a thematic perspective, the review implies that the digitalization of pedagogies is not merely technological but ontological. The digitalization of pedagogies redefines the meaning of learning, teaching, and knowing. The continuum from pedagogy to heutagogy represents a shift from teacher dependence to self-determination, which is both enabled and complicated by digital technologies. The digital technologies and platforms are vital to enable personalized, flexible,

and collaborative learning experiences and outcomes. It is also evident that pedagogy, andragogy, and heutagogy are overlapping modes that can coexist within dynamic digital ecosystems. While the digitalization of pedagogies fosters self-determined learning, the realization requires systemic investment in infrastructure, institutional support, thoughtful pedagogical design, teacher preparedness, and an ongoing dialogue on epistemological foundations of education. However, the persistent digital divide poses significant challenges to realizing this potential of digital learning. Closing the digital divide requires targeted, collaborative, and sustained efforts from governments, education institutions, and society at large.

When all things considered, the present scoping review is novel and make important contributions. It is important to note that even the most recent studies focused on the pre-COVID-19 period[79, 80] or the immediate pandemic context[81]. In contrast, the present review uniquely applied heutagogy as a coding framework, investigated 4IR technologies in the post-COVID-19 era, and integrated equity, diversity, and inclusion together with decolonial lenses into the analysis. Therefore, the findings presented in this paper offer valuable insights for academic, research, and practitioner communities, contributing to both theoretical advancement and practical application.

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