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Characteristics and Efficacy of Play Therapy Interventions in Visually Impaired Children and Adolescents: A Systematic Review Study

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Abstract

Background: Visual impairment can hinder achieving developmental markers in children. Various studies have examined the effectiveness of play therapy in children with visual impairment. However, lack of a comprehensive review study that examined the characteristics and overall effectiveness of these interventions, led to conducting of the present study.
Objectives: This study aimed to provide strong evidence on the characteristics and efficacy of play therapy interventions in children and adolescents (0-21 years) with visual impairment.
Methods: Our literature searching was done with English and Persian keywords obtained from Mesh in the Cochrane, PubMed, Scopus, Web of Science, Magiran, Iran Medex, Iranian Archive for Scientific Documents Center (IASD), Iranian National Library (INL), Google and Google Scholar, until 2020. The selection process of articles was according to PRISMA. Text data was analyzed by convention content analysis. Additionally, the modified Downs and Black Checklist was used to assess the quality of primary studies.
Results: From 1763 articles, finally nine were analyzed which met the inclusion criteria. The major findings were presented in the categories of on participants, implementation, measurements, and efficacy of interventions. All subjects were with visual impairment, without severe physical or cognitive impairment. Play interventions were done by children, or with operational children and their caregivers or parents. Play therapy interventions were in two forms of computer/video based game and child-therapist/parent based game, which were conducted in different settings resembling home, school, or sport camp conditions. Data were gathered by observation of researchers and reports of children using different questionnaires. All of the interventions were effective in improving cognitive, visual, physical, communicative and vestibular skills of the children.
Conclusions: Despite the comprehensive efficacy of play therapy intervention in children with visual impairment, few studies have been conducted in this field. Considering multi-biases such as missing control of confounders, more high quality standard studies are needed to further evaluate the effectiveness of play therapy in children with visual impairments.

Keywords: Play therapy, Visual impairment, Review study, Children

1. Background

A physical or psychological disability can hinder achieving developmental markers in children (1). Visual impairment, restricts the reduction of visual stimuli, acquisition of physical, perceptual, cognitive, psychosocial abilities, and also their self-concept, self-esteem, and playing ability (2, 3). Seventy percent of body sensory receptors are vision-related, and according to the motor learning theory, our visual receptors sense play an important role in integrating information, formulating concepts, planning, environmental adaptation, and recognition (2-4), Therefore, children with visual impairment are deprived of access to such physical, social, and functional skills. As defined by the International Classification of Diseases (ICD-10), visual function is divided into four categories of normal vision, moderate visual disability, severe visual disability, and blindness (5-7).

A play experience could have therapeutic effect as it gives a secure relationship between the child and the parents/adults, so the child could have independence and space to state him/herself in his/her terms (8). Also, to provide opportunities for expression and fun, play improves children's physical, linguistic, cognitive, and socio-emotional health (9). The play transfers children from solitude to more interactive social environments (10). The stages of transition include single play, observer play, collateral play, associable play, and supportive play (10). Neuroscience scientists found that playing games re-

leases high amounts of dopamine in the human brain. Dopamine is linked to enhanced knowledge, reinforcement of the general behavior, and attention (11). Health problems in children can hinder their growth development. Children with physical disabilities like visual impairment, need to be resilient to overcome their limitations (12). IT based or traditional games may improve resiliency of the low vision children.

IT based games combine techniques, theories and skills to create a new game that is different from traditional games, which involve full body movement rather than just a thumb on a controller that leads to a specific learning goal (13, 14). IT-based ramified enhancing services have different benefits such as increasing child satisfaction, self-confidence and facilitating social interaction (15). This mechanism facilitates the understanding of control, independence and entertainment, and increases motivation and performance (16). Traditional play could increase social connection of visually impaired children with their teachers, parents and peers by competition, social interaction, or cooperation (17).

A number of studies have shown that inactive video games and computer use may reduce the level of physical activity in children (18-20). However, there is evidence that active video games have a positive effect on children's development (21, 22); increased visual field (23), reaction time (24), attention (25), energy expenditure (26), and enjoyment levels of play (27, 28).

As mentioned above, various studies have examined the effectiveness of different types of traditional and IT-based play therapy interventions on the functional ability of children with controversial results. Each of these studies examined the effectiveness of different types of rehabilitation interventions in a specific area of functional development in children with visual impairment. However, a comprehensive study to evaluate the effectiveness of all play therapy interventions on different physical, cognitive, functional, social and developmental dimensions of these children has not yet been conducted.

Conducting such a systematic review study seems necessary because it can get more supplementary and detailed information about the types of performed play therapies, reviewing and comparing of their effectiveness, used tools and questionnaires, and identifying related existing gap of knowledge and biases.

2. Objectives

Due to lack of review studies related to the effectiveness of play therapy interventions on children with visual impairment, we conducted the present review study to obtain more information about the type of play therapy interventions performed, their duration, frequency, and effectiveness on visually impaired children.

3. Methods

3.1. Search Strategy

This systematic review of play therapy in visually impaired children was conducted according to studies published in national and international journals in English and Persian languages until May 2020. The Cochrane, PubMed, Scopus, Web of Science, Magiran, Iran Medex, Iranian Archive for Scientific Documents Center (IASD), and Iranian National Library (INL), Google Scholar and Google were assessed. Reference lists of primary studies were also searched by hand. The keywords of play, game, leisure, visual impairment, low vision, blind, vision, visual, and syntheses of these with Boolean operators and "*" were utilized to find related studies. The extraction process of articles from the literature followed PRISMA guidelines (29).

3.2. Study Selection and Data Extraction

All interventional play therapy with random or non-random, quasi-experimental, or pre-test and post-test designs were included in this study. The study population consisted of school-age participants under the age of 21 whose main disability was visual dysfunction or blindness. The interventions of interest included any form of play therapy. The non-interventional or observational studies, letters, and articles with outcome measures of visual acuity, visual field, and evaluation related to eye structure disorders like amblyopia were excluded. During reviewing of the literature, two researchers (F.G and M.J) critically evaluated titles and abstracts of studies and for related ones, the full texts were assessed. Any doubt between two analysts was solved by argument and agreement.

A data form used to extract data including author's name, year of study, the visual status of the studied children, sample size, age, setting, intervention, duration, measurement, main finding, follow up, and quality scores.

3.3. Quality Assessment

The modified Downs and Black checklist with acceptable validity and inter-rater reliability (30), was used to assess study's quality. This checklist is with five subscales related to the assessment of internal and external validity, bias, confounders, and power. The score range of the scale was as excellent (26-28); good (20-25); fair (15-19), and poor ($\leq$ 14) (30). The checklist evaluates both randomized controlled and non-controlled trials (30). All the studies were of acceptable quality and all of them underwent the analysis.

3.4. Data Analysis

The text data of primary studies were analyzed using conventional content analysis (31). After repeated evaluation of the results, primary codes were recognized and classified in different groupings according to degree of likeness.

4. Results

4.1. Study Characteristics

All studies related to play therapy interventions were systematically evaluated with the PRISMA guidelines (Figure 1) until May 2020. In the first search, 1757 articles were identified, after removing duplicated ones, the headline and abstracts of 153 articles were checked out, and finally, nine suited studies offered for analysis. The quality score of the primary selected articles was good (32, 33), fair (34-39), and poor (40). The sample size of nine studies was totally 448 children under 21 years old. The smallest and biggest sample size was that of Skellenger (35) and Shesterova et al. (39), respectively. The design of all studies was quasi-experimental. Out of nine primary studies four originated from USA (36, 37, 39, 40), one from United Kingdom (34), two from the Netherlands (32, 33), and one from Ukraine (39). The studies were published during 1990 and 2020. More data and characteristics of the primary studies are presented in Table 1.

After reviewing the results of the studies, we classified findings in four categories of participants, implementation, measurements, and efficacy.

4.2. Participants

The participants were characterized as completely blind (35, 37), visually impaired and completely blind (38, 40), with homonymous visual field loss (HVFL) (sectoral defect to complete hemianopia) (34) and only with visual impairment (32, 33, 36, 39). All participants were able to play on the floor with small objects or play with electronic games. They did not have orthopedic disorders, cognitive impairment (IQ-score above 70), hearing defect, and were without or with mild or moderate physical disabilities. In one study, the children played with caregivers or their parents at home (40) and in the rest of the studies, children played alone or with the guidance of a therapist or a teacher. As a control group in studies participated normal sighted classmates. The etiology of visual impairment was Oculocutaneous albinism, congenital cataract, congenital nystagmus, rightsided Aphakia, retinitis pigmentosa, retinal dystrophy, Steven Johnson Syndrome, damaged cornea, achromatopsia, strabismus, glaucoma, bilateral anophthalmia and Vitreo-retinopathy. According to the World Health Organization classification. the severity of the participants' visual impairment has been categorized in three ranges of mild (visual acuity between 6/18 and 6/60), severe (visual acuity between 6/60 and 3/ 60) and blindness (visual acuity < 3/60) (5).

4.3. Implementation

Two types of play therapy interventions were conducted in the studies. The first type of intervention was based on child-therapist/parent play therapy or active games and the second one was related to computer/video games.

Three studies were in the first category of intervention (35, 39, 40), and the others were related to the second one (32-34, 36-38). Interventions were implemented at home (34, 40), school (32, 33, 35, 38, 39), or sport camp (36, 37). A preparation phase for participants before starting the intervention was done in all (32, 34, 36, 37, 39, 40) but two (33, 35) studies. The studies had 2 to 80 interventional sessions. Each session's duration varied from five to 180 minutes and consisted of a structured and nonstructural intervention. Playing of games were repeated 1 - 15 times in each session.

There were different IT-games including dance, dance, revolution [DDR]; EyeToy Kinetic; and Wii Boxing) (36), Multimodal Video Game (34, 36, 38), audio-based environment simulator (AbES) (37), and augmented toys (33), These games are an interactive video game with sensory, visual, auditory, and haptic feedback. All participants in this group were powerful users of technology such as smartphones, computers, email and text messages, and entertainment devices such as iPads.

Child-parents, peer or caregiver's cooperative play consist of singing, movement like dance, explore musical instruments, and experience turn-taking, reading books and stories which helped to increase the fine and gross movements of children, their cognitive status and socialization (35, 39, 40).

4.4. Measurements

The data were collected by two methods of data gathering including observation of researchers and reports by children. Related to the observational method, Social and cognitive play observation scale (32, 33), Individual Social Behavior scale (33), and a researcher-made form (35) were used. Also, some others were based on outcome measurements. These invluded tabletop tests of visual search ability (34), moderate-to-vigorous physical activity (MVP) (36), assessment of behavioral performance (37), Oregon Project for Visually Impaired Preschool kids test (40), Orientation & mobility evaluation (38), the stability of the vestibular analyzer (39), Social Cognitive Skills Test

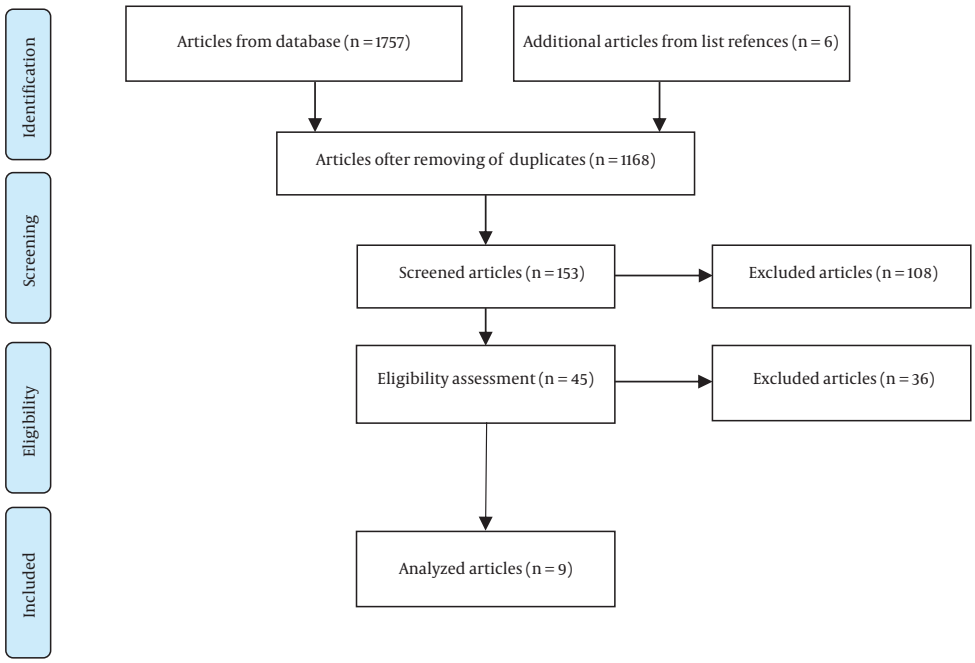

Figure 1. Articles selecting process based on PRISMA

(33), Vocabulary subtest of the Wechsler Intelligence scale for children-III (WISC-III) (33), and the Wechsler Preschool scale of Intelligence-III (33). Related to the children's reports method, two questionnaires were used including Cardiff Visual Ability questionnaire for Children (CVAQC) (34), and the Impact of Vision Impairment for Children (IVI-C) questionnaire.

4.5. Efficacy

All studies reported a positive effect of the interventions. The interventions improved some characteristics in children including play skills (32, 33, 35), visual functions (34), physical activity levels (36), navigation skills (37, 38), functional state of the vestibular (39), and cognitive, dialect, compensatory, self-help, community, fine motor, and gross motor skills (40) positively.

In navigation skills, spatial cognition skills (37), tempo-spatial orientation and mobility skills improved after video game interventions (38). According to the play skills, although collateral behavior (35), transition behaviors (35), shared attention (32), parallel play (32, 33), social interaction (33) and object exploration (33) increased, but purposeful simple manipulation (35), involvement (35), perseverative/self-stimulation (35), disengagement (32), and cooperative play (32, 33) decreased. In one study engaging with gamified compensatory training and time to discover things throughout tabletop works improved by an average of 24% - 95% CI (2%, 46%) after training (34). In the others, physical activity levels increased significantly ($P < 0/05$) (36). Improvement in cognitive, verbal, recovery, visibility, self-help, public, fine motor, and gross motor ability sets were seen after Oregon Project intervention (40) and the indicators of the functional state of the vestibular analyzer also significantly improved ($P < 0.05$) after intervention (39).

4.6. Quality of Studies

Quality of studies was assessed using the modified Downs and Black checklist for the nine included studies (Table 1). The range of scores among studies was 14 - 25.

Common biases and faults in the studies were missing the controlling of confounders, not reporting of adverse events, or the detailed attributes of the participants, like the categorization system of visual impairment. In addition, the studies were not conducted as a randomized clinical trial. In some studies, it seemed that detailed information about the intervention protocol or main findings was not provided.

5. Discussion

The purpose of our study was to assess the published articles on play therapy interventions in children and adolescents with visual impairment. We categorized findings

as participants, implementation, measurements, and efficacy of interventions.

Most of the initial studies found in this article were of fair quality articles and were quasi-experimental studies. Two kinds of play therapy interventions were used for children with visual impairment. Play with and without electronics. In some studies, the support of parents or adults was used in the play of these children whereas in others children played alone. This study also showed that both play therapy methods can improve fine and gross motor skills, cognitive skills, interaction, functional vision, balance and orientation in children and adolescents with visual impairment. A past systematic review was conducted on physical activity interventions in kids and youth with visual impairment by Piva et al. (sited in Furtado et al.) (41). A part of their main finding was focused on assessing physical activity interventions, which were the training of structured exercise, physical activity, and instructional strategy interventions on physical fitness, motor skills, and active lifestyle. Their result is consistent with our findings especially in the characteristic of participants and they suggested a need for a high-quality study with a specific protocol with more sample size and valid measurement in future.

Also, improvement and promotion of growth abilities of children with visual impairment in our findings are in line with other studies conducted in this field (42-44). In blind children, action video game play could result in changes and enhancement in spatial attention ability (45). In our study, the interventions had a positive effect on the balance and vestibular system and functional status of children. Studies revealed that vestibular function can be affected with the help of special motor exercises (39, 46), although some studies have reported that children with vision problems may face difficulties and challenges in performing the interventions (47-49). However, the findings of our study showed that children with low vision had similar performance and active participation compared to sighted children. This may be due to the increase in effectiveness of new computer-based games in attracting visually impaired children and increasing their focus on interventions. Findings of our study indicate the positive effect of new games in increasing social participation activities of visually impaired children in line with the other studies (33).

Developing a game especially for visually impaired children is often difficult as it has many facets and requires technical skills in various areas, such as illustration, sound and storytelling. People often do developing a game from different disciplines in the fields from creativity to scientific backgrounds which eventually congregate. MDA framework is the most frequently used framework for game design and game research and was presented by Hunicke et al. The MDA framework standing for mechanics, dynamics and aesthetics is a formal approach for understanding games. The MDA framework allows us to reason explicitly about particular design goals, and anticipates how changes will impact each aspect of the framework and the resulting design/implementation (11).

Due to the importance of play in promoting various aspects of development, especially in children with visual impairment who are delayed in acquiring developmental skills compared to their peers, it is suggested that in addition to addressing educational, sensory-motor, cognitive and social issues, to pay attention to the development of play skills and develop suitable games, which is an important factor in the development of other basic skills of children and adolescents.

5.1. Quality of Studies

We discovered several methodological biases after applying the modified Downs and Black checklist. One typical origin of bias was the failure of most studies to clearly describe or use a visual impairment classification system. Another fault was not having a clear play therapy intervention protocol as discussed in a past review (41) and not reporting the effect size which challenges the generalization of findings. As in a previous review, Bakke et al. (50) emphasized the need for more developing a valid and reliable assessment in children with visual impairment, in our study we found that many used assessments lacked reporting of their psychometric properties. In analyzing data, the effects of confounder variables have not been assessed and controlled which was hinted in a similar previous study (51). Except for two studies (32, 33), other early studies were not of high quality. Most of them did not have precise explanations about randomization, blinding, and follow-up of samples, while are needed in high-quality studies to generalize it to all children with impaired vision. In addition, a low sample size and heterogeneity of participants were other issues of studies. These issues hinder us draw firm conclusions about play therapy intervention effects in this population.

5.2. Strengths and Limitations

As a limitation in our study the number of primary articles was limited and we were not able to analyze more articles. Because of varying instruments used in the primary studies, we were unable to compare the effectiveness of interventions with each other, and our searching was restricted to English and Persian languages, even though, this study had some strengths like assessing of wide internal and external database and searching engine, extrac-

tion of extensive primary data from the studies, assessing of methodological quality, and conduction the review based on the PRISMA statement.

5.3. Recommendations

Since we found that play therapy interventions could facilitate the improved growth of visually impaired and blind children and decrease the delay in their functions, so the following recommendations seem necessary:

1) Future studies need to be conducted with more quality and controlling of confounders.

2) Intervention programs should be described clearly and in full detail, other researchers as needed can perform that.

3) More standardized assessments should be applied to different studies that can be comparable.

4) For enhancing the children's social participation, there is a need to conduct play interventions via groups.

5) It is recommended to pay more attention to the adaptation of the environment and compensatory techniques.

5.4. Conclusion

Although our study revealed new and overall information related to the play therapy interventions for children and adolescents with visual impairment like its positive effect on different growth dimensions as play skills, visual functions, physical activity levels, navigation skills, vestibular and cognitive abilities, verbal, compensatory, self-help, fine and gross motor skills, the lack of homogeneity in the finding of primary studies made it impossible for us to do a meta-analysis. Unfortunately, since the importance of considering the impact of play on visually impaired children has been emphasized many times in the past, few studies have yet investigated it. Therefore conducting more high quality studies in this field seems needed.

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Footnotes

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References

1. Filaccio MD. *Child-centered play therapy for children with low vision: A multiple case study*. University of Northern Colorado; 2008.
2. Hinojosa J; Kramer P. *frame of reference for pediatric occupational therapy*. 3 th ed. Philadelphia; 2010. 602 p.
3. Pogrund RL, Fazzi DL. *Early focus: Working with young blind and visually impaired children and their families*. American Foundation for the Blind; 2002.
4. Magill R, Anderson D. *Motor learning and control*. McGraw-Hill Publishing; 2010.
5. World Health Organization (WHO). *Consultation on development of standards for characterization of vision loss and visual functioning*. Geneva, Switzerland, 4-5 September 2003; 2012. Available from: wwwwhoint/blindness/partnerships/research/en/indexhtml.
6. Kazem M, Joghataei M, Siadati S, Rahgozar M. Epidemiology of visual impairment in Iran. *J Med Council Iran*. 2000;**19**(3):203–9.
7. Bourne RR, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *Lancet Glob Health*. 2017;**5**(9):e888–97. doi: 10.1016/s2214-109x(17)30293-0.
8. Axline VM. *Play therapy*. New York: Ballantine; 1969.
9. Klein TP, Wirth D, Linas K. Play: Children's context for development. *Young Children*. 2003;**58**(3):38–45.
10. Frost JL, Wortham SC, Reifel RS. *Play and child development*. Pearson/Merrill Prentice Hall Upper Saddle River, NJ; 2008.
11. Karimi K, Nickpayam J. Gamification from the viewpoint of motivational theory. *Emerging Science Journal*. 2017;**1**(1):34. doi: 10.28991/esj-2017-01114.
12. Gamble B, Crouse D. Strategies for supporting and building student resilience in canadian secondary and post-secondary educational institutions. *SciMed J*. 2020;**2**(2):70–6. doi: 10.28991/SciMedJ-2020-0202-4.
13. Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness. *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*. 2011. 9 p.
14. Simões J, Redondo RD, Vilas AF. A social gamification framework for a K-6 learning platform. *Comput Hum Behav*. 2013;**29**(2):345–53. doi: 10.1016/j.chb.2012.06.007.
15. McGonigal J. *Reality is broken: Why games make us better and how they can change the world*. Penguin; 2011.
16. de G; Markus. Why break the habit of a lifetime? Rethinking the roles of intention, habit, and emotion in continuing information technology use. *MIS Quarterly*. 2009;**33**(3):433. doi: 10.2307/20650303.
17. Malone T. Toward a theory of intrinsically motivating instruction. *Cognitive Science*. 1981;**5**(4):333–69. doi: 10.1016/s0364-0213(81)80017-1.
18. Boone JE, Gordon-Larsen P, Adair LS, Popkin BM. Screen time and physical activity during adolescence: longitudinal effects on obesity in young adulthood. *Int J Behav Nutr Phys Act*. 2007;**4**:26. doi: 10.1186/1479-5868-4-26. [PubMed: 17559668]. [PubMed Central: PMC1906831].

19. Nelson MC, Neumark-Stzainer D, Hannan PJ, Sirard JR, Story M. Longitudinal and secular trends in physical activity and sedentary behavior during adolescence. *Pediatrics*. 2006;**118**(6):e1627–34. doi: 10.1542/peds.2006-0926. [PubMed: 17142492].
20. Vandewater EA, Huang X. Parental weight status as a moderator of the relationship between television viewing and childhood overweight. *Arch Pediatr Adolesc Med*. 2006;**160**(4):425–31. doi: 10.1001/archpedi.160.4.425. [PubMed: 16585489].
21. Yang S, Foley J. Exergames get kids moving. *Breakthrough Teaching and Learning*. Springer; 2011. p. 87–109. doi: 10.1007/978-1-4419-7768-7_6.
22. Gray T, Silver-Pacuilla H. *Breakthrough teaching and learning: How educational and assistive technologies are driving innovation: Springer Science & Business Media*. Germany: Springer; 2011.
23. Green CS, Bavelier D. Action video game modifies visual selective attention. *Nature*. 2003;**423**(6939):534–7. doi: 10.1038/nature01647. [PubMed: 12774121].
24. Castel AD, Pratt J, Drummond E. The effects of action video game experience on the time course of inhibition of return and the efficiency of visual search. *Acta Psychol (Amst)*. 2005;**119**(2):217–30. doi: 10.1016/j.actpsy.2005.02.004. [PubMed: 15877981].
25. Boot WR, Kramer AF, Simons DJ, Fabiani M, Gratton G. The effects of video game playing on attention, memory, and executive control. *Acta Psychol (Amst)*. 2008;**129**(3):387–98. doi: 10.1016/j.actpsy.2008.09.005. [PubMed: 18929349].
26. Wang X, Perry AC. Metabolic and physiologic responses to video game play in 7- to 10-year-old boys. *Arch Pediatr Adolesc Med*. 2006;**160**(4):411–5. doi: 10.1001/archpedi.160.4.411. [PubMed: 16585487].
27. Boffoli N, Foley JT, Gasperetti B, Yang SP, Lieberman L. Enjoyment levels of youth with visual impairments playing different exergames. *AER J*. 2011;**4**(4):171–6.
28. Wood RT, Griffiths MD, Parke A. Experiences of time loss among videogame players: an empirical study. *Cyberpsychol Behav*. 2007;**10**(1):38–44. doi: 10.1089/cpb.2006.9994. [PubMed: 17305447].
29. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol*. 2009;**62**(10):e1–34. doi: 10.1016/j.jclinepi.2009.06.006. [PubMed: 19631507].
30. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health*. 1998;**52**(6):377–84. doi: 10.1136/jech.52.6.377. [PubMed: 9764259]. [PubMed Central: PMC1756728].
31. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res*. 2005;**15**(9):1277–88. doi: 10.1177/1049732305276687. [PubMed: 16204405].
32. Verver SH, Vervloed MPJ, Steenbergen B. The use of augmented toys to facilitate play in school-aged children with visual impairments. *Res Dev Disabil*. 2019;**85**:70–81. doi: 10.1016/j.ridd.2018.11.006. [PubMed: 30481675].
33. Verver SH, Vervloed MP, Steenbergen B. Facilitating play and social interaction between children with visual impairments and sighted peers by means of augmented toys. *J Dev Phys Disabil*. 2019;**32**(1):93–111. doi: 10.1007/s10882-019-09680-6.
34. Waddington J, Linehan C, Gerling K, Williams C, Robson L, Ellis R, et al. Evaluation of eyelander, a video game designed to engage children and young people with homonymous visual field loss in compensatory training. *AER J*. 2018;**112**(6):717–30. doi: 10.1177/0145482x1811200607.
35. Skellenger AC. Play as a means for increasing multiple skills of young children with visual impairments. *Peabody J Educ*. 1990;**67**(2):34–40. doi: 10.1080/01619569009538679.
36. Gasperetti BA, Foley JT, Yang S, Columna L, Lieberman LJ. Comparison of three interactive video games for youth with visual impairments. *Br J Vis Impair*. 2018;**36**(1):31–41. doi: 10.1177/0264619617735143.
37. Connors EC, Chrastil ER, SÃ¡nchez J, Merabet LB. Action video game play and transfer of navigation and spatial cognition skills in adolescents who are blind. *Front Hum Neurosci*. 2014;**8**. doi: 10.3389/fnhum.2014.00133.
38. Sánchez J, Saenz M, Garrido JM. Usability of a multimodal video game to improve navigation skills for blind children. *ACM Trans Access Comput*. 2010;**3**(2):1–29. doi: 10.1145/1857920.1857924.
39. Shtsterova LY, Riadova L, Yefremenko A, Masliak I, Kryvoruchko N, Bala T, et al. Influence of specifically aimed exercises and active games on indicators of the functional state of the vestibular sensory system in 10–16-year-old children with visual impairments. *J Phys Edu Sport*. 2019.
40. Jacko VA, Mayros R, Brady-Simmons C, Chica I, Moore J. Blind babies play program: A model for affordable, sustainable early childhood literacy intervention through play and socialization. *J Vis Impair Blind*. 2019;**107**(3):238–42. doi: 10.1177/0145482x1310700310.
41. Furtado OL, Allums-Featherston K, Lieberman LJ, Gutierrez GL. Physical activity interventions for children and youth with visual impairments. *Adapt Phys Activ Q*. 2015;**32**(2):156–76. doi: 10.1123/APAQ.2014-0164. [PubMed: 25799595].
42. Bavelier D, Green CS, Dye MW. Children, wired: for better and for worse. *Neuron*. 2010;**67**(5):692–701. doi: 10.1016/j.neuron.2010.08.035. [PubMed: 20826302]. [PubMed Central: PMC3170902].
43. Bavelier D, Green CS, Han DH, Renshaw PF, Merzenich MM, Gentile DA. Brains on video games. *Nat Rev Neurosci*. 2011;**12**(12):763–8. doi: 10.1038/nrn3135. [PubMed: 22095065]. [PubMed Central: PMC4633025].
44. Chebat DR, Schneider FC, Kupers R, Ptito M. Navigation with a sensory substitution device in congenitally blind individuals. *Neuroreport*. 2011;**22**(7):342–7. doi: 10.1097/WNR.0b013e3283462def. [PubMed: 21451425].
45. Spence I, Feng J. Video games and spatial cognition. *Rev Gen Psychol*. 2010;**14**(2):92–104. doi: 10.1037/a0019491.
46. Melo RS, Lemos A, Paiva GS, Ithamar L, Lima MC, Eickmann SH, et al. Vestibular rehabilitation exercises programs to improve the postural control, balance and gait of children with sensorineural hearing loss: A systematic review. *Int J Pediatr Otorhinolaryngol*. 2019;**127**:109650. doi: 10.1016/j.ijporl.2019.109650. [PubMed: 31466025].
47. Guralnick MJ, Connor RT, Hammond M. Parent perspectives of peer relationships and friendships in integrated and specialized programs. *Am J Ment Retard*. 1995;**99**(5):457–75.
48. Hestenes LL, Carroll DE. The play interactions of young children with and without disabilities: Individual and environmental influences. *Early Child Res Q*. 2000;**15**(2):229–46. doi: 10.1016/s0885-2006(00)00052-1.
49. Ozkubat U, Ozdemir S. A comparison of social skills in Turkish children with visual impairments, children with intellectual impairments and typically developing children. *International Journal of Inclusive Education*. 2013;**18**(5):500–14. doi: 10.1080/13603116.2013.789088.
50. Bakke HA, Cavalcante WA, de Oliveira IS, Sarinho SW, Cattuzzo MT. Assessment of motor skills in children with visual impairment: A systematic and integrative review. *Clin Med Insights Pediatr*. 2019;**13**:1179556519838290. doi: 10.1177/1179556519838287. [PubMed: 31105435]. [PubMed Central: PMC6503598].
51. Haegele JA, Porretta D. Physical activity and school-age individuals with visual impairments: a literature review. *Adapt Phys Activ Q*. 2015;**32**(1):68–82. doi: 10.1123/apaq.2013-0110. [PubMed: 25544721].

Table 1. Attributes of the Final Primary Analyzed Studies

Author, Year	Visual Status	Sample Size	Age	Intervention	Duration	Measurement	Main Findings	Follow-Up	Setting	Quality Scores
Waddington et al. , 2018 (34)	HVFL	8	7 - 21	Unsupervised compensatory training using an Eye lander video game.	20-min preparation. Six weeks, 16.1 sessions, 1,676 visual search trials, 55 minutes each week on average & an average of 5.6 hours.	tests tests of visual search ability, Cardiff Visual Ability Questionnaire for Children, Impact of Vision Impairment for Children.	Engaging with gamified compensatory training and time to find objects during tabletop activities improved by an average of 24% - 95% CI (2%, 46%).	Two assessments by 4weeks	At home, United Kingdom.	Fair
Skellenger, 1990 (35)	Blind	3	5,6,7	A Shared teacher-child package of non-intrusive, incidental teaching strategies designed to suggest and model play skills.	10-minute sessions.	Observation.	Collateral behavior, increase play skills. Purposeful simple manipulation, involvement, and perseverative/self-stimulation decreased& transition behaviors increased.	-	Empty classroom with a corner area equipped with typical play materials.	Fair
Gasperetti et al., 2018 (36)	VI	5: 3M, 2F	10 - 16	Modification of 3 active video games (dance, dance, revolution; EyeToy kineticand Wii boxing).	A 5-min warm-up. One game at night during one week; each one had a 5-min warm-up and at least 10 min game.	Moderate-to-vigorous physical activity.	Physical activity levels increased-MVPA, $\chi^2(2) = 7.4$, P = 0.024.	-	Overnight sports camp, USA.	Fair
Ververet al., 2019 (32)	VI	52, 26 dyads; 25.3% girls	mean age: 9.22	During the same week, dyads played in both the augmented (Play Mobil knight's castle) and non-augmented toys with at least two days in between both sessions.	The warm-up session before the first session, three times, each play session lasted thirty minutes.	Social and cognitive play observation scales.	Increased shared attention, less disengagement, and more parallel play, but less cooperative play (social and cognitive aspects of play changed).	-	Six different special schools for children with a visual impairment, Netherlands.	Good
Connors et al., 2014 (37)	Blind	7: 3M,4F	16-17	Video games, audio-based Environment Simulator.	15 minutes of preparation. 2, 30-min sessions.	Assessment of behavioral performance.	Facilitated navigation and spatial cognition skills.	-	At the Carroll Center for the blind, Newton, MA, USA.	Fair
Jacko et al., 2013 (40)	VI	73, 36% female, 64% male	birth through five years	Oregon Project for visually Impaired and blind preschool children that provides interactive child-therapist learning experiences.	Playgroup a minimum of 5 times, for a total of at least 10 hours of preparation. Twice weekly, two-hour supplements to the in-home intervention throughout the year, except in June and July.	Oregon Project for Visually Impaired and Blind Preschool Children test	Improvement in cognitive, language, compensatory, vision, self-help, social, fine motor, and gross motor skill sets.	-	At home, USA	Poor
Sanchez et al., 2010(38)	VI	24: 11M, 13F	7 - 14	The digital clock carpet, in combination with a 3D video game.	One session preparation. Three months, in eight sessions that lasted 3 hours and 15 minutes each.	Orientation and mobility evaluation (orientation and mobility techniques, sensory-motor coordination, sensory-spatial orientation).	Significant gains in tempo-spatial orientation and mobility skills.	-	Unfamiliar spaces (school and real space), USA.	Fair
Shesterova et al., 2019 (39)	VI	204	10-16,	Specifically aimed exercises and active games.	Preparation session, 9 exercises, 4-15 times, each exercise, 5-10 minutes, during the school year.	Stability of the vestibular analyzer.	Significantly improved on the indicators of the functional state of the vestibular analyzer, (> 0, 05).	-	Schools in Kharkov & Dnepropetrovsk, Ukraine.	Fair
Ververet al., 2020 (33)	VI and sighted	18 dyads of children with VI and their sighted classmates.	4-11, (7.46), (7.56)	Augmented Toys (Play Mobil® knight's castle) and non-augmented toy.	Four play sessions, 20 min each.	Social and Cognitive Play Observations, Individual Social Behavior Scale, Social Cognitive Skills Test, Wechsler Intelligence Scale, WechslerIII.	Facilitating play and social interaction, more parallel play and object exploration, but less cooperative play.	-	a quiet room at schools, Netherlands.	Good