Beyond Access: A Systematic Literature Review on the Role of Digital Literacy and Human Support in Addressing the Second-Level Digital Divide

Sarah Halleluyah Adeyemi, Morgan State University

Sarah Halleluyah Adeyemi is a Master student in the Department of Bioinformatics at Morgan State University. She holds a B.Sc. in Microbiology from Mountain Top University, Nigeria. Her research interests focus on gene expression analysis, cardiovascular genomics, antimicrobial resistance, and the application of computational tools in biomedical research. She is also currently working towards being a Data Scientist.

Sarah has research experience from the Nigerian Institute of Medical Research, where she contributed to infectious disease diagnostics and antimicrobial studies. She also worked in the R&D division at FrieslandCampina WAMCO, gaining insight into food safety, quality control, and process validation. Currently, she serves as a graduate assistant on interdisciplinary research projects funded by NASA and ETA-STEM, supporting data analysis and science education initiatives.

She is a member of ASEE, IEEE, passionate about STEM education and is passionate about integrating bioinformatics and molecular biology to solve health-related challenges and promote inclusive scientific research.

Johnson Boluwatife Odumosu, Morgan State University
Julius Ogaga Etuke, Morgan State University

Julius Ogaga Etuke is a seasoned civil engineer and Ph.D. Candidate in Civil Engineering at Morgan State University, where his research focuses on sustainable and resilient infrastructure engineering. With over 15 years of consulting and project leadership experience, primarily in Nigeria's infrastructure landscape, he brings a robust, practical perspective to academic inquiry. His doctoral research is at the cutting edge of transportation resilience, integrating virtual and augmented reality (VR/AR), climate adaptation modeling, and data-driven solutions to improve disaster preparedness and risk mitigation in complex transportation systems. As a COREN-registered engineer and member of the Nigerian Society of Engineers, his work emphasizes impactful research and consultancy that bridges structural design principles with urgent sustainability and resilience challenges.

Dr. Oludare Adegbola Owolabi P.E., Morgan State University

Dr. Oludare Owolabi, a professional engineer in Maryland, joined the Morgan State University faculty in 2010. He is the director of the Sustainable Infrastructure Development, Smart Innovation and Resilient Engineering Research Lab, Department of Civil Engineering at Morgan State University

Dr. Uttam Gaulee
Dr. Olushola V. Emiola-Owolabi, Morgan State University

Olushola Emiola-Owolabi is an engineering pedagogy specialist, researching active learning in engineering classrooms and specializing in qualitative methods research on teaching and learning – particularly in remote synchronous learning environments.

Abiola Olayinka Ajala, Morgan State University

Abiola Olayinka Ajala is an AI researcher for the National Airspace System (NAS) at Morgan State University, pursuing a Ph.D. in Electrical and Computer Systems Engineering with a focus on Data Science, Machine Learning, and AI. Currently working on a research on climate resilience and aviation security using AI-driven solutions. With a Master's in Advanced Computing and a Bachelor's in Computer Science, Abiola has expertise in data science, cybersecurity, networking, business analysis, and system administration. A member of ASEE,IEEE who is passionate about STEM education to introduce K1-12 students to computing/ engineering skills and digital literacy.

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Abstract
As digital technologies become integral to daily life, disparities in digital access have evolved beyond connectivity to include differences in skills, usage patterns, and outcomes. This is a phenomenon known as the second-level digital divide. Second level digital divide outcomes are also influenced not only by connection but also by how well people have the skills and support needed to make effective use of digital tools. This paper provides a synthetic overview of evidence of the impact of digital literacy interventions and human supports on digital skills, engagement, and equity impacts. Using a structured extraction workbook designed to ensure consistent data extraction and coding across studies, 65 studies were analyzed after full-text review. We coded intervention format, support roles, settings of delivery, outcome measures, and equity impacts before performing descriptive and thematic synthesis. The included studies were published between 2014 and 2025, with most being empirical (around three quarters). Hybrid and online instructions were the most common delivery format, and instructors or facilitators occupied the dominant role as support persons. A large majority of coded studies reported that human support had improved at least one proximal outcome, such as engagement, confidence, self-efficacy, retention, or task performance, and almost two thirds reported some reduction in disparities for underserved groups. We propose a Human Supported Digital Literacy framework that bridges intervention design choices to equity mechanisms, and we use findings to make actionable recommendations for engineering educators and community partners designing digital inclusion programs. A salutary, which means beneficial, implication of this is that digital literacy curricula should be supported by sustained relational support and explicit referrals and pathways to broadband, devices, and services.

Keywords: digital literacy, ICT literacy, information literacy, human support, social support, community support, peer support, mentorship, training, capacity building, second-level digital divide, digital divide, digital skills gap, usage divide

1. Introduction

Over the past 20 years or so, digital inclusion efforts have been dominated by the increase in access to broadband infrastructure and digital tools. While these investments have led to a large rise in the overall level of connectivity, there is a growing body of evidence that indicates that access is not enough for equitable participation in digitally mediated services. Disparities are increasingly appearing at the level of skills, confidence, usage patterns, and outcomes, known generally as the second-level digital divide [1]. This divide serves a disproportionate burden on older people, low-income individuals, and communities in rural areas, who may technically have access to digital technologies but lack the capacity to use them effectively and sustainably. Studies looking at broadband and health outcomes have shown that although better access is related to better outcomes for the population as a whole, the mechanisms by which access and meaningful use are linked are complex and inconsistent across populations [1, 2].

Research in healthcare and public service settings points to an important point: that infrastructure gaps exist, but digital literacy and support systems exist too. For example, differences in patient

portal, telehealth-based, and health information technology use persist, even in the availability of connectivity, particularly among socioeconomically disadvantaged groups [3]. Rural communities are faced with compounded challenges such as inconsistent quality of broadband, underrepresentation in broadband performance data, and reduced institutional capacity to support digital engagement [4, 5]. These challenges point to how digital exclusion is perpetuated by social, educational, and organizational factors, which are not limited to the level of connectivity itself.

Emerging evidence points to human support mechanisms such as mentorship, peer assistance, community facilitation, and institutional guidance as critical enablers of effective digital literacy interventions. Programs that combine skills training with structured human support have been shown to improve sustained engagement, confidence, and self-efficacy, particularly among populations facing structural disadvantage [3, 6]. In healthcare contexts, the absence of training, trust building, and ongoing assistance has been identified as a key barrier to technology adoption, even when digital tools are technically available [7]. Similarly, research on rural digital development emphasizes that smart technologies and digital systems are unlikely to achieve their intended benefits without parallel investments in human capacity and local support structures [5].

Despite a growing body of work addressing digital literacy, broadband access, and technology adoption, the literature remains fragmented. Existing studies vary widely in their definitions of digital literacy, forms of human support, outcome measures, and program designs, making it difficult to draw consolidated conclusions about what types of support configurations are most effective. Key implementation details such as mentor-to-learner ratios, program duration, delivery modality, and subgroup-specific outcomes are often inconsistently reported or examined in isolation. This fragmentation limits the ability of policymakers, educators, and community organizations to design evidence-based digital inclusion strategies that move beyond access toward meaningful use.

To address this gap, this study conducts a systematic literature review examining how digital literacy interventions combined with human support mechanisms contribute to bridging the second-level digital divide. Guided by Digital Capital Theory, Social Support Theory, Economic Development Theory, and the Technology Acceptance Model, the review synthesizes evidence from peer-reviewed literature and program evaluations to assess how supported digital literacy initiatives influence engagement, confidence, and technology use among underserved populations.

Research Question

- How do digital literacy programs and human support mechanisms contribute to bridging the second-level digital divide beyond mere access to technology?
- How do human supported digital literacy interventions influence engagement, sustained use, and equity outcomes beyond access to technology?

2. Theoretical Framework

This systematic literature review is grounded in four complementary theoretical frameworks: Digital Capital Theory, Social Support Theory, Economic Development Theory, and the Technology Acceptance Model (TAM). Together, these frameworks provide a robust lens for understanding how digital literacy interventions and human support mechanisms influence technology use beyond access, particularly among underserved populations. See figure 1 below

Digital Capital Theory reminds us that technology success is not just about internet access. It is about whether people have the necessary tools and whether they possess the confidence and skills to use them effectively.
Social Support Theory reminds us that people do not adopt technology in isolation. Many people only move forward because someone helps them, shows them, encourages them, or reduces the stress that comes with trying something unfamiliar.
Economic Development Theory, through a human development lens, reminds us that the goal is not gadgets. The goal is a better life, more real options, and fairer outcomes, especially for people who are already vulnerable.
The TAM keeps us honest about the simplest question: Does this feel useful, and does it feel easy enough to use without draining the user?
So the review is not only asking whether a technology exists. It is asking who can realistically use it, who helps them use it, what benefits it truly creates in real life, and what perceptions drive people to accept it or reject it. It focuses on how institutions drive local economic growth through job creation, infrastructure, and partnerships.

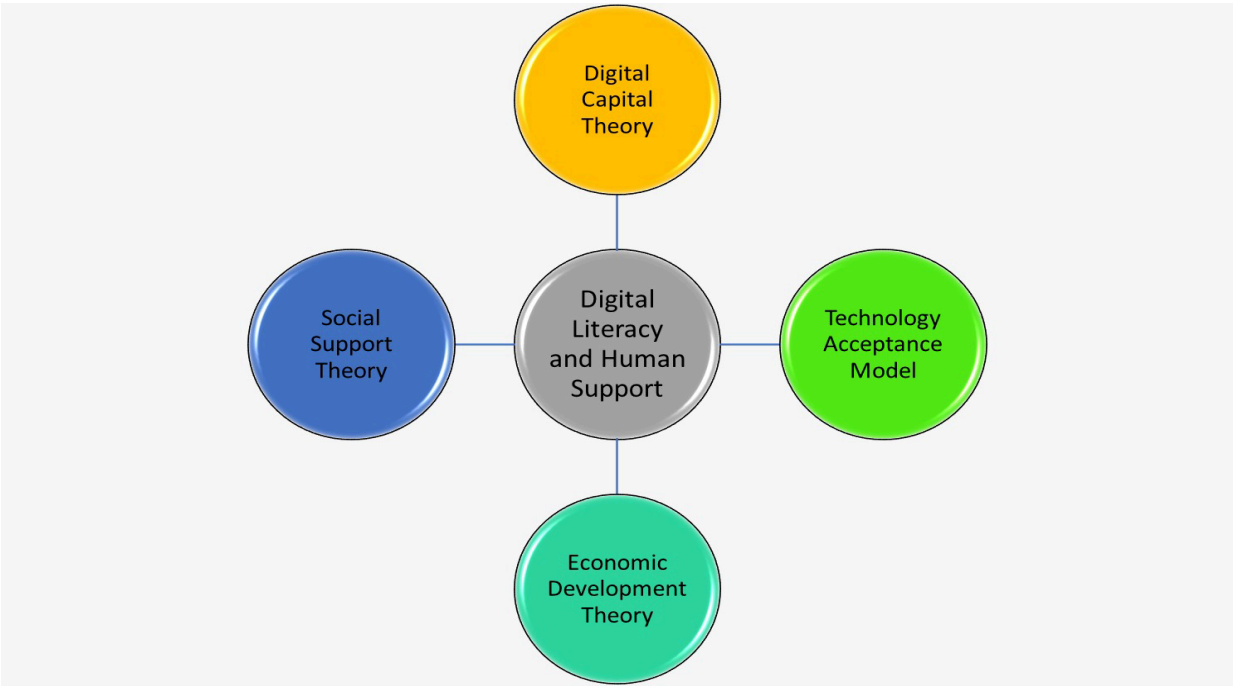

Figure 1: *Theoretical framework linking Digital literacy and Human Support to Equity Outcomes Beyond Access.*

3. Methodology

This study follows a systematic literature review methodology in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review protocol was designed to ensure transparency, reproducibility, and methodological rigor in identifying and synthesizing evidence on digital literacy interventions and human support mechanisms addressing the second-level digital divide.

A. Search Strategy

A structured literature search was conducted across three databases: Scopus, Google Scholar, and ERIC. These databases were selected to capture interdisciplinary research spanning public health, education, information science, and social sciences. Searches targeted peer-reviewed journal articles, policy reports, and program evaluations published within the past decade. The review included studies published between 2014 and 2025.

B. Search Strings

Search strings combined terms related to digital literacy, human support, and the second-level digital divide, including variations of digital literacy, ICT literacy, information literacy, human support, peer support, mentorship, community training, and usage divide. Boolean operators and truncation were applied to optimize sensitivity and specificity across databases. The same search strings were not used across the databases because some search strings were not identified by the database used. These search terms were iteratively refined based on preliminary searches to improve both sensitivity and specificity. See Table 1 below:

Table 1: Shows the search strings used across the database

S/N	Databases	Search Strings
1	Scopus	("digital literacy" OR "ICT literacy" OR "information literacy") AND ("human support" OR "social support" OR "community support" OR "peer support" OR "mentorship" OR "training" OR "capacity building") AND ("second-level digital divide" OR "digital divide 2.0" OR "skills divide" OR "digital skills gap" OR "usage divide") AND ("bridging" OR "reducing" OR "addressing" OR "mitigating")
2	Google Scholar	("digital literacy" OR "ICT literacy" OR "information literacy") AND ("human support" OR "social support" OR "community support" OR "peer support" OR mentorship OR training OR "capacity building") AND ("second-level digital divide" OR "dgital divide 2.0" OR "digital skills gap" OR "usage divide")
3	ERIC	("digital literacy" OR "ICT literacy" OR "information literacy" OR "digital skills" OR "digital competence" OR "technology skills") AND ("human support" OR "social support" OR "community support" OR "peer support" OR "mentorship" OR "tutoring" OR "instructional support" OR "training") AND ("digital divide" OR "skills divide" OR "digital skills gap" OR "usage divide")

C. Inclusion and Exclusion criteria

Inclusion and exclusion criteria were adapted from systematic review frameworks. See Table 2 below, which summarizes the inclusion and exclusion criteria used to guide study selection for this review. Studies were included if they focused on underserved or marginalized

populations and examined digital literacy (e.g., ICT or information literacy) interventions that addressed second-level digital divide outcomes such as engagement, confidence, self-efficacy, sustained use, or task success. Studies were excluded if they focused only on first-level access (infrastructure or devices), reported only technical performance metrics without user-level outcomes, were non-empirical (e.g., opinion pieces), fell outside the 2014–2025 publication window, were not in English, or were unavailable in full text.

Table 2: Shows the Inclusion and Exclusion criteria

Inclusion	**Exclusion**
Studies involving underserved or marginalized populations, including low-income groups, older adults, rural communities, or socially disadvantaged populations	Studies focused exclusively on general or highly resourced populations without relevance to digital inequity
Studies examining digital literacy, ICT skills, or information literacy interventions addressing the second-level digital divide	Studies focused solely on first-level digital divide (e.g., broadband infrastructure or device access only)
Studies reporting outcomes related to digital engagement, sustained use, confidence, self-efficacy, task success, or usage patterns	Studies reporting only technical performance metrics (e.g., bandwidth speed, system latency) without user-level outcomes
Employed empirical methods (qualitative, quantitative, or mixed-methods)	Consisted of opinion pieces, commentaries, theoretical essays, or other non-empirical work
Published between 2014 and 2025	Published before 2014
Published in English	Not published in English
Available in full text	Not accessible in full text

D. Study Selection and Data Extraction

All identified records were screened using a dual-review process. Titles and abstracts were independently reviewed by two reviewers, followed by full-text screening for eligibility. Discrepancies were resolved through discussion to ensure consistency. Data extraction captured study characteristics (population, setting, intervention type), forms of human support, program duration, and delivery modality, and reported outcomes.

A structured extraction workbook was developed using Microsoft Excel to ensure consistency in data recording across all included studies. The workbook was organized into standardized fields for bibliographic information, participant characteristics, intervention type, delivery format, forms of human support, duration, and equity related outcomes. It also included a coding column for effectiveness and equity impact ratings used in the descriptive synthesis. This tool supported consistent comparison across heterogeneous study designs and reporting styles. A de-identified

version of the extraction schema is available from the corresponding author upon reasonable request to enhance transparency and reproducibility.

E. Screening Process

As shown in Figure 2, the PRISMA flow diagram, 2,180 records were initially identified across databases. After duplicate removal and preliminary filtering, 1,180 records underwent title and abstract screening. Of these, 1,000 studies were excluded for failing to meet inclusion criteria, primarily due to a sole focus on access-level interventions. Full-text screening was conducted for 180 articles, of which 20 could not be retrieved. The remaining 160 full-text articles were assessed for eligibility, resulting in the exclusion of 95 studies due to irrelevance to second-level digital outcomes or lack of accessible full text. Ultimately, 65 studies met all criteria and were included in the final synthesis. These studies provided the basis for evidence in analyzing the role of digital literacy interventions and human support mechanisms in tackling the second-level digital divide beyond just access.

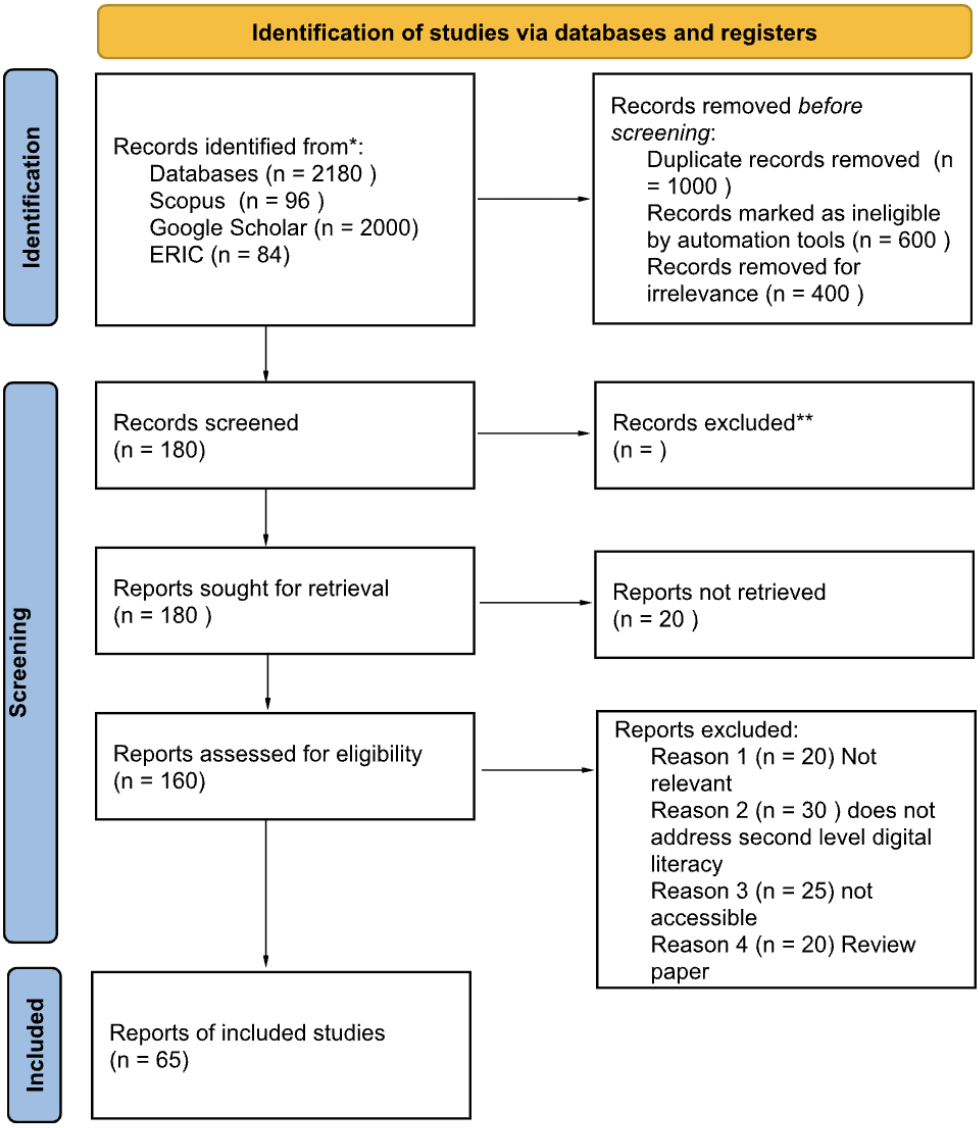

Figure 2: PRISMA, 2020 flow diagram

4. Results

A. Study characteristics

Publication Trends

The distribution of studies over time shows that there has been an obvious increment in the scholarly interest in digital literacy and human support concerning the second-level digital divide. In Figure 3 very few studies met the criteria to be included in this review, and they are mostly published before 2017, which indicates that early research mainly focused on access oriented approaches rather than capabilities at the user-level. Beginning in 2018, publication volume increases steadily and accelerates after 2020. The peak of the concentration of studies seems to suggest the year 2023-2025, as a result of the growing interest after the pandemic of Covid-19 and a widespread trend of the digital delivery of healthcare, education, and public services. This pattern reflects an emerging understanding of digital skills and supports as key features of digital equity.

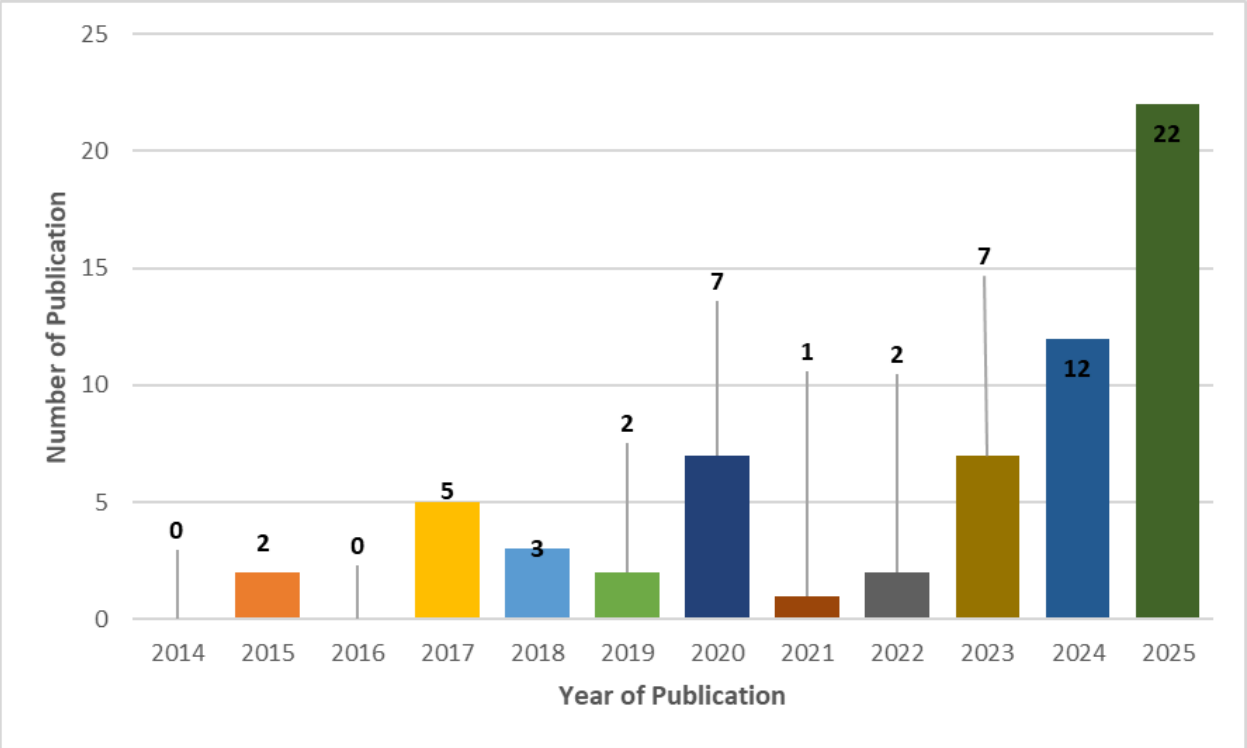

Figure 3: Included studies by publication year

Types of Studies Included

The reviewed literature was mainly empirical in nature. Figure 4 shows that Empirical studies had the highest proportion of included papers, followed by review articles and research-focused studies. Policy-oriented documents were relatively scarce and very few papers did not fit into conventional classification categories. This distribution indicates the extent to which the field has progressed from a conceptual to an applied investigation, with a profound focus on the issues of evaluation of interventions, documentation of outcomes, and production of practice-relevant science.

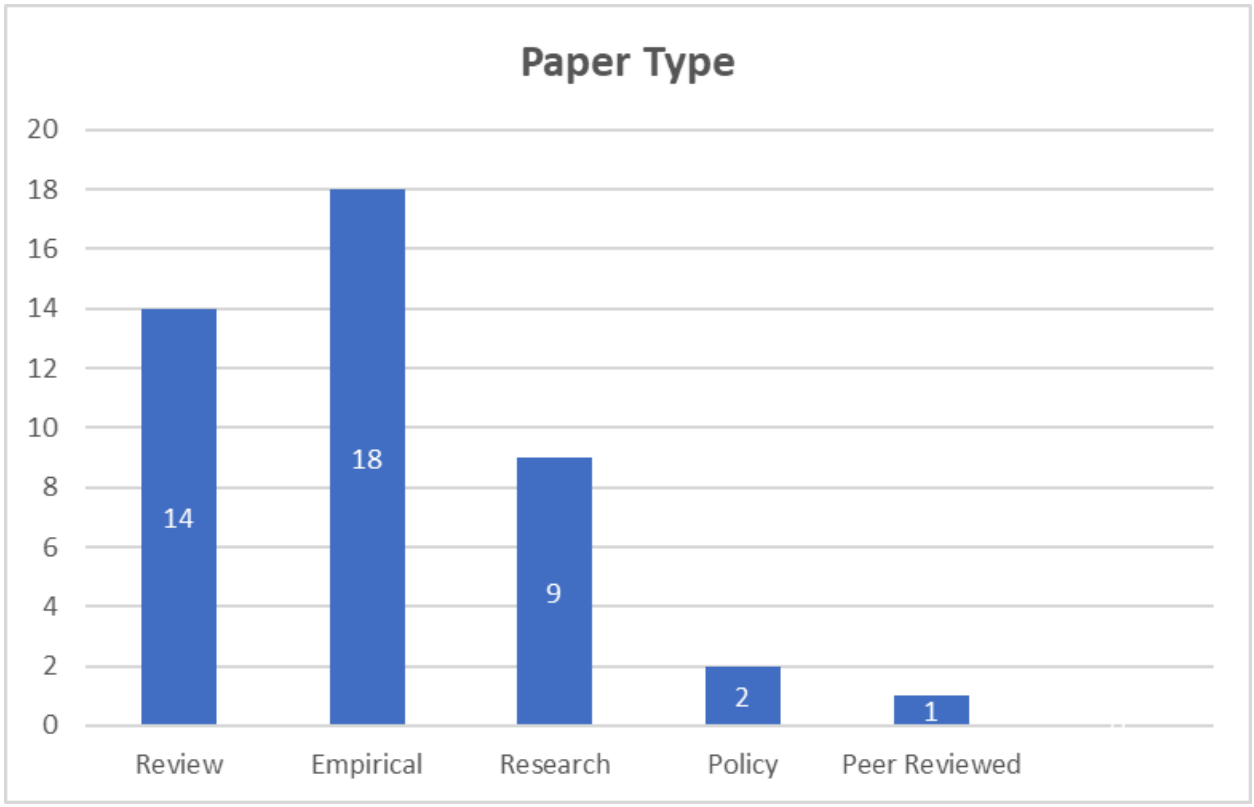

Figure 4: The publication distribution with respect to the type of papers published

B. Digital literacy formats

Across these included studies, Figure 5 shows that digital literacy interventions most often used hybrid delivery formats that integrated in-person instruction with online components. Fully online formats were also well represented, and the classroom only approaches were relatively rare. Less notable but noteworthy rates of interventions were provided in self-paced formats. These results show a lean toward not using the models that balance independent engagement with guided feedback (the participant engages with the digital content, but they still get some direction and feedback), not to use the traditional classroom teaching model, or the independent model.

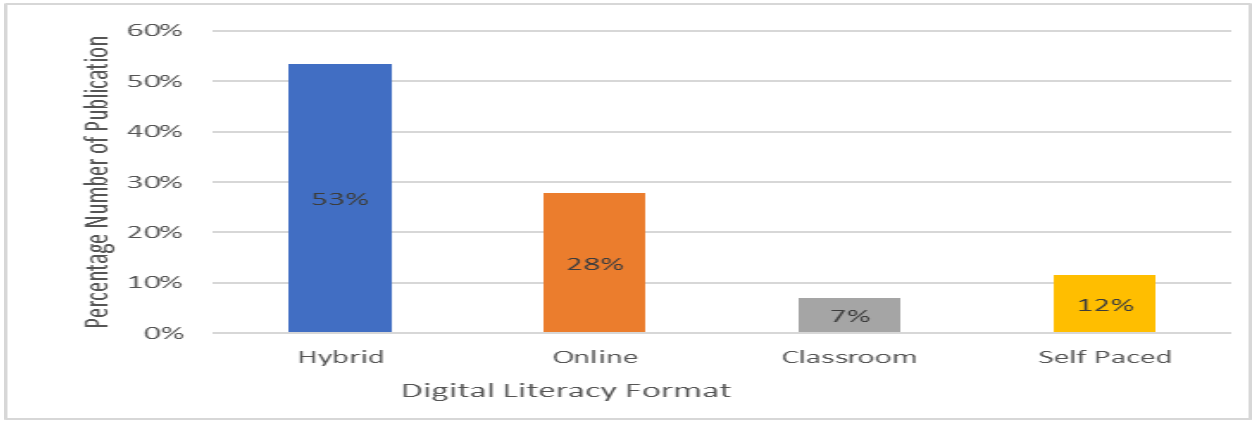

Figure 5: *Digital literacy formats reported in the included studies.*

C. Human Supports structures

Human support was a notable characteristic in most of the interventions. Figure 6 shows that Structured roles, including the roles of facilitators and instructors, were the most often reported types of support and accounted for the largest number of coded studies. Support mechanisms such as peer support, technical assistance, mentors, family members, and community health workers may have been included, though they were less common. In a minority of studies, the particular role of support was not clearly stated. Taken in its entirety, the results of this research indicate that most digital literacy interventions focused on guided, organized support versus informal or ad hoc support.

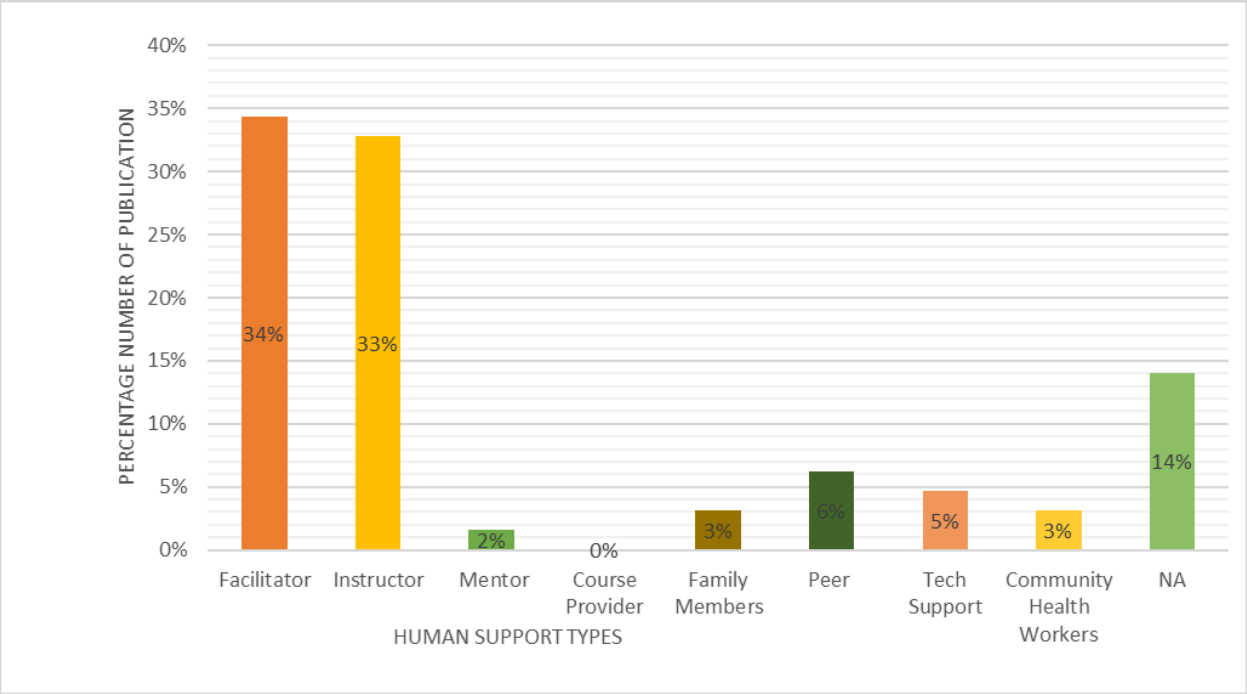

Figure 6: *Human support types reported in included studies.*

D. Effectiveness and equity impacts

Across the included studies, 80% of studies with coded entries reported that human support improved at least one proximal outcome (engagement, confidence, self-efficacy, retention, or task performance). In addition, 20% reported reductions in disparities or differential improvements for underserved groups. Figure 7 shows that Equity impact ratings were predominantly High in the workbook, and effectiveness ratings clustered around Moderate to High. While these ratings reflect the workbook coding and may not be directly comparable across designs, they indicate a consistent pattern: supports are frequently positioned as a key mechanism for translating digital literacy into equitable outcomes.

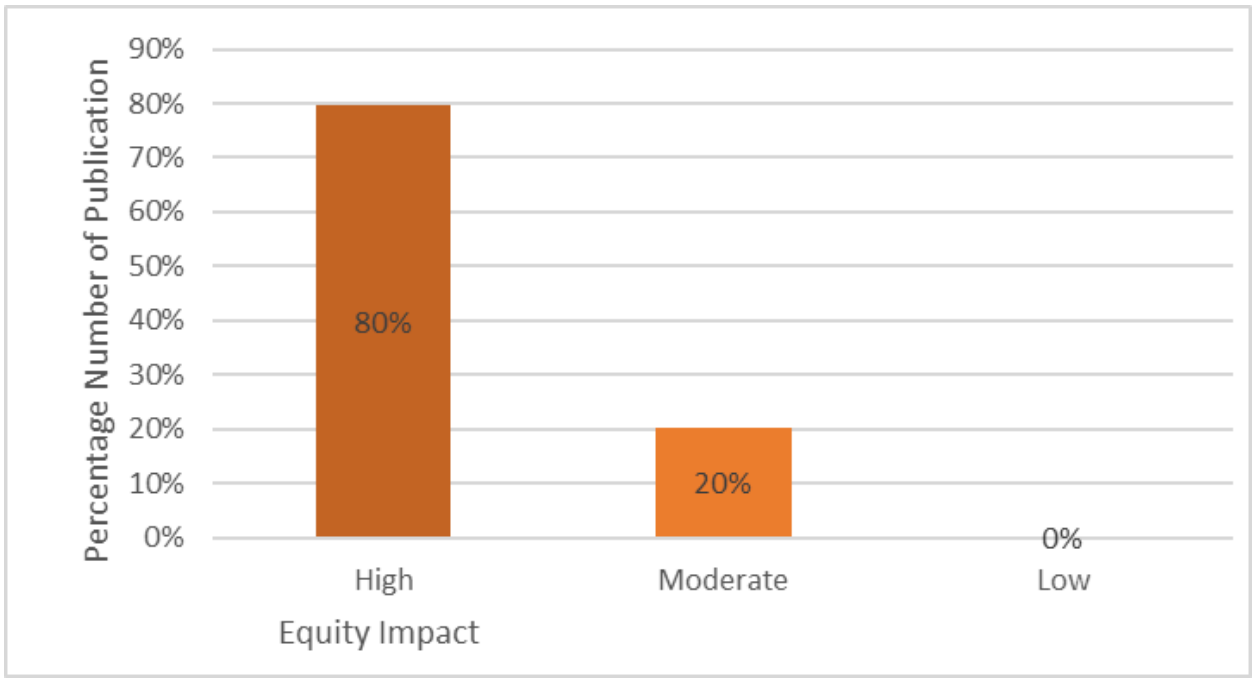

Figure 7. Equity impact of the human support and digital literacy reported in the included studies.

5. Discussion

The results of this review are a clear indication that it is more than the need to increase access to broadband or to devices in order to address the second-level digital divide. Instead, the findings suggest digital literacy along with organized human support as a major mechanism for enabling meaningful, sustained, and equitable technology use. This overlaps closely with the theme, which is going beyond access to interventions that promote skills, confidence, and engagement among those in the underserved population.

Where reported, the sample sizes of the included studies varied substantially, reflecting the diversity of methods and study designs across the digital literacy literature. Cohort-based qualitative interventions commonly engaged between 10 and 30 participants, while larger quantitative or mixed-methods evaluations included between 200 and 3,000 participants. Approximately two-thirds of the included studies involved fewer than 200 participants, emphasizing the community-level and resource-limited context in which much of the digital literacy research has been conducted. Similar variability in study size and methodological scope has been noted in prior systematic analyses of digital inclusion and ICT literacy programs [5, 11, 12].

The recent increase in publications is a reflection of wider societal changes during and after the onset of the COVID-19 pandemic, during which dependence on digital platforms for healthcare, education, and public services has increased. While broadband access has been framed as a social determinant of health, several studies underline that it is not sufficient as a driver of social and economic equity if users lack the skills or confidence to effectively use digital systems (some studies note that access to healthcare was the primary cause of being left behind in the digital divide) [9, 10]. The results reinforce this distinction by showing that the majority of included

studies explicitly targeted second-level outcomes such as engagement, self-efficacy, and task performance, and were not focused on infrastructure alone.

One of the most notable findings is the predominance of the hybrid delivery formats and the issuance of online delivery formats, which might tell us that flexibility is key when designing digital literacy interventions for underserved populations. Hybrid models seem especially suitable for situations in which both guided instruction and time for independent practice are important to the learners. This pattern is in line with previous studies showing the shortcomings of unguided self directed learning with digital tools for the elderly and other groups with limited prior exposure to technology [11, 12]. Classroom only formats were relatively uncommon, suggesting that there has been a trend away from the traditional model of instruction in favor of more adaptive approaches to instruction.

Human support was an important characteristic of effective interventions across the board. Facilitators and instructors were dominant in terms of the role of guidance in learning, a demonstration of the importance of controlled learning, and not taking for granted the ability of people to look for their own way around digital systems. Previous studies have shown that social support is important to how people develop digital skills, especially through encouragement, reassurance, and by enabling them to experiment with low risks [13]. Observational models and peer reinforced training models additionally propose that the social relationships of learning (i.e., who is providing support, how it is being delivered) can impact concepts of confidence and persistence [12].

The powerful equity impacts that were demonstrated across the data set are an additional measure of the importance of humans as a bridge between digital literacy and significant outcomes. A significant number of studies found improvements among populations that have been disproportionately affected in the past by persistent digital exclusion, such as older people, rural residents and low-income populations. These findings are in line with intersectional analysis of the digital divide, which reveals that inequalities in skills and use continue even when access is available [14]. By building support into digital literacy interventions, many programs were able to offset these gaps instead of putting them into practice.

From the systems perspective, the results support thinking about digital literacy interventions as sociotechnical systems, in which outcomes are not just functions of the technology per se, but also social relationships, institutional capacity, and context of implementation [15]. Frameworks for promoting digital health equity similarly shows the importance of matching the design of an intervention with broader system objectives, such as inclusion, trust, and sustainability [16]. The results of this review suggest that human-supported digital literacy interventions put these principles into practice.

For engineering education and practice, their implications are important. Designing digital tools without those other considerations related to training, facilitation, and support for users, with the expectation that this will make content more inclusive, runs the risk of widening existing inequities. Instead, engineers and system designers must integrate mechanisms to offer human support through the lifecycle of digital solutions, especially those that are targeted at public facing (or equity-sensitive) settings. Community partnerships, training of facilitators, and iterative support structures seem to be a critical part of successful implementation.

The findings indicate that human support is not qualitative but the basis of how we go about making digital access equitable. The applicability of this trend across a range of different

contexts lends weight to the case for emphasizing supported digital literacy as a key way of working around the consequences of the second-level digital divide.

6. Limitations

This paper is bound by the content and scope of the structured extraction workbook used for data synthesis. The workbook served as a standardized mechanism for collating information across studies. However, it was limited by the quality and completeness of reporting in the original articles. Some fields, such as population subgroups (including subgroups sample size), support details, and quantitative measures, were variably or sparsely populated. For this reason, descriptive statistics represent summaries of available coded data rather than comprehensive population estimates of the broader literature. While the workbook improved consistency and traceability, the lack of standardized reporting across studies meant that some nuanced contextual information could not be uniformly coded. Despite these limitations, the structured extraction tool remains a valuable asset for organizing heterogeneous evidence and could be enhanced in future reviews through expanded field definitions and data validation procedures.

7. Conclusion

This systematic literature review shows that initiatives to counter the second-level digital divide are most effective when digital literacy interventions are combined on purpose with structured human support. Across healthcare, education, and public services, interviews of interventions focused on integrating skills training with facilitation by instructors, peers, or community based supporters, found consistent reports of improvements with engagement, confidence, self-efficacy, and the ability of users to perform digital tasks among underserved populations. These findings support the need to work on digital inclusion as a multidimensional challenge that goes beyond connectivity.

The results also represent a noticeable lag in literature due to a shift from an access only approach toward conceptualization of digital inclusion as a human centered process. This shift is especially pronounced in the growing use of hybrid delivery forms and the use of deliberate supports, which are suggestive of flexibility in instructional design and guided learning as important criteria for maintaining digital engagement. Importantly, many studies reported on aspects of equity-relevance, suggesting that with appropriate design and implementation, supported digital literacy intervening measures have the potential to reduce, rather than reproduce, existing differences.

Taken together, these findings underscore the importance of human support being an important part of the suite of design decisions that policymakers are making, educators and practitioners make in their classrooms and schools, and systems architectures set out. Digital technologies intended to help increase access and efficiency must be paired with investments in training, facilitation, and support at the community-level to ensure equitable outcomes. For engineering education and practice, it highlights the usefulness of human centered and participatory methodologies when designing and deploying a digital system.

Future research should emphasize the need to standardize measurements of outcomes so that stronger comparisons between studies can be conducted, test the scalability and cost-effectiveness of different support models, and identify which models of human support are

effective in different populations and settings. By going beyond access to invest in human supported digital capability, digital transformation initiatives are more likely to have sustained, meaningful, and equitable impact.

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