International Journal of Evaluation and Research in Education (IJERE)
Vol. 14, No. 3, June 2025, pp. 2088~2098
ISSN: 2252-8822, DOI: 10.11591/ijere.v14i3.30449

Managing cooperative learning and digital competences in secondary education: a systematic review

Virginia A. Samane-Cutipa, Juan Carlos Callacondo Velarde, Fabian Hugo Rucano Paucar, Fabiola Talavera-Mendoza
Faculty of Education Sciences, Universidad Nacional de San Agustín de Arequipa, Arequipa, Perú

Article Info

Article history:

Received Mar 1, 2024
Revised Oct 25, 2024
Accepted Nov 14, 2024

Keywords:

Cooperative learning
Digital competence
Digital literacy
Information and communication technology
Secondary education
Strategies

ABSTRACT

The COVID-19 pandemic led most schools to opt for distance education, resulting in challenges in the educational field. However, the increased use of digital technology prompted studies on strategies to help reduce the digital divide concerning two key 21st-century skills: cooperation and digital competencies. This article aims to analyze the study of cooperative learning in relation to the achievement of digital competencies in secondary education. It was developed through a systematic literature review (SLR) using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) methodology, retrieving scientific information from the Web of Science (WoS) and ERIC databases, published from 2018 to 2024. The results and findings emphasize the existence of strategies aimed at improving teaching and learning, academic performance, and students' communication and social skills through task management, the formation of cooperative teams, and conflict resolution with shared leadership. Additionally, it highlights the development of digital competencies such as information retrieval, digital interaction, virtual object creation, digital security, and responsible citizenship. The conclusions focus on using cooperative learning strategies to make the teacher's role more efficient in interactive spaces.

Corresponding Author:

Fabian Hugo Rucano Paucar
Faculty of Education Sciences, Universidad Nacional de San Agustín de Arequipa
Calle Santa Catalina 117 Arequipa, Perú
Email: frucano@unsa.edu.pe

1. INTRODUCTION

The isolation caused by the COVID-19 pandemic highlighted issues in the educational field, such as the lack of digital skills, where students worldwide struggled with both synchronous and asynchronous learning, leading to frustrations in their expectations regarding online interactions with peers and teachers [1]. The learning system, which was previously conducted in the classroom with activities proposed by the teacher, shifted to online learning during the pandemic, leaving students to resolve their connection and interaction problems through self-instruction [2], [3]. The most commonly used online methods included webinars, platforms, and social media, such as WhatsApp, Meet, and Zoom [4]. Additionally, there was a persistent reliance on the traditional teaching model, which sidelined cooperative and inquiry-based methodologies, with information and communication technology (ICT) playing a secondary role. This resulted in low levels of digital competencies developed by students and teachers, limited ability to transfer digital information, monitor, evaluate, and respond to questions arising from interaction [5], [6]. Despite the presence of ICT in some educational institutions, it did not guarantee innovation, and autonomous, ethical, creative, and critical thinking was relegated to students' participation in conversations outside the learning

context, with group formation focused solely on competition within the same team and the completion of academic tasks by members who failed to fulfill their responsibilities [5], [7], [8].

In response to these challenges, cooperative learning emerges as an innovative methodology that, through structured strategies, offers a different approach to solving problems in the educational field, such as low motivation, academic failure, bullying, student-teacher interaction, and multiculturalism [7], [9], [10]. Cooperation enables active student participation in projects that involve the development of five principles in learning: positive interdependence, individual accountability, face-to-face interaction, appropriate personal skills, and group function evaluation [11]. This leads students to form functional and efficient learning teams that support each other and exchange information between groups, strengthening their learning both individually and collectively with responsibility and positive interdependence [12]. This leads students to form functional and efficient learning teams that support each other. When combined with digital skills, this facilitates the search for relevant information on the web, subsequent discussion in cooperative work groups, synthesis, and presentation [2], [7], [13].

Previous systematic reviews explored cooperative learning but overlooked the fact that there are few long-term experiential studies; most studies are short, and the methodology used is not clearly explained [14], [15]. However, they agree that digital tools have the potential to develop collaborative skills. Other studies reveal a positive and moderate relationship between digital competence and cooperative learning, with a significant impact on teaching activities, fostering a greater attitude and predisposition toward learning in students [16]. Previous systematic reviews have explored cooperative learning and the impact of digital tools on the development of collaborative skills, highlighting the positive relationship between digital competence and teaching, which enhances students' willingness to learn [17]. In this regard, it is emphasized that education should focus on digital literacy for content creation, as well as teamwork that enables communication and cooperation, with students taking an active role in their own learning efforts [3]. Analyzing the relationships between students' academic performance and the use of digital technologies, with an emphasis on the quality control of digital content and the regional peculiarities of educational systems, considering the combination of traditional and digital pedagogy, group collaboration, and digital trust [18].

The importance of this study lies in the comprehensive analysis of the literature with a constructivist approach, seeking to promote cooperative learning through interactive classroom work, using ICT as a cross-cutting competence while considering cultural diversity. Therefore, it presents proposals and strategies used to foster cooperative learning [19], as well as the use of technological resources in digital environments that contribute to the development of students' soft and hard skills [7]. It also guides the use of successful methodologies in various fields of human knowledge, serving as a guide for teachers in designing activities both inside and outside the classroom, allowing students to absorb more first-order knowledge, cooperative awareness, critical and reflective thinking, and serving as a basis for building skills for the development of digital competencies [20], [21], in accessing information on the web, constructing their own knowledge, and exercising digital citizenship, solidifying their transition towards technologies for empowerment and participation (TEP) [5].

Education plays a significant role in sustainable development. As a transformative agent, it should foster awareness, social, and environmental consciousness among students [2], [22], leading to better social relationships that promote cooperation, respect, responsibility, greater democracy, and the achievement of common goals [23]–[25]. This requires an effective, efficient, and enhanced teaching approach, such as cooperative learning, which develops knowledge, awareness, thinking skills, and attitudes towards learning [26]–[28]. Progressing from one level to another requires developing competencies that enable students to solve problems in their environment, beginning with individualistic learning and advancing to cooperative learning, which encourages two or more individuals to learn together [7].

To achieve learning objectives, it is necessary to develop interaction, mutual assistance, and responsible exchange through cooperative learning, with the goal of creating both individualized and group responsibility among students. Cooperative learning as a strategy requires characteristics and skills that facilitate the formation of cooperative groups, fostering trust among students to improve their individual learning efficiency and cultivate a sense of cooperation, establishing a team spirit in areas such as morale and prosocial development. Therefore, teachers, as facilitators, play a crucial role in designing activities both inside and outside the classroom, helping to internalize knowledge [2], [7], [13], [29].

The study highlights the role of cooperative learning in developing digital competencies through task management, group management, and conflict resolution [30]. This requires altering mental structures to motivate learning, demonstrating teamwork skills in data collection, case studies, discussion, and problem-solving. Consequently, improving motivation enhances learning outcomes [7], [19], [31], [32].

The emergence of digital technologies in 21st-century education has led students to adjust their study habits, creating experiences that allow them to utilize digital resources to their fullest cognitive capacity, empowering them with new skills in the digital world [33], [34]. Consequently, academic demands

have resulted in less tolerance for traditional teaching methods and a greater emphasis on active learning within the educational system [7], [35]. Innovative digital resources, software, and gamification strategies, among other ICT, facilitate teaching and learning processes through their didactic use, enabling students to develop inquiry skills, data analysis, and communication of ideas [5], [29], [36]. Therefore, a shift is necessary in the teacher's role concerning the methodology and evaluation system to promote autonomous, ethical, creative, and critical thinking, ensuring the work is carried out efficiently [5], [6].

Students have become self-taught in handling technologies by using their smartphones, laptops, computers, and tablets. However, achieving digital competencies with self-discipline in searching for information, communication, planning, creation, and organization of digital learning mechanisms remains a challenge [2]. Additionally, digital technology has been recreated to bridge gaps in interaction and socialization. Therefore, the role of the teacher as a guide and facilitator enables students to focus on content, discussion, feedback, and correction, improving team performance [3], [13].

The analysis allows for understanding the scope of studies conducted in educational contexts worldwide, covering studies in countries across the Americas (Canada, Mexico, Dominican Republic, and Chile), Europe (Spain, Sweden, Murcia, Bosnia and Herzegovina, Greece, Cyprus, and Turkey), and Asia (China, United Arab Emirates, Hong Kong, Indonesia, Malaysia, and Taiwan). This broad scope allows for a better understanding of cooperative learning management in powerful regions like Europe and Asia, with studies that enhance students' learning capacity [37] and optimize their interest, performance, and sense of cooperation [29]. This understanding will lead to more in-depth studies on cooperative learning strategies in alignment with the development of digital competencies presented from an educational, critical, and social analysis perspective.

2. METHOD

This study considers the existence of efficient management of cooperative learning that enables students to develop their digital competencies in a globalized world with 21st-century skills, particularly among secondary school students who were the most affected during the COVID-19 pandemic, as they were unable to meet their educational goals satisfactorily due to multiple deficiencies. To address this, a systematic literature review (SLR) was conducted by consulting the Web of Science (WoS) and ERIC databases [38]. For the SLR, a qualitative approach was structured, involving data collection and analysis to refine the research questions [39]. The literature review was utilized as a fundamental stage in every research project to obtain relevant information in the field of study [40]. The research employed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) methodology, using systematic and explicit methods to identify, select, and critically evaluate relevant studies, in order to collect and analyze data from the studies included in the review.

2.1. Procedure

2.1.1. Systematic procedure

The research process followed a systematic review methodology based on established academic standards. Initially, the topic was defined through a search using thesauri and educational descriptors, ensuring relevance to the field. Since no prior systematic reviews were found, the databases were selected based on their high impact, research quality, thematic relevance, coverage, and accessibility. The procedure was carried out in three stages:

- Stage 1: the topic to be investigated and its search in thesauri and descriptors were established, the research questions were posed, and the search protocol in WoS and ERIC databases was established.
- Stage 2: Table 1 presents the retrieval of documents using search equations, selecting articles by reading the title, abstract, and keywords, including quantitative and qualitative studies, experimental and quasi-experimental studies related to cooperative learning and digital competencies.
- Stage 3: Table 2 shows the information found, analyzed, and organized in a structured manner to identify the key elements of the scientific research based on the inclusion and exclusion criteria.

The information retrieval sequence was conducted using the PRISMA methodology. Figure 1 presents a flowchart illustrating the process from the initial identification of documents to the final review of the sample of articles that comprise the systematic review study. Ultimately, 29 articles from WoS and 10 articles from ERIC were selected, all directly related to the study topic. Subsequently, the content of these articles was thoroughly analyzed to address the research questions posed.

- RQ1: What is the dispersion of scientific literature regarding the management of cooperative learning and digital competencies in the WoS and ERIC databases?
- RQ2: Which processes of cooperative learning management are related to the development of digital competencies in the analyzed documents from journals indexed in WoS and ERIC?

- RQ3: What are the strategies used for task management of secondary education students with the highest incidence in documents published in journals indexed in WoS and ERIC?
- RQ4: Which skills should teachers promote to manage cooperative groups, based on the most cited authors and the most referenced keywords?
- RQ5: What considerations are taken into account in the management of cooperative learning regarding conflict resolution in the publications of the analyzed documents?
- RQ6: Which digital competencies are developed when managing cooperative learning in the analyzed literature?
- RQ7: What are the strategies used in cooperative learning in relation to digital competencies with the highest incidence in the publications of the analyzed documents?

Table 1. Search equation according to WoS and ERIC

Databases	Search equation
WoS	TS= ((“Cooperative Learning Management*” OR “Cooperative Learning *”) AND (“Digital Competence” OR “Digital Skill” OR “Computer literacy”) AND “high school”) Refined by: publication years (2018 OR 2019 OR 2020 OR 2021 OR 2022 OR 2023 OR 2024), quick filters (Open Access) Document Types (Article) categories (Education Educational Research) Languages (Spanish or English)
ERIC	= (Cooperative Learning Management OR “Cooperative Learning” AND “Digital Competence” OR Digital Skills) REFINED BY: PUBLICATION YEARS (since 2018) AND PUBLICATION TYPE (Journal articles) AND EDUCATION LEVEL (Secondary Education)

Date of extraction ERIC: 31/01/2024 15:52; WoS: 05/02/2024

Table 2. Inclusion and exclusion criteria

Inclusion	Exclusion
Studies on cooperative learning and digital competencies in the WOS and ERIC databases	Studies address collaborative learning
Original articles published in open access education journals and documents	Unpublished articles in education journals and papers
Articles published in English and Spanish	Articles published in other languages
Articles published during 2018-2024	Articles not published during 2018-2024
Studies carried out in secondary educationinstitutions	Studies in higher education

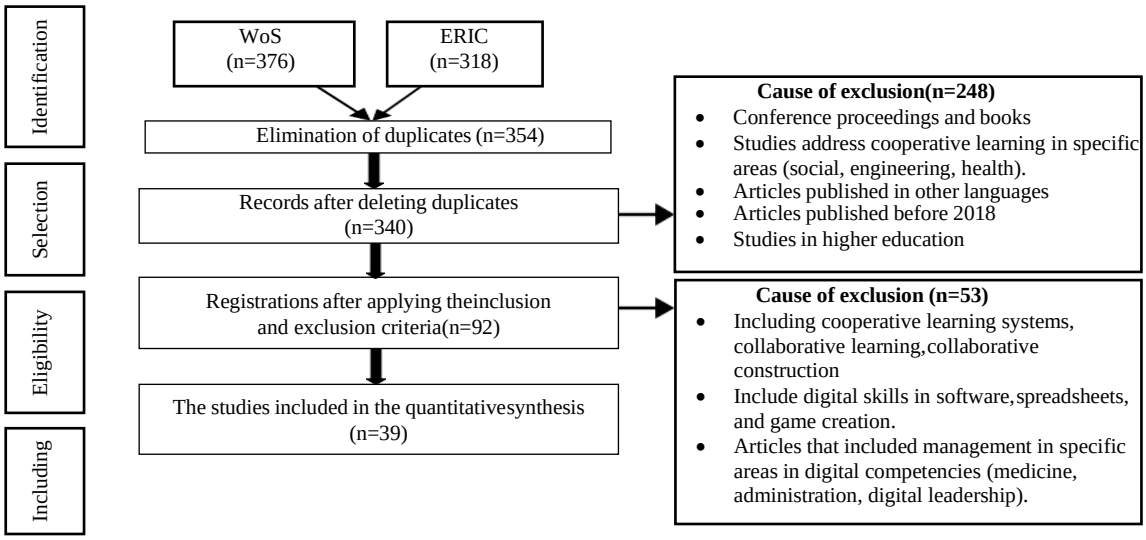

Figure 1. Retrieval process of the analyzed information from the WoS and ERIC databases (PRISMA)

3. RESULTS AND DISCUSSION

3.1. Bibliographical dispersion on cooperative learning and digital competences

The first analysis of the systematic review is related to the distribution of scientific literature based on the regions where it was most commonly published. Figure 2 shows the 39 articles, with 38% of studies conducted in Spain and 10% in China, delving into cooperative learning strategies, team heterogeneity, critical thinking, responsibility, and digital environments for problem-solving, cooperative activities, ICT

skills, digital security, and identity. An additional 18% of the studies were conducted in Indonesia, Turkey, and Chile, focusing on digital learning, negotiation activities, and cooperative group work. The remaining 34% of the studies were carried out in independent countries, including Murcia, Malaysia, Mexico, Greece, Hong Kong, Canada, Taiwan, Sweden, the United Arab Emirates, the Dominican Republic, Bosnia and Herzegovina, Cyprus, and Mexico, centering on digital competencies such as information retrieval, interaction in digital environments, digital content, and cooperative learning skills.

Figure 3 reinforces the keywords used in the search, with authors [2], [6], [8], [22], [25]–[27], [33], [35], [41]–[43] using the term "cooperative learning" most frequently. Other authors [5], [36] frequently use the term "ICT", while the term "digital" is most cited by authors [20], [21], [32], [44], along with other terms directly related to the study of cooperative learning and the development of digital competencies.

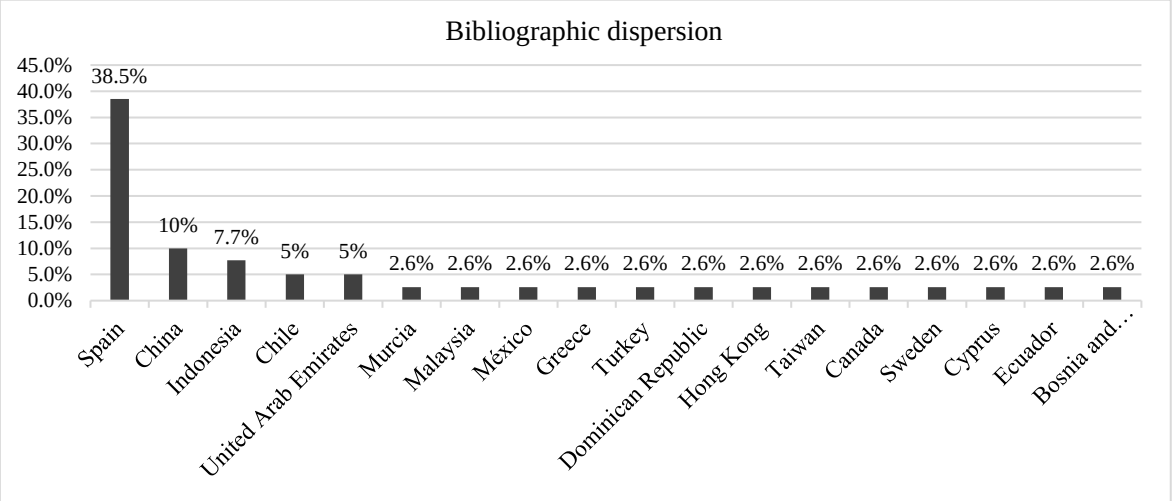

Figure 2. Country where the studies on cooperative learning and digital competences were carried out

Figure 3. Keyword cloud

3.2. Processes of cooperative learning management and their relationship with the development of digital competencies

Table 3 illustrates that cooperative learning can be managed in the classroom from three aspects: i) eight documents highlighted management in task completion, emphasizing the creation of necessary conditions to improve the effectiveness and efficiency of both individual and collective learning; ii) 21 documents emphasized the aspect of cooperation management in teams, establishing team spirit and the development of cooperative skills, assuming commitment to the team while considering time management, self-assessment, and feedback; and iii) six documents underscored management in problem-solving and conflict resolution, promoting skills for cognitive decentering, negotiation, decision-making, and shared leadership, enabling the constructive resolution of conflicts that may arise during the teaching-learning process.

Table 3. Cooperative learning management processes

Articles	Quantity	Process
[2], [6], [7], [13], [20], [24], [29], [45]	8	Task management
[3], [5], [8], [10], [13], [19], [21], [23], [25], [27], [28], [31]–[37], [46]–[48]	21	Team cooperation management
[9], [13], [20], [22], [44], [49]	6	Conflict resolution management

3.3. Strategies used for task management

Table 4 presents the most commonly used strategies according to the literature analysis: forming heterogeneous groups (6 articles), fostering positive interdependence, emphasizing the need and trust among students (5 articles), setting team goals and objectives for the common good (3 articles), developing individual responsibility to contribute to the team, achieving a level of self-awareness for each member (9 articles), reciprocity, which values the relationships between members (3 articles), and promoting face-to-face interaction, where students share and help each other in real-time (7 articles). Task management requires heterogeneity in cooperative groups [9], [19], achieving creative commitment where school and extracurricular practices are combined and recontextualized [46]. Therefore, digital tools have the potential to develop collaborative skills that should be incorporated into national curricula to assess their effectiveness [15]. Regarding individual and collective responsibility, better academic results are achieved [6], [9], as well as social responsibility that considers resilience and a willingness to take risks, leading to deeper and more meaningful levels of understanding [32]. On the other hand, insufficient planning can lead to inappropriate behaviors, interruptions, and conversations unrelated to the designed activities [8], with time being the main challenge in development. Additionally, not all team members may be equally involved, and some may not fulfill their commitments and obligations [33].

Table 4. Strategies used for task management

Articles	Dimensions	Indicator
[6], [7], [19], [29], [31], [34]	Formation ofheterogeneous groups	Composed of students of diverse characteristics such as gender, age, and different abilities, which provide a great cognitive richness for such diversity, formulate brief and practical rules and regulations to ensure learning and practice inside and outside the classroom.
[2], [9], [13], [25], [32]	Positive interdependence	Students need each other to complete a given task, mutual dependency
[9], [24], [45]	Team objectives and goals	Helping others and working together for the common good.
[2], [6], [7], [9], [13], [19], [25], [32], [36]	Individual responsibility and contribution to the team	Each member of the group is responsible for his or her contribution to the group, stimulates a better level of self-awareness
[6], [9], [13]	Reciprocity	Consider the value of relationships, the value of helping, sharing rather than competing.
[2], [6], [7], [9], [13], [19], [46]	Face-to-face interaction	Students emphasize the importance of sharing andhelping one another

3.4. Skills that teachers promote for the management of cooperative groups

Table 5 shows that teachers take on the role of guides and mentors in managing cooperative learning [25]. They must promote skills by designing interactive activities that recreate the nature of interaction, reducing stress and motivating teamwork [43]. These skills include fostering critical thinking, designing cooperative sessions, self-assessment, and feedback. The art of cooperation involves diversifying strategies, combining resources by working with heterogeneous groups, enhancing the impact of students' holistic development, improving academic outcomes, and promoting values and attitudes [50]. Reflective cooperative teaching in social interaction develops students' ability to share and build ideas, knowledge, and express opinions [19], [32], [49].

In cooperative management, the groups formed must develop life and work skills, aiming to lead their own learning efforts [3], as well as habits and attitudes that enable them to perform successfully in challenging activities, expand their knowledge, and reflect on environmental and social issues, thereby raising awareness about sustainable development [2], [27]. Another approach is reflective critical thinking, which involves understanding, analyzing, and transferring knowledge [5], with reflective processes that include identifying assumptions, induction, deduction, interpretation, and evaluation of arguments [47]. Peer feedback requires questions, fosters understanding and analytical thinking, and prevents subjective cognitive hierarchies [13]. Self-assessment allows teams to recognize their work, advantages, and disadvantages, observing progress or setbacks as challenges to overcome among members [9], [19], [32]. On the contrary, unequal distribution of workload among team members can lead to stress. Adapting to such diversified evaluation can create a lack of autonomy in task execution [19], along with insufficient or almost nonexistent technological and digital materials, which could enhance motivation, creativity, and knowledge [26].

Table 5. Skills promoted by teachers for the management of cooperative groups

Articles	Skills promoted	Indicator
[19], [20], [31], [32], [49]	Cooperation skills	Sharing materials, ideas, asking for and providing help, teaching cooperatively.
[6], [19], [31], [32], [41], [46], [47]	Cooperative habits	Fulfillment of commitments, time control, acceptance and fulfillment of assigned role tasks, group discussion
[3], [5], [13], [19], [21], [25], [29], [37], [47]	Promotion of autonomous, ethical, creative and critical thinking.	Posing, solving and answering dilemmas, complicated and messy problems, closely related to innovative andcreative thinking
[9], [10], [23], [27], [36]	Design of cooperative activities	Develops digital competence, gaining confidence, mediation and practices followed to achieve student and team impact
[2], [3], [5], [8], [13], [19], [28], [31], [46]	Cooperative attitudes	Listening attentively to peers, speaking at an appropriate volume, respecting the right to speak, asking and answering questions correctly, communicating ideas, encouraging
[6], [19], [22], [32], [48]	Self-assessmentand evaluation	Describe what they achieved, challenges they overcame and what level they believe they are at withspecific skills, peer, and hetero assessment
[10], [13], [23], [27], [31], [42], [46], [48]	Feedback	Feedback among peers, involving the analysis of critical thinking and the formulation of statements to group members, promotes discovery learning.

3.5. Conflict resolution management

Table 6 shows that the authors have focused on how conflicts exist in cooperative learning and are addressed through strategies implemented in the classroom, with the guidance and intervention of the teacher to moderate behaviors and promote amicable resolution of differences with openness [6], [49]. Conflict management has always been a sensitive issue in teamwork, requiring the teacher's intervention [48]. Demonstrating leadership, decision-making, and trust was challenging for the students. It is imperative to address their differences amicably [6], [50]. Negotiation allows for making compromises with the team, adopting a cooperative stance [21]. Conversely, unity and solidarity can be lost due to demotivation caused by conflicts within the group, which calls for heterogeneity within the groups and homogeneity between them [35].

Table 6. Conflict resolution management

Articles	Indicator	Description
[6], [9], [32], [47], [49]	Conflict resolution attitude	Working out their differences in a friendly manner, teacher interventions to moderate behaviors, development of a strong sense of community with openness tocooperation
[9], [13], [32], [33]	Shared leadership	For the cognitive or attitudinal decentralization of a single member, but to work around the team.
[9], [24], [42], [44], [49]	Decision making	Develops tolerance, generates confidence in conflict management
[13]	Communicating in thefirst person	Coordinate with each other and join together to solve problems on task or with teamwork, effectively andaffectively.
[8], [9], [46]	Negotiating agreements	Make requests and give or ask for advice, make room for creative engagement.

3.6. Digital competencies that are developed when managing cooperative learning

Table 7 shows the digital competencies most frequently developed through cooperative learning in the literature. Cooperation, when implemented as a systematic and structured strategy, facilitates active student participation. When integrated with digital skills, it enables students to combine their abilities, allowing them to engage with the digital world effectively by making appropriate use of technological tools. This empowerment leads them to take decisive roles in managing the vast amount of web information they can access, creating virtual objects, and personalizing the spaces where they interact. Additionally, it encourages them to assume their role as digital citizens—critical, active, and guided by civic and democratic values.

Table 7. Digital competencies developed through cooperative learning

Articles	Digital competence	Description
[8], [44]	Operational skills	Use and operate computer software and hardware and the internet.
[2], [3], [22], [36], [44], [49]	Information skills	Searching for, selecting, managing and evaluating media content
[13], [44], [49]	Strategic skills	Classify and integrate data, evaluate and communicate
[6], [20], [31], [44], [46], [48], [49]	Communication skills	Cooperating and interacting in digital environments, security, and digital identity
[34], [44]	Formal skills	Understand and use the features of the computer and the internet, file structures, hyperlinks and navigation through the internet;
[3], [6], [8], [21], [32], [35], [36], [44], [47]	Content creation skills	Creation and design of environments that facilitate interaction and digital content

3.7. Strategies used in cooperative learning in relation to digital competencies

Table 8 shows the strategies and tools for cooperative learning used to develop digital competencies in terms of information search, interaction, and digital object creation. The results show that cooperative teaching helps students strive for the progress of everyone [23], [29]. Conversely, there is a shortfall in cooperative learning if it is not used with digital technology [13], which motivates students who use contemporary digital technology [26]. Technology enhances students' motor actions [7], supporting their ability to think, search for information, reflect, and build their own knowledge [20], [24], [25], [48]. Therefore, the art of cooperation requires teachers to master key competencies for life, collaboration, and digital skills [16], its potential lies in incorporating digital technology resources and playful strategies into its planning [51].

The findings show the application of cooperative learning in educational digital environments with strategies that address risk situations such as COVID-19. Firstly, the use of ICT improves academic performance [37], [42], develops soft and hard skills, and fosters environmental and social awareness [2], [20], which are key aspects for success in today's digitalized world [28]. A second finding relates to the strategies, methods, and tools used effectively, such as WebQuest, social networks, Jigsaw, and puzzles, which teachers have used innovatively during and after the pandemic, establishing a new way of working in real-time and remotely, proving effective for decision-making [20], increasing creativity, autonomous thinking, critical and reflective thought [21], and motivating self-assessment and feedback [42]. A third finding revolves around the digital competencies developed through the application of cooperative learning, reducing digital gaps in information search using Google, YouTube, interaction, and collaboration; use of email, Gmail, Hotmail, Blogs, E-portfolios, OneNote, and educational platforms [9], [22], improving digital security and identity [48], and creating digital objects with QR code generation [35], and 3D software [52]. A fourth finding shows confusion over collaborative and cooperative terms in different databases, regarding performing activities under teacher guidance [7] and without it in a more individualized manner [45]; considering that cooperative learning has yielded better academic results [53].

Table 8. Cooperative learning strategies and tools

Articles	Strategy/tool	Description
[3], [19], [23], [24], [28], [35]	Aronson Puzzle (Jigsaw Puzzle)	Give each student a share of the resources needed, so that the group should coordinate
[6], [47]	WebQuest tasks	Inquiry or research activity oriented to students, obtain most of the information to be used from existing Internetresources.
[6], [10], [32], [48]	Digital diary-Glossaries	To recall what they had learned, review their experiences and make reflections through self-assessment.
[6], [10], [35], [36], [47], [48]	Tasks on social networks (Facebook, Edmodo, Twitter, WhatsApp) and web platforms	Participation in computer-assisted group tasks, social interaction and communication among group members to generate knowledge
[6], [8], [21], [22], [32], [42], [47]	Cooperation tools (Google Docs, OneDrive, Dropbox), Google Classroom or Moodle.	Allow to create, edit and share information together, to improve students' problem-solving skills
[10], [26], [34]	Puzzle, numbered heads, collective score board	The aim is to develop digital competence, “mobile learning” strategy and management of technological resources.

4. CONCLUSION

The systematic review of the literature provides teachers with multiple perspectives for designing learning activities that promote interaction in various physical and virtual settings, fostering coexistence in the school through active listening, agreement negotiation, time management, and respect in decision-making at personal, group, and social levels, offering effective solutions. The teacher plays a crucial role in managing cooperative learning, promoting student interest and motivation while enhancing academic performance and social skills both inside and outside the classroom. The literature trend indicates the need for an in-depth analysis of conflict management in cooperative teams, focusing on decision-making and agreement negotiation as an emerging line for future research.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Virginia A. Samane-Cutipa	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	
Juan Carlos Callacondo Velarde	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
Fabian Hugo Rucano Paucar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Fabiola Talavera-Mendoz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Derived data supporting the findings of this study are available from the corresponding author [FHRP] on request.

REFERENCES

[1] Z. N. Khlaif, S. Salha, S. Fareed, and H. Rashed, "The hidden shadow of coronavirus on education in developing countries," *Online Learning*, vol. 25, no. 1, pp. 269–285, Mar. 2021, doi: 10.24059/olj.v25i1.2287.

[2] N. D. Nawi *et al.*, "Instilling low carbon awareness through technology-enhanced cooperative problem based learning," *International Journal of Emerging Technologies in Learning*, vol. 14, no. 24, pp. 152–166, Dec. 2019, doi: 10.3991/ijet.v14i24.12135.

[3] A. Peña-Ayala, "A learning design cooperative framework to instill 21st century education," *Telematics and Informatics*, vol. 62, p. 101632, Sep. 2021, doi: 10.1016/j.tele.2021.101632.

[4] H. M. R. P. Herath, Y. Bano, and S. Vasantha, "E-learning capability maturity during COVID 19 pandemic – a qualitative approach," *Quality - Access to Success*, vol. 22, no. 184, pp. 232–236, 2021, doi: 10.47750/QAS/22.184.29.

[5] J. Monteagudo-Fernández, R. A. R. Pérez, A. Escribano-Miralles, and A. M. R. García, "Perceptions of secondary education students on the teaching of history, through the use of ICT and digital resources," (in Spanish), *Revista Electrónica Interuniversitaria de Formación del Profesorado*, vol. 23, no. 2, pp. 67–79, Apr. 2020, doi: 10.6018/reifop.417611.

[6] E. de la Barra and S. Carbone, "Bridging inequality: cooperative learning through literature in two vulnerable schools in Santiago," *Profile: Issues in Teachers´ Professional Development*, vol. 22, no. 2, pp. 49–63, Jul. 2020, doi: 10.15446/profile.v22n2.81384.

[7] Y.-T. Sung, K.-E. Chang, and T.-C. Liu, "The effects of integrating mobile devices with teaching and learning on students' learning performance: a meta-analysis and research synthesis," *Computers & Education*, vol. 94, no. 94, pp. 252–275, Mar. 2016, doi: 10.1016/j.*compedu*.2015.11.008.

[8] C. Alonso-Campuzano *et al.*, "Tangible digital collaborative storytelling in adolescents with intellectual disability and neurodevelopmental disorders," *Journal of Applied Research in Intellectual Disabilities*, vol. 37, 2024, doi: 10.1111/jar.13159.

[9] R. A. Corporan, J. Joo-Nagata, A. V. M. García, and A. H. Martín, "Perception of teachers on collaborative tools knowledge level mediated by ICT and their experience with students," *International Journal of Emerging Technologies in Learning*, vol. 15, no. 11, pp. 137–161, 2020, doi: 10.3991/IJET.V15I11.13121.

[10] C. Casas-Moreno, A. García-De-Alcaraz, R. Hernández-García, and A. Valero-Valenzuela, "The flipped classroom for teaching judo in physical education," *Journal of Sport and Health Research*, vol. 14, no. 1, pp. 161–170, 2022.

[11] D. W. Johnson, R. T. Johnson, and E. J. Holubec, *Cooperative learning in the classroom*. Alexandria, VA: Association for Supervision and Curriculum Development, 1994.

[12] N. Mafarja, M. M. Mohamad, and H. Zulnaidi, "Effect of cooperative learning with internet reciprocal teaching strategy on attitude toward learning STEM literacy," *Sage Open*, vol. 14, no. 3, p. 21582440241280900, Jul. 2024, doi: 10.1177/21582440241280899.

[13] Y.-P. Wang and T.-J. Wu, "Effects of online cooperative learning on students' problem-solving ability and learning satisfaction," *Frontiers in Psychology*, vol. 13, p. 817968, Jun. 2022, doi: 10.3389/fpsyg.2022.817968.

[14] D. Bores-García, D. Hortigüela-Alcalá, F. J. Fernandez-Rio, G. González-Calvo, and R. Barba-Martín, "Research on cooperative learning in physical education: systematic review of the last five years," *Research Quarterly for Exercise and Sport*, vol. 92, no. 1, pp. 146–155, Jan. 2021, doi: 10.1080/02701367.2020.1719276.

[15] A. Cherbonnier, B. Hémon, N. Michinov, E. Jamet, and E. Michinov, "Collaborative skills training using digital tools: a systematic literature review," *International Journal of Human–Computer Interaction*, pp. 1–19, May 2024, doi: 10.1080/10447318.2024.2348227.

[16] J. Félix, F. Pimentel, R. D. Arenas, D. Eulogia, F. Pimentel, and N. Shirley, "Digital competence and cooperative learning in high school students," *Educational Administration: Theory and Practice*, vol. 30, no. 4, pp. 5582–5592, 2024, doi: 10.53555/kuey.v30i4.2250.

[17] L. Filimonyuk, V. Ivashova, V. Burlyaeva, M. Bogdanova, and E. Litvinova, "Digital competencies of higher education's scientific and pedagogical staff in Russia: the practice of empirical research," *E3S Web of Conferences*, vol. 460, p. 05033, Dec. 2023, doi: 10.1051/e3sconf/202346005033.

[18] E. V. Frolova, O. V. Rogach, and T. M. Ryabova, "Digitalization of education in modern scientific discourse: new trends and risks analysis," *European Journal of Contemporary Education*, vol. 9, no. 2, pp. 313–336, Jun. 2020, doi: 10.13187/ejced.2020.2.313.

[19] F. Erdogan, "Effect of cooperative learning supported by reflective thinking activities on students' critical thinking skills," *Eurasian Journal of Educational Research*, vol. 19, no. 80, pp. 1–24, Apr. 2019, doi: 10.14689/ejer.2019.80.5.
[20] S. Sariyatun, N. Suryani, L. A. Sutimin, N. F. Abidin, and A. Akmal, "The effect of digital learning material on students' social skills in social studies learning," *International Journal of Instruction*, vol. 14, no. 3, pp. 417–432, Jul. 2021, doi: 10.29333/iji.2021.14324a.
[21] M. Diniyyah, H. Susilo, B. Balqis, and A. K. Sudrajat, "Improving critical thinking and problem-solving skills through POGIL combined with digital mind map," *JPBI (Jurnal Pendidikan Biologi Indonesia)*, vol. 8, no. 3, pp. 275–284, Nov. 2022, doi: 10.22219/jpbi.v8i3.18992.
[22] J. A. Lopez and F. J. P. Palacios, "Reinvent your city': project-based learning for the improvement of environmental awareness in secondary school students," (in Spanish), *Enseñanza de las Ciencias. Revista de investigación y experiencias didácticas*, vol. 38, no. 2, pp. 181–203, Mar. 2020, doi: 10.5565/rev/ensciencias.2812.
[23] J. S. B. Magraner and A. M. B. Nicolás, "Learning by projects in the high school class: the operetta the court of pharaoh," (in Spanish), *Revista de Comunicación de la SEECI*, pp. 1–15, Mar. 2020, doi: 10.15198/seeci.2020.51.1-15.
[24] J. R. M. Vera, "Public history and historical thinking. New methodological approaches to learn the Peninsular War," (in Spanish), *HISPANIA NOVA. Primera Revista de Historia Contemporánea on-line en castellano. Segunda Época*, no. 1, p. 161, May 2020, doi: 10.20318/hn.2020.5369.
[25] M. Á. S. Rego, M. L. Moledo, A. G. Otero, and A. S. Losada, "Cooperative learning, self-image and perception of the learning environment in secondary education," (in Spanish), *Bordón. Revista de Pedagogía*, vol. 72, no. 4, pp. 117–132, Dec. 2020, doi: 10.13042/Bordon.2020.77726.
[26] Y. M. Wilce and I. Salcines-Talledo, "Students' perceptions of the educational value of videogames and their design as a pedagogical strategy," (in Spanish), *Revista Virtual Universidad Católica del Norte*, no. 64, pp. 5–40, Apr. 2021, doi: 10.35575/rvucn.n64a2.
[27] J. S. Blasco-Magraner, A. Català-Saiz, and P. Marín-Liébana, "Cooperative learning and the Aronson puzzle technique in the secondary music classroom," (in Spanish), *Praxis*, vol. 18, no. 1, pp. 50–67, 2023, doi: 10.21676/23897856.3909.
[28] E. Quines, "Effectiveness of cooperative learning approach in developing critical thinking skills of secondary students," in *Empowering 21st Century Learners Through Holistic and Enterprising Learning*, 2017, pp. 115–123, doi: 10.1007/978-981-10-4241-6_12.
[29] W. Liu, "Analysis on the effectiveness of PE FCT model based on cooperative learning model," *Wireless Communications and Mobile Computing*, vol. 2022, pp. 1–10, Feb. 2022, doi: 10.1155/2022/7955813.
[30] Y.-T. Sung, J.-M. Yang, and H.-Y. Lee, "The effects of mobile-computer-supported collaborative learning: meta-analysis and critical synthesis," *Review of Educational Research*, vol. 87, no. 4, pp. 768–805, Apr. 2017, doi: 10.3102/0034654317704307.
[31] U. Massler, W. Müller, I. Iurgel, S. Haake, A. Gantikow, and T. Hadzilacos, "Meaningful, gamified training of reading fluency," *Frontiers in Computer Science*, vol. 4, p. 968137, Sep. 2022, doi: 10.3389/fcomp.2022.968137.
[32] E. Howe and A. Ruberg, "DigiPen: secondary school project-based learning in game design, digital arts and life skills," *The Canadian Journal of Action Research*, vol. 20, no. 2, pp. 28–47, Apr. 2019, doi: 10.33524/cjar.v20i2.462.
[33] J. J. M. Guasp and D. F. Forteza, "Impact of cooperative learning on the inclusion of students in secondary education," (in Spanish), *Educar*, vol. 57, no. 2, pp. 305–318, Jul. 2021, doi: 10.5565/rev/educar.1236.
[34] M. R. Lopez, "Development of project based learning with augmented reality in secondary education to improve performance in the music classroom," (in Spanish), *ARTSEDUCA*, no. 32, pp. 135–146, Feb. 2022, doi: 10.6035/artseduca.6272.
[35] E. Uçak and S. Usta, "Opinions of students and parents on the QR code-supported cooperative learning method," *International Journal of Curriculum and Instruction*, vol. 15, no. 1, pp. 662–692, 2016.
[36] V. Giannakos and M. Darra, "The contribution of computer-supported collaborative learning to the development of collaboration between students: results of pilot implementation in Greek secondary education," *International Education Studies*, vol. 12, no. 3, pp. 158–169, Feb. 2019, doi: 10.5539/ies.v12n3p158.
[37] H. Liu, J. Sheng, and L. Zhao, "Innovation of teaching tools during robot programming learning to promote middle school students' critical thinking," *Sustainability*, vol. 14, no. 11, p. 6625, May 2022, doi: 10.3390/su14116625.
[38] E. A. Akl *et al.*, "Extension of the PRISMA 2020 statement for living systematic reviews (PRISMA-LSR): checklist and explanation," *BMJ*, vol. 387, p. e079183, Nov. 2024, doi: 10.1136/bmj-2024-079183.
[39] O. A. Ponce, J. Gómez-Galán, and N. Pagán-Maldonado, "Qualitative research in education: revisiting its theories, practicesand developments in a scientific-political era," *IJERI: International Journal of Educational Research and Innovation*, no. 18, pp. 278–295, Dec. 2022, doi: 10.46661/ijeri.5917.
[40] E. Crisol-Moya, M. J. Caurcel-Cara, P. Peregrina-Nievas, and C. del P. Gallardo-Montes, "Future mathematics teachers' perceptions towards inclusion in secondary education: University of Granada," *Education Sciences*, vol. 13, no. 3, pp. 245–245, Feb. 2023, doi: 10.3390/educsci13030245.
[41] S. Bećirović, V. Dubravac, and A. Brdarević-Čeljo, "Cooperative learning as a pathway to strengthening motivation and improving achievement in an EFL classroom," *SAGE Open*, vol. 12, no. 1, pp. 1–13, Jan. 2022, doi: 10.1177/21582440221078016.
[42] Y. R. López and E. R. Cao, "Cooperative learning and academic performance in language and literature," (in Spanish), *Revista Ciencias Pedagógicas E Innovación*, vol. 9, no. 1, pp. 11–15, Jun. 2021, doi: 10.26423/rcpi.v9i1.399.
[43] P. A. G. Jerez, O. M. Blanco, and M. E. S. Rollán, "Cooperative learning in explicit lexical instruction in ELE: a quasi-experimental study with German speakers," (in Spanish), *Sintagma: revista de lingüística*, vol. 32, pp. 57–70, 2020, doi: 10.21001/sintagma.2020.32.04.
[44] S. Alaleeli and A. Alnajjar, "The Arab digital generation's engagement with technology: the case of high school students in the UAE," *Journal of Technology and Science Education*, vol. 10, no. 1, pp. 159–178, Mar. 2020, doi: 10.3926/jotse.756.
[45] T. Zhou, H. Wang, and D. Li, "Focusing on the value of cooperative learning in physical education: a bibliometric analysis," *Frontiers in Psychology*, vol. 14, p. 1300986, Nov. 2023, doi: 10.3389/fpsyg.2023.1300986.
[46] H. M. Bowden, "Problem-solving in collaborative game design practices: epistemic stance, affect, and engagement," *Learning, Media and Technology*, vol. 44, no. 2, pp. 124–143, Apr. 2019, doi: 10.1080/17439884.2018.1563106.
[47] H. Chen and Y. Chuang, "The effects of digital storytelling games on high school students' critical thinking skills," *Journal of Computer Assisted Learning*, vol. 37, no. 1, pp. 265–274, Feb. 2021, doi: 10.1111/jcal.12487.
[48] A. Soto, O. Camerino, and M. Castañer, "Innovations didactics in physical education, observation with the software LINCE PLUS," (in Spanish), *Sportis. Scientific Journal of School Sport, Physical Education and Psychomotricity*, vol. 6, no. 2, pp. 390–406, Apr. 2020, doi: 10.17979/sportis.2020.6.2.6117.
[49] J. G. Quintana and S. Osuna-Acedo, "Transmedia practices and collaborative strategies in informal learning of adolescents," *Social Sciences*, vol. 9, no. 6, p. 92, Jun. 2020, doi: 10.3390/SOCSCI9060092.
[50] K. D. C. M. Díaz, R. I. S. González, and C. J. O. Maldonado, "Argumentative processes among Chilean teachers regarding their collaborative experience as part of the universal design for learning framework," (in Spanish), *Revista Educación*, vol. 45, no. 2, pp. 1–16, May 2021, doi: 10.15517/revedu.v45i1.43500.

[51] W. Huang, C. Walkington, and M. J. Nathan, "Coordinating modalities of mathematical collaboration in shared VR environments," *International Journal of Computer-Supported Collaborative Learning*, vol. 18, no. 2, pp. 163–201, Jun. 2023, doi: 10.1007/s11412-023-09397-x.
[52] X. Weng, Z. Cui, O.-L. Ng, M. S. Y. Jong, and T. K. F. Chiu, "Characterizing students' 4C skills development during problem-based digital making," *Journal of Science Education and Technology*, vol. 31, no. 3, pp. 372–385, Jun. 2022, doi: 10.1007/s10956-022-09961-4.
[53] A. Lozano, R. López, F. J. Pereira, and C. B. Fontao, "Impact of cooperative learning and project-based learning through emotional intelligence: a comparison of methodologies for implementing SDGs," *International Journal of Environmental Research and Public Health*, vol. 19, no. 24, p. 16977, Dec. 2022, doi: 10.3390/ijerph192416977.

BIOGRAPHIES OF AUTHORS

Virginia A. Samane-Cutipa studied at the Instituto Superior Pedagógico Público Arequipa specializing in biology and chemistry. She has a degree in education and continued her postgraduate studies at the Universidad Nacional de San Agustín in Arequipa, Peru. She currently works as a teacher in the area of Science and Technology in the Local Educational Management Unit of Caraveli, Arequipa of the Peruvian Ministry of Education, she is the main advisor in the National School Fair of Science and Technology FENCYT-EUREKA. She can be contacted at email: vsamane@unsa.edu.pe.

Juan Carlos Callacondo Velarde is doctor in Educational Sciences, master's degree in Educational Management and Administration, master's degree in Public Administration and Management. Master's degree in Text Linguistics; Bachelor's degree in Education from Universidad Nacional San Marcos de Lima; Social Communicator from Universidad Nacional del Altiplano Puno. Teacher at the Universidad Nacional San Agustín de Arequipa in the course Management of Social Projects and Didactics of Communication. Teacher at Universidad La Salle in the National Reality and Region course. Teacher of Educational Projects at Universidad Católica San Pablo. His line of research: educational management, teacher training, didactics, and technologies. He can be contacted at email: jcallacondo@unsa.edu.pe.

Fabian Hugo Rucano Paucar is a professor of Education at the National University of San Agustín de Arequipa, with a master's degree in Higher Education and a Doctorate in Education, from the National University of San Agustín de Arequipa. He is a RENACYT research professor, with participation in basic and applied research projects, has publications in journals and conferences, as well as a patent and intellectual property registry. He can be contacted at email: frucano@unsa.edu.pe.

Fabiola Talavera-Mendoza is a teacher of primary education, with a master's degree in higher education and a doctorate in education, all carried out at the National University of San Agustín de Arequipa. She is currently serving as a full-time appointed teacher at the Faculty of Educational Sciences of the Universidad Nacional de San Agustín de Arequipa. She is in the category of RENACYT research professor. She can be contacted at email: ftalaveram@unsa.edu.pe.