

A Systematic Review of Serious Games for Training Emotion Regulation Skills in Preschool Children

Catarina Gonçalves, Eliana Silva and Luís Paulo Reis

LIACC/ FEUP, Artificial Intelligence and Computer Science Lab, Faculty of Engineering, University of Porto, Portugal

up201906638@fe.up.pt

elianasilva@fe.up.pt

lpreis@fe.up.pt

Abstract: Emotion regulation (ER) is a vital skill that supports children's social, emotional, and cognitive development. Although early childhood education plays a key role in nurturing these abilities, traditional teaching strategies often lack engagement and interactivity. Serious games (SGs) have emerged as an innovative tool to promote ER by providing immersive and interactive experiences tailored to young children. This systematic review examines the current landscape of SGs aimed at enhancing ER in preschool-aged children (3-5 years), focusing on methodologies, technological strategies, and research gaps. Following PRISMA guidelines, a literature search was conducted across IEEE Xplore, ScienceDirect, and Scopus, using predefined inclusion and exclusion criteria. From an initial pool of 343 records, 37 studies met the final eligibility criteria. Findings indicate that while SGs hold promise for supporting ER, most existing solutions target clinical populations, such as children with autism spectrum disorder, rather than normative samples of preschoolers. Furthermore, few studies employ a co-design approach involving educators, psychologists, and children, despite this being crucial for creating age-appropriate and engaging interventions. The integration of these games into formal educational settings also remains limited. This review highlights the lack of SGs designed specifically for ER in preschool-aged children. By identifying key needs and best practices, the review lays the groundwork for the development of a new game, currently underway, that aims to effectively and engagingly address this gap.

Keywords: Serious games, Emotion regulation, Preschool children, Education, Systematic review

1. Introduction

Emotion regulation (ER) in early childhood plays a critical role in a child's social, academic and psychological development. Delays or difficulties in ER can lead to long-term consequences in academic achievement, peer relationships and mental health. Therefore, it is essential to provide children with tools and strategies to support the healthy development of emotional competencies from an early age.

The ability to regulate emotions is closely tied to executive functions like attention control and inhibitory control, which also undergo rapid development during these years (Zelazo, Blair and Willoughby, 2016). For example, children with well-developed ER skills at this stage are better able to cope with stress, develop healthy friendships with peers, and succeed academically (McClelland et al., 2017).

The development of ER is also supported by key theories of child development and learning. Vygotsky's sociocultural theory emphasizes the importance of social interaction and play in the development of self-regulation, as children internalize emotional and behavioral norms through guided and imaginative activities (Vygotsky, 1978). In parallel, socio-emotional learning (SEL) frameworks highlight the role of early experiences in fostering emotional awareness, empathy, and coping strategies, which are foundational for long-term well-being and academic success (CASEL, 2020). These perspectives provide a theoretical basis for using playful, interactive tools to support ER during the preschool years.

Serious games (SGs), digital games designed for educational purposes, are gaining recognition as promising tools to enhance emotional learning. They provide age-appropriate, dynamic and captivating experiences that can encourage the play-based development of ER skills. They have the capacity to captivate children in particular and offer chances for repeated practice in secure, replicated settings. But in spite of its potential, the field is still dispersed, with limited research focusing on preschool-aged children in particular.

This paper provides a systematic review of SGs designed to support ER in preschool children aged 3 to 5. It aims to explore the current landscape, analyze methodological approaches, and identify technological strategies and research gaps. By doing this, the evaluation helps provide the groundwork for the creation of more inclusive and successful teaching resources for early emotional learning in the future.

2. Methodology

Data sources

The databases IEEE Xplore, ScienceDirect and Scopus were selected for their comprehensive coverage in engineering, psychology, and educational technology. The search aimed to identify empirical studies evaluating SGs developed to improve ER in children. Additionally, the findings from the literature search and the screening and inclusion steps were reported in the flow diagram of Figure 1.

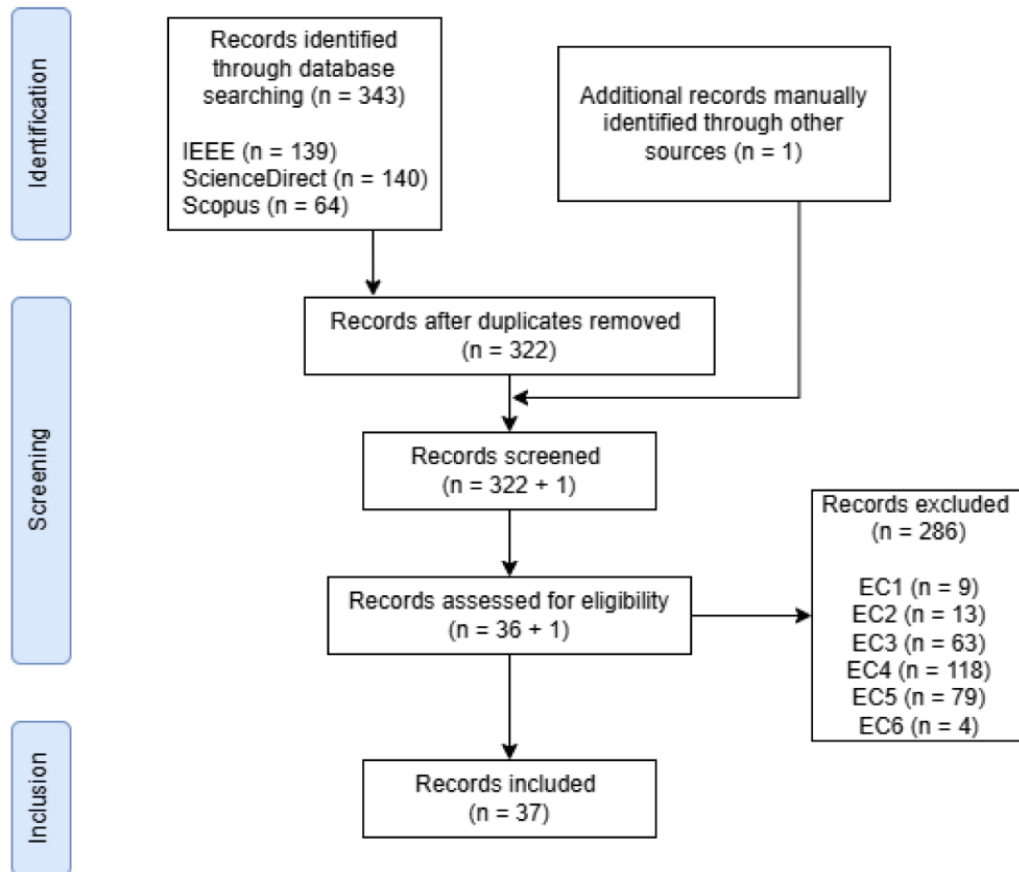


Figure 1 Prisma flow diagram

Inclusion and exclusion criteria

To ensure the relevance and quality of the research included in this review, a set of inclusion and exclusion criteria was applied. These criteria, outlined in Table 1, guided the selection process by filtering studies that aligned with the thesis objectives.

Table 1: Inclusion and exclusion criteria 1

Inclusion criteria	Exclusion criteria
IC1 Presents a game or application. IC2 Focused on emotion regulation or emotion. IC3 Includes children.	EC1 Publications not in English. EC2 Books, literature reviews, or book chapters. EC3 Studies focused on adults or adolescents. EC4 Studies that do not address emotion regulation. EC5 Studies that do not present a game or application. No full-text access available.

Search strategy

The query used: ("game" OR "platform" OR "app") AND ("emotion regulation" OR "emotional regulation" OR "emotion" OR "emotion dysregulation") AND ("children").

Screening and selection

After applying selection criteria, 37 studies were included in the final analysis.

3. Results

The majority of studies (over 70%) focused on children with Autism Spectrum Disorder (ASD) or other specific needs. Only 25% targeted typically developing children, and very few addressed preschool-aged learners explicitly. The distribution of studies, as shown in Figure 2, highlights this imbalance in the focus of the target population.

Most games were designed for computers, tablets, or web platforms. Only a minority involved co-design with educators, parents, or psychologists, which is essential for ensuring the games are developmentally appropriate and engaging.

Studies generally reported positive outcomes, such as improved emotional recognition and increased use of adaptive ER strategies. However, the evidence was often preliminary or qualitative, with limited long-term data.

An overview of these selected studies can be found in Table 2.

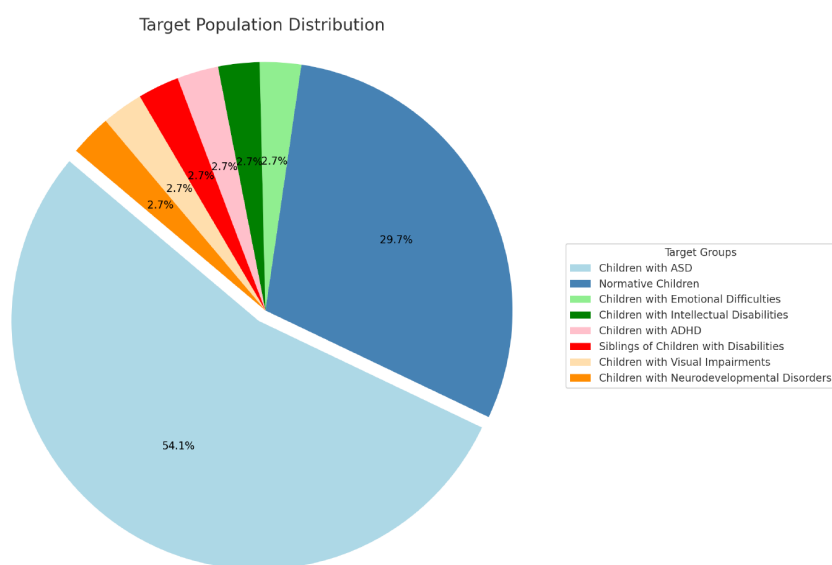


Figure 2 Distribution of studies by target population

Table 2: Overview of selected studies

Study	Game Name	Objective	Platform	Findings
Almeida et al. (2019)	ALTRIRAS	Train emotion recognition	Computer	Improved emotion recognition
Alves et al. (2013)	LIFEisGAME	Teach emotion expression	Computer	Potential improvement
Barba et al. (2022)	EMOLEARN	Emotion recognition & management	Computer	Potential support for learning
Carreño-León et al. (2021)	N/A	Emotion understanding	Computer	Positive reception
David et al. (2022)	REThink	Enhance emotion regulation	Online	Improvements linked to better mental health
DeRosier & Thomas (2018)	Zoo U	Assess social-emotional skills	N/A	Higher competence linked to school behavior
Elhaddadi et al. (2021)	JeStiMulE	Improve facial emotion recognition	N/A	Significant improvement
Fridenson-Hayo et al. (2017)	Emotiplay	Teach emotion recognition	Internet	Significant improvements

Study	Game Name	Objective	Platform	Findings
Fuentes García et al. (2015)	N/A	Teaching emotions	N/A	N/A
Gray et al. (2019)	BrainQuest	Enhance executive functions	Mobile	Qualitative improvements
Humphries & McDonald (2011)	Emotion Faces	Enhance emotion recognition	Touchscreen	Effective engagement
Lievense et al. (2021)	See	Improve self-concept	Computer	Significant improvements
Liu et al. (2021)	N/A	Improve social communication	N/A	N/A
Löytömäki et al. (2024)	Emotion Detectives	Teach emotion discrimination	Web	Significant improvements
Marchi et al. (2019)	ASC-Inclusion	Teach emotion recognition & expression	Internet	N/A
Moltrecht et al. (2021)	N/A	Support emotion regulation	Web	App perceived as helpful
Pacella & López-Pérez (2018)	Emodiscovery	Evaluate regulation strategies	Web	Adaptive strategies preferred
Papoutsis et al. (2024)	The Park of Emotions	Improve emotional intelligence	Web	Significant improvement
Ravale et al. (2023)	N/A	Improve learning/social skills	N/A	N/A
Vázquez-Reyes et al. (2023)	TEA Learning	Improve learning/social skills	N/A	N/A
Sandoval-Bringas et al. (2021)	N/A	Teach emotional/social skills	N/A	N/A
Shams et al. (2020)	EmoGalaxy	Compare emotion regulation tools	N/A	N/A
Sturm et al. (2016)	eMot-iCan	Improve emotion recognition	N/A	N/A
Veerman et al. (2024)	Broodles	Support siblings' emotions	Digital	Culturally acceptable
Wang et al. (2021)	N/A	Develop educational intervention	N/A	N/A
Weilun et al. (2011)	N/A	Rehabilitate socio-emotional skills	N/A	N/A
Wiguna et al. (2021)	N/A	Support ADHD symptoms	N/A	Improvements observed
Wintner et al. (2022)	Mightier	Improve emotion regulation	Online	Positive outcomes
Finkelstein et al. (2009)	cMotion	Teach emotion recognition	N/A	N/A
Dizicheh et al. (2021)	EmoAnim	Screen emotions	N/A	N/A
Heni & Hamam (2016)	N/A	Design emotion games	Mobile	N/A
Speer et al. (2021)	MindfulNest	Support emotion regulation	Tablet	Needed teacher guidance
Kashani-Vahid & Mohajeri (2018)	N/A	Enhance emotion regulation	N/A	Significant improvement

Study	Game Name	Objective	Platform	Findings
Piazzalunga et al. (2023)	N/A	Track emotion & attention	Tablet	Significant improvement
Stankova et al. (2021)	N/A	Train emotional understanding	N/A	Need for frequent training
Sudarmilah et al. (2015)	N/A	Identify game preferences	N/A	Preferred animal characters
Zoerner et al. (2016)	Zirkus Empathico	Train socio-emotional skills	Mobile	Showed potential

4. Conclusion

This systematic review reveals a significant gap in the current landscape of SGs for ER: there is a notable lack of interventions specifically designed for preschool-aged children. Most existing games are developed for older children or for those with developmental conditions, particularly ASD, leaving the needs of typically developing preschoolers largely unmet. This limited scope raises important considerations for researchers and game designers.

Many existing serious games lack core design features essential for this age group. For instance, few incorporate intuitive, non-verbal interaction methods (e.g., touch-based navigation, visual cues), or narrative frameworks that support emotional understanding through relatable characters and scenarios. Moreover, the absence of co-design with key stakeholders, particularly educators, psychologists, and the children themselves, often results in games that are misaligned with real-world educational contexts, cultural relevance, or user engagement needs. Co-design can ensure that emotional challenges, vocabulary, and gameplay mechanics are developmentally appropriate, and practically implementable in classroom or home settings. Another critical issue is the predominance of qualitative or exploratory findings in the current literature. While many studies suggest positive outcomes in terms of emotional recognition or regulation, the lack of rigorous methodologies, such as randomized controlled trials, longitudinal designs, and comparative analyses, limits the generalizability and scalability of these results. Without stronger empirical evidence, integrating SGs into formal curricula or therapeutic programs remains a challenge.

In conclusion, addressing these gaps is crucial for developing effective tools that foster ER skills during a foundational period of emotional development. Future game designers should prioritize features such as: multimodal interaction, emotionally intelligent characters and storylines, and a strong grounding in participatory design with early childhood experts and end-users.

This review lays the foundation for the development of a new serious game currently in progress, designed collaboratively with stakeholders and tailored to the needs of typically developing preschoolers. Moving forward, interdisciplinary and participatory research will be essential to ensure that digital interventions are not only evidence-based but also developmentally appropriate, engaging, and contextually relevant.

Acknowledgements

This work was financially supported by: UID/00027 of the LIACC - Artificial Intelligence and Computer Science Laboratory - funded by Fundação para a Ciência e a Tecnologia, I.P./ MCTES through the national funds.

Ethics declaration: No ethical approval was required for this literature-based study.

AI declaration: AI tools were used to support language refinement and the detection of grammatical errors. All ideas, analysis, and content were developed and validated by the author.

References

- Almeida, L., Silva, D., Theodório, D., Silva, W., Rodrigues, S., Scardovelli, T., Silva, A. and Bissaco, M. (2019) "ALTRIRAS: A computer game for training children with autism spectrum disorder in the recognition of basic emotions", *International Journal of Environmental Research and Public Health*, 2019.
- Alves, S., Marques, A., Queirós, C. and Orvalho, V. (2016) "LifeisGame prototype: A serious game about emotions for children with autism spectrum disorders", *Journal of Behavioral and Cognitive Therapy*, 11(3), pp. 191–211.
- Barba, A., Rufo, V., Iandolo, G. and García-Cuesta, E. (2019) "EMOLEARN-'las aventuras de marco'- a serious game to train emotions to children with ASD", *Computers & Education*, 3305.

- Carreño-León, M. A., Sandoval-Bringas, J. A., Encinas, I. D., Castro, R. C., Cota, I. E. and Carrillo, A. L. (2021) "Managing emotions in autistic children through serious game with tangible interfaces", in 2021 4th International Conference on Inclusive Technology and Education (CONTIE), pp. 126–133.
- Collaborative for Academic, Social, and Emotional Learning (CASEL) (2020) Core SEL competencies.
- David, O., Magurean, S. and Tomoiagă, C. (2022) "Do improvements in therapeutic game-based skills transfer to real life improvements in children's emotion regulation abilities and mental health? A pilot study that offers preliminary validity of the RETHink in-game performance scoring", *Frontiers in Psychology*, 13.
- DeRosier, M. E. and Thomas, J. M. (2016) "Establishing the criterion validity of zoo u's game-based social emotional skills assessment for school-based outcomes", *Journal of School Psychology*, 55, pp. 52–61.
- Dizicheh, E. G., Moradi, H., Nezam Abadi, M. B., Shahrokh, F., Samani, R., and Kashani-Vahid, L. (2021) "EmoAnim: A serious game for screening children with autism using emotions in animations," in 2021 International Serious Games Symposium (ISGS), pp. 75–80.
- Elhaddadi, M., Maazouz, H., Alami, N., Drissi, M., Mènon, C., Latifi, M. and Ahami, A. (2021) "N serious games to teach emotion recognition to children with autism spectrum disorders (asd)", *International Journal of Advanced Computer Science and Applications*, 19(1), pp. 81–92.
- Finkelstein, S. L., Nickel, A., Harrison, L., Suma, E. A., and Barnes, T. (2009) "cMotion: A new game design to teach emotion recognition and programming logic to children using virtual humans," in 2009 IEEE Virtual Reality Conference, pp. 249–250.
- Fridenson-Hayo, S., Berggren, S., Lassalle, A., Tal, S., Pigat, D., Meir-Goren, N., O'Reilly, H., Ben-Zur, S., Bölte, S., Baron-Cohen, S. and Golan, O. (2017) "Emotiplay': A serious game for learning about emotions in children with autism: results of a cross-cultural evaluation", *Journal of Autism and Developmental Disorders*, 26(8), pp. 979–992.
- García, N., Arcos, R., Vela, F., Rodríguez, P. and Zea, N. (2015) "Teaching emotions to children by using video games", *Proceedings of the 7th International Conference on Games and Virtual Worlds for Serious Applications*, 07-09 September.
- Gray, S. I., Robertson, J., Manches, A. and Rajendran, G. (2018) "BrainQuest: The use of motivational design theories to create a cognitive training game supporting hot executive function", *Computers in Human Behavior*, 127, pp. 124–149.
- Heni, N., and Hamam, H. (2016) "Design of emotional educational system mobile games for autistic children," in 2016 2nd International Conference on Advanced Technologies for Signal and Image Processing (ATSIP), pp. 631–637.
- Humphries, L. and McDonald, S. (2010) "Emotion faces: The design and evaluation of a game for preschool children", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 1453–1458.
- Kashani-Vahid, L., Mohajeri, M., Moradi, H., and Irani, A. (2018) "Effectiveness of computer games of emotion regulation on social skills of children with intellectual disability," in 2018 2nd National and 1st International Digital Games Research Conference: Trends, Technologies, and Applications (DGRC), pp. 46–50.
- Lievense, P., Vacaru, V. S., Kruithof, Y., Bronzewijker, N., Doeve, M. and Sterkenburg, P. S. (2020) "Effectiveness of a serious game on the self-concept of children with visual impairments: A randomized controlled trial", *Computers in Human Behavior*, 14(2), p. 101017.
- Liu, L., Meng, J., Wu, X. and Chen, J. (2021) "Avatarizing children with autism spectrum disorder into serious games for social communication skill intervention", in 2021 Tenth International Conference of Educational Innovation through Technology (EITT), pp. 299–303.
- Löytömäki, J., Ohtonen, P. and Huttunen, K. (2021) "Serious game the emotion detectives helps to improve social-emotional skills of children with neurodevelopmental disorders", *BJET - British Journal of Educational Technology*, 55(3), pp. 1126–1144.
- Marchi, E., Schuller, B., Baird, A., Baron-Cohen, S., Lassalle, A., O'Reilly, H., Pigat, D., Robinson, P., Davies, I., Baltrušaitis, T., Adams, A., Mahmoud, M., Golan, O., Fridenson-Hayo, S., Tal, S., Newman, S., Meir-Goren, N., Camurri, A., Piana, S., Bölte, S., Sezgin, M., Alyuz, N., Rynkiewicz, A., Baranger, A. (2018) "The ASC-inclusion perceptual serious gaming platform for autistic children", *IEEE Transactions on Games*, 11(4), pp. 328–339.
- McClelland, M.M., Tominey, S.L., Schmitt, S.A. and Duncan, R. (2017) 'SEL interventions in early childhood', *The Future of Children*, 27(1), pp. 33–47.
- Moltrecht, B., Patalay, P., Deighton, J. and Edbrooke-Childs, J. (2021) "A school-based mobile app intervention for enhancing emotion regulation in children: Exploratory trial", *Journal of Medical Internet Research*, 9(7).
- Pacella, D. and López-Pérez, B. (2018) "Assessing children's interpersonal emotion regulation with virtual agents: The serious game emodiscovery", *Computers in Human Behavior*, 123, pp. 1–12.
- Papoutsis, C., Drigas, A., Skianis, C., Skordoulis, C. and Pappas, M. (2020) "The Park of Emotions': A serious game for the development of emotional intelligence in children", *Applied Sciences*, 14(14).
- Ravale, U., Gnanasekar, D., Kulkarni, S. and Suryanarayan, L. (2023) "An interactive game based learning model for autistic children", in 2023 7th International Conference on Intelligent Computing and Control Systems (ICICCS), pp. 1–6.
- Piazzalunga, C., Molino, P., Giangregorio, C., Fontolan, S., Termine, C., and Ferrante, S. (2023) "Development and validation of an iPad-based serious game for emotion recognition and attention tracking towards early identification of autism," in 2023 11th International Conference on Affective Computing and Intelligent Interaction Workshops and Demos (ACIIW), pp. 1–8.

- Reyes, S. V., Gutierrez Villalobos, M. V., Galván Tejada, C. E., Velasco-Elizondo, P., Hernández, A. G. and González, A. M. (2023) "Serious game prototype based on strategies for children with autism spectrum disorder: Learning with 'TEA'", in 2023 11th International Conference in Software Engineering Research and Innovation (CONISOFT), pp. 140–149.
- Sandoval-Bringas, J., Carreño-León, M., Álvarez Robles, T., Durán-Encinas, I., Leyva-Carrillo, A. and Estrada-Cota, I. (2020) "Use of a video game with tangible interfaces to work emotions in children with autism", *Lecture Notes in Computer Science (LNCS)*, 13096, pp. 295–305.
- Shams, Z., Kashani-Vahid, L. and Moradi, H. (2020) "Comparing the effectiveness of 'EmoGalaxy video game' with 'card games' on emotion regulation of children with autism spectrum disorder", in 2020 International Serious Games Symposium (ISGS), pp. 94–98.
- Speer, S., Hamner, E., Tasota, M., Zito, L., and Byrne-Houser, S. K. (2021) "MindfulNest: Strengthening emotion regulation with tangible user interfaces," in *Proceedings of the 2021 International Conference on Multimodal Interaction*, pp. 103–111.
- Stankova, M., Mihova, P., Kamenski, T., and Mehandjijska, K. (2021) "Emotional understanding skills training using educational computer game in children with autism spectrum disorder (ASD) - case study," in 2021 44th International Convention on Information, Communication and Electronic Technology (MIPRO), pp. 672–677.
- Sturm, D., Peppe, E. and Ploog, B. (2016) "eMot-iCan: Design of an assessment game for emotion recognition in players with autism", in 2016 IEEE International Conference on Serious Games and Applications for Health (SeGAH), pp. 1–7.
- Sudarmilah, E., Susanto, A., Ferdiana, R., and Ramdhani, N. (2015) "Developing a game for preschoolers: What character, emotion and reward will tend to hack preschoolers?" in 2015 International Conference on Data and Software Engineering (ICoDSE), pp. 89–92.
- Veerman, L. K. M., Fjermestad, K. W., Vatne, T. M., Sterkenburg, P. S., Derks, S. D. M., Brouwer-van Dijken, A. A. J. and Willemen, A. M. (2024) "Cultural applicability and desirability of 'broodles': The first serious game intervention for siblings of children with disabilities", *ScienceDirect*, 4, p. 100277.
- Vygotsky, L. S. (1978) *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
- Wang, G., Zheng, S., Zhang, K. and Wang, X. (2021) "The intervention model for children with autism spectrum disorder based on educational game", in 2021 IEEE International Conference on Engineering, Technology & Education (TALE), pp. 695–702.
- Weilun, L., Elara, M. R. and Garcia, E. M. A. (2011) "Virtual game approach for rehabilitation in autistic children", in 2011 8th International Conference on Information, Communications & Signal Processing, pp. 1–6.
- Wiguna, T., Ismail, R. I., Kaligis, F., Minayati, K., Murtani, B. J., Wigantara, N. A., Pradana, K., Bahana, R., Dirgantoro, B. P. and Nugroho, E. (2021) "Developing and feasibility testing of the Indonesian computer-based game prototype for children with attention deficit/hyperactivity disorder", *ScienceDirect*, 7(7), p. e07571.
- Wintner, S. R., Waters, S. E., Peechatka, A., Gonzalez-Heydrich, J. and Kahn, J. (2020) "Evaluation of a scalable online videogame-based biofeedback program to improve emotion regulation", *Journal of Behavioral Health and Medicine*, pp. 1–12.
- Zelazo, P.D., Blair, C. and Willoughby, M.T. (2016) *Executive function: Implications for education*. Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. Technical Report.
- Zoerner, D., Schütze, J., Kirst, S., Dziobek, I., and Lucke, U. (2016) "Zirkus empathico: Mobile training of socio-emotional competences for children with autism," in 2016 IEEE 16th International Conference on Advanced Learning Technologies (ICALT), pp. 448–452.