

# Innovative Approaches in Education: A Systematic Literature Review on Computer-Supported Collaborative Activities and Digital Inclusion for Youth and Adult Education

Flávio Lopes da Silva

*Dept of Computing Engineering and Digital Systems  
Universidade de São Paulo  
São Paulo, Brazil  
flaviolopes@usp.br*

Anarosa Alves Franco Brandão

*Dept of Computing Engineering and Digital Systems  
Universidade de São Paulo  
São Paulo, Brazil  
anarosa.brandão@usp.br*

**Abstract**—This research full paper presents a systematic review exploring methods and pedagogical strategies utilized for digitally including adult education students through computer-assisted collaborative activities. Youth and adult education faces significant disparities along the globe, with low enrollment rates in many countries as highlighted in the UNESCO's 5<sup>th</sup> Global Report. Whenever we consider the 4<sup>th</sup> United Nations' Sustainable Development Goal for 2030, education aims for inclusion and lifelong learning opportunities. With the aim of investigating the literature about existing computer-assisted collaborative methods and strategies for digital inclusion of youth and adults, we conduct a systematic literature review on the theme. Findings reveal a scarcity of works tailored to adult education, especially in developing nations, even with the inclusion of Brazilian and South African knowledge repositories to broaden the scope. Collaboration emerges as a prevalent strategy, often alongside other methodologies. Notably, mobile devices are widely utilized due to their accessibility, and social networks and virtual learning environments play significant roles. However, the integration of computational thinking and artificial intelligence for digital inclusion is still in its infancy. Overall, digitally including adult learners is crucial for fostering inclusive education and enhancing opportunities for marginalized populations.

**Index Terms**—Systematic Review, Adult Education, Collaborative Learning, Cooperative Learning, CSCW, CSCL, Digital Inclusion, Inclusivity, Social Responsibility

## I. INTRODUCTION

The rapid evolution of digital culture is sparking profound changes in education, fostering stronger connections between educators and learners through the integration of digital technologies. These tools serve a myriad of purposes in everyday life, spanning health

management, financial transactions, interpersonal relationships, and educational pursuits [1]. A clear trend is emerging towards the creation of technologically enhanced educational environments, where stakeholders can actively engage in pedagogical processes using remote or in-person technological setups. Consequently, mastery of digital technologies becomes essential for all participants in educational practices. Both students and educators are encouraged to fully immerse themselves in the digital realm, utilizing digital tools adeptly to facilitate the teaching-learning continuum and ensure comprehensive digital inclusion.

Simultaneously, a profound transformation is underway in the realms of employment and adult education, highlighting the urgent need to cultivate both fundamental and advanced digital competencies to thrive in an increasingly digitized and interconnected world. As educational institutions strive to remain relevant amidst this digital shift, the imperative of modernizing curricula and enhancing educator capacities arises to equip learners to tackle the fluid demands and opportunities of the evolving labor market. While technological innovations like virtual reality and artificial intelligence offer myriad avenues to enhance adult learning experiences, they also pose significant challenges related to inclusion and accessibility [2].

The COVID-19 pandemic has accelerated the transition to online learning, underscoring the imperative of addressing existing disparities and risks of exclusion affecting vulnerable groups. This highlights the urgent need for advocating inclusive and equitable strategies and policies. In this dynamic landscape, it is crucial to adopt a critical and introspective stance regarding the impact of digital technologies on adult education and workforce readiness for future challenges. Such efforts aim to foster a society that is more equitable, inclusive, and digitally proficient [2]. As outlined in the Sala-

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manca document, individuals with educational needs stemming from disabilities or learning challenges, regardless of age, ethnicity, sexual orientation, or other factors, are classified as having special educational needs. In this framework, all students encountering obstacles in the learning process, including physical, cognitive, psychological, and social factors, are categorized as students with special educational needs [3].

In the context of Adult Learning and Education (ALE), this perspective becomes particularly pertinent, given the recurring emergence of distinctive needs among these learners, necessitating tailored pedagogical strategies to support their seamless progression and enhancement within the vocational training framework. Moreover, by ensuring the digital inclusion of these students, efforts are made to address or potentially eliminate other educational requirements that may hinder their progress.

This paper is structured as follows: The section II outlines the theory of computer-supported collaborative learning, followed by an exploration of the adult learning and education approach. The section III presents the method adopted to conduct the systematic review. Therefore, we present the review findings in IV, discuss them in section V and close the paper with our conclusions in section VI.

## II. BACKGROUND

In this section, we explore the theoretical framework of Computer-Supported Collaborative Learning (CSCL) and its potential to promote digital inclusion, particularly among adult education students. The discussion is organized into two subsections: the first delves into the principles and applications of CSCL, emphasizing its role in creating interactive and collaborative learning environments that enhance digital literacy. The second subsection examines the Adult Learning Education (ALE) approach, focusing on its key characteristics and the challenges it presents. Together, these subsections provide a robust theoretical foundation for understanding how targeted educational strategies can effectively achieve digital inclusion.

### A. Computer-Supported Collaborative Learning

The concept of Computer-Supported Collaborative Learning (CSCL) stems from socio-cultural theories of learning, particularly those of Lev Vigotski, who emphasized the social nature of learning through interaction and collaboration [4]. Scholars like Gerry Stahl, Tim Koschmann, Allan Collins, John Roschelle, and Stephanie Teasley expanded on these ideas, focusing on how technology can enhance collaborative learning environments [5]–[8]. CSCL examines the intersection of technology, learning, and collaboration, emphasizing group interactions and shared knowledge construction.

Gerry Stahl's work has been central to understanding collaborative knowledge-building in CSCL environments, demonstrating how these settings enable

complex problem-solving and shared knowledge construction [5]. Tim Koschmann emphasized the need to rethink pedagogical approaches when integrating technology, while John Roschelle and Stephanie Teasley explored how CSCL facilitates cognitive development through shared learning experiences [6], [8]. Allan Collins contributed to understanding how technology can scaffold meaningful collaborative learning activities [7].

Dillenbourg and Fischer expanded on CSCL by emphasizing the importance of structuring environments to optimize interaction, reflection, and negotiation among learners [9]. They argue that these elements are key to successful collaborative learning. Lehtinen et al. reviewed CSCL, highlighting the significance of contextual factors like learning environment design and instructor roles in facilitating collaboration [10]. They underscore the dynamic interplay between technology, pedagogy, and social interaction in CSCL.

O'Malley examined how CSCL has evolved with changing technologies, emphasizing the integration of new media and digital tools to support diverse learning communities [11]. Her work stresses the need for flexible, responsive CSCL environments that adapt to learners' needs in a globalized educational context. She highlights the ongoing importance of research in CSCL to address emerging technological challenges and opportunities.

CSCL is recognized for its potential to enhance digital inclusion and literacy, particularly among marginalized populations [12]. By providing access to digital tools and fostering collaborative learning, CSCL helps bridge the digital divide and equips students with critical digital literacy skills, such as online navigation and effective digital communication [13]. Research shows that inclusive CSCL design can lead to more equitable educational outcomes, ensuring all students can engage in meaningful, technology-enhanced learning experiences.

### B. The Adult Learning and Education

The UNESCO, in its 5th Global Report on Adult Learning and Education (GRALE) [14], observes that the participation of youth and adults in education is uneven worldwide. Among the countries that provided data on youth and adult education, 12% reported a participation rate between 5% and 10% of learners, while 19% indicated a participation rate between 20% and 50%. Furthermore, 16% of the countries reported a participation rate close to 50% of learners in this educational modality. Remarkably, 23% of the countries recorded less than 1% enrollment of youth and adult students. Only 16% of the countries achieved a participation rate above 50% in this form of education.

Noteworthy progress has been made, with 52% of countries reporting increased engagement in Adult Learning and Education (ALE), particularly in lower middle-income nations, reaching 67%. However, con-

cerns arise from a significant trend: 24% of surveyed countries noted a decline in ALE participation among older adults, up from 10% in the previous survey (GRALE 4) [15]. This widening disparity underscores the need for urgent policy interventions, such as promoting internet-based learning and tailored programs for older demographics [14].

One of the primary factors leading to school dropout among these students is the quest for family income and challenges in accessing educational institutions [15]. Nevertheless, retaining these students in school during adulthood is a challenge, and the digital inclusion of this demographic emerges as a strategy for fostering their engagement and curbing attrition rates within educational settings. In CONFINTEA VII 2022 conference, it was a consensus that the United Nations SDG for 2030 agenda cannot be achieved without learning. Specifically Goal 4, "*Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all*" and its related seven targets [16]. Targets 4.4 and 4.6 deal with adult education:

4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy.

The ALE endeavors to integrate this demographic socially, economically, and digitally. Learners in adult education encounter diverse impediments in the learning trajectory, positioning them as individuals with special educational requisites. Among these challenges, notable factors include socioeconomic constraints, psychosocial barriers, limited or lacking digital literacy, diminished engagement in learning activities, constrained flexibility in scheduling attendance, and the inadequacy of traditional pedagogical approaches in catering them.

### C. Research Purpose and Questions

The purpose of this article is to identify and analyze pedagogical approaches and strategies that have been employed to foster digital inclusion. By conducting a systematic literature review, the study aims to provide a comprehensive overview of the methods that have proven effective in this area. The findings of this review will serve as a crucial foundation for developing and implementing targeted digital literacy programs, particularly for students in adult education. These insights are intended to inform educators and policymakers, enabling them to design more effective educational interventions that address the unique challenges faced by adult learners in the digital age.

The following research questions have been defined:

RQ1 What methods or pedagogical strategies are utilized for digital inclusion?

RQ2 Which of these methods or strategies are applied in adult education?

RQ3 Which of these methods employ computer-assisted collaborative activities?

Based on the findings of this review, it is envisaged to furnish educators with assistance in crafting activities tailored to ALE.

## III. METHODS

This Systematic Literature Review aims to identify methods or pedagogical strategies for digital inclusion in the educational context of adults. A combination of the protocol models by [17] and [18] was followed. Parsifal platform<sup>1</sup> was employed as a tool to assist in conducting the Systematic Review.

### A. Search Criteria

The search was conducted utilizing the online digital libraries ACM, Web of Science, and Scopus. Given the prominence of Adult Learning and Education as a prevalent issue within developing nations, additional digital libraries from Latin America (SciELO - Scientific Electronic Library Online and SOL - the repository of the the Brazilian Computing Society), as well as one from Africa (African Education Research Database), were incorporated into the search strategy. English and Portuguese were selected as the primary languages for inclusion, aiming to encompass academic works from both international and Brazilian researchers. The following search string was used for ACM, WoS and Scopus:

((("adult" OR "youth" OR "youth and adult") AND ("education" OR "learning")) OR "andragogy") AND ("collaborative" OR "collaborative work\*" OR "collaborative learn\*" OR "cscw" OR "cscf" OR "groupware" OR "learningware") AND (("digital") AND ("inclusion" OR "divide" OR "literacy" OR "accessibility" OR "transformation" OR "culture" OR "world"))

Specifically for the Brazilian and South African platforms, the following strings were employed: ("*educação de jovens e adultos*" OR "*educação de adultos*" OR "*eja*" OR "*PROEJA*") para SciELO e SBC e a string ("*adult education*") para African Education Research Database.

### B. Selection Criteria

The following criteria were adopted for inclusion:

- Studies assessing methods or strategies for digital inclusion utilizing computer-supported collaborative activities
- Studies developing methods or strategies for digital inclusion utilizing computer-supported collaborative activities

<sup>1</sup>Online platform for systematic literature review. Available at: <https://parsif.al/>

- Studies reflecting on methods or strategies for digital inclusion utilizing computer-supported collaborative activities

And the studies were excluded based on the following criteria:

- Studies lacking coverage of collaborative activities
- Studies comprising only abstracts
- Studies applied beyond the educational context
- Studies published over 5 years ago
- Duplicate studies
- Studies failing to address digital inclusion
- Studies lacking presentation of the utilized method or strategy
- Studies not available freely and in full on the Capes periodicals platform

In addition to the inclusion and exclusion criteria, the following quality criteria were also applied.

- Is the study applied in youth and adult education?
- Does the study comprehensively detail the method or strategy employed for digital inclusion?
- Does the study assess the method?
- Does the abstract encompass all the information presented in the study?

#### IV. RESULTS

From applying the search string to the database, a total of 1085 works were retrieved. From these 1085 papers, exclusion and inclusion criteria were implemented, alongside the assessment of duplicate works, leading to the identification of 98 selected studies. Following this, the identified 98 works underwent thorough examination, during which quality criteria were applied, culminating in the selection of 63 studies for data extraction.

The extracted information from the selected studies includes: year of publication, target audience, educational level, digital inclusion type, technology employed, study type, pedagogical approach, and the methodology used for assessing the method or strategy. A synthesis of these details is presented in Table I. Table II presents the pedagogical strategies and technologies utilized in the studies related to this systematic review.

##### A. Target Audience

One of the research questions of this study is to understand which methods or pedagogical strategies for digital inclusion are applied in the education of youth and adults. Essentially, the selected works returned the following groups: children, individuals with special needs, youth and adults, and seniors. The majority of the works, 75%, were applied for digital inclusion of youth and adults, five works were applied in children, four works in children and seniors, five works in children and youth and/or adults. Only one work involved individuals with specific needs, and one addressed youth and/or adults with seniors.

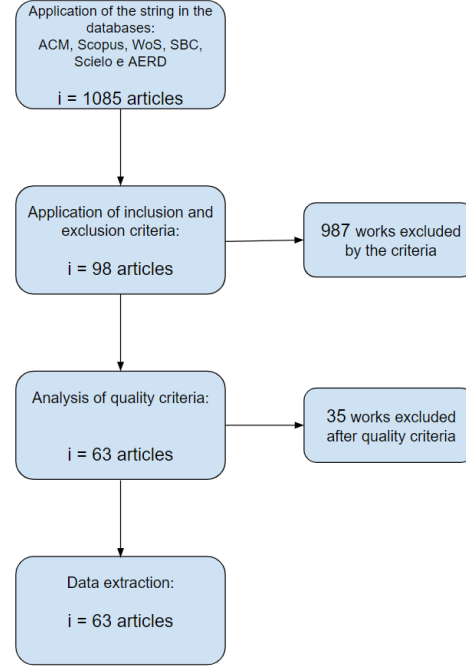


Figure 1. Stages of work selection. Source: Author.

##### B. Digital Inclusion

According [60], this study adheres to the conceptualization that digital inclusion can manifest through several avenues: i) Access to Information and Communication Technologies (ICTs); ii) Digital Literacy; iii) Assistive Technologies (aimed at accessibility for individuals with special needs); and iv) Social Inclusion. Within this conceptual framework, the predominant focus of the identified literature in the review process pertains to fostering digital literacy among users. This suggests a predominant research emphasis on ensuring both access to and proficient utilization of digital technologies within educational contexts. Thirteen works specifically addressed digital inclusion through facilitating access to ICTs. Merely one work directly addressed inclusion initiatives for individuals with special needs, aiming to ensure technological accessibility, while two works concentrated on fostering social inclusion. Notably, ten works encompassed digital inclusion through the dual lenses of digital literacy and social inclusion.

##### C. Types of Work

One of the inclusion criteria stipulated in this systematic review pertained to studies that either developed, created, evaluated, or reflected upon methods or pedagogical strategies for digital inclusion through computer-assisted collaborative activities. Among these, 32 studies focused on the development and implementation of such methods or strategies, 20 studies undertook evaluations, and nine engaged in reflective analysis of methods or strategies.

During the information extraction phase, pedagogical approaches were delimited to the following do-

Table I  
SUMMARY OF EXTRACTED INFORMATION.

Extracted Information		# Findings
Target audience	Children	4
	Youth and adults	47
	Individuals with special needs	1
	Elderly	0
	Children and youth and/or adults	5
	Elderly and youth and/or adults	1
	Children and elderly	4
Level of education	Preschool	2
	Elementary	14
	Secondary	10
	Vocational Education and Training	2
	Higher Education	11
	Not applicable	24
Type of digital inclusion	Digital Literacy	26
	Acess to ICTs	13
	Assistive Technologies	2
	Social Inclusion	2
	Assistive Technologies Social Inclusion	2
	Assistive Technologies Access to ICTs	2
	Social Inclusion Digital Literacy	10
	Acess to ICTs Social Inclusion	3
	Acess to ICTs Digital Literacy	3
	Social networks	7
	LMS	10
	AI	1
Technology	Shared stories	5
	Games in general	6
	Courses and workshops	9
	Programming	3
	Not applicable	13
Type of work	Creation	32
	Assessment	20
	Reflection	9
Pedagogical strategy	Game-based learning	0
	Colaboration	25
	PBL	2
	Computational thinking	1
	Colaboration Computational Thinking	2
	Colaboration Game-based learning	6
	Colaboration, PBL	7
	Not presented	20
Type of assessment	Quantitative	15
	Qualitative	18
	Formative	1
	Qualitative Quantitative	16
	Formative Qualitative	1
	Not presented	12

mains: Project-Based Learning (PBL), Collaboration, Gamification, and Computational Thinking. The findings revealed that 25 studies employed collaboration as a pedagogical strategy to foster digital inclusion, two studies utilized PBL strategies, and solely [58] focused exclusively on computational thinking. A number of studies adopted multiple pedagogical strategies, with

Table II  
PEDAGOGICAL STRATEGIES AND ASSOCIATED TECHNOLOGIES.

Pedagogical Approach and Applied Technologies for Digital Inclusion	Findings
Virtual Learning Environments	[19], [20], [21], [22] and [23]
Platforms or frameworks	[24], [25], [26], [27], [28] and [29]
Courses and Workshops	[30], [31], [32], [33], [34], [35], [36], [37] and [38]
WhatsApp or Facebook	[39], [40], [41], [42] and [43]
Custom Social Network	[44] and [38]
Game-Based Learning	[45], [46], [47], [48], [49] and [50]
Shared Stories	[51], [52], [53], [54] and [55]
Artificial Intelligence	[56]
Creative Programming	[57], [58] and [59]
Computational Thinking	[58]

eight studies integrating collaboration and PBL, and six studies combining collaboration and gamification.

#### D. Pedagogical Strategies and Applied Technologies

Most of the studies employed virtual learning environments to facilitate digital inclusion. Cruz and Torres-Delgado [19], Barake and colleagues [20], Flores-Chacón and colleagues [21], Norris and Saudelli [22] and Sharp [23] utilized established teaching and learning platforms, such as Moodle. Also, platforms and/or frameworks were developed or implemented to bolster digital inclusion [24], [25], [26], [27], [28] and [29]. To foster digital inclusion, [30], [31], [32], [33], [34] and [35] utilized in-person and online courses and workshops, [37] employed video courses distributed via online platforms, while [36] the videos were via CD-ROM in cases where local infrastructure impeded online access. Additionally, [38] facilitated digital literacy through the utilization of text editor courses.

Social media platforms were also utilized as a strategy for digital and social inclusion. We can highlight [39], [40], [41], [42] and [43] which employed WhatsApp and/or Facebook networks. Edmodo, an educational social network was developed for the enhancement of digital skills [44] and a blog was used to foster digital literacy and support the learning of Spanish with adult education students [38].

Regarding the use of gamification for digital inclusion, [45] and [46] employed game creation using the Blockly Games tool<sup>2</sup> with students. In [47] and [48] digital games were employed for the cultivation of digital proficiency. Reference [49] introduced the Lepi tool for the collaborative creation of accessible games,

<sup>2</sup>Blockly Games is a series of educational games that teach programming

while [50] advocates for inclusion through 3D virtual gaming experiences.

Digital inclusion can also be observed through the creation of shared narratives. In the studies [51] and [52] the StoryTapestry<sup>3</sup> platform is employed for the development of collaborative storytelling. In [53] The Storybird<sup>4</sup> platform is used, while [54] employs the Blackboard<sup>5</sup> or networked learning facilitation via forums. In the study by [55], the digital storytelling approach is applied for digital literacy improvement and language enhancement among refugees. Meanwhile, [56] conducts a systematic literature review examining digital inclusion through collaborative storytelling utilizing artificial intelligence.

In the studies conducted by [57], [58] and [59], the focus lies on creative programming as a means to foster the development of digital skills and competencies. The authors employ tools such as Scratch<sup>6</sup>, Construct<sup>7</sup>, Processing<sup>8</sup>, EarSketch<sup>9</sup>, danceON<sup>10</sup> and Arduino<sup>11</sup>.

#### *E. Advantages and Disadvantages of Applied Technologies*

Virtual Learning Environments (VLEs), such as Moodle, offer structured and accessible platforms for delivering educational content and facilitating collaboration. The advantages of these environments primarily include their ability to centralize resources, track student progress, and enable both synchronous and asynchronous communication [19]. However, it is important to note that these environments can also present challenges. For instance, issues may arise related to limited engagement from students who are less motivated or experience technological difficulties, as well as potential difficulties in adapting to diverse learning styles [22].

On the other hand, social media platforms provide innovative ways to promote digital and social inclusion through familiar and widely-used tools like WhatsApp and Facebook. In this context, the advantages include increased accessibility and the ability to engage learners in a more informal and interactive environment [39]. Nevertheless, these platforms also present disadvantages, such as concerns about privacy, the potential for distraction, and the need for moderation to ensure educational effectiveness [40].

<sup>3</sup>Web-based application for storytelling and creation of digital artifacts representing these stories.

<sup>4</sup>Web 2.0 collaborative writing platform that provides collections of illustrations for the creation of digital stories.

<sup>5</sup>Web-based learning environment and learning management system developed by Blackboard Inc.

<sup>6</sup>Programming language for creating stories, games, and animations with block-based scripting.

<sup>7</sup>HTML5-based 2D game editor.

<sup>8</sup>Open-source programming language and integrated development environment (IDE).

<sup>9</sup>Educational programming environment that utilizes music composition and remixing.

<sup>10</sup>Educational programming system for creating visual animations that respond to body motion data.

<sup>11</sup>Platform that enables the development of electronic projects.

Gamification through tools like Blockly Games and digital games can significantly boost engagement and motivation by incorporating elements of play into learning. The primary advantage here is the increased student interaction and enjoyment, which can enhance learning outcomes [45]. However, it is necessary to consider certain challenges, such as the risk of an excessive focus on entertainment over educational value and the potential for unequal access to gaming resources [47].

In addition, shared narrative platforms, such as StoryTapestry and Storybird, facilitate collaborative storytelling and creative expression, fostering digital literacy and collaboration. These platforms provide a rich, interactive learning experience [51]. Nonetheless, they may require a significant investment of time and technical skills from both educators and students, which can limit their accessibility and effectiveness for all users [53].

Finally, creative programming tools, such as Scratch and Arduino, offer hands-on learning experiences that can effectively build digital skills and problem-solving abilities. These tools are noted for their high degree of customization and engagement [57]. However, it is important to acknowledge that they may require substantial technical support and resources, and the complexity of some tools might be challenging for beginners [58].

#### *F. Assessment*

Studies were identified that conducted quantitative, qualitative, formative, or combined evaluations. Among these, the majority (28%) employed qualitative assessment of outcomes. Additionally, 24% of the studies utilized quantitative evaluation, with only one study, [49], employing formative assessment. Fifteen studies, comprising 25%, employed both qualitative and quantitative assessments.

It is noteworthy that 11 studies did not provide any assessment of the adopted method or strategy, while 20 studies did not outline the pedagogical strategy, and 13 did not specify the technology employed. In the majority of cases, these pertain to studies that deliberated on the method or strategy or engaged in systematic literature review.

## V. DISCUSSION

This systematic literature review sheds light on the limited research addressing Adult Learning and Education contexts. Among the 1085 works surveyed, only 98 (9%) met the inclusion criteria, indicating a scarcity of comprehensive studies. Notably, a mere 16 were sourced from Brazilian databases such as Scielo and SBC, alongside the AERD platform in South Africa, underscoring the challenges faced by developing nations in contributing to this body of knowledge.

In the realm of adult education, various methods and pedagogical strategies are harnessed to promote digital

inclusion and enhance learners' skills in navigating the digital landscape. Collaborative activities stand out as a prevalent approach, fostering interaction and shared learning experiences among participants. Additionally, gamification techniques, such as game-based learning, inject elements of fun and engagement into educational activities, motivating learners to develop their digital proficiency. Project-Based Learning (PBL) strategies provide opportunities for hands-on, real-world projects, nurturing problem-solving abilities and digital literacy. Computational thinking emerges as a focused pedagogical approach, cultivating critical thinking skills essential for digital fluency. Virtual learning environments like Moodle offer interactive spaces for collaborative learning, while social media platforms facilitate communication and social connectivity. Shared storytelling platforms further enrich the educational experience, encouraging collaborative storytelling and enhancing digital literacy through creative expression. These diverse methods collectively contribute to fostering digital inclusion and empowering adult learners to thrive in the digital age and answered the research question: *"What methods or pedagogical strategies are utilized for digital inclusion?"*.

The predominant approach, found in 63% of the selected works, involved collaboration or its integration with other methodologies, particularly focusing on the efficacy of computer-assisted collaborative activities. While 84% of the studies targeted youth and adult demographics, nearly 35% delved into non-educational social initiatives employing digital inclusion strategies, broadening the scope of inquiry to encompass approaches tailored for young adults beyond formal educational settings. These data answered the research questions: *"Which of these methods or strategies are applied in adult education?"* and *"Which of these methods employ computer-assisted collaborative activities?"*.

Regarding technological tools, the widespread utilization of smart mobile devices for communication during activities emerged as a notable trend due to their user-friendly interfaces and ubiquitous presence in daily life. Furthermore, social media platforms and virtual learning environments played pivotal roles in the educational landscape. However, only a minority of studies focused on vocational high school students, aligning with the primary demographic of this inquiry.

By integrating computer-assisted collaborative activities into these methods and strategies, adult education programs can enhance engagement, foster teamwork, and promote digital literacy among learners. The use of technology-enabled collaboration not only enriches the learning experience but also prepares adult learners for effective participation in digital environments and collaborative work settings.

The nascent integration of computational thinking and artificial intelligence within digital inclusion initiatives is apparent, reflected by the limited presence

of relevant studies identified in this systematic review: three pertaining to computational thinking and two concerning artificial intelligence. This scarcity underscores the early stages of these integrations within the broader domain of digital inclusion, emphasizing the need for further scholarly investigation and empirical inquiry to comprehensively explore, evaluate, and leverage the potential of these technologies in advancing digital equity and inclusion.

## VI. CONCLUSION

This systematic literature review sheds light on the importance of digital inclusion in Adult and Learning Education through collaborative activities. The findings underscore the need for tailored strategies to address disparities in educational opportunities, particularly in developing nations. Collaboration emerges as a key strategy, often complemented by the use of mobile devices, social networks, and virtual learning environments. However, there is still untapped potential in integrating computational thinking and artificial intelligence for enhanced digital inclusion.

Moving forward, it is imperative to prioritize the digital inclusion of both young and adult learners to foster inclusive education and empower marginalized populations. By leveraging innovative pedagogical approaches and emerging technologies, educators can create more inclusive learning environments and bridge the digital divide. This review highlights the significance of ongoing research and collaboration in advancing digital inclusion efforts in adult education, ultimately contributing to a more equitable and accessible educational landscape.

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