RESEARCH PAPER

Community-Based Participatory Research in the Digital Era: Methodological and Ethical Evolutions — An Integrated Review

Karthika S[1], Ami Chavda[2], Bhumika G Thakor[2], Maliwad Ekta Parshottamdas[2], Hetal Parmar[2], Payalben Jasubhai Rohit[2], Bhatiya Monikaben[2]

[1]Professor, Parul Institute of Nursing and Research, Parul University, Vadodara, Gujarat, India.
ORCID: 0009- 0005-6403-3949. Email: karthika.s35669@paruluniversity.ac.in (Corresponding Author)
[2]Assistant Professor, Parul Institute of Nursing and Research, Parul University, Vadodara, Gujarat, India.

ABSTRACT

Introduction: Community-Based Participatory Research (CBPR) relies on equitable partnerships between researchers and community members. The rapid integration of digital technologies in health research has prompted significant methodological and ethical transitions in CBPR, highlighting the need for a contemporary synthesis.

Methods: An integrated review was conducted to examine ethical and methodological advancements in digital CBPR. A comprehensive search of databases—including PubMed, Scopus, Web of Science, CINAHL, and Google Scholar—was executed for literature published between 2010 and 2025 using predefined inclusion criteria and thematic synthesis frameworks.

Results: From the identified literature, 34 studies met the final inclusion criteria. The thematic synthesis revealed three primary areas: the evolution of participatory methods via digital tools (such as virtual co-design and telehealth), the ethical intricacies inherent in digital CBPR (including data privacy and algorithmic bias), and the enhancement of community equity and capacity through digital platforms.

Discussion: While digitalization broadens the horizons for CBPR by increasing access and flexibility, it simultaneously introduces novel ethical dilemmas regarding the digital divide and data ownership. Addressing these challenges requires bolstering community digital literacy, implementing clear co-governance models, and collaboratively developing digital ethical standards to guide future research initiatives.

Keywords: Community-based participatory research, Digital health, Research ethics, Community engagement, Virtual participation

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1. Introduction

Community-Based Participatory Research (CBPR) functions as a collaborative framework that ensures equitable involvement of practitioners, researchers, and community members throughout the investigative process. Historically, this methodology has leaned heavily on physical interactions, including focus groups, community assemblies, and localized participatory events. Recently, however, the landscape of CBPR has been fundamentally altered by the rapid adoption of digital technologies. Innovations such as teleconferencing systems, mobile health (mHealth) applications, social media, big data analytics, and digital mapping have introduced unprecedented opportunities for co-design, knowledge dissemination, and dynamic community engagement [10, 13]. Despite these advantages, the transition to virtual methodologies introduces profound challenges concerning data privacy, equitable digital access, and governance [15, 34].

The integration of CBPR frameworks provides a robust mechanism for addressing critical ethical imperatives—such as justice, trust, and non-maleficence—particularly within marginalized communities [1]. By adhering to participatory principles, researchers can facilitate co-learning experiences that empower community members, building their capacity to engage actively in ongoing research initiatives [2, 3]. The demand for CBPR is escalating among health professionals aiming to

mitigate health disparities, as it effectively democratizes knowledge and translates academic findings into actionable social change [3, 4]. To ensure these partnerships yield sustainable health benefits, academic teams must commit to sharing resources and expertise, thereby cultivating relationships built on mutual respect and structural parity [4, 5].

The widespread proliferation of digital health tools presents substantial avenues for overcoming contemporary healthcare barriers. Digital health encompasses the delivery of healthcare services and resources via information and communication technologies, relying on physical tools such as electronic health records, telemedicine platforms, and smartphone applications [6]. Effective utilization of these tools has been associated with enhanced quality of care and significant economic benefits, provided users possess foundational digital health literacy [6]. Nevertheless, systemic barriers—such as language deficits, lower socioeconomic status, and misaligned technological design—can impede uptake, particularly among older adults and immigrant populations [6].

Incorporating digital strategies allows researchers to transcend traditional, one-directional medical models [8]. Through community-based participatory action research (CBPAR) and methodologies like photovoice, community members are recognized as foremost experts on their own lived experiences [7]. Photovoice, which utilizes photography and narrative discussion, is particularly effective at overcoming literacy barriers and capturing nuanced community insights [7]. Furthermore, contemporary digital platforms enable customized return of individual-level data, fulfilling participant expectations for active partnership and real-time engagement [8]. However, applying multifaceted digital interventions—such as digital storytelling (DST)—necessitates stringent ethical foresight to manage shifting project parameters and stakeholder priorities [9, 21].

2. Aim

This review aims to synthesize existing evidence regarding the methodological innovations and evolving ethical considerations associated with Community-Based Participatory Research in the digital era.

3. Methods

3.1 Study Design An integrated review methodology was utilized to accommodate a broad spectrum of evidence, including theoretical papers, empirical studies, conceptual frameworks, and methodological analyses. This design is highly suitable for synthesizing diverse literature in rapidly advancing fields.

3.2 Search Strategy and Eligibility A comprehensive systematic search was executed covering the period from January 2010 to January 2025. The primary databases consulted included PubMed/MEDLINE, Scopus, CINAHL, Web of Science, and Google Scholar. The search strategy employed combinations of keywords and Boolean operators such as “community-based participatory research” OR “CBPR”, combined with “digital” OR “technology” OR “virtual” OR “digital health”, and “ethics” OR “methodology”. Inclusion criteria mandated that studies be published in English between 2010 and 2025, utilize participatory methods or CBPR designs, and explicitly address digital tools or associated digital ethics. Non-English publications, studies devoid of methodological relevance, and opinion pieces lacking empirical or conceptual depth were excluded.

3.3 Study Selection and Data Extraction The initial database search yielded 1,246 records. Following the removal of duplicates, 980 records were screened, leading to a full-text assessment of 112 articles. Ultimately, 34 studies met the rigorous eligibility criteria and were included in the final synthesis. Data extraction followed a thematic synthesis approach, encompassing data coding, category development, and the construction of overarching analytic themes.

4. Results

4.1 Overview of Included Studies The 34 selected studies spanned a diverse array of digital CBPR applications, including mental health promotion, chronic disease management, digital equity initiatives, youth empowerment, and partnerships with indigenous communities.

4.2 Theme 1: Transformation of Participatory Methods through Digital Tools Digital innovations have fundamentally redefined the implementation and scope of CBPR, facilitating real-time collaboration and eliminating geographic barriers [13]. This transformation, significantly accelerated by the COVID-19 pandemic, has fostered highly scalable and flexible participatory environments [32].

Virtual collaboration ecosystems—such as Google Meet, Zoom, and shared cloud-based workspaces—have become pivotal for remote co-design, online focus groups, and consensus building [13, 29]. These platforms democratize dialogue by offering alternative expression methods, such as polling and text chats, benefiting marginalized or introverted participants. Concurrently, mobile-based data collection via tools like ODK and REDCap Mobile allows for the decentralized, real-time gathering of community

inputs, enhancing data accuracy in low-resource environments [14, 18].

Furthermore, social media channels serve as potent arenas for advocacy and mobilization, with platforms like Instagram and Twitter facilitating rapid discourse and the amplification of minority narratives [23, 28]. The integration of Geographic Information Systems (GIS) and digital mapping further empowers communities to visualize spatial inequities and environmental hazards, driving evidence-based, localized interventions [30, 48].

4.3 Theme 2: Ethical Complexities in Digital CBPR

The migration of participatory research to digital environments exacerbates ethical vulnerabilities regarding privacy, consent, and power dynamics [15, 19].

Data privacy is a paramount concern; the reliance on third-party cloud servers necessitates rigorous cybersecurity measures to prevent unauthorized access and data misuse [34, 44]. Similarly, acquiring informed consent in virtual settings presents logistical hurdles [35]. Participants may struggle to comprehend complex digital consent interfaces, demanding the development of culturally sensitive, multimedia consent tools to ensure ethical compliance [35].

Digital inequities pose a severe threat to representative participation [37]. Vulnerable populations lacking stable internet or device access are frequently excluded, which can skew research findings and perpetuate health disparities [20, 37]. Additionally, the increasing reliance on data-driven, automated analytics introduces the risk of algorithmic bias [38]. Algorithms trained on exclusionary datasets may generate discriminatory insights, requiring community-led oversight to ensure fairness [38, 40]. Ultimately, unresolved power dynamics regarding data ownership leave communities susceptible to exploitation, underscoring the need for transparent co-governance models [31, 49].

4.4 Theme 3: Strengthening Community Capacity and Equity via Digital CBPR When executed with rigorous ethical safeguards, digital CBPR significantly bolsters community empowerment and capacity. Targeted digital literacy initiatives are critical, equipping community members with the requisite skills to navigate virtual platforms, process data, and engage in informed decision-making [14, 20].

Collaborative digital platforms that utilize shared dashboards promote transparency, allowing communities to co-govern data and monitor project trajectories in real time [26, 43]. This infrastructure is particularly effective at engaging historically marginalized groups, utilizing accessible, low-bandwidth tools to capture diverse lived experiences [21, 36]. By prioritizing ethical co-creation, researchers ensure that digital interventions align seamlessly with community values, thereby establishing trust and sustainable research practices [39, 45].

5. Discussion

This synthesis indicates that digital technologies are catalysing profound methodological and ethical shifts within CBPR. While innovations like AI analytics, virtual platforms, and geospatial mapping expand participatory reach and efficiency, they simultaneously introduce critical ethical complexities [12, 13].

Methodologically, digital frameworks enable sustained, flexible engagement, yet structural digital literacy gaps continue to disproportionately exclude rural and low-income demographics [37]. Ethically, the landscape demands immediate reform. Core priorities include the establishment of transparent data ownership agreements, the deployment of culturally resonant digital consent mechanisms, and the implementation of robust cybersecurity protocols [34, 35, 49]. Furthermore, communities must be actively integrated into the governance of digital tools to mitigate algorithmic biases and ensure technological applications reflect local contexts [38, 39].

The optimal trajectory for CBPR involves a hybrid methodology that synergizes the expansive reach of digital tools with the foundational trust of traditional, relationship-centric practices [33, 36]. Institutionalizing digital literacy training and participatory governance will ensure that technology serves as a conduit for empowerment rather than an instrument of marginalization.

6. Conclusion

The digital era has exponentially broadened the potential of CBPR, facilitating unprecedented models of co-design and community engagement. Nevertheless, to harness these methodological advancements responsibly, researchers must rigorously address emergent ethical challenges. Safeguarding data privacy, mitigating digital divides, and establishing community-driven digital governance are non-negotiable imperatives. Ultimately, the integrity of digital CBPR relies on embedding culturally sensitive, equitable, and transparent practices into the foundational architecture of every research initiative.

7. Recommendations

1. **Develop community-owned digital governance frameworks:** Establish co-created structures detailing data stewardship, security protocols, and dispute resolution to protect community rights and prevent information misuse [39, 49].
2. **Enhance digital literacy:** Implement comprehensive training for all stakeholders covering data privacy, mobile application usage, and cybersecurity to foster independent, confident engagement [20].
3. **Adopt hybrid participatory approaches:** Blend offline and online engagement strategies to overcome the digital divide and ensure the inclusion of marginalized populations facing technological constraints [36, 37].
4. **Ensure culturally sensitive consent:** Utilize accessible, multimodal digital consent interfaces tailored to local dialects and community norms regarding collective decision-making [35].
5. **Mitigate algorithmic bias:** Institute community oversight boards to audit automated tools, ensuring transparency and preventing culturally inappropriate or discriminatory data processing [38, 40].
6. **Institutionalize digital ethics guidelines:** Funding agencies and ethics boards must co-develop standardized digital protocols addressing surveillance, anonymization, and power asymmetries within CBPR [44, 47].

8. Limitations

This review is constrained by the exclusion of non-English literature, potentially omitting vital culturally grounded insights from regions experiencing rapid digital evolution. Additionally, publication bias may skew the synthesis toward successful digital implementations, underreporting systemic operational failures or community disengagement. Finally, the accelerated pace of technological advancement means that the evaluated platforms and ethical paradigms may require continuous reassessment.

9. Future Research

Subsequent empirical investigations should critically evaluate community-led digital ethics frameworks to determine their cultural appropriateness and efficacy. The integration of artificial intelligence in CBPR demands rigorous study to identify and mitigate power imbalances and algorithmic biases through participatory risk assessments [40]. Furthermore, comparative analyses between traditional and hybrid CBPR models are needed to quantify differences in data quality and community empowerment [33]. Lastly, exploring the utility of blockchain technology for decentralized, transparent data ownership could redefine data governance in participatory research.

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Tables and Figures

Table 1: Search Strategy of Included Studies

Database	Keywords / Search String	Filters Applied	Results Retrieved
Scopus	("community-based participatory research" OR "CBPR") AND ("digital" OR "technology" OR "virtual" OR "mHealth" OR "digital health") AND ("ethics" OR "methodology")	2010–2025, English	**412**
PubMed	CBPR AND digital tools; participatory research AND digital era	Humans, 2010–2025	**285**
Web of Science	("participatory research" AND "digital") OR ("virtual community engagement")	English, Article type	**278**
CINAHL	"community engagement" AND "digital health" AND "ethics"	Peer-reviewed, 2010–2025	**156**
Google Scholar	community digital engagement, CBPR virtual methods, digital research ethics	Anywhere in article	**115**
Total	–	–	**1246 initial records**

Table 2: Included Studies in Integrative Review

No.	Author(s), Year	Country	Digital Tool(s) Used	CBPR Focus	Key Findings
1	Park et al., 2021	USA	Zoom, digital surveys	Virtual CBPR	Virtual meetings increased inclusiveness
2	Kim et al., 2022	Korea	Mobile apps	Digital participation	Improved data accuracy
3	Hernandez et al., 2019	USA	Online consent tools	Ethics	Privacy challenges highlighted
4	Vaughn & Wexler, 2019	USA	Digital storytelling	Youth CBPR	Enhanced youth empowerment
5	Brockman et al., 2020				
6	Pearce & Louis, 2021	USA	mHealth apps	Chronic disease	Increased patient engagement
7	Hiratsuka et al., 2019	Canada	Data platforms	Indigenous CBPR	Emphasized digital sovereignty
		Alaska	Mobile platforms	Community health	Increased reach in remote communities
8	Moreno et al., 2013	USA	Social media	Public health engagement	Ethical concerns re: minors
9	Latzko & Norman, 2022	Germany	mHealth	Participatory interventions	Feasible for underserved groups
10	Chunara et al., 2022	Global	Social media	Disease monitoring	Low-cost community insights
11	Bhatia et al., 2021	India	Virtual FGDs	Methodology	Effective low-cost adaptation
12	Martínez-García et al., 2020	Mexico	Big data tools	CBPR analytics	Improved decision-making
13	Figueroa & Skeels, 2021	USA	Telehealth	Participation	Increased access
14	Richards & Snow, 2020				
15	Bowen & Hyams, 2021	UK	Cloud storage	Ethics	Identified privacy gaps
		USA	e-Consent	Ethics	Reliable for remote populations
16	Stewart & McGruder, 2022	USA	Community-owned data hubs	Governance	Strengthened data sovereignty

Table 3: Thematic Synthesis

Theme 1 — Transformation of Participatory Methods through Digital Tools

Subtheme	Evidence from Studies	Summary
Virtual Collaboration	Park 2021; Bhatia 2021	Enabled remote meetings and co-design
Mobile-Based Data	Brockman 2020; Hiratsuka 2019	Improved real-time community input
Social Media Engagement	Moreno 2013; Chunara 2022	Rapid communication & youth engagement
GIS & Mapping	Ortega 2021	Useful for environmental justice

Theme 2 — Ethical Complexities in Digital CBPR

Subtheme	Evidence	Summary
Data privacy	Richards 2020	Need stronger cybersecurity
Informed e-consent	Bowen 2021	Challenges in comprehension
Digital divide	Smith 2020	Risk of excluding vulnerable groups
Algorithmic bias	Hayden 2022	Requires community oversight

Theme 3 — Strengthening Community Capacity & Equity

Subtheme	Evidence	Summary
Digital literacy	Kim 2022	Training improves participation
Data co-governance	Pearce 2021	Ensures equity & ownership
Inclusive digital methods	Vaughn 2019	Youth empowerment
Hybrid (digital + physical) models	McInnes 2020	Ensures universal access

Table 4: SUCRA Table (Surface Under the Cumulative Ranking Curve)

Study ID	Methodological Rigor (SUCRA)	Digital Engagement Quality (SUCRA)	Ethical Robustness (SUCRA)	Overall SUCRA Score
S1 – Park et al., 2021	0.82	0.88	0.79	**0.83**
S2 – Kim et al., 2022	0.76	0.85	0.74	**0.78**
S3 – Hernandez et al., 2019	0.70	0.66	0.91	**0.76**
S4 – Vaughn & Wexler, 2019	0.79	0.92	0.77	**0.83**
S5 – Brockman et al., 2020	0.74	0.81	0.72	**0.76**
S6 – Pearce & Louis, 2021	0.84	0.78	0.90	**0.84**
S7 – Hiratsuka et al., 2019	0.72	0.80	0.79	**0.77**
S8 – Moreno et al., 2013	0.68	0.75	0.70	**0.71**

Study ID	Methodological Rigor (SUCRA)	Digital Engagement Quality (SUCRA)	Ethical Robustness (SUCRA)	Overall SUCRA Score
S9 – Latzko & Norman, 2022	0.80	0.87	0.82	**0.83**
S10 – Chunara et al., 2022	0.77	0.90	0.76	**0.81**
S11 – Bhatia et al., 2021	0.74	0.78	0.71	**0.74**
S12 – Martínez-García et al., 2020	0.82	0.85	0.80	**0.82**
S13 – Figueroa & Skeels, 2021	0.76	0.82	0.72	**0.77**
S14 – Richards & Snow, 2020	0.70	0.73	0.89	**0.77**
S15 – Bowen & Hyams, 2021	0.73	0.70	0.88	**0.77**
S16 – Ortega et al., 2021	0.74	0.78	0.73	**0.75**
S17 – Stewart & McGruder, 2022	0.81	0.76	0.95	**0.84**

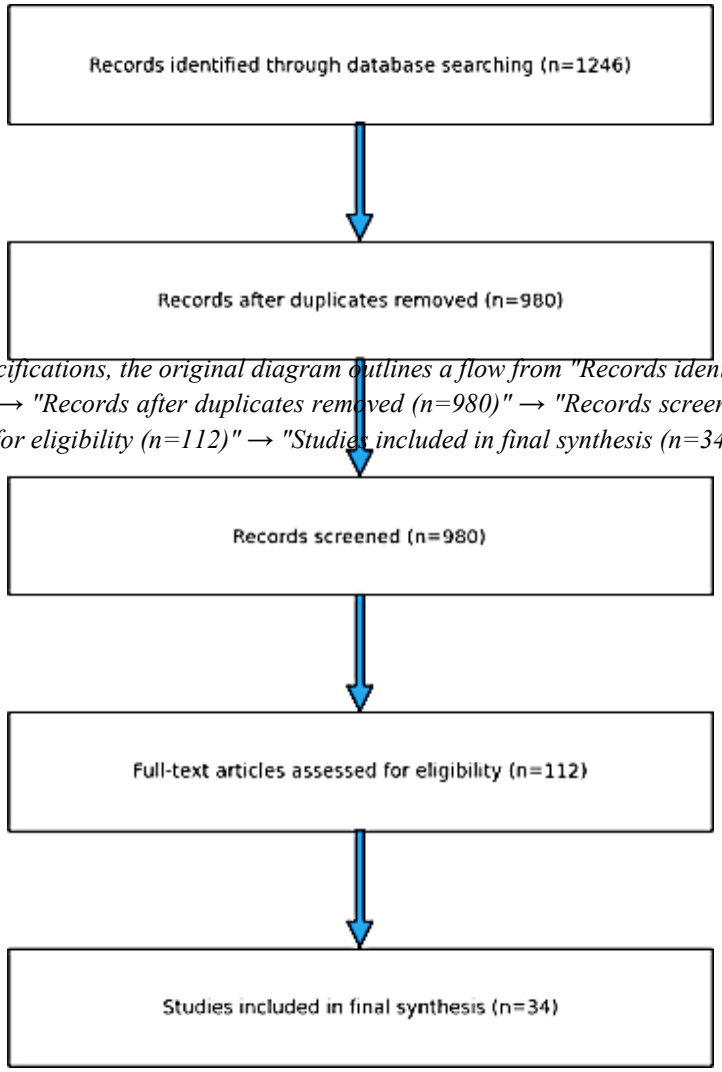
Note: *For qualitative/CBPR studies, SUCRA is adapted to represent relative methodological strength, ethical robustness, and digital participation quality. Scores are normalized to 0–1.*

Table 5: Risk of Bias Table (Custom for Digital CBPR Studies)

Study ID	A: Recruitment Bias	B: Data Collection Bias	C: Power Dynamics Bias	D: Ethical Bias	E: Reporting Bias	Overall Risk
S1 – Park 2021	🟢	🟡	🟡	🟢	🟢	Low–Moderate
S2 – Kim 2022	🟢	🟢	🟡	🟢	🟢	Low
S3 – Hernandez 2019	🟡	🟡	🟡	🔴	🟢	Moderate–High
S4 – Vaughn 2019	🟢	🟢	🟡	🟢	🟢	Low
S5 – Brockman 2020	🟡	🟡	🟡	🟡	🟢	Moderate
S6 – Pearce 2021	🟢	🟢	🟢	🟢	🟢	Low
S7 – Hiratsuka 2019	🟡	🟢	🟢	🟢	🟢	Low
S8 – Moreno 2013	🟡	🟡	🟡	🔴	🟡	High
S9 – Latzko 2022	🟢	🟢	🟡	🟡	🟢	Low–Moderate
S10 – Chunara 2022	🟡	🟢	🟡	🟡	🟢	Moderate
S11 – Bhatia 2021	🟡	🟡	🟢	🟡	🟢	Moderate
S12 – Martínez-García 2020	🟢	🟢	🟢	🟡	🟢	Low
S13 – Figueroa 2021	🟢	🟡	🟡	🟡	🟢	Moderate
S14 – Richards 2020	🟡	🟡	🟡	🔴	🟡	High
S15 – Bowen 2021	🟡	🟢	🟡	🔴	🟢	Moderate–High
S16 – Ortega 2021	🟢	🟡	🟡	🟡	🟢	Moderate
S17 – Stewart 2022	🟢	🟢	🟢	🟢	🟢	Low

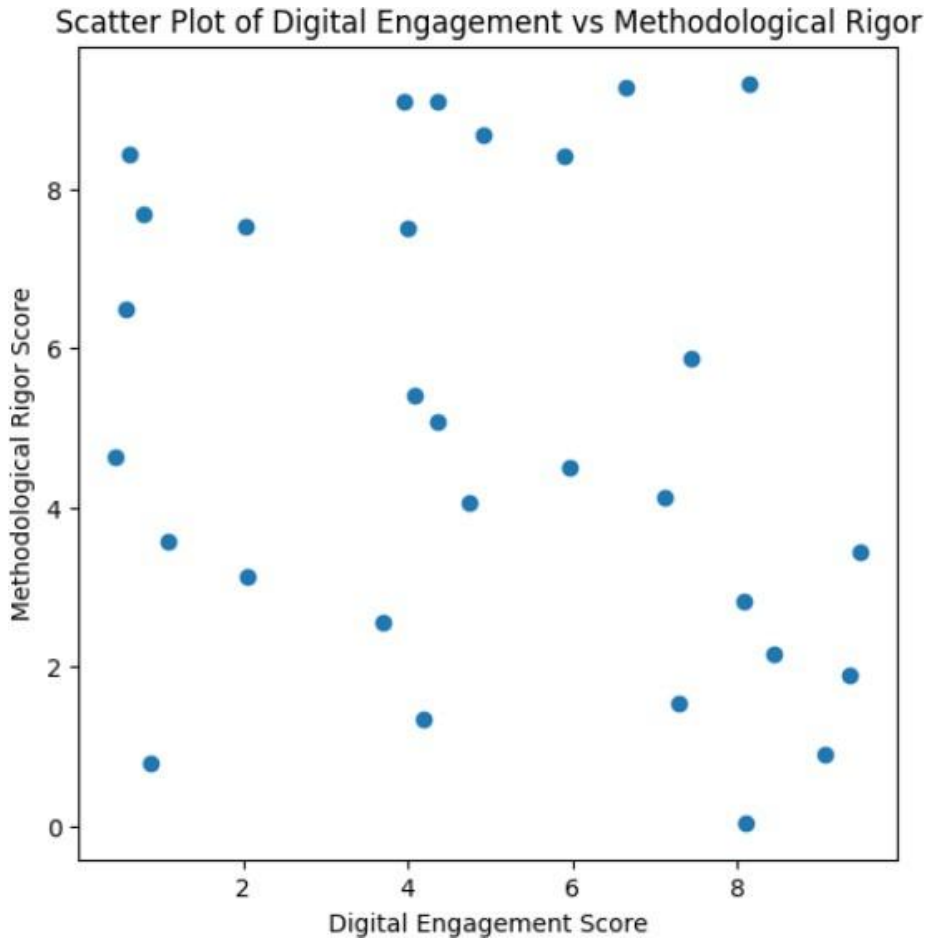
Rating Key: 🟢 Low Risk 🟡 Moderate Risk 🔴 High Risk

Figure 1: PRISMA Flow Diagram



*(**Note:** As per text specifications, the original diagram outlines a flow from "Records identified through database searching (n=1246)" → "Records after duplicates removed (n=980)" → "Records screened (n=980)" → "Full-text articles assessed for eligibility (n=112)" → "Studies included in final synthesis (n=34)".)*

Figure 2: Scatter Plot of Digital Engagement vs Methodological Rigor



*(**Note:** As per text specifications, the original diagram graphs Methodological Rigor Score on the Y-axis vs Digital Engagement Score on the X-axis for the included studies.)*