CTE Workshop Proceedings, 2026, Vol. **13**, pp. 271–288 10.55056/cte.1435

Learners' digital mobility: an evolutionary concept analysis and conceptual framework

Vasyl I. Kovalchuk[1], Taras V. Kovalenko[2] and Andrii V. Kovalchuk[3]

[1]*State Institution "Scientific and Methodological Center for Higher and Pre-Higher Education", 11 Smilianska Str., Kyiv, 03151, Ukraine*

[2]*Separate Structural Subdivision "Nemishaeve Professional College" of the National University of Life and Environmental Sciences of Ukraine, 4 Tekhnikumivska Str., Nemishaeve, Bucha District, Kyiv Region, 07854, Ukraine*

[3]*Korolivka Secondary School of Grades I–II, Korolivka village, Ternopil Region, 48736, Ukraine*

Abstract. "Digital mobility" is increasingly used to describe learners in digitally transformed education, but the term is applied inconsistently and lacks an agreed definition, attribute set, and boundary. This study clarifies learners' digital mobility as a concept and distinguishes it from neighbouring constructs through an evolutionary concept analysis in the tradition of Rodgers, conducted on a purposive, maximum-variation sample of 51 sources retrieved from Semantic Scholar, Crossref, and the Wiley Online Library (primary window 2015–2026). Data were analysed by constant comparison, with an attribute retained as defining only where supported by at least three independent sources. Learners' digital mobility is defined as an evolving, context-sensitive capability to move purposefully, adaptively, critically, and ethically across digital tools, platforms, information spaces, learning communities, institutions, and cultures, carrying learning forward under changing conditions. Seven defining attributes were derived – (1) cross-context portability, (2) platform and tool fluidity, (3) self-regulated orchestration, (4) networked communication and collaboration, (5) critical information and data practice, (6) digital identity, safety, and ethical agency, and (7) adaptive resilience under disruption – together with micro-, meso-, and macro-level antecedents and a two-sided set of consequences. Mapping onto DigComp 2.2 shows that digital mobility extends beyond existing competence frameworks in cross-context portability and resilience, which they address at most implicitly, and a conceptual framework with eight propositions is proposed. Digital mobility is, therefore, a distinct learner capability, not reducible to digital competence or access, and its uneven distribution – "digital immobility" – is an equity question requiring policy attention.

Keywords: digital mobility, learners, evolutionary concept analysis, digital competence, virtual mobility, digital transformation of education, educational resilience, Ukraine

1. Introduction

Globalisation and the digital transformation of education have together reshaped how learners study, communicate, and progress. Learning increasingly moves across electronic platforms, cloud services, virtual learning environments, open resources, and international online communities, loosening the tie between education and a single physical place [3, 40]. In this setting a learner's ability to operate effectively *across* digital environments – rather than within any one of them – has become consequential for access, participation, and continuity of learning. This ability is increasingly named "digital mobility."

The term, however, is used loosely and inconsistently. It is invoked as a near-synonym for mobile learning, for the institutional schemes of virtual and academic mobility, for digital competence, and, in sociology, for the digitally mediated (im)mobilities of students [10, 36, 37]. The result is conceptual confusion: it is unclear whether digital mobility is a technology, a modality, an opportunity,

0000-0002-5006-573X (V. I. Kovalchuk); 0009-0008-8744-8567 (T. V. Kovalenko); 0000-0002-9180-9635 (A. V. Kovalchuk)

v.i_kovalchuk@ukr.net (V. I. Kovalchuk)

Received 2026-03-05 | Accepted 2026-03-20 | Published 2026-03-21 | Version of record 2026-03-21

a competence, or a capability of the learner, and the construct lacks an agreed definition, attribute set, and boundary. A particular source of confusion is the conflation of digital mobility with digital competence. Possessing the knowledge and skills to use technology, as codified in the European frameworks [49], does not by itself entail the capacity to carry learning across platforms, institutions, and cultures; competence within one environment may not transfer to another. Clarifying this distinction matters for theory and for the design of curricula and policy.

The European Union and Ukraine offer an instructive setting in which to examine the concept. The EU has built an extensive policy architecture for digital education and competence [15, 49], while Ukraine is aligning with that architecture under the exceptional conditions of war, in which sustaining learning across displacement and infrastructure disruption has become a national priority [27, 33]. This contrast makes both the enabling and the equity dimensions of digital mobility unusually visible.

The aim of this study is to clarify the concept of learners' digital mobility through an evolutionary concept analysis. It addresses five research questions:

RQ1. What surrogate and related terms are used in the literature for learners' digital mobility, and how do they differ?

RQ2. What defining attributes distinguish learners' digital mobility from digital competence, digital literacy, mobile learning, virtual mobility, academic mobility, and learner agency?

RQ3. What antecedents and consequences – positive and negative – of learners' digital mobility are identifiable in the literature?

RQ4. How has the conceptualisation evolved across disciplines and temporal and geopolitical contexts, particularly the EU–Ukraine policy environment and wartime continuity of learning?

RQ5. What conceptual framework, propositions, and research agenda follow from the analysis?

The study makes the following contributions. (1) It provides, to our knowledge, the first Rodgers' evolutionary concept analysis of learners' digital mobility. (2) It disambiguates the concept from a cluster of surrogate and related constructs. (3) It establishes seven evidence-grounded defining attributes, each with observable referents. (4) It produces a testable conceptual framework with eight propositions. (5) It maps the construct onto EU (DigComp 2.2) and Ukrainian policy and identifies alignment gaps. (6) It introduces a critical account of *digital immobility* as the concept's conditional shadow, countering purely techno-optimistic framings.

2. Background

The digital transformation of education denotes more than the adoption of tools; it is a systemic reorganisation of content, communication, and provision around digital platforms, cloud services, and data [23, 29]. International policy frames this transformation as a route to quality, access, and inclusion, with the European Digital Education Action Plan and the DigComp frameworks the most influential instruments [15, 17, 49]. Within this transformation, mobility has long been a theme of educational thought, but its meaning has shifted. Mobility once referred chiefly to the physical movement of students between institutions and countries; the mobilities turn in social science broadened it to encompass virtual and imagined movement [10, 45], and internationalisation policy developed virtual and open virtual mobility as digital complements to, or substitutes for, physical exchange [12, 28, 37].

In parallel, the mobile-learning literature reframed mobility as a property of the learner rather than of the device, distinguishing mobile learning from electronic and digital learning by the learner's movement across physical, conceptual, and social contexts [1, 3, 34], and emphasising the critical literacies and agency this requires [2, 5]. The digital-competence tradition, meanwhile, specified what learners must know and be able to do with technology, producing reference frameworks and learner-oriented derivatives [20, 26, 49], while research on self-regulated learning, learner agency, and learning ecologies described how learners direct their own learning across digital settings [14, 40].

These literatures each illuminate part of the phenomenon, yet none names the learner-level capability that integrates them: the ability to move learning across the whole socio-technical environment. The COVID-19 pandemic and, in Ukraine, the war made this capability salient by forcing learning to migrate rapidly across platforms and places, foregrounding both resilience and inequality [27, 29, 41, 51]. The emerging need, then, is for a clear account of digital mobility as a learner attribute – its meaning, attributes, antecedents, consequences, and boundaries – which the present concept analysis seeks to provide.

3. Methods

3.1. Design rationale

This study is an *evolutionary concept analysis* in the tradition of Rodgers [39]. Concept analysis comprises several recognised approaches, including the classical (Wilsonian) method codified for the social and health sciences by Walker and Avant [50] and Rodgers' evolutionary approach. Classical methods assume that a concept possesses a fixed essence that can be settled once and for all; the evolutionary approach instead treats a concept as dynamic, context-dependent, and continuously revised through use [39]. Learners' digital mobility is plainly of the latter kind: its meaning is unstable, it is claimed simultaneously by several disciplinary communities, and it has shifted markedly since 2015 under the pressures of platformisation, the COVID-19 pandemic, the war in Ukraine, and generative artificial intelligence. The evolutionary method is therefore the better fit, because its explicit attention to surrogate terms, contextual variation, and temporal change is exactly what an emergent and contested construct requires. Although the method originates in nursing, it has been applied to educational and *digital* constructs – for example, to digital citizenship in education [11] and, using Rodgers' procedure, to e-health literacy [22] and other health concepts [35] – which establishes its suitability beyond its disciplinary origin. The analysis followed Rodgers' six activities: identifying the concept and its surrogate and related terms; selecting an appropriate realm; collecting data on attributes, antecedents, consequences, and contextual basis; analysing those data; identifying a model case; and deriving implications for further development.

3.2. Realm, databases, and search strategy

The realm of analysis comprised peer-reviewed literature and high-credibility policy documents at the intersection of education, digital, virtual, and mobile learning, digital competence, learner agency, online collaboration, and educational resilience, together with European Union and Ukrainian instruments on the digital transformation of education. Searches were conducted in March 2026 across Semantic Scholar and Crossref (through a federated academic-search interface), the Wiley Online Library, and – for initial scoping – the Consensus research engine. Search strings combined the core term with learner-, modality-, competence-, agency-, crisis-, and policy-oriented blocks. Representative strings included:

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"digital mobility" AND (learner* OR student* OR education);
"virtual mobility" OR "open virtual mobility";
("mobile learning" OR m-learning) AND (mobility OR agency);
("continuity of learning" OR "emergency remote teaching") AND (Ukraine
OR war) AND digital.
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The primary window was 2015–2026, with foundational and methodological works retained irrespective of date. Scopus, Web of Science, and ERIC were not accessible in the present environment; this constraint is acknowledged in the limitations. The full query log is retained as an audit trail.

3.3. Eligibility and analytic sampling

Sources were included if they concerned human learners (secondary, higher, vocational, adult/professional, or displaced), addressed digital, virtual, mobile, online, or networked learning, and offered a definition, attribute description, or empirical referent of digital mobility or one of its surrogate or related terms. Records were excluded if "mobility" referred to transport, urban, or clinical/physical mobility with no learner dimension, if no full text was retrievable, or if they were superseded preprints or non-accountable grey literature. Consistent with Rodgers' method, an evolutionary concept analysis does not seek the exhaustive coverage of a systematic review but rather a *purposive, maximum-variation* sample sufficient to characterise the concept across labels, educational levels, disciplines, and geopolitical settings. From 152 records identified and 131 screened after duplicate removal, 63 were assessed in full and 51 were retained for in-depth coding (figure 1). The retained corpus was deliberately heterogeneous: roughly four-fifths was published in 2018–2026, it combined peer-reviewed empirical and theoretical work with European and Ukrainian policy instruments, and it spanned several disciplines (education, information science, sociology of mobilities, and policy studies), educational levels (secondary, higher, vocational, adult, and displaced learners), and geographies (EU, Ukraine, and other settings) – the dimensions of variation the maximum-variation strategy was designed to capture.

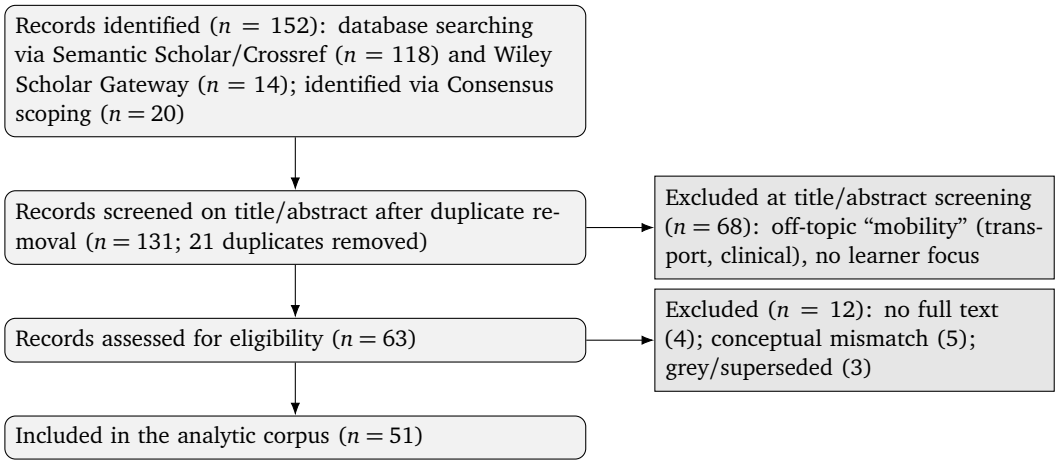

Figure 1: PRISMA-style flow of corpus identification and analytic-sample selection. The analysis is an evolutionary concept analysis with a purposive (non-exhaustive) sample; the flow documents transparency rather than systematic-review exhaustiveness.

3.4. Data extraction and analysis

Each source was charted for bibliographic details, concept label, any explicit definition, surrogate and related terms, the implied meaning of "mobility", and candidate attributes, antecedents, consequences, and observable referents. Analysis proceeded by constant comparison: attribute candidates were first extracted verbatim (open coding), then grouped and compared against the neighbouring constructs of virtual mobility, mobile learning, digital competence, and learner agency, and tested through negative cases in which access or competence did not yield mobility. A candidate was retained as a *defining attribute* only where it was supported by at least three independent sources; for this purpose "independent sources" were peer-reviewed or scholarly works by different author teams, while policy and legal instruments were used as corroborating contextual evidence and were not, on their own, counted toward the threshold. Candidates falling below the threshold were reclassified as antecedents, consequences, or peripheral features. The present authors' own earlier, descriptive Ukrainian-language formulation of the topic, which had proposed a six-component structure, was treated only as a sensitising framework rather than as an a priori coding scheme, so that the resulting attributes were derived inductively from the corpus.

3.5. Rigour, reflexivity, and ethics

Trustworthiness was supported by an explicit search protocol, an audit trail of queries and coding decisions, analytic memoing, and triangulation of empirical and policy literature. Disagreements were resolved through reflexive consensus rather than statistical inter-rater reliability, consistent with the interpretive nature of concept analysis. The authors are Ukrainian educators and researchers positioned within the national system during its wartime digital transformation; this proximity afforded contextual insight but risked a confirmation bias towards resilience and equity framings. To mitigate this, the first and third authors independently coded a 20% subsample of the corpus and resolved discrepancies by discussion, while the second author, teaching in a professional college, reviewed the meso-level antecedent coding to ensure applicability beyond research-intensive universities. The study analysed published literature only: it involved no human participants, no personal data, and no primary data collection, and the cases presented in section 4 are constructed illustrations rather than studies of identifiable individuals.

4. Results

4.1. Surrogate and related terms

The corpus uses "digital mobility" alongside a cluster of overlapping terms whose conflation is itself a source of conceptual confusion (table 1). The analysis distinguishes three groups. First are *resources and antecedents* that are frequently mistaken for the concept: digital competence, codified in the European reference frameworks [17, 49] and assessed as a learner attribute in its own right [26], and digital literacy [2, 20]. These describe what a learner knows and can do with technology, but, as the negative-case analysis showed, competence in a single environment does not entail moving learning *across* environments. Second are *related modalities*: mobile, e-, and d-learning [3, 13, 43]. The mobile-learning literature is instructive because it locates the defining feature of the field not in the device but in the "mobility of the learner" across physical, conceptual, and social settings [1, 34]; digital mobility generalises this insight from devices to the whole socio-technical environment. Third are *institutional and sociological constructs*: virtual mobility and open virtual mobility, which name cross-border study opportunities offered by institutions [12, 21, 25, 28, 37, 44]; academic and social mobility, which are broader and historically physical [31, 42]; and the sociological lens of (im)mobilities, which foregrounds inequality and the immobile as much as the mobile [10]. Two constructs sit especially close. Learner agency recurs across the corpus as the underlying mechanism of digital mobility [14, 40], yet agency is necessary rather than sufficient. Learning ecologies describe the self-organised contexts within which mobility unfolds [40], but they are environments rather than a learner-level capability. Digital nomadism, finally, is a boundary concept oriented to work and lifestyle rather than to learning, and is treated here only to mark the concept's edge. Across these distinctions a consistent differentia emerges: digital mobility is the learner's capability to *move learning forward across contexts*, whereas the surrogate terms name either the resources that enable such movement, the modalities through which it occurs, or the institutional and social structures that surround it.

4.2. Defining attributes

Seven attributes met the threshold of support in at least three independent sources and are taken to define learners' digital mobility (table 2). *Cross-context portability* – carrying learning, artefacts, and identity across tools, platforms, institutions, and cultures – is the conceptual core that the surrounding literature most consistently implies but rarely names: it is visible in accounts of mobility across physical, conceptual, and social settings [1], in the entanglement of mobility, data, and agency in networked learning [14], in "miniaturised" mobility compressed into devices and platforms across borders [36], and in the (im)mobilities of digitally mediated study [10]. *Platform and tool fluidity* – the rapid adoption of and movement between digital services – follows from the comparative analyses

Table 1
Surrogate and related terms identified in the corpus, and their relation to learners' digital mobility.

Term	Relation to digital mobility	Key distinction	Representative sources
Digital competence	Antecedent and partial resource	Competence in using technology does not entail moving learning across contexts	[17, 26, 49]
Digital literacy	Overlapping (critical information practice)	Typically information/text-focused rather than mobility-focused	[2, 5, 20]
Mobile learning (m-learning)	Related modality	Mobility of the *device*; narrower than mobility of the *learner*	[3, 34, 43]
E-/d-learning	Related modality	A delivery mode, not a learner capability	[3, 13]
Virtual mobility	Institutional opportunity/context	Digital mobility is the learner capability to exploit such opportunities	[12, 28, 37, 44]
Open virtual mobility	Related programmatic framework	More programmatic and higher-education-specific	[37]
Academic mobility	Related but broader/traditional	Historically physical; digital mobility may complement or substitute it	[28, 31]
Social mobility	Possible distal consequence	Movement in socioeconomic status, not in digital learning contexts	[42]
Learner agency	Core underlying mechanism	Agency is necessary but not sufficient for digital mobility	[14, 31, 40]
Digital citizenship	Related (ethical dimension)	Civic-participation focus rather than cross-context learning	[11]
(Im)mobilities	Critical sociological lens	Foregrounds immobility and inequality, not a learner capability	[10]
Learning ecologies	Related (self-organization across contexts)	An ecological context, not a learner-level capability	[40]
Digital nomadism	Boundary concept	Work/lifestyle orientation, not learner-focused	– †

Note. †Digital nomadism has no supporting source in the analytic corpus; it is included only to mark the outer boundary of the concept.

of learning modalities [3, 13] and from frameworks that treat portability and connectivity as defining features of mobile learning [4, 34]. *Self-regulated orchestration of learning* – planning, monitoring, and adjusting one's learning across several environments – is among the best-evidenced attributes, appearing in work on learning ecologies and agency [14, 40], on self-direction within international mobility [24], and on the self-regulation that underpins resilience [51]. *Networked communication and collaboration* – participation in digital and international learning communities – is documented in the open-virtual-mobility skill set [37], in collaborative online international learning [12, 44], and in studies of participation through everyday digital tools [38]. *Critical information and data practice* – locating, evaluating, and synthesising information and data, including the critical use of generative AI – draws on the European competence frameworks [20, 49] and on the critical mobile literacies that distinguish interpretation from mere device skill [2, 5]. *Digital identity, safety, and ethical agency* – integrity, privacy, safety, and ethical conduct – is anchored in the safety strand of the competence

frameworks [49], in concerns about datafication and surveillance [23], and in the concept analysis of digital citizenship [11]. *Adaptive resilience under disruption* – sustaining learning across platform shifts, outages, displacement, and crisis – is evidenced in studies of instructional resilience and pandemic continuity [29, 51] and, acutely, in the Ukrainian wartime experience [27, 32]. Taken together, attributes two through six broadly recover the operational, cognitive, communicative, and socio-ethical components proposed in the authors' earlier descriptive formulation, while self-regulated orchestration and adaptive resilience recover its "adaptive-reflective" component; the convergence offers a measure of convergent validity. Two corrections are notable. The motivational-value "component" of that earlier formulation did not survive as a defining attribute and is better read as an antecedent (below). And cross-context portability, largely absent from prior framings, emerges as the attribute that most clearly separates digital mobility from digital competence.

Table 2
Defining attributes of learners' digital mobility, with observable referents and representative sources (each attribute supported by ≥ 3 independent peer-reviewed or scholarly sources; policy instruments, where listed, corroborate but are not counted toward the threshold).

Defining attribute	Description	Observable referent	Representative sources
Cross-context portability	Carrying learning, artefacts, and identity across tools, platforms, institutions, and cultures	Resumes a task or e-portfolio on a new platform or at a new institution; transfers work across borders	[1, 2, 10, 14, 34, 36, 40]
Platform and tool fluidity	Rapidly adopting and switching between digital services and environments	Learns an unfamiliar learning-management system or AI tool quickly; changes tools without losing momentum	[3, 4, 13, 26, 34, 36]
Self-regulated orchestration of learning	Planning, monitoring, and adapting one's own learning across digital settings	Sets goals, sequences resources, and adjusts strategy across several environments	[14, 24, 34, 37, 40, 43, 51]
Networked communication and collaboration	Participating in digital and international learning communities and joint work	Joins virtual exchange, online projects, and peer or professional networks	[12, 14, 24, 37, 38, 44]
Critical information and data practice	Searching, evaluating, and synthesizing information and data, including critical use of generative AI	Verifies and triangulates sources; recognises misinformation; uses AI tools critically	[2, 5, 20, 37, 49]
Digital identity, safety, and ethical agency	Observing integrity, privacy, safety, and ethical conduct online	Protects personal data; respects academic integrity and copyright; discloses AI use	[7, 11, 23, 49]
Adaptive resilience under disruption	Sustaining learning across platform shifts, outages, displacement, and crisis	Continues studying during connectivity loss, relocation, or emergency remote teaching	[18, 19, 27, 29, 32, 51]

4.3. Antecedents and consequences

Antecedents operate at three levels (table 3). At the *micro* level they include prior digital competence and self-efficacy [26, 49], motivation and agency [14], and – fundamentally – access to devices and connectivity [38, 46]. At the *meso* level they include institutional infrastructure and interoperability, the recognition of virtual mobility, micro-credentials, and e-portfolios, and teacher competence and support [12, 13, 33, 37]. At the *macro* level they include national and European digital-education policy, socioeconomic equity, and conditions of crisis and displacement [15, 27, 41, 47, 49]. The consequences are deliberately presented in two registers. The *positive* consequences – continuity of learning, virtual academic mobility and internationalisation, access to international resources, lifelong-learning readiness, employability, and educational resilience – are well represented [1, 27, 28, 30, 36, 37, 51]. But the corpus equally supports a set of *conditional and negative* consequences that a purely optimistic account would miss, and which are best captured by the notion of *digital immobility*. We use this compound term – which the corpus does not attest as a fixed label – to condense the sociological (im)mobilities perspective [10] and the digital-divide literature [46, 47] into a single derived construct: *the condition in which structural, material, or capability constraints prevent a learner from exercising digital mobility, so that the same socio-technical conditions that enable movement for some immobilise others*. Its referents in the corpus are the widening of digital inequality [46, 47], dependency on closed platforms together with datafication and surveillance [23], the exclusion of low-connectivity, displaced, or under-prepared learners [38, 41], cognitive overload and digital fatigue [13], and the loss of co-presence in digitally mediated study [10]. Whether digital mobility realises its positive or its negative potential is, the analysis suggests, conditioned by the antecedents – above all by equity-related conditions at the macro and micro levels.

Table 3
Antecedents and consequences of learners' digital mobility identified in the corpus.

Level / type	Element	Representative sources
	Antecedents	
Micro	Prior digital competence; digital self-efficacy and readiness; motivation and agency; device and connectivity access	[14, 26, 38, 43, 46, 49]
Meso	Institutional infrastructure and interoperability; recognition of virtual mobility, micro-credentials, and e-portfolios; teacher digital competence and support	[12, 13, 23, 28, 33, 37]
Macro	National and EU digital-education policy; crisis, war, and displacement; socioeconomic equity	[7, 8, 15, 27, 41, 47, 49]
	Consequences	
Positive	Continuity of learning; virtual academic mobility and internationalisation; access to international resources and intercultural participation; lifelong-learning readiness; employability and professional identity; educational resilience	[1, 5, 6, 27, 28, 36, 37, 51]
Conditional / negative (*digital immobility*)	Widening digital inequality; platform dependency, datafication, and surveillance; exclusion of low-connectivity, displaced, or under-prepared learners; cognitive overload and digital fatigue; loss of co-presence	[10, 13, 23, 38, 41, 46, 47]

4.4. Contextual and temporal variation

As an evolutionary concept, digital mobility varies by context and over time. Its salience differs across the spectrum of learners considered here – secondary, higher, vocational, adult, displaced, and cross-border – so the analysis does not claim that the attributes manifest identically at every level, only that they recur as a recognisable set. Policy context is a particularly strong source of variation. Mapping the concept onto the European Digital Competence Framework for Citizens (DigComp 2.2) shows both alignment and a revealing gap (table 4): the framework's areas of information and data literacy, communication and collaboration, content creation, safety, and problem solving correspond closely to five of the seven attributes [49], and the European Digital Education Action Plan provides the policy scaffolding for virtual mobility and digital-competence development [15, 16]. Ukraine has moved to align with these frameworks [8, 9, 33], yet its instruments still emphasise access and basic skills over critical data practice, offer limited recognition of virtual-mobility credit, and address data protection and artificial-intelligence governance only nascently [7, 48]. Crucially, DigComp 2.2 has no dedicated competence for cross-context portability or for adaptive resilience under disruption; its problem-solving area touches adaptation only in generic terms. In these two respects digital mobility *extends beyond* the competence frameworks, treating as defining attributes what the frameworks address, at most, implicitly – which is one of the analysis's central findings. The Ukrainian wartime experience functions here as a critical contextual lens rather than as primary evidence. Studies of distance education under war and displacement [27, 32, 41] make the resilience attribute unusually visible – learning is sustained across relocation, infrastructure failure, and platform change – while simultaneously exposing how the same conditions intensify digital inequality. Read over time (figure 2), the concept has evolved from a device-centred reading of mobile learning, through the consolidation of digital-competence frameworks and virtual mobility, the pandemic turn to emergency remote teaching, and the wartime and generative-AI period, towards an agentic, networked, resilient, and cross-context capability.

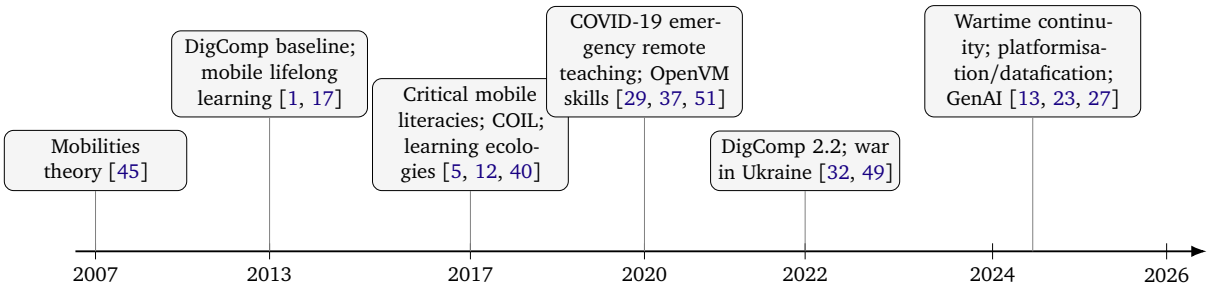

Figure 2: Temporal and contextual evolution of learners' digital mobility, 2007–2026. Each milestone is anchored to verified sources in the corpus.

4.5. Delimiting the concept: model, borderline, and contrary cases

Following Rodgers' procedure, the concept is bounded by three constructed cases (Box 1). The *model case* depicts a displaced vocational learner who sustains and extends her studies under wartime disruption while displaying all seven defining attributes at once, showing how they interlock rather than operate in isolation; the high-disruption setting is chosen deliberately because it brings every attribute, including the otherwise latent resilience and portability, into simultaneous view. The *borderline case* depicts a learner who is fluent and confident within a single platform but whose participation collapses when learning must move across environments; it isolates cross-context portability and self-regulated orchestration as the attributes whose absence reduces digital mobility to mere in-platform competence. The *contrary case* depicts a learner with a device and connectivity but none of the attributes, and so demonstrates the study's central distinction: access and ownership

Table 4
Mapping learners' digital mobility onto the European Digital Competence Framework for Citizens (DigComp 2.2) and EU–Ukraine digital-education policy, with alignment gaps.

DigComp 2.2 area	Area descriptor (abridged)	Digital-mobility attribute	Relevant EU / Ukrainian instruments	Alignment gaps
1. Information and data literacy	Articulating data and information needs; locating, evaluating and managing digital content [49]	Critical information and data practice	EU DEAP [15]; UA digital-competence concept [8]	Ukrainian instruments emphasise access and basic skills over critical evaluation and data practice
2. Communication and collaboration	Interacting, sharing and collaborating through digital technologies across cultural and generational diversity [49]	Networked communication and collaboration	EU Erasmus+ virtual exchange / DEAP [15, 16]; UA concept [8]	Limited Ukrainian recognition of virtual-mobility credits and micro-credentials
3. Digital content creation	Creating and editing content; respecting copyright and licences [49]	Platform/tool fluidity; critical information practice	EU DEAP [15]; UA digital-development strategy [9]	Content-creation and intellectual-property competence weakly operationalised
4. Safety	Protecting devices, personal data, privacy, health and well-being [49]	Digital identity, safety and ethical agency	EU DEAP + data protection; UA AI and informatisation instruments [7, 48]	Data-protection and AI-governance provisions nascent; learner well-being under-addressed
5. Problem solving	Identifying needs and technological responses; using digital tools to innovate and adapt [49]	Platform/tool fluidity (cross-context portability and adaptive resilience only implicitly)	EU DEAP [15]; UA strategy [9]	DigComp's problem-solving area addresses adaptation only generically; it has no dedicated competence for cross-context portability or disruption-driven resilience – **here digital mobility extends beyond DigComp**

Note. Ukrainian uptake of DigComp 2.2 is discussed by Ovcharuk [33]; policy instruments are cited from official government sources.

are antecedents of digital mobility, not constituents of it.

Box 1. Model, borderline, and contrary cases (constructed illustrations)

Model case. Maryna, a vocational-education student displaced from her home city during the war, continues studying across a shifting set of digital environments. When her college's learning-management system becomes unreliable, she moves coursework to shared cloud documents and a low-bandwidth messaging group, resuming tasks without losing progress *(cross-context portability)*. She adopts an unfamiliar video-conferencing tool and an AI writing assistant within a day *(platform and tool fluidity)*, plans her week around intermittent electricity, and revises her study schedule as conditions change *(self-regulated orchestration; adaptive resilience under disruption)*. She joins an international virtual-exchange project, co-authoring a report with peers abroad *(networked communication and collaboration)*. Preparing it, she cross-checks sources, separates reliable data from misinformation, and

uses the AI assistant critically *(critical information and data practice)*. Throughout, she protects her personal data, attributes sources, and discloses her use of AI *(digital identity, safety, and ethical agency)*. The case displays all seven defining attributes simultaneously and shows how they interlock under disruption.

Borderline case. Andrii is confident within his university's single learning-management system and attends synchronous lectures without difficulty *(platform fluidity; networked communication)*. When a course migrates to a different platform requiring collaborative cloud authoring and independent source evaluation, however, his participation collapses. High competence *within* one environment does not transfer *across* contexts: the case lacks cross-context portability and self-regulated orchestration, and so represents digital mobility only partially.

Contrary case. Olha owns a smartphone and has connectivity, yet cannot locate reliable learning resources, communicates ineffectively online, and abandons study whenever the institutional platform changes; her occasional AI use breaches academic-integrity norms. Despite physical access, none of the defining attributes are present – demonstrating that access and device ownership are *antecedents*, not constituents, of digital mobility.

5. Discussion

5.1. A synthesised definition and conceptual framework

Drawing the analysis together, learners' digital mobility may be defined as *an evolving, context-sensitive capability and disposition of a learner to move purposefully, adaptively, critically, and ethically across digital tools, platforms, information and data spaces, learning communities, institutional arrangements, and cultural contexts – carrying forward their learning, artefacts, and identity – in order to sustain, extend, and transform learning and professional development under changing socio-technical conditions, including disruption*. The genus is a learner-level capability-and-disposition, distinguishing the concept from a technology, a delivery modality, or an institutional programme; the differentia is cross-context movement that carries learning forward, distinguishing it from the possession of digital competence or access to online study. Figure 3 renders this as a framework in which micro-, meso-, and macro-level antecedents enable the seven defining attributes, which in turn yield both positive and conditional or negative consequences, with the whole shaped by a contextual basis (the EU–Ukraine policy environment, wartime continuity of learning, and lifelong learning) and a set of moderators (equity, accessibility, digital well-being, crisis conditions, and the governance of AI and data).

5.2. Propositions

The framework yields the following propositions to guide future empirical work. They differ in epistemic status. Propositions P1 and P2 are largely *analytic*: they follow from the definition and serve to fix the construct's boundary rather than to make a contingent prediction. Propositions P3–P8 are *empirical*, framed so as to be testable and, in principle, falsifiable through the kinds of studies set out in section 6.

P1. Digital competence is a necessary but insufficient antecedent of digital mobility; mobility emerges only when competence is transferred across platforms, institutions, and cultures. The competence frameworks describe knowledge, skills, and attitudes [26, 49], but the mobility literature locates the distinctive act in movement across settings [1, 36].

P2. The distinguishing feature of digital mobility is adaptive cross-context orchestration rather than isolated proficiency with any tool. Accounts of networked learning, agency, and learning ecologies converge on orchestration across environments rather than mastery of one [14, 34, 40].

P3. Virtual-mobility opportunities produce learning outcomes only when learners possess sufficient self-regulation, networked collaboration, and critical information practice. The open-virtual-mobility skill set and studies of digital learning within mobility schemes make these capabilities preconditions of benefit [12, 24, 37].

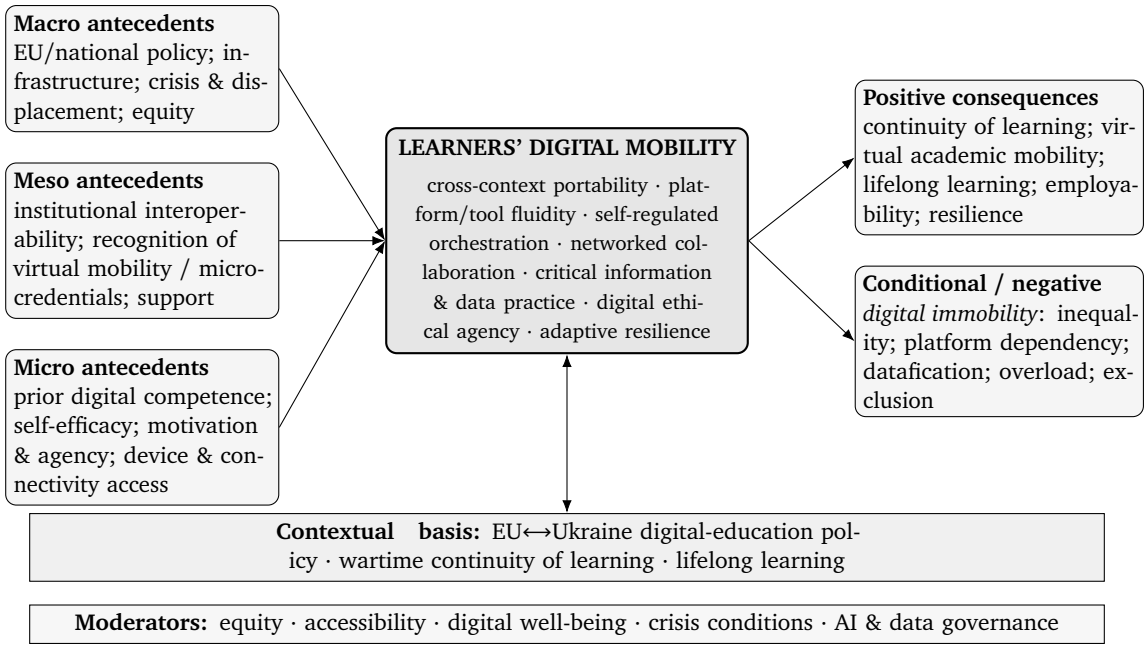

Figure 3: Conceptual framework of learners' digital mobility: micro/meso/macro antecedents enable seven defining attributes, which yield positive and conditional/negative (digital immobility) consequences, all shaped by a contextual basis and a set of moderators.

P4. Pedagogies that require collaborative work across multiple digital environments foster digital mobility more than platform-bound content delivery. Evidence on participation through everyday tools and on collaborative online international learning points to cross-environment collaboration as a developmental driver [12, 14, 38].

P5. Crisis conditions make the resilience attribute visible while simultaneously intensifying digital inequalities. The pandemic and wartime literatures show resilience operating under disruption even as access gaps widen [27, 46, 51].

P6. Meso-level interoperability, accessible design, and learner support mediate the relationship between macro-level policy and actual learner digital mobility. Policy ambition is filtered through institutional infrastructure and recognition before it reaches learners [13, 23, 33].

P7. Digital-ethical agency moderates the benefits and risks of AI-assisted learning within digital mobility. The safety strand of the competence frameworks, critiques of datafication, and AI-governance policy together suggest that ethical agency conditions whether AI use helps or harms [7, 23, 49].

P8. Without equity-oriented policy, digital mobility reproduces new forms of digital immobility. Where access and recognition are unequal, the same socio-technical conditions that enable mobility for some immobilise others [10, 46, 47].

5.3. Relationship to adjacent constructs

The framework clarifies several long-standing conflations. Against digital competence, digital mobility is not a larger competence but a different kind of construct – a capability to deploy and transfer competence across contexts; competence is therefore positioned as an antecedent. Against virtual mobility, the analysis separates the institutional *opportunity* from the learner *capability* required to exploit it, which explains why equivalent virtual-mobility provision yields unequal outcomes [28, 37]. Against learner agency, digital mobility specifies the domain in which agency is exercised and the attributes through which it becomes effective, so that agency is the mechanism and mobility the patterned capability [14]. And against the optimistic readings common in the policy literature, the (im)mobilities perspective insists that mobility and immobility are produced together [10].

5.4. Implications and the shadow of digital immobility

For theory, the contribution is a defined, bounded, and evidence-grounded construct with testable propositions, addressing the conceptual confusion that motivated the study. For practice, the framework implies that fostering digital mobility requires more than provisioning devices or teaching tool-specific skills: it requires curricula that deliberately move learners across platforms, institutions, and cultures and that cultivate self-regulation, critical data practice, and ethical agency. For policy, the EU–Ukraine mapping indicates concrete priorities for alignment – recognising virtual-mobility credit, strengthening data protection and AI governance, and, above all, embedding portability and resilience, which current competence frameworks do not capture. These implications are, however, shadowed by *digital immobility*. The same analysis that identifies the benefits of digital mobility identifies its conditional costs: the deepening of inequality, dependency on closed and datafied platforms, cognitive overload, and the exclusion of low-connectivity, disabled, displaced, or underprepared learners [23, 41, 47]. Treating digital mobility as an unqualified good would therefore be a category error; the construct is better understood as a capability whose distribution is itself an equity question, and whose realisation depends on the antecedents and moderators that the framework makes explicit.

6. Research agenda and limitations

The framework opens a concept-to-empirical research agenda. Priorities include qualitative studies of how learners transition across platforms and institutions; longitudinal research on how digital mobility develops across educational levels and the lifespan; studies of displaced and crisis-affected learners, for whom the resilience attribute is most consequential; comparative EU–Ukraine research on how policy shapes learner mobility; design-based research on pedagogies that deliberately move learners across digital environments; investigations of generative AI and ethical digital mobility; and equity-focused studies of digital *immobility*. Two methodological steps would consolidate the construct: the development and validation of indicators or instruments operationalising the seven attributes (deliberately left to future work here), and studies of e-portfolios, micro-credentials, and credential portability as mechanisms of cross-context movement. Research on digital well-being, cognitive load, and platform fatigue would further illuminate the conditional consequences identified above.

Several limitations qualify the findings. The analysis is interpretive rather than a systematic review, and its purposive, maximum-variation sample is not exhaustive; a different sample might foreground different attributes, although the $\geq$ 3-source threshold guards against idiosyncratic inclusion. The search was limited to English- and Ukrainian-language literature and to the databases available in this environment – Semantic Scholar, Crossref, and the Wiley Online Library, with Consensus used for scoping; Scopus, Web of Science, and ERIC were not searched, which may have biased coverage. The construct is evolving rapidly under the pressures of AI and policy change, so the temporal account is necessarily provisional. The decision to treat digital mobility as a lifespan-wide learner attribute, while defensible, may obscure level-specific differences that future work should examine. The framework has not been empirically validated. The Ukrainian wartime material is used as a contextual lens grounded in published studies, not as primary evidence collected by the authors, and the model, borderline, and contrary cases are constructed illustrations rather than observed individuals.

7. Conclusion

Learners' digital mobility has been treated, until now, as an intuitively appealing but under-specified idea. This study has clarified it through an evolutionary concept analysis, defining it as a learner's evolving, context-sensitive capability to move learning purposefully, adaptively, critically, and ethically across digital tools, platforms, information spaces, communities, institutions, and cultures. The

analysis distinguished the concept from a cluster of surrogate terms, established seven defining attributes with observable referents, situated the construct within micro-, meso-, and macro-level antecedents and a two-sided set of consequences, and mapped it onto EU and Ukrainian policy, where it was found to extend beyond existing competence frameworks in two respects that they address only implicitly – cross-context portability and adaptive resilience. Equally, the study has resisted a purely optimistic reading by naming digital immobility as the concept's conditional shadow, and by showing that whether digital mobility expands or narrows educational opportunity depends on equity-oriented antecedents and moderators. The resulting framework and propositions are offered as a foundation for the empirical study of a capability that has become central to learning in a digitally transformed and frequently disrupted world.

Author contributions

Conceptualisation, V.I.K.; methodology, V.I.K. and A.V.K.; investigation and coding, V.I.K., T.V.K. and A.V.K.; formal analysis, V.I.K. and A.V.K.; writing – original draft, V.I.K.; writing – review and editing, all authors; supervision, V.I.K. All authors have read and agreed to the published version of the manuscript.

Funding

The authors received no specific funding for this study.

Data availability statement

The analytic corpus (the list of included sources with extraction codes), the search strings, the inclusion and exclusion criteria, and the coding scheme are reported in the article; the coding matrix is available from the corresponding author upon reasonable request. No new primary data were generated, as the study analyses published literature only.

Conflicts of interest

The authors declare no conflict of interest.

Ethics approval

This study is a theoretical concept analysis involving no human participants, no personal data, and no primary data collection; ethics-committee approval was therefore not required. The cases in section 4.5 are constructed illustrative scenarios and do not describe identifiable individuals.

Declaration on Generative AI

The authors used AI-assisted tools (large language model–based academic-search assistants and literature-retrieval interfaces) to support search planning, search-string refinement, bibliographic-metadata verification through Semantic Scholar and the Wiley Scholar Gateway, and structural drafting. AI tools were not used to generate empirical data, to make final inclusion decisions, to fabricate references, or to replace scholarly interpretation. All sources, metadata, quotations, and claims were verified by the authors, who take full responsibility for the content of the manuscript.

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