Digital Educational Games to Promote Social Emotional Learning in Preschool-Aged Children: Trends and Challenges in Co-Design

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Abstract. The integration of Digital Educational Games (DEGs) in preschool education offers new opportunities to foster Social-Emotional Learning (SEL) through engaging, adaptive learning environments. This systematic literature review, conducted following PRISMA 2020 guidelines, examines key game design features that support SEL competencies in preschool-aged children. A total of 18 studies published between 2020 and 2025 were analyzed, focusing on participatory design, the roles of educators and children, and methodologies to assess SEL outcomes. Findings highlight the prevalence of game mechanics targeting emotional regulation, responsible decision-making, and prosocial behavior, with insights into the inclusion of nutrition and autism-related interventions within the CASEL-5 framework. The study also explores the role of educators in facilitating DEGs and the digital literacy skills needed for effective integration. By aligning technological advancements with child-centered design principles, this review contributes to the discourse on smart learning ecosystems and the future of participatory digital learning tools.

Keywords: digital game-based learning, digital learning environments, social emotional learning, preschool-aged children

1   Introduction

During the preschool years, spanning from 3 to 6 years old [1], children exhibit remarkable plasticity and responsiveness to educational and learning opportunities due to their psychophysiological characteristics [2]. This inherent adaptability enables them to effortlessly acquire knowledge and skills [3]. Although the definitions of early childhood and preschool years overlap in emphasizing the critical developmental role of early years, it is important to note that early childhood encompasses the period from birth to eight years of age [4], while preschool is merely a subset of early childhood. Many theorists such as Maria Montessori [5], Jean Piaget [6] and Lev Vygotsky [7] have provided key insights regarding young children's development and learning processes throughout decades. Montessori characterized the period from birth to six years of age as the "absorbent mind" phase, during which children effortlessly assimilate information from their environment. [5]. Piaget's Theory of Cognitive Development (TCD) further explains the early years through the preoperational stage (ages 2 to 7) during which children develop symbolic thinking, imagination, and language skills but still struggle with logical reasoning and perspective-taking [6]. In Vygotsky's work [7] introduced the Zone of Proximal Development (ZPD) which states that children learn best with support from knowledgeable individuals. As children begin navigating the complexities of social interactions and managing their own emotions, Social Emotional Learning (SEL)

becomes critical to their development [8]. SEL is the process through which individuals of all ages learn to understand and manage emotions, set and achieve positive goals, demonstrate empathy, build positive relationships, and make responsible decisions [9]. The CASEL-5 framework outlines five core competencies essential to SEL: self-awareness, self-management, social awareness, relationship skills and responsible decision-making. The more we focus on investing and improving our SEL skills, the more we can navigate towards a thriving and well-functioning society [10], given that early SEL intervention is concomitant to preventing mental health disorders [11]. The World Economic Forum [12] highlights the growing value of SEL skills to employers, which is why school plays a pivotal role in developing these skills before students enter the workforce [13]. Table 1 provides a summary of social and emotional milestones that typically occur during the preschool years.

Table 1. Social emotional milestones in preschool years [14], [15]

Age	Social emotional milestones
3 years	Calms down within ten minutes of arriving at school
	Engages in interactive play
	Learns cooperation and sharing skills
	Can't distinguish between reality and imagination
4 years	Pretends to be something else during play (teacher, superhero, dog)
	Asks to go play with children if none are around
	Comforts others who are hurt or sad
	Avoids danger by refraining from jumping from high places
	Enjoys being helpful
	Adapts its behavior based on its location
5 and 6 years	Follows rules or takes turns when playing with peers
	Sings, dances, or acts
	Enjoys doing simple chores at home
	Learns adult skills such as giving praise or apologizing
	Enjoys spending time in peer groups
	Likes to dress up and act out fantasies

Innovative approaches that engage young learners are essential for maximizing their social and emotional development and have captured the interest of policy makers and researchers [10], [13]. Digital Educational Games (DEGs), an emerging tool in Early Childhood Education (ECE) are software applications designed to facilitate the understanding of concepts, the exploration of specific topics, and the development of various skills [16]. In this context, Digital Game-Based Learning (DGBL) has gained significant attention for its capacity to engage children while simultaneously fostering the development of cognitive skills [17]. DGBL integrates educational content into digital games to enhance student engagement and learning outcomes [18], [19]. Concomitant to Vygostky's research [7], DGBL features allow children to negotiate, collaborate, and regulate emotions in a safe and controlled environment.

With the rise of touchscreen technology, learning environments are becoming more accessible and tailored to younger learners' individual needs and abilities [20]. Adopting a child-centered design approach, which prioritizes children as the primary focus and is process-oriented rather than product-oriented [21] can simultaneously enhance both the learning experience and the overall quality of the final product [22].

In Participatory Design (PD), often referred to as collaborative design or co-design, experts and designers work alongside their target audience to address an issue [23]. Children's role in PD aims to benefit young learners by developing their skills and critical thinking abilities, while also aligning their skills with the demands of the 21st century [24]. As first conceptualized by Druin [25], children's involvement in

technology design can range from minimal participation to active collaboration. Doorn [26] subsequently introduced the concept of co-researcher, and Iversen et al. [24] proposed the child as a protagonist, who engages in the entire design process. Table 2 encapsulates the evolving role of children in PD over time.

Table 2. The role of children in participatory design [24], [25], [26]

Role	Role of children	Author
User	Video recording or tested before/after using technology	
Tester	Testing prototypes of a particular technology	
Informant	Engaging with new technologies and providing input throughout the entire design process	Druin (2002) [25]
Design partner	Participating in design sessions with a shared goal of designing new technology	
Co-researcher	Sharing, gathering, and analyzing data from their own practice	Doorn (2016) [26]
Protagonist	Engaging in a complete design process having product reflection as the central component	Iversen et al. (2017) [24]

Despite evidence suggesting that involving young learners in the design process through PD approaches leads to more engaging and developmentally appropriate educational tools as highlighted in the work of Druin [25], Paracha et al. [27], [28] and Buckmayer et al. [28] — most DEGs are developed *for* children and not *with* them. When narrowing the focus to DEGs designed to promote SEL skills and prosocial behaviors — both essential for children's development — relevant research and available examples become even more limited. Given this gap, it becomes imperative to explore design principles that can guide the creation of DEGs that not only engage young learners but also effectively promote SEL.

A systematic literature and meta-analysis review will be conducted to identify key principles for developing of a DEG aimed at promoting SEL in early childhood of an ongoing research. The findings from this review will serve as a foundational framework and guide the game's development by integrating theory-based knowledge and ensuring that its design aligns with the latest developments in Child Psychology and Technology. A systematic review is necessary to synthesize and evaluate the existing body of literature on this topic, as it will provide a comprehensive overview of current practices and identified challenges. Several systematic reviews have explored aspects of digital game-based learning (DGBL) and social-emotional learning (SEL) in early childhood education; however, few have specifically examined the integration of SEL competencies within digital educational games (DEGs) for preschool-aged children. For instance, Behnamia et al. [29] and Ongoro & Fanjiang [30] focus on DGBL in relation to cognitive and language development, without addressing how these games may foster SEL skills. Similarly, Blewitt et al. [31] and Luo et al. [32] investigate universal SEL interventions in preschool settings but do not incorporate digital or game-based approaches. Lu & Kharrazi [33] offer a broader analysis of SEL through digital media, while Tsortanidou et al. [34] examine SEL in connection with media literacy and imagination; however, neither study focuses on digital games.

In contrast, the present review offers a novel synthesis by focusing specifically on how digital educational games can support SEL in preschool education, using the CASEL-5 framework as an analytical lens. It also highlights the limited presence of participatory design in existing DEGs and emphasizes the critical roles that both educators and children can play in the development and application of these tools. By addressing this gap, the study contributes to a more inclusive and context-aware

understanding of how DEGs can support emotional and social development during early childhood.

To guide this process, the following Research Questions (RQ) will be addressed, focusing on the characteristics and design elements essential for creating a digital educational game that effectively promotes SEL in early childhood education.

RQ1. What game design features are used to help support the development of social emotional learning skills in preschool-aged children?

RQ2. What are the most common SEL skills targeted in digital educational games for preschool-aged children?

RQ3. What roles do children and educators play in using and supporting SEL-focused digital games in early childhood education?

RQ4. What are the most common data collection tools used to evaluate DEGs promoting social emotional learning in preschool-aged children?

2 Methods

This study conducts a Systematic Literature Review (SLR) of studies with diverse research designs (quantitative or qualitative) that report on digital educational tools for preschool-aged children's SEL. A Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 [35] approach was followed to address the research questions. The search covered a five-year period, from 2020 to 2025, thus ensuring the results reflected the most recent developments in DEGs, while keeping the sample size manageable for in-depth qualitative analysis of the papers. A total of 18 papers were identified. In January 2025, we conducted the initial search, generating 809 entries from databases (Scopus: 151; ERIC: 151; Web of Science: 59; Science Direct: 110; EBSCO: 107; ACM: 178; IEEE Explore: 53) as illustrated in Figure 1. All references were imported to Mendeley Software. From the initial entries, 93 duplicate records were removed.

2.1. Eligibility criteria

The inclusion criteria for this SLR required empirical research incorporating a field-based research component, meaning that studies had to involve the real-world implementation of digital educational games in preschool-aged children's educational settings. This criterion ensured that the data collected were based on genuine interactions and outcomes observed in realistic learning environments. The researchers established exclusion criteria regarding studies that did not directly apply in real-world contexts or involve fieldwork with preschoolers. Additionally, studies that were purely theoretical, conceptual, or conducted in controlled settings were also excluded. Appendix A provides detailed inclusion and exclusion criteria.

2.2. Search method

Seven internationally well-known databases were used to search for empirical studies between 2020 and 2025: ERIC (education), Scopus and Web of Science (general), ACM (computing), EBSCO (multidisciplinary), ScienceDirect (Science, Technology, Engineering and Mathematics (STEM) and social sciences) and IEEE Explore (engineering and technology) from January to March 2025. All databases' searches were limited to English, Spanish and Portuguese articles. Following the PICO strategy—Population, Intervention, Comparison, and Outcome [36] — the researchers developed search phrases based on three targets: the user group (preschool-aged children), the intervention (digital games), and SEL. Table 3 summarizes the search terms used.

Table 3. PICO strategy: elements and keywords [36]

Elements	Description	Keywords
Population	Preschool-aged children	preschool OR kindergarten OR "early childhood"
Intervention	Digital educational games	"digital game" OR "video game" OR videogame OR "game development" OR "game design" OR "educational game" OR "serious game"
Comparison	This criterion was not relevant in this research	
Outcome	Social emotional learning	education* OR "child development" OR "play-based learning" OR emotion* OR learning OR "social emotional learning" OR "socioemotional learning" OR "SEL" OR "emotional competence" OR "emotional intelligence"

2.3. Selection process

The authors downloaded 809 abstracts from the databases using the above search items. After removing duplicates, there were a total of 716 abstracts. Next, the titles and abstracts were screened for eligibility based on whether their language was English, Spanish, or Portuguese, had open access, appeared to be a digital learning tool for preschool-aged children, and focused on the development of SEL skills. All titles were screened by the three authors. This was followed by the first two authors reading the abstracts of articles that appeared to meet all inclusion criteria to confirm eligibility, where any ambiguous cases were discussed.

Papers were excluded if (a) the article was an opinion piece, editorial, theoretical paper, non-empirical reviews, literature review, dissertation or gray literature; (b) the study was outside the preschool-age range; (c) the interventional was non-digital or is purely entertaining and not for educational purposes; (d) the article does not address SEL-related skills. From the 716 abstracts thoroughly reviewed, 698 were excluded due to not meeting the inclusion criteria: they were not targeted at preschoolers (n =

69), did not address the development of SEL skills (n = 348), did not cover educational content (n = 209), were literature reviews (n = 65), full-text was not available (n = 7). Thus, we proceeded to synthetize and analyze 18 papers. **Figure 1** illustrates the article selection process.
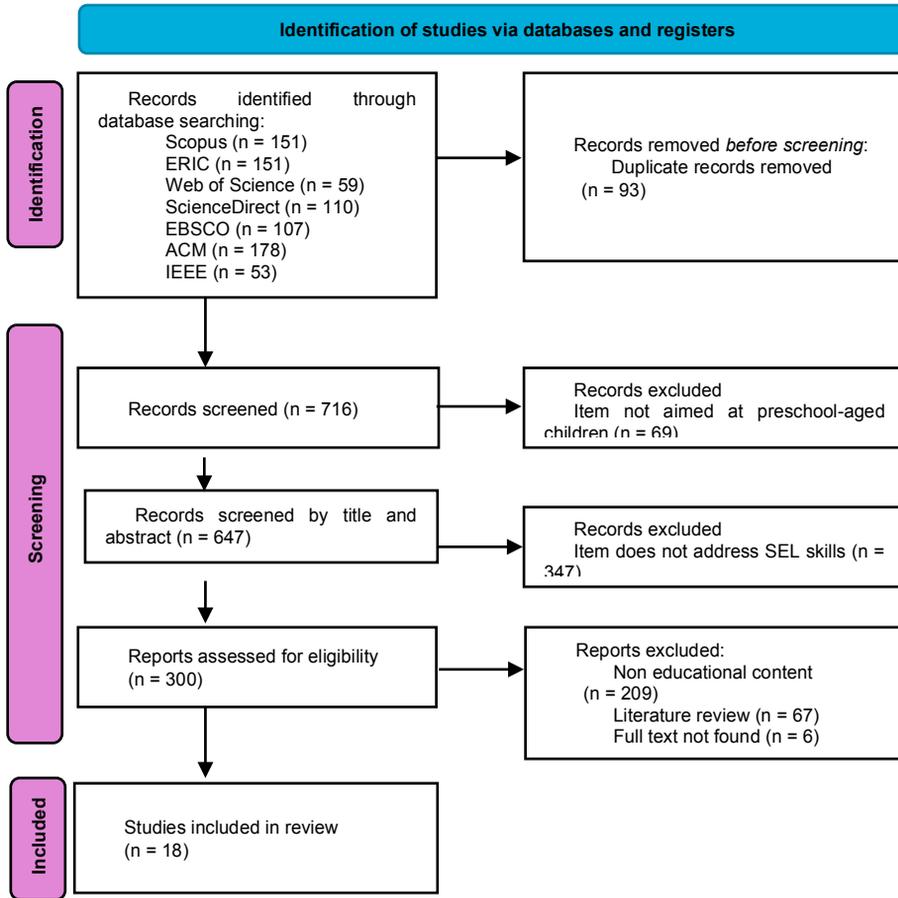

Figure 1. PRISMA 2020 flow diagram to illustrate article selection

3 Results

The initial analysis of the 18 publications presented in Table 4 revealed the highest number in 2022 (5) and the lowest in 2025 (1). Geographically, the studies came from Europe, Asia, the Americas, and Oceania. Finland and Turkey led with three

publications each, followed by Azerbaijan, China, and the US with two each. Two articles were authored by Ersin Kara and Kursat Cagiltay in 2023 and 2024.

Table 4. Articles selected

Author	Title
Heumos & Kickmeier-Rust (2020) [37]	Developing young children's empathic perception through digitally mediated interpersonal experience: Principles for a hybrid design of empathy games
Wu et al. (2020) [38]	Developing young children's empathic perception through digitally mediated interpersonal experience: Principles for a hybrid design of empathy games
Carreño-León et al. (2021) [39]	Managing emotions in autistic children through serious games with tangible interfaces
Nicolaidou et al. (2021) [40]	A gamified app on emotion recognition and anger management for pre-school children
Braga-Pontes et al. (2022) [41]	Using Game-Based Training to Reduce Media Induced Anxiety in Young Children – A Pilot Study on the Basis of a Game-Based app (MARTY)
Chang et al. (2022) [42]	The Effects of a Computer Game (Healthy Rat King) on Preschool Children's Nutritional Knowledge and Junk Food Intake Behavior: Nonrandomized Controlled Trial
Torres-Rojas et al. (2022) [43]	Development of an M-Learning Application for Early Childhood Education in Emotional Consciousness
Vepsäläinen et al. (2022) [44]	A Mobile App to Increase Fruit and Vegetable Acceptance among Finnish and Polish Preschoolers: Randomized Trial
Guler et al. (2023) [17]	Design and development
Kara & Cagiltay (2023) [45]	Using E-textiles to Design and Develop Educational Games for Preschool-aged Children
Liu et al (2023) [46]	Starrypia: An AR Gamified Music Adjuvant Treatment Application for Children with Autism Based on Combined Therapy
Sakka & Gouscous (2023) [47]	Children's Rights Education via Game-based Activities: An Intervention in Kindergarten
Bei et al. (2024) [48]	StarRescue: the Design and Evaluation of a Turn-Taking Collaborative Game for Facilitating Autistic Children's Social Skills
Eng et al. (2024) [49]	Incorporating Evidence-Based Gamification and Machine Learning to Assess Preschool Executive Function: A Feasibility Study
Guillén et al. (2024) [50]	Exercising Executive Functions with a Playful Software in Early Childhood Education
Kara & Cagiltay (2024) [51]	Designing for Executive Functions: Exploring Design Issues and Preschool-aged Children's Characteristics Through Digital Games
Lipponen et al. (2025) [52]	ECEC educators' Attitudes and Perceptions Toward and Supportive Role in Children's Digital Gameplay: The Emotion Detectives Game as an example

The reviewed studies employed a range of research designs to evaluate the development and effectiveness of the DEGs. Design and Development Research was the most common Study Design with 39% (7 articles). Table 5 lists the designs used in the articles reviewed.

Table 5. Study design by article

Study Design	n	Percentage	Articles
Design and Development Research	7	39%	[17], [38], [40], [43], [45], [51], [53]
Experimental and Quasi-	6	34%	[41], [42], [44], [46], [47], [48]

Experimental			
Feasibility and Pilot Studies	3	16%	[37], [49], [50]
Case Study	2	11%	[39], [52]

As presented in Table 6, 67% (12 articles) of the studies focused on game design and development, while 28% (5 articles) evaluated the learning impact and effectiveness of the interventions examined.

Table 6. Research approach by article

Research Approach	n	Percentage	Articles
Game design and development	12	67%	[17], [38], [39], [40], [43], [44], [45], [46], [47], [48], [51], [53]
Learning impact and effectiveness	5	28%	[37], [41], [42], [49], [50]
Classroom integration and teachers' perspectives	1	5%	[52]

The studies analyzed included 17% (3 articles) of autism-related digital educational games as illustrated in Table 7. This subset was incorporated based on the relevance of the interventions to the broader scope of SEL in early childhood, recognizing that autism spectrum disorder (ASD) often presents unique challenges in the development of social and emotional skills. Similarly, 17% (3 articles) focusing on nutrition literacy were included. After reviewing the selected articles, there was a clear alignment between the evaluation of benefits and consequences of food-related decisions and the responsible decision-making competence in the CASEL framework [54]. Children reflect on their personal, family, and community well-being by being more informed about their health and nutrition.

Table 7. Studies addressing autism SEL and nutrition literacy by article

Category	n	Percentage	Articles
Studies targeting autistic preschool-aged children	3	17%	[39], [46], [48]
Studies targeting nutritional literacy of preschool-aged children	3	17%	[41], [42], [44]

The meta-analysis also examined the DEGs' thematic focus, which addressed four areas. As demonstrated in Table 8, 50% of the studies (9 articles) addressed Emotional Awareness, followed by 28% (5 articles) addressing Executive Functions, 17% (3 articles) addressing Nutrition Literacy, and 5% (1 article) addressing Children's Rights Education.

Table 8. Thematic focus by article

Thematic focus	n	Percentage	Articles
Emotional Awareness	9	50%	[37], [38], [39], [40], [43], [46], [48], [52], [53]
Executive Functions	5	28%	[17], [45], [49], [50], [51]
Nutrition Literacy	3	17%	[41], [42], [44]
Children's Rights Education	1	5%	[47]

The current study addressed the previously formulated research questions based on these insights. The researchers conducted a comprehensive qualitative data analysis across four distinct categories, one addressing each one of the RQ previously defined:

(1) Game design features; (2) SEL competencies; (3) Intervention framework; (4) Data collection tools.

The qualitative research was conducted in WebQDA, a Computer-Assisted Qualitative Data Analysis Software (CAQDAS) developed in Portugal, known for its versatility and intuitive interface [55].

4 Discussion

4.1. Game design features

Understanding the specific game design features that facilitate this process is crucial to support the development of Social and Emotional Learning (SEL) skills in preschool-aged children. DEGs provide an engaging and interactive medium for young learners, but their effectiveness depends on their well-designed features. By analyzing the game design strategies employed in existing SEL-focused DEGs, this study aims to identify and report best practices that can inform the development of future interventions. Understanding these principles can guide the creation of more inclusive and developmentally appropriate digital learning environments for children.

Audiovisual support stands out most prominently among the observed game characteristics, referred in 84% of studies (16 articles). Specifically, visual feedback was referred to in 9 articles, while audio feedback was referred to in 7 articles. Reward mechanisms used to motivate and engage learners [18] were mentioned in 55% of studies (10 articles). Among the most frequent UI features were also easy to learn interfaces in 50% of studies (9 articles), scaffolding techniques, a process that enables a child to solve a problem, complete a task, or achieve a goal that would be beyond his unassisted efforts [56] were present in 50% of studies (9 articles). Roleplaying strategies were used in 44% of studies (8 articles) and clear goals to motivate players were included in 33% (6 articles).

Among the least referred game features were avoiding mistakes, simple and clear menus, avoiding unexpected events and character customization in 6% of studies (1 article each). Table 9 presents a comprehensive list of game characteristics for each article.

Table 9. Game features by article

Game features	n	Percentage	Articles
Audiovisual support	16	84%	Visual feedback [17], [38], [39], [40], [46], [47], [48], [49], [53]; Audio feedback [38], [39], [40], [45], [46], [47], [49]
Rewards mechanisms	10	55%	[38], [39], [40], [45], [46], [47], [49]
Easy to learn interface	9	50%	[17], [37], [39], [43], [45], [46], [47], [48], [53]
Scaffolding techniques	9	50%	[17], [43], [45], [47], [48], [49], [51], [52], [53]
Roleplaying strategies	8	44%	[37], [38], [40], [42], [47], [48], [50], [53]
Clear goals to motivate players	6	33%	[38], [42], [43], [47], [48], [49]
Tutorial	6	33%	[37], [40], [46], [48], [50], [51]
Digital representation of real life	5	28%	[38], [46], [47], [52], [53]

No boring or repetitive tasks; Increased level of difficulty	5	28%	[38], [40], [46], [48], [49]
Feeling of progress over time	4	22%	[38], [43], [47], [49]
Age suitability	4	22%	[47], [49], [53], [57]
Importance of color	3	17%	[45], [46], [53]
Consistency within similar functions	3	17%	[36, 38, 42]
Balance between easy and difficult tasks	2	11%	[17], [47]
Avoid mistakes	1	6%	[47]
Simple and clear menu	1	6%	[47]
Avoid unexpected events	1	6%	[47]
Character customization	1	6%	[47]
Avoid text in buttons	1	6%	[46]
Rounded corners	1	6%	[46]
Simplified structures	1	6%	[46]
Cute and intuitive cartoon characters	1	6%	[46]

The analysis revealed that most studies feature main animal characters. Examples include the *Healthy-Rat King* [42], *Mole's Veggie Adventure* [57], the anesthesia preparation game starring an owl [53], RETRO's dinosaur protagonist [17], *StarRescue* led by monsters [48], and *Starrypia* featuring various animal species [46]. Regarding the UI design style, color has been reported to play an important role in facilitating the use of technology by autistic children [39]. Preschool children report to prefer the use of bright colors [40] as they suppress the brain from overexcitation [46]. Cute and intuitive characters were reported to more likely grab autistic children's attention [46]. Figure 2 illustrates the type of characters and colors used in Ingadottir et al. [53] and Liu et al. [46].
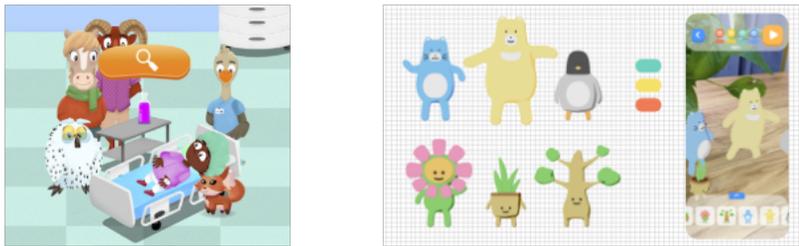

Figure 2. Screenshots from Ingadottir et al. [53] and Liu et al. [46]

The implementation of feedback strategies plays a key role in guiding players and reinforcing learning [58]. Positive feedback has been shown to increase the likelihood of students returning to an activity and reporting higher levels of interest [59], while negative feedback often leads to improved performance as individuals set higher goals for subsequent attempts [60]. Table 10 summarizes the type of feedback mentioned by article, having positive and negative feedback equally mentioned in 22% of studies (4 articles) each, visual feedback is present in 50% of studies (9 articles) and audio feedback in 39% of studies (7 articles).

Table 10. Feedback features by article

Feedback features	n	Percentage	Articles
Visual Feedback	9	50%	[17], [38], [39], [40], [46], [47], [48], [49], [53]
Audio Feedback	7	39%	[38], [39], [40], [45], [46], [47], [49]
Positive Feedback	4	22%	[38], [39], [42], [52]

Negative Feedback	4	22%	[17], [38], [42], [49]

Findings related to game design features, which addressed RQ1, were presented in Tables 9 and 10. Table 9 contained game characteristics, while Table 10 comprised feedback features. The most notable findings were audiovisual support, which was mentioned in 84% of the studies, and visual feedback, which was mentioned in 50% of the studies.

4.2. SEL skills

This section explores how DEGs can foster SEL skills in preschool-aged children, with a particular focus on the CASEL-5 framework. The CASEL-5 identifies five competencies essential to SEL: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making [9]. Through interactive gameplay, DEGs can provide young learners with opportunities to learn and apply these skills which are directly linked to academic success, school and civic engagement, health and wellness, and fulfilling careers [54].

Addressing one of the CASEL-5 skills was a mandatory inclusion criterion for a study to enter this systematic literature review. Table 11 presents the distribution of analyzed articles categorized by CASEL-5 skills. Self-management emerges as the most frequently mentioned skill in 61% of the studies (11 articles), while self-awareness ranks last in 6% (1 article).

Table 11. CASEL-5 skills by article

CASEL-5 skill	n	Percentage	Articles
Self-management	11	61%	[17], [37], [39], [40], [44], [45], [46], [47], [50], [51], [53]
Responsible decision-making	5	28%	[41], [42], [43], [47], [52]
Relationship skills	4	22%	[43], [44], [48], [52]
Social awareness	4	22%	[38], [39], [48], [52]
Self-awareness	1	6%	[39]

Self-management relates to the ability to manage one's emotions, thoughts and behaviors effectively, such as identifying and using stress-management strategies [40] such as the ones described in Table 12.

Table 12. Self-management strategies by article

Self-management strategy	n	Percentage	Articles
Problem-solving	8	44%	[17], [37], [44], [47], [48], [49], [51], [52]
Relaxation techniques	4	22%	[37], [40], [46], [53]
Breathing exercise	3	17%	[37], [40], [53]
Coping mechanisms	3	17%	[37], [40], [53]
Positive self-talk	2	11%	[51], [53]

Findings pertaining to Social and Emotional Learning (SEL) skills, which address RQ2, can be summarized in Table 11, which incorporates the CASEL-5 skills, and Table 12, which presents self-management strategies. The most significant findings are self-management, which is mentioned in 61% of the studies, and problem-solving, which is mentioned in 44% of the studies, respectively.

4.3. Intervention framework

The studies analyzed involve collaborative processes involving researchers, children, educators, and families. Understanding the distinct roles each plays in successfully implementing and supporting these DEGs is crucial for optimizing their educational impact. The findings mutually benefit all involved in research: children gain an enriching learning experience that boosts their self-confidence and tech knowledge [22], while researchers gain unfiltered access to children's perspectives, challenges, and demands for designing a new tool [61]. By establishing collaborative partnerships between schools, families, and communities, all stakeholders can collectively contribute to align goals [62] and enable safe and healthy learning environments [12].

In the analyzed studies, children were most frequently depicted as Testers, accounting for 50% of the cases (9 articles) as depicted in Table 13. On the other hand, the most intricate role as Design Partners was only mentioned once in Ingadottir et al.'s study, which comprised a child-centered design aimed at role-playing medical procedures to familiarize children with anesthesia and surgery, therefore reducing their anxiety levels.

Table 13. Role of children by article

Role of children	n	Percentage	Articles
Tester	9	50%	[17], [38], [39], [40], [43], [44], [45], [48], [51]
User	8	44%	[37], [41], [42], [46], [47], [49], [50], [52]
Design Partner	1	6%	[53]

Educators' involvement in the selected studies was diverse, ranging from minimal engagement such as session monitoring, to more extensive roles including facilitation, data collection, game assessment, and research participation. Table 14 summarizes the role of educators in the analyzed articles.

Table 14. Role of educators by article

Role of educators	n	Percentage	Articles
Facilitation and data collection	6	33%	[38], [40], [44], [47], [50], [53]
Session monitoring	5	28%	[37], [41], [42], [43], [49]
Game assessment	4	22%	[39], [46], [51], [52]
Research participation	3	17%	[17], [45], [48]

Empirical analysis revealed that the sample sizes varied from 1 to 322 participants, encompassing a total of 1460 participants across the 18 studies. The average participation per study was 81 participants. Study duration, when reported, ranged from 15 to 40 minutes. On average, each session lasted 24 minutes. Table 15 condenses information regarding session duration.

Table 15. Session duration (when reported) by article

Session duration (max)	N	Percentage	Articles
15 minutes	3	17%	[37], [38], [51]
20 minutes	1	6%	[41]
30 minutes	3	17%	[44], [47], [52]
40 minutes	1	6%	[48]

Investigators' frequency of contact with children, when reported, was analyzed to determine the average number of interactions. Three studies reported weekly contact, followed by two studies reporting contact once or twice. Table 16 details the session frequency for each article.

Table 16. Session frequency

Session frequency	N	Percentage	Articles
Daily	1	6%	[48]
Weekly	3	17%	[37], [41], [52]
1-2 times a week	2	11%	[44], [47]
3 times a week	1	6%	[38]

Regarding RQ3, our research reveals that a significant portion of the children participating in the study are testers (50%). In contrast, the educators' roles are almost equally divided, with 33% supporting data collection, 28% monitoring sessions, and 24% evaluating the games. Furthermore, it is noteworthy that the average session duration is 15 minutes long (18%), and most sessions take place weekly (17%).

4.4. Data collection tools

The selection of appropriate data collection tools is essential for evaluating the effectiveness of digital educational games (DEGs) in promoting Social Emotional Learning (SEL). Druin [25] highlighted the importance of the appropriateness of materials and methods when working with children, as this ensures both the reliability of data and the engagement of young learners. The reviewed studies vary in scope and approach, some focusing on direct user feedback, while others prioritize observational data and learning outcome assessment.

Among the most frequently mentioned data collection tools, demographic information collection was referenced in 44% of studies (8 articles) to gather information about participants' backgrounds. Semi-structured interviews, a valuable way of gaining insights regarding children and educators' perspectives [63], were present in 33% of studies (6 articles). Usability, a trait that assesses interfaces ease-of-use [64] was referred in 28% of studies (5 articles). A complete list of data collection tools by article is available in Appendix B.

Furthermore, specialized data collection instruments designed to assess children's dietary knowledge and habits were integrated into three studies investigating nutrition literacy. These studies encompassed knowledge of vegetables [41], cognition regarding healthy food choices and dietary habits [42], and fruit and vegetable acceptance [44].

Child-centered data collection tools were referred in the articles analyzed. Tools such as the *Smileyometer*, a 5-point likert scale used to assess children's enjoyment with five faces ranging from a frowny face to a big smiley, allow children to express enjoyment in an intuitive way. Similarly, the *Again Again* table captures children's willingness to engage with a game, while the *Fun Sorter Table* enables children to rank game activities based on preferences and enjoyment.

Regarding RQ4, the most commonly used data collection tools include demographic information (44%), semi-structured interviews (33%), usability assessments (28%), nutrition literacy questionnaires (17%), and the child-centered Smileyometer (12%).

5 Conclusions

This systematic literature review and meta-analysis presented evidence supporting the conceivable effectiveness of digital learning in fostering social and emotional skills among preschool-aged children. The scope of SEL has been proven to extend beyond regular education, going as far as autistic interventions regarding social skills and nutrition strategies that foster responsible decision-making and well-being. The

analysis addressed four central research questions. The scope of SEL has been proven to extend beyond regular education, going as far as autistic interventions regarding social skills and nutrition strategies that foster responsible decision-making and well-being. The reviewed studies assessed not only emotional awareness but also Executive Functions (EFs), which are a set of regulation skills that address cognitive processes related to attention, information maintenance, effortful thinking, adaptability, and goal-directed behavior. EF skills overlap with the broader constructs of self-regulation, a broad term that refers to the spectrum in which humans adjust their behavior in a conscious and deliberate way, and SEL skills including emotional self-awareness and a wide range of self-regulatory and pro-social strategies.

In response to RQ1, which adressed game design features to support SEL skills, the review revealed that audiovisual support, reward mechanisms, easy to learn interfaces, scaffolding techniques, and roleplaying strategies were the most commonly observed. Although these features align with Perrota et al.'s [18] DGBL principles the definition of best practices remains inconsistent, highlighting the need for greater standardization in future development. Among the research findings, the authors reported that cute and intuitive characters were more likely to capture children's attention. Additionally, bright colors were found to suppress excessive excitement and facilitate the use of DEG in both autistic and non-autistic children.

Concerning RQ2, the most common SEL skills targeted revealed to be self-management and responsible decision-making. While self-management is closely linked to the identification and effective application of stress-management strategies [40], responsible decision-making targets constructive choices about one's behavior and social interactions such as the development of critical thinking [41], [42]. The remaining three CASEL-5 competencies — self-awareness, social awareness and relationship skills — are comparatively underrepresented. Given the paramount importance of all five skills for holistic development, future research and game design should encompass all of them for a more balanced approach to supporting young children's social and emotional growth. Integrating real-life elements has the potential to provide a valuable and engaging tool that promotes SEL skills.

Considering RQ3, children and educators play diverse yet interconnected roles in the implementation of SEL-focused DEGs. Children predominantly engage as Testers and Users, with a small proportion involved as Design Partners. This suggests that while children are actively engaged in the design and development of digital learning experiences, their direct involvement remains limited. Educators, on the other hand, serve a range of roles but mostly engage in active facilitation, which underscores the importance of educator feedback in rethinking and adapting DEGs for educational settings. Further findings reveal that session duration varied across studies with an average of 24 minutes, which indicates that short and structured sessions are the most common approach to integrate DEGs into preschool education due to their short attention spans. These results emphasize the collaborative nature of the analyzed studies where researchers, educators, and children contribute for the development, implementation and evaluation of these tools. Expanding participatory design approaches could enhance the child-centered nature of these interventions, ensuring that digital learning environments are both engaging and pedagogically sound.

Finally, RQ4 revealed that the most common data collection tools in this context were demographic information surveys, semi-structured interviews, and usability assessments. Several child-friendly experience assessment tools were identified, including the *Smileyometer*, *Again Again* and *Fun Sorter Table*. Some studies also incorporated cognitive and behavioral assessments including the *Attention Network Task* (ATN), *Theory of Mind* (ToM) and *Flanker Task*. These tools offer deeper insights into cognitive and emotional development, particularly regarding SEL competencies such as self-regulation and decision-making. From the studies analyzed, data collection strategies blend traditional research tools with playful, child-centered

approaches, ensuring accurate measurement while maintaining engagement. Selecting appropriate data collection tools is essential for assessing the effectiveness of DEGs in fostering SEL. These tools must balance scientific rigor with child-friendly methods, ensuring that data collection is both reliable and engaging for young children [25]. The reviewed studies employed a variety of methods, ranging from structured assessments to child-centered feedback tools. Future research could benefit from expanding interactive and gamified assessment techniques to align more closely with young children's developmental needs.

In conclusion, this review highlights the potential of DEGs to support SEL development in preschool education and their growing role in smart, inclusive, and adaptive learning ecosystems. The findings offer important guidance for researchers, designers, and policymakers seeking to implement high-quality, evidence-based digital tools. Addressing the gaps in skill coverage, participatory design, and assessment innovation will be critical to ensuring that DEGs are not only effective but also developmentally appropriate.

Although participatory design is increasingly recognized, our findings show limited direct involvement of children in the design process. The authors propose the following strategies to enhance effective inclusion: (1) adopt child-centered design methods such as storytelling and prototyping in order to empower children to shape game narratives, characters and mechanics; (2) involve educators and caregivers as co-mediators who can help translate children's preferences into actionable design goals while ensuring developmental appropriateness; (3) develop standardized frameworks for designing and evaluating similar tools; (4) ensure comprehensive coverage of all CASEL-5 competencies, recognizing their equal significance in fostering holistic development; (5) explore the scalability and long-term impact of similar DEGs across diverse educational settings. By doing so, DEGs can become powerful, evidence-based resources that nurture holistic SEL development in the foundational years of life.

Limitations. This study has limitations to consider. Studies analyzed were published in the last five years, potentially excluding earlier relevant research. Search was also restricted to specific databases (Scopus, ERIC, WoS, IEEE, ACM, EBSCO, ScienceDirect). The authors analyzed only articles published in the last five years, potentially excluding earlier relevant research. The research was also restricted to specific databases (Scopus, ERIC, WoS, IEEE, ACM, EBSCO and ScienceDirect), limiting access to studies in other sources, and focused exclusively on articles in English, Spanish, and Portuguese. Additionally, only peer-reviewed articles were considered, leaving out gray literature such as theses and technical reports. Future research could expand the analysis to include older studies, explore more databases, and investigate the impact of DEGs across different cultures and languages. Further studies could also compare the effectiveness of different types of DEGs, incorporate children's active involvement in game design, and assess the long-term impact of DEGs on SEL. Moreover, exploring questions about how DEGs compare to traditional teaching methods and the influence of specific game features on SEL would be valuable.

CRediT author statement. Conceptualization, Methodology, Formal analysis, Writing – Original Draft, Software **Oksana Tymoshchuk**: Validation, Software, Writing – review and editing, Supervision, Funding acquisition. **Ana Isabel**

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Appendix A. Inclusion and exclusion criteria by component

Component	Inclusion criteria	Exclusion criteria
Population	Studies focusing on preschool-aged children (ages 3-6) in formal or informal early childhood settings	Studies involving children outside the preschool-age or focusing on older children, adolescents or adults
Intervention	Digital games designed for educational purposes or SEL development, including video games, serious games, and game-based learning interventions.	Studies focusing exclusively on academic skill development without a clear SEL component. Studies on non-digital interventions.
Comparison	This component was not relevant for this study	
Outcome	Interventions with the aim of fostering SEL skills, including the CASEL-5 competencies (responsible decision making, self-awareness, self-management, social awareness, relationship skills)	Studies that do not assess SEL outcomes or lack clear evidence of SEL skill development
Study Design	Empirical studies (quantitative, qualitative, or mixed methods), including randomized controlled trials, quasi-experimental studies, case studies, and educational design research	Theoretical papers, literature reviews, opinion pieces or conceptual studies without empirical data. Studies that do not include fieldwork with preschoolers
Publication Type	Peer-reviewed open access journal articles published in Scopus, ERIC, WoS, IEEE, ACM, EBSCO or ScienceDirect	Non peer-reviewed articles, conference abstracts, book chapters, theses, and unpublished manuscripts
Language	Studies published in English, Spanish or Portuguese	Studies published in languages other than English, Spanish, or Portuguese

Appendix B. Data collection tools by article

Data collection tool	n	Percentage	Articles
Demographic information	8	44%	[37], [41], [42], [44], [45], [47], [48], [52]
Semi-structured interview	6	33%	[17], [40], [45], [47], [51], [52]
Usability assessment	5	28%	[39], [45], [47], [48], [53]
Nutrition literacy questionnaires	3	17%	[41], [42], [44]
Smileyometer	2	12%	[40, 42]
Unstructured interview	1	6%	[17]
Focus group	1	6%	[17]
Preschoolers' Demographics and ICT Use Survey	1	6%	[17]
Preschool Teacher Demographics and ICT Use Survey	1	6%	[17]
Pan European Game Information (PEGI)	1	6%	[40]
Full-Scale Intelligence Quocient (FSIQ)	1	6%	[41]
Autism Spectrum Quotient: Children's Version (AQ-Child)	1	6%	[41]
Spence Children Anxiety Scale (SCAS)	1	6%	[42]
Preschool Anxiety Scale	1	6%	[42]
Hand-eye coordination	1	6%	[41]
Fine motor skills	1	6%	[41]
Dynamic Systems Approach (DSA)	1	6%	[31]
State Space Grids	1	6%	[31]
Theory of Mind (ToM)	1	6%	[41]
Heuristic evaluation	1	6%	[40]
Questionnaire from *MindLight* [60] study	1	6%	[30]
Again Again	1	6%	[40]
Fun Sorter Table	1	6%	[40]
Attention Network Task (ATN)	1	6%	[43]
Corsi Task	1	6%	[43]
Stroop Task	1	6%	[43]
Test Of Nonverbal Intelligence (TONI)	1	6%	[43]
Flanker Task	1	6%	[42]
Verbal Information Subtask	1	6%	[42]
Matrix Reasoning Subtest	1	6%	[42]