

THE EFFICACY OF STRUCTURED SPATIAL SKILLS VIDEO GAME FOR CHILDREN - PARENTS AND PHYSIOTHERAPIST PERSPECTIVE

Madhumathi^{1,*}, Senthilselvam¹, Subramanian² and Jibi Paul³

Received: September 21, 2021; Revised: December 10, 2021; Accepted: January 25, 2022

Abstract

Video games are used for educational purposes in most of the grades and in college curriculum. The games will make the learning easier without the cognitive load. Structured spatial skill educational game was designed under the concept of improving spatial skills and academic performance. Before the game goes for the actual clinical trials, certain aspects of the game must be tested. The objective of this study is to find the perception of SSST edugame by the parents and Paediatric physiotherapist. The parents play a major part in selecting the games for their children and Physiotherapist as a part of rehabilitation team have a vital role in rehabilitation. The parents (n=20) who have children within the age group 6 years and 10 years, Paediatric Physiotherapist (n=20) who have 10-15 years of experience were selected for the study. The survey has 30 questions filled by them in the google forms which takes around 4 - 7 minutes. The following attributes, explanation of the game, goals, feedback and notification, challenges, audio-visual support and child's attitude of the game are analysed. The 5 - point Likert scale was used for scoring. The hypothesis to be tested is whether the perception of the game differs or remains the same between the parents and Physiotherapist. The results of the analysis clearly show that at least 75% of the subjects (both parents and physiotherapist) were agreed or strongly agreed with all the questions. Thus, the game can be used by the children for academic outcomes.

Keywords: Perception, Video game, Education, Physiotherapist, SSST edugame

Introduction

The traditional method of learning is replaced by the ICT based learning in the developing process of teaching and learning system. Starting from the play group to the post graduation the virtual classes are gaining more importance. The game based learning has “fun, play, goals, outcomes, win states, challenges, problem solving, task, and

feedback” (Cheng and Su, 2012). The computer based learning and games are blooming concepts in this digital era. The children way of learning became easier with the this edutainment. The games which have learning outcome based is attracting the new mode of pedagogy in education. The computer interface is providing motivation as it is

¹ School of physiotherapy, Vels Institute of Science Technology and Advanced Studies, Thalambur, Chennai, Tamilnadu, India, E-mail: saimadhupt@gmail.com *; hodphysiotherapy@velsuniv.ac.in

² Principal, Sree Balaji college of Physiotherapy, Chennai, Tamilnadu, India, E-mail; Subramanian.podhigai1968@gmail.com

³ Faculty of Physiotherapy, Dr. MGR Educational and Research Institute, E-mail: jibipau74l@gmail.com

* Corresponding Author

incorporated with sounds, graphics, challenges, cartoon characters, hints and instructions. Apart from the development in cognition, the games are also influencing the health of the children (Baranowski *et al.*, 2016).

The video game is found to have the following academic objectives, reading, logical thinking, observation, spatiality, basic knowledge, problem solving, decision making, and strategic planning (de Aguilera and Mendiz, 2003). Numerous studies quoted the fact that playing video game can improve the spatial skills of the children. The action video game “enhances several cognitive and perceptual abilities”, and the inclusion of variable games will improve the transfer effect within the same training module (Oei and Patterson, 2013).

The Structured spatial skills training educational video game (SSST edu game) was designed under the concept of improving academic performance of the children (Both typically and atypically developed children). The typically developed children who are slow learner, difficulty in reading, writing and atypically developing children like cerebral palsy, Autism disorder, Attention deficit hyperactive disorder all will have visuospatial deficits. Due to this deficits the children are having problems in excelling in the academics. The spatial skills and maths skills plays a vital role in the day to the day activities of the human being. The direction to the new place is given by the google map which is operated under the concept of spatial relation (referring one object with other). Buying things from shop, billing, taking a bus, paying bills all require maths skills. The studies says that there is strong bond between the spatial skills and maths skills. “Spatial skills correlates with the numerical magnitude representations across the broad age ranges” (Young *et al.*, 2018).

The SSST edu game have seven different games and three increasing level of challenges. The seven games includes maze, puzzle, mental rotation, building blocks, identifying objects, matching shapes, and spatial language. The game have disclaimer, mind map, scoring and audio system to provide the hints and instructions to play the game. The game is therapeutically programmed in such a way that it has control in time, session and play days. The child can play only for 40 minutes in a day, three days in a week (Monday, Wednesday and Friday), and 24 play sessions. The cartoon Characters Sai and Sri will guide the children on how to play the game.

This game is designed to help the children with learning disabilities like slow learners, mathematical delays, children diagnosed with dyslexia and children who have visuospatial disabilities. The visuospatial disabilities are seen in

conditions like Cerebral palsy, Autism, Attention Deficit Hyperactive Disorders. Accordingb to Ramona Cardillo *et al.*, (2020) nonverbal learning disability was impaired in visuospatial processing speed, abilities, construction, and working memory. ADHD children have problem mainly in visuospatial processing speed. When comparing the typically developing children and atypically developing children like dyslexia and non-verbal learning disability, the later have problems in binding and backward recall (Ricardo Basso Garcia, 2013). Children with nonverbal learning disabilities and Autism specturm disorder will have problems in visuo-construction task (Mammarella, 2019). Dyslexic children have issues in visuospatial functioning and it is one of the characteristics of dyslexia (Malgorzata Llpowska, 2001).

Before the game goes for the clinical trail it has to be tested on varios aspects. One of its criteira is whether the games is perceived as the educational game and the level of agreement of the variable is the same between the parents and physiotherapist. Parents has the deciding authority over the development of their children. Most of the parents have a dilemma whether to support the gaming habits of their children since they are worried about the time spent, change in behaviour, mental wellbeing, and other social changes. In a case-control study of can worried parents predict the effects of video game on their children, the results showed that they are happy and “cognitively healthy as other kids of their age”(Lieberoth and Fiskaali, 2021). Kanikar *et al.*, (2021) studied the parents perception on two interventions using computer, the results showed that the parents accepted the children fine motor activities are improving and showed a positive attitude towards the rehabilitation.

The study on parents perception on childrens digital game use stated that most of the parents played along with their children, gives respect to their opinion, and 40 % of the parents worried about the children game use (Lim, 2019).

On the other side Paediatric physiotherapist as one of the team member in rehabilitation makes treatment protocols to uplift the social participation of the child. In the field of rehabilitation the interactive video game has drawing more attention. Some games are used for rehabilitation purpose for patients who have disorders (Forsberg *et al.*, 2015). Epileptic children have attention problems and deficits in visuospatial ability, Marianne Saard *et al.*, (2019) tested the FORAMENRehab software among 17 children with epilepsy between the age group 8-12 years for duration of 1 month and 1 week. The FORAMENRehab is meant for “visuospatial

function rehabilitation. The following four components are assessed before and after the intervention, “visual organization, visual attention, visuospatial perception. The author concluded that the intervention had positive outcome and in addition, the area of skills improved out of this rehabilitation is transferred to the real life daily activities. L. Hawe *et al.*, (2020), assessed the “Bilateral motor skills and visuospatial attention” for children diagnosed with perinatal stroke. The results showed that these children have problems in both the visuospatial skills and bilateral motor skills and rehabilitation should be focused on addressing this defects. Catarina. Santos *et al.*, (2020) described the steps involved in application of “Rehabvisual platform”. They selected 6 premature infants within age 18 months along with some problems noted in their developmental milestones. During the therapy session, most of the infants made progression to all the difficulty levels. Gaetan Ickx (2018) studied the “prevalence of visuospatial deficits in unilateral spastic cerebral palsy children” and the observation using visuospatial attention test says that the children are affected with visuospatial deficits, concluded that rehabilitation process have to be planned and executed to improve this skills.

Previous research were based on either parent’s perception or parent’s and teacher’s perception or parents and children’s attitude towards the new video game or any therapy session. Since this game is developed for children to increase their academic performance, the perception of both the parents and Physiotherapist on the game have to be tested. The Paediatric Physiotherapist role as an academic support in special schools will have an addition aspect of designing and testifying the new games and therapy. They can assist the other team members like special educators in planning, designing games and learning material. Since the visuospatial abilities are delayed in some neurological conditions, the game can be used as both academic and therapeutic purpose. The objective of the study is to find whether the SSST edu game is effective educational game and the level of agreement of the variables (Explanation of the game, Goal, feedback, notification, Audio-Visual support, and child attitude towards the game) are same between the parents and Physiotherapist

Materials and Methods

Qualitative research was designed to find out the perception of the SSST edugame by the parents and Paediatric physiotherapist. The purpose of the study was explained in detail to the study

population. The study is meant only for the research purpose and none of the details will expose the identity of the participants. The demographics details are collected, and informed consent was given to all the participants. They are informed that they can leave the study at any point of time. The parents (n=20) of children with the age group between 6 years to 10 years (the children who underwent the pilot study of playing this SSST Edugame) are included in this study. On the other side Paediatric physiotherapist (n=20) who have experience of 10 - 15 years in rehabilitating the children are included.

SSST Edugame Description

This game is designed to help the children who have visuospatial disabilities. The visuospatial skills are important in day-to-day activities, and it is directly correlated to children’s Mathematical skills (Valerie Critten, 2018), reading (Giulia Giovagnoli, 2016) and writing skills (Thierry Olive 2012), and academic achievements. These can also be used by the physiotherapist in treating the children diagnosed with cerebral palsy, where the visuospatial attention, visuo-construction processing and speed can be improved. The SSST edugame have seven games maze, puzzle, mental rotation, building blocks, matching shapes, identifying objects and spatial language. Maze - where the player must find the correct path out of multiple paths (Hendrawan, 2018). Playing maze involves complex visual-motor planning and problem-solving skills. The cognitive involvement almost mimics the day-to-day activities which require planning and problem solving (Trabacca A. Vespino, 2016)

Puzzle - " Puzzle games have simple rules around the basis of a challenge that requires interrelating pieces over a given board (Trajkovik, V., 2018). Depending upon the objects used in the game the rule can be fixed. The main concept is to interlink all the available pieces together to get the original image within the stipulated time.



Figure 1. Shows level 2 puzzle Note - Author permission needed to use the figures

Mental Rotation - Mental rotation is a step-by-step process of organizing the mental representation of the visual stimulus, rotating the objects mentally to get the target object either clockwise or anti-clockwise (Xue J. *et al.*, 2017). The mental rotation game enhances the spatial ability of the children.



Figure 2. Shows level 1 mental rotation Note - Author permission needed to use the figures

Building blocks - Block building is the intelligence uplifting and more enjoyable game among the pre-schoolers (Zhang X, 2020). It is used as a tool to assess the intelligence of the psychologist. It improves the children's "technological thinking, critical thinking, problem-solving, creativity, and abstract thinking". It is also related to maths and reading achievement of the children in later life.



Figure 3. Shows level 1 building blocks Note - Author permission needed to use the figures

Matching shapes - Children learn the concepts of shapes in early life, shapes play a major role in mathematics especially when they learn geometrics. The child has to find the exact match pair in the matching game. When shapes are given in a matching game, it will be very fun-filled and increase the motivational level of



Figure 4. Shows level 1 matching shapes Note - Author permission needed to use the figures

the children to play. This type of play involves the visual and spatial working memory of the individual (Demir U, 2020).

Identifying objects - children learn through relations between the objects. The objects enter the kid's world early in their life and the learning continues (Fasulo A, 2017). Identifying the objects given on the board will make the play more interesting. Finding the hidden objects can also be used as an assessment tool for the kids to examine the cognitive level.

Spatial language - "when the words are used in a way that helps the child understand their meaning (Weizman and Snow, 2001)". The spatial language guides the play activities. The spatial categories include (1) spatial locations (up, down), (2) deictic terms (here, there), (3) dimension (long, tall), (4) spatial features or properties (curvy, straight), (5) shapes (rectangle, square), and (6) spatial orientations or transformations ("turn it around," "the man is facing the block"). (Ferrara K, 2011)

All the above said games are meant to improve the visuospatial skills of the children.

The additional features of the game are, providing hints and instructions to each game for easy understanding and it provide both audio and visual cues. The time spend in playing game is the major concern of the parents, so the automatic lock in duration and session of the games is applied. From the remote server, the games played by the children and games yet to play. The total duration for each game is also monitored

The questionnaire is developed which consist of 30 questions. The questions are framed in such a way that it explains the game features. First 4 questions are related to the attribute "Explanation of the entire game", next nine questions "goals, feedback, and notification", questions 14- 17 are related to challenges, 18-24

are related to Audio-Visual support and last six questions (25-30) are related to child's perception of the SSST edugame. The questionnaire is given to the participants in the google form. The overall time to fill the form is about 4 to 7 minutes. 5-point Likert scale was used, strongly agree, agree, undecided, disagree and strongly disagree. Even though questions are framed according to the developed software, the results out of this research can be generalised in terms of outcome from the training session. Each video games are developed to get the desired specific and generalised output for the population.

Thus, the questionnaire consists of Age and Gender of Parents and Physiotherapists, including 30 questions to measure 5 attributes of Structured spatial skills educational video game. Each survey question used 5-point scale to measure a respondent's agreement on the questions related to the five attributes, namely Explanation, Goal, Feedback, and Notification, Challenges, Audio-Visual Support, Child Attitude Towards the Game. To analyze the respondents' level of agreement on each question, the 5-point scale has been recoded with numerical values as follows: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly Agree. As mentioned, the 5-point scale has been encoded with numerical values from 1 to 5 appropriately and then summed up the values of those questions comes under each attribute. The questions are as follows

1. The content of the game is explained clearly.
2. The mind map of the game is clearly presented
3. Game plots is clearly instructed
4. Use of game is understandable
5. The game Goal presented in the beginning
6. The Overall goal presented clearly
7. Intermediate goal presented in beginning of each level.
8. The game provides the Feedback on progress.
9. The game provides the Feedback on action.
10. Notification of new task is intimated immediately.
11. Notification of new events intimated immediately.
12. Success and failure notification are given.
13. Information of status about - score and level are given.
14. The progression of the Challenge is adequate.
15. The game is not over burden.
16. The game workload is adequate.
17. The game Provides online support.
18. The game provides Video/audio support.
19. New level is given at appropriate pacing.

20. The Cartoon characters Sai and Sri are enjoyable.
21. Voices and music are clear and audible.
22. Text size are visible.
23. The game is age appropriate.
24. The game has appealing colour and graphics.
25. The game is related to child's academics.
26. The game does not distract the child.
27. The child can remain concentrated throughout the game.
28. The child is attentive throughout the game.
29. The child likes to play the game.
30. The game is recommended to others.

The research question is to find whether the perception about the game is same or different from parents and qualified physiotherapist.

Results and Discussions

To test whether SSST edugame contains all the features of the educational video game, first we need to find the proportion subjects agreed or strongly agreed for each question. Then Single Proportion Test can be applied to test whether majority of the subjects agreed or strongly agreed to each question. That is, to test whether the proportion of subjects agreed or strongly agreed is greater than 50% (i.e., $P > 0.50$). Hypotheses: Null hypothesis, H_0 : Proportion of subjects agreed or strongly agreed is only 50% (i.e., $P = 0.50$). Alternate hypothesis, H_1 : Proportion of subjects agreed or strongly agreed is greater than 50% (i.e., $P > 0.50$). To test the above hypothesis, Single Proportion Test has been applied for each question. Among 4 questions related to Explanation, first 3 questions were agreed or strongly agreed by at least 85% of the subjects involved in this study. 100% of the parents and 100% of the physiotherapists were agreed or strongly agreed with Question No. 1 and 2, while 85% of the parents and 95% of the physiotherapists were agreed or strongly agreed with Question No.3. However, the Question No.4 was agreed or strongly agreed by only 65% of the parents and 65% of the physiotherapist. Also, the hypothesis test clearly shows that the p-values of the test statistic for first 3 questions are less than 0.05, indicating that the null hypothesis is rejected at 5% level of significance. Hence, the evidence is sufficient to conclude that majority of the subjects and majority of the physiotherapists were agreed or strongly agreed with first 3 questions related to explanation of the entire game.

There are 9 questions under the attribute of “Goal, Feedback and Notification”, of which 7 questions (Question No. 5, 6, 8, 9, 10, 12, and 13) were agreed or strongly agreed by majority of the parents (p -value < 0.05), while Question No. 7 and 11 were agreed or strongly agreed by only 25% and 55% respectively (p -value > 0.05). That is, majority of the parents were agreed or strongly agreed with Question No. 5, 6, 8, 9, 10, 12, and 13 (p -value < 0.05). Similarly, the results of hypothesis test for physiotherapist showed that majority of the physiotherapists agreed or strongly agreed with Question No. 5, 8, 9, 10, 12, and 13 (p -value < 0.05), while less than 50% of the physiotherapists were agreed or strongly agreed with the remaining 3 questions (p -value > 0.05).

All the subjects (100% of parents and 100% of physiotherapists) were agreed or strongly agreed with all the questions under the attribute ‘Challenges’. Also, the p -values for all the four questions under the attribute ‘Challenges’ are less than 0.05, indicating majority (100%) of the subjects were agreed or strongly agreed with all the questions under the attribute ‘Challenges’. All the subjects (100% of parents and 100% of physiotherapists) were agreed or strongly agreed

with all the questions under the attribute ‘Audio and Visual Support’. Also, the p -values for all the 7 questions under the attribute ‘Audio and Visual Support’ are less than 0.05, indicating majority (100%) of the subjects were agreed or strongly agreed with all the questions under the attribute ‘Audio and Visual Support’. All the subjects (100% of parents and 100% of physiotherapists) were agreed or strongly agreed with all the questions under the attribute “Child Attitude towards the Game”. Also, the p -values for all the 6 questions under the attribute “Child Attitude towards the Game” are less than 0.05, indicating that majority (100%) of the subjects were agreed or strongly agreed with all the questions under the attribute “Child Attitude towards the Game”. To compare the perception about the game between parents and qualified physiotherapist, the mean scores of each of the 5 attributes have been compared between Parents and Physiotherapist. For each attribute, the recoded values of the questions under each attribute had been summed up to get the total score. Then the total score of each attribute has been compared between Parents and Physiotherapist using Independent Samples t -test.

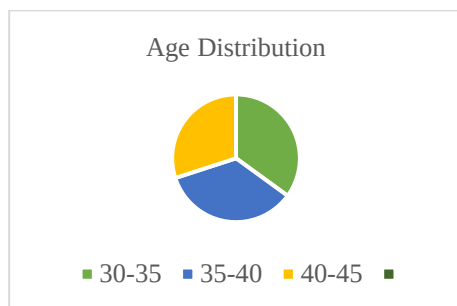


Figure 5. Shows Age distribution of parents

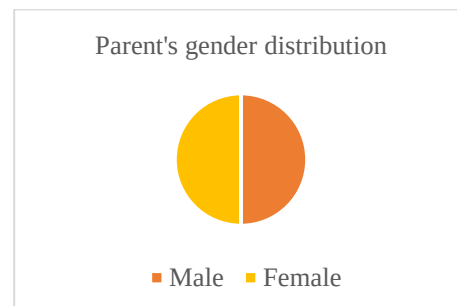


Figure 7. Shows gender distribution of parents

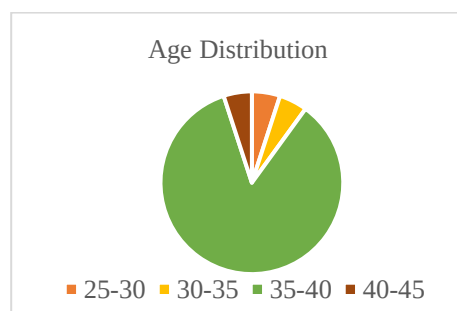


Figure 6. Shows Age distribution of Paediatric Physiotherapist

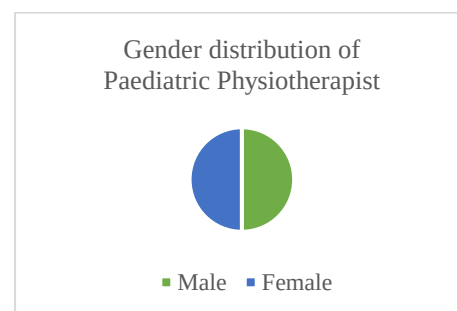


Figure 8. Shows gender distribution of Paediatric Physiotherapist

Table 1. Shows Questions and its attributes

S.No	Questions	Questions related to	Variable Name
1	The content of the game is explained clearly	Explanation	A_Explanation_q1
2	The mind map of the game is clearly presented		A_Explanation_q2
3	Game plots is clearly instructed		A_Explanation_q3
4	Use of game is understandable		A_Explanation_q4
5	The game Goal presented in the beginning	Goal, feedback and notification	A_Goal_FB_Notif_q5
6	The Overall goal presented clearly		A_Goal_FB_Notif_q6
7	Intermediate goal presented in beginning of each level		A_Goal_FB_Notif_q7
8	The game provides the Feedback on progress		A_Goal_FB_Notif_q8
9	The game provides the Feedback on action		A_Goal_FB_Notif_q9
10	Notification of new task is intimated immediately		A_Goal_FB_Notif_q10
11	Notification of new events intimated immediately		A_Goal_FB_Notif_q11
12	Success and failure notification are given		A_Goal_FB_Notif_q12
13	Information of status about – score and level is given		A_Goal_FB_Notif_q13
14	The progression of the Challenge is adequate	Challenges	A_Challenges_q14
15	The game is not over burden		A_Challenges_q15
16	The game workload is adequate		A_Challenges_q16
17	New level is given at appropriate pacing		A_Challenges_q17
18	The game Provides online support	Audio-Visual Support	A_Audio_Visual_Support_q18
19	The game provides Video/audio support		A_Audio_Visual_Support_q19
20	The Cartoon characters Sai and Sri are enjoyable		A_Audio_Visual_Support_q20
21	Voices and music are clear and audible		A_Audio_Visual_Support_q21
22	Text size are visible		A_Audio_Visual_Support_q22
23	The game is age appropriate		A_Audio_Visual_Support_q23
24	The game has appealing colour and graphics		A_Audio_Visual_Support_q24
25	The game is related to child's academics	Child attitude towards the game	A_Child_Attitude_q25
26	The game does not distract the child		A_Child_Attitude_q26
27	The child can remain concentrated throughout the game		A_Child_Attitude_q27
28	The child is attentive throughout the game		A_Child_Attitude_q28
29	The child likes to play the game		A_Child_Attitude_q29
30	The game is recommended to others		A_Child_Attitude_q30

Table 2. Shows inferential statistics of parents' perspective of the SSST edugame

Parents	No. of parents agree or strongly agreed (X)	Proportion of parents agree or strongly agreed (p)	Z	P-value
Explanation_q1	20	100%	4.47	0.000
Explanation_q2	20	100%	4.47	0.000
Explanation_q3	17	85%	3.13	0.001
Explanation_q4	13	65%	1.34	0.090
Goal_FB_Notif_q5	19	95%	4.02	0.000
Goal_FB_Notif_q6	14	70%	1.79	0.037
Goal_FB_Notif_q7	5	25%	-2.24	0.987
Goal_FB_Notif_q8	19	95%	4.02	0.000
Goal_FB_Notif_q9	15	75%	2.24	0.013
Goal_FB_Notif_q10	15	75%	2.24	0.013
Goal_FB_Notif_q11	11	55%	0.45	0.327
Goal_FB_Notif_q12	20	100%	4.47	0.000
Goal_FB_Notif_q13	19	95%	4.02	0.000
Challenges_q14	20	100%	4.47	0.000
Challenges_q15	20	100%	4.47	0.000
Challenges_q16	20	100%	4.47	0.000
Challenges_q17	19	95%	4.02	0.000
Audio_Visual_Support_q18	16	80%	2.68	0.004
Audio_Visual_Support_q19	20	100%	4.47	0.000
Audio_Visual_Support_q20	20	100%	4.47	0.000
Audio_Visual_Support_q21	20	100%	4.47	0.000
Audio_Visual_Support_q22	20	100%	4.47	0.000
Audio_Visual_Support_q23	20	100%	4.47	0.000
Audio_Visual_Support_q24	20	100%	4.47	0.000
Child_Attitude_q25	20	100%	4.47	0.000
Child_Attitude_q26	20	100%	4.47	0.000
Child_Attitude_q27	20	100%	4.47	0.000
Child_Attitude_q28	20	100%	4.47	0.000
Child_Attitude_q29	20	100%	4.47	0.000
Child_Attitude_q30	20	100%	4.47	0.000

Table 3. Shows inferential statistics of Physiotherapist's perspective of the SSST edugame

Physiotherapist	No. of physiotherapists agree or strongly agreed (X)	Proportion of physiotherapist agree or strongly agreed (p)	Z	P-value
Explanation_q1	20	100%	4.47	0.000
Explanation_q2	20	100%	4.47	0.000
Explanation_q3	19	95%	4.02	0.000
Explanation_q4	13	65%	1.34	0.090
Goal_FB_Notif_q5	20	100%	4.47	0.000
Goal_FB_Notif_q6	10	50%	0.00	0.500
Goal_FB_Notif_q7	4	20%	-2.68	0.996
Goal_FB_Notif_q8	16	80%	2.68	0.004
Goal_FB_Notif_q9	14	70%	1.79	0.037
Goal_FB_Notif_q10	17	85%	3.13	0.001
Goal_FB_Notif_q11	9	45%	-0.45	0.673
Goal_FB_Notif_q12	20	100%	4.47	0.000
Goal_FB_Notif_q13	20	100%	4.47	0.000
Challenges_q14	20	100%	4.47	0.000
Challenges_q15	20	100%	4.47	0.000
Challenges_q16	20	100%	4.47	0.000
Challenges_q17	20	100%	4.47	0.000
Audio_Visual_Support_q18	15	75%	2.24	0.013
Audio_Visual_Support_q19	20	100%	4.47	0.000
Audio_Visual_Support_q20	20	100%	4.47	0.000
Audio_Visual_Support_q21	20	100%	4.47	0.000
Audio_Visual_Support_q22	20	100%	4.47	0.000
Audio_Visual_Support_q23	20	100%	4.47	0.000
Audio_Visual_Support_q24	19	95%	4.02	0.000
Child_Attitude_q25	20	100%	4.47	0.000
Child_Attitude_q26	20	100%	4.47	0.000
Child_Attitude_q27	20	100%	4.47	0.000
Child_Attitude_q28	20	100%	4.47	0.000
Child_Attitude_q29	20	100%	4.47	0.000
Child_Attitude_q30	20	100%	4.47	0.000

To test whether the perception about the “Explanation of the entire game” is same or significantly different between parents and qualified physiotherapist Hypotheses: Null hypothesis, H_0 : There is no significant difference between Parents and Physiotherapists in terms of their perception about the “Explanation of the entire game”. Alternate hypothesis, H_1 : There is significant difference between Parents and Physiotherapists in terms of their perception about the “Explanation of the entire game”. Test to be applied: Independent Samples t-test

Table 4. shows the result of explanation of the entire game

	A_Explanation	B_Explanation
Mean	18.00	18.50
SD	1.52	1.64
Variance	2.32	2.68
Observations	20.00	20.00
Pooled Variance	2.50	
Hypothesized	0.00	
df	38.00	
t Stat	-1.00	
P(T<=t) one-tail	0.162	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.324	
t Critical two-tail	2.02	

t-Test: Two-Sample Assuming Equal Variances,
A_Explanation - Parents, B_Explanation - Physiotherapist

The value of test statistic is $t = -1.00$ and the corresponding p-value is $0.324 > 0.05$. Since the p-value of the test statistic is greater than 0.05, we fail to reject the null hypothesis at 5% level of significance. Hence, the evidence is not sufficient to conclude that there is significant difference between Parents and Physiotherapists in terms of their perception about the “Explanation of the entire game”. That is, parents and physiotherapists are appears to have no significant difference in terms of their opinion about the “Explanation of the entire game”.

To test whether the perception about the “Goal, Feedback, and Notification” is same or significantly different between parents and qualified physiotherapist. Hypotheses: Null hypothesis, H_0 : There is no significant difference between Parents and Physiotherapists in terms of their perception about the “Goal, Feedback, and Notification”. Alternate hypothesis, H_1 : There is significant difference between Parents and Physiotherapists in terms of their perception about the “Goal, Feedback, and Notification”. Test to be applied: Independent Samples t-test

Table 5. shows the result of Goal, feedback and notification

	A_Goal_FB_Notification	B_Goal_FB_Notification
Mean	37.90	36.80
SD	3.84	3.89
Variance	14.73	15.12
Observations	20.00	20.00
Pooled Variance	14.92	
Hypothesized	0.00	
df	38.00	
t Stat	0.90	
P(T<=t) one-tail	0.187	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.374	
t Critical two-tail	2.02	

t-Test: Two-Sample Assuming Equal Variances,
A_Explanation - Parents, B_Explanation - Physiotherapist

The value of test statistic is $t = 0.90$ and the corresponding p-value is $0.274 > 0.05$. Since the p-value of the test statistic is greater than 0.05, we fail to reject the null hypothesis at 5% level of significance. Hence, the evidence is not sufficient to conclude that there is significant difference between Parents and Physiotherapists in terms of their perception about the “Goal, Feedback, and Notification”. That is, parents and physiotherapists are appears to have no significant difference in terms of their opinion about the “Goal, Feedback, and Notification”.

To test whether the perception about the “Challenges” is same or significantly different between parents and qualified physiotherapist. Hypotheses: Null hypothesis, H_0 : There is no significant difference between Parents and Physiotherapists in terms of their perception about the “Challenges”. Alternate hypothesis, H_1 : There is significant difference between Parents and Physiotherapists in terms of their perception about the “Challenges”. Test to be applied: Independent Samples t-test

Table 6. shows the result of Challenges

	A_Challenges	B_Challenges
Mean	19.50	36.80
SD	0.95	3.89
Variance	0.89	15.12
Observations	20.00	20.00
Pooled Variance	0.94	
Hypothesized	0.00	
df	38.00	
t Stat	-0.33	
P(T<=t) one-tail	0.373	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.746	
t Critical two-tail	2.02	

t-Test: Two-Sample Assuming Equal Variances,
A_Challenges - Parents B_Challenges - Physiotherapist

The value of test statistic is $t = -0.33$ and the corresponding p-value is $0.746 > 0.05$. Since the p-value of the test statistic is greater than 0.05, we fail to reject the null hypothesis at 5% level of significance. Hence, the evidence is not sufficient to conclude that there is significant difference between Parents and Physiotherapists in terms of their perception about the “Challenges”. That is, parents and physiotherapists are appears to have no significant difference in terms of their opinion about the “Challenges”.

To test whether the perception about the “Audio and Visual Support” is same or significantly different between parents and qualified physiotherapist. Hypotheses: Null hypothesis, H_0 : There is no significant difference between Parents and Physiotherapists in terms of their perception about the “Audio and Visual Support”. Alternate hypothesis, H_1 : There is significant difference between Parents and Physiotherapists in terms of their perception about the “Audio and Visual Support”. Test to be applied: Independent Samples t-test.

The value of test statistic is $t = -0.94$ and the corresponding p-value is $0.352 > 0.05$. Since the p-value of the test statistic is greater than 0.05, we fail to reject the null hypothesis at 5% level of significance. Hence, the evidence is not sufficient to conclude that there is significant difference between Parents and Physiotherapists in terms of their perception about the “Audio and Visual Support”. That is, parents and physiotherapists are appears to have no significant difference in terms of their opinion about the “Audio and Visual Support”.

To test whether the perception about the “Child Attitude Towards the Game” is same or significantly

different between parents and qualified physiotherapist. Hypotheses: Null hypothesis, H_0 : There is no significant difference between Parents and Physiotherapists in terms of their perception about the “Child Attitude Towards the Game”. Alternate hypothesis, H_1 : There is significant difference between Parents and Physiotherapists in terms of their perception about the “Child Attitude Towards the Game”. Test to be applied: Independent Samples t-test

The value of test statistic is $t = 0.79$ and the corresponding p-value is $0.435 > 0.05$. Since the p-value of the test statistic is greater than 0.05, we fail to reject the null hypothesis at 5% level of significance. Hence, the evidence is not sufficient to conclude that there is significant difference between Parents and Physiotherapists in terms of their perception about the “Child Attitude Towards the Game”. That is, parents and physiotherapists are appears to have no significant difference in terms of their opinion about the “Child Attitude Towards the Game”. The child perception of the game is included in the parent’s attitude towards the acceptance of the video game. This is explained in detail by Kanitkar *et al.*, (2021), they collected the feedback from the parents of the children who underwent therapy sessions using computers. Some of the comments are “happy, good, child interest increased, he wants to use them, it motivates him”. So, the questions related to child’s attitude are included so the use of game can be verified strongly. On the other hand, from physiotherapist point of view, the child’s interaction in the therapy or learning sessions are seen as most important aspect to get the desired outcome from the intervention.

Table 7. shows the result of Audio-Visual Support.

	A_Audio_Visual_Support	B_Audio_Visual_Support
Mean	33.25	33.85
SD	1.94	2.08
Variance	3.78	4.34
Observations	20.00	20.00
Pooled Variance	4.06	
Hypothesized Mean Difference	0.00	
df	38.00	
t Stat	-0.94	
P(T<=t) one-tail	0.176	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.352	
t Critical two-tail	2.02	

t-Test: Two-Sample Assuming Equal Variances, A_Audio-visual support - Parents B_Audio-Visual support - Physiotherapist

Table 8. shows the result of Child’s attitude towards the game

	A_Child_Attitude	B_Child_Attitude
Mean	29.80	29.65
SD	0.41	0.75
Variance	0.17	0.56
Observations	20.00	20.00
Pooled Variance	0.36	
Hypothesized Mean Difference	0.00	
df	38.00	
t Stat	0.79	
P(T<=t) one-tail	0.218	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.435	
t Critical two-tail	2.02	

t-Test: Two-Sample Assuming Equal Variances, A_Child Attitude- Parents B_Child attitude - Physiotherapist

The aim of this study is to investigate whether the level of agreement of the attributes are the same between the Parents and Physiotherapist. Many parents are themselves “avid Players”, new issues are arising out that how to control the content of the game and time spent by their children. The knowledge or the basic things understood by the parents influence the child’s gaming activity (Aierbe *et al.*, 2019). For this, the clear understanding of the game is very important for the parent to mediate the child to play. The study results shows that the perception of parents and physiotherapist remains the same for the explanation of the SSST edugame.

The positive feedback is a powerful mode to motivate the player when compared to the negative feedbacks (Burgers *et al.*, 2015). The players who follow a specific designed goal have more fun which shows that the setting a goal in the video game can affect the cognitive outcome (Steve Nebel 2017). The challenges in the video game are the key motivation factor, it is associated with difficulty. Overcoming this difficulty depends upon the players skills such as problem solving, understanding of the game, abilities, motivation and knowledge (Vahlo and Karhulahti, 2020). The educational game with “fun, moving objects, fast tempo music, carefree color like blue” will increase the interest of the students (Hartono *et al.*, 2016). The child’s attitude towards playing the game is necessary for framing the educational video game it includes, academic outcomes, concentration, happiness of the child. Educational video game provides “meaningful learning experience” and “decreases the cognition load” (Sun and Gao, 2016).

The results of the analysis clearly show that at least 75% of the subjects (both parents and physiotherapist) were agreed or strongly agreed with all the questions related to three attributes, namely Challenges, Audio and Visual Support, and Child Attitude. The single proportion test also showed that majority of the subjects (both parents and physiotherapist) were agreed or strongly agreed with all the questions related to the above said three attributes. On the other hand, for the remaining 2 attributes (Explanation and Goal, Feedback and Notification), most of the questions were agreed or strongly agreed by at least 70% of the subjects (both parents and physiotherapist). In Real-world scenario there is different perception level between the parent’s and therapist related to the new or novel therapy. McDonald *et al.*, (2003) stated that the parent’s are more concerned with the “day-to-day management issues and physiotherapist on technical issues”. The perception of the therapy session is different from the parents view and physiotherapist view. (Shazia Haq, 2020). Testing

of the two stake holders’ perception is needed, if the parents are not satisfied, the education about the therapy sessions and benefits of using video game must be educated.

Conclusions

By comparing parents with physiotherapist with respect to their agreement on questions related to each attribute, we found that there is no significant difference between them in terms of the mean scores of each of the 5 attributes. Hence, the study concludes that the structured spatial skills training educational video game have all the features of the educational video game and it was agreed by most of the parents and physiotherapists with no significant difference between them in terms of their perception about each of the 5 characteristics of the game. Clinical implication of this study, since the level of agreement is the same between the parents and physiotherapist, this game is highly recommended for the children from educational point of view.

References

- Aierbe, A., Oregui, E., and Bartau, I. (2019). Video games, parental mediation and gender socialization. *Digital Education Review*, 36:100-116. <https://doi.org/10.1344/der.2019.36.100-116>
- Anuprita Kanitkar, Sanjay Tejjraj parmar, Tony J Szturm, Gayle Restall, Gina Rempel, Nariman Sepehri (2001). *JMIR Rehabilitation and Assistive Technologies*, 8(2). <https://rehab.jmir.org/2021/2/e24337>.
- Baranowski, T., Blumberg, F., Buday, R., DeSmet, A., Fiellin, L. E., Green, C.S., Kato, P.M., Lu, A.S., Maloney, A.E., Mellecker, R., Morrill, B.A., Peng, W., Shegog, R., Simons, M., Staiano, A.E., Thompson, D., and Young, K. (2016). Games for Health for Children - Current Status and Needed Research. *Games for Health Journal*, 5(1):1-12. <https://doi.org/10.1089/g4h.2015.0026>
- Burgers, C., Eden, A., Van Engelenburg, M.D., and Buningh, S. (2015). How feedback boosts motivation and play in a brain-training game. *Computers in Human Behavior*, 48(February), 94-103. <https://doi.org/10.1016/j.chb.2015.01.038>
- Catarina Santos, Ana Ferreira, Claudia Quaresma, Carlo Quintao (2020). RehabVisual: An Application to stimulate Visuomotor skills in preterm babies with developmental alterationa. *Springer Nature*, 177-184, DOI: 10.1007/978-3-030-20040-416.
- Cheng, C. H. and Su, C. H. (2012). A Game-based learning system for improving student’s learning effectiveness in system analysis course. *Procedia - Social and Behavioral Sciences*, 31(2011):669-675. <https://doi.org/10.1016/j.sbspro.2011.12.122>
- de Aguilera, M. and Mendiz, A. (2003). Video games and education: (Education in the Face of a “Parallel School”). *Computers in Entertainment (CIE)*, 1(1):1-10. <https://doi.org/10.1145/950566.950583>
- Demir, Ü. (2020). An Examination of the Impact of Game-Based Geometric Shapes Education Software Usage on

- the Education of Students With Intellectual Disabilities. ECNU Rev. Educ. 209653112094072 doi:10.1177/2096531120940721.
- Fasulo, A., Shukla, J. and Bennett, S. (2017). Find the hidden object. understanding play in psychological assessments. *Front. Psychol.*, 8:1-12
- Ferrara, K., Hirsh-Pasek, K., Newcombe, N. S., Golinkoff, R. M. and Lam, W. S. (2011). Block Talk: Spatial Language During Block Play. *Mind, Brain, Educ.*, 5:143-151
- Forsberg, A., Nilsaard, Y., and Boström, K. (2015). Perceptions of using videogames in rehabilitation: A dual perspective of people with multiple sclerosis and physiotherapists. *Disability and Rehabilitation*, 37(4):338-334. <https://doi.org/10.3109/09638288.2014.918196>
- Gaetan Ickx, Samar M. Hatem, Inmaculada Riquelme, Kathleen M. Friel, Camille Henne, Rodrigo Araneda, Andrew M. Gordon, Yannik Bleyenheuf (2018). Impairments. Neural Plasticity after congenital brain lesions. <https://doi.org/10.1155/2018/1435808>
- Giulia Giovagnoli, Stefano Vicari, Serena Tomasetti, Deny Menghini (2016). The role of Visuo-spatial abilities in dyslexia: Age Difference in Children's Reading. *frontiers in Psychology*. doi: 10.3389/fpsyg.2016.01997.
- Hartono, M., Santoso, A. G., Raya, C. L., Yulianto, B., and Suwarno, S. (2016). Audio Visual Media Components in Educational Game for Elementary Students. *ComTech: Computer, Mathematics and Engineering Applications*, 7(4):255. <https://doi.org/10.21512/comtech.v7i4.2515>
- Hendrawan, Y. F. (2018). A Maze Game on Android Using Growing Tree Method. *J. Phys. Conf. Ser.* 953.
- Kanitkar, A., Parmar, S. T., Szturm, T. J., Restall, G., Rempel, G., & Sepehri, N. (2021). Parents' Perspectives on a Computer Game-Assisted Rehabilitation Program for Manual Dexterity in Children With Cerebral Palsy: Qualitative Analysis of Expectations, Child Engagement, and Benefits. *JMIR rehabilitation and assistive technologies*, 8(2):e24337. <https://doi.org/10.2196/24337>
- Lieberoth, A. and Fiskaali, A. (2021). Can Worried Parents Predict Effects of Video Games on Their Children? A Case-Control Study of Cognitive Abilities, Addiction Indicators and Wellbeing. *Frontiers in Psychology*, 11(January). <https://doi.org/10.3389/fpsyg.2020.586699>
- Lim, J. S. (2019). Parents' Perception of Children's Digital Game Use., 13(1):75-83.
- Malgorzata Llpowska, Ewa Czaplewska, Anna Wysocka (2001). Visuospatial deficits in dyslexic children. *Med Sci Monit.*, 17(4):216-221.
- Mammarella, I.C., Cardillo, R., and Zocante, L. (2019). Differences in visuospatial processing in individuals with nonverbal learning disability or autism spectrum disorder without intellectual disability. *Neuropsychology*, 33(1):123-134. <https://doi.org/10.1037/neu0000492>
- Marianne Saard, Madis Bachmann, Kirsi Sepp, Lisanna Pertens, Kai Kornet, Liina Reinart, Christen Koop, Anneli Kolk. (2019). Positive outcome of visuospatial deficit in children with Epilepsy using computer based FORAMENRehab program. *Epilepsy and Behaviour*, <https://doi.org/10.1016/j.yebeh.2019.106521>
- McDonald Surtees, Wirz (2003). A comparison between parent's and therapist's views on their child's individual seating system. *International Journal of Rehabilitation Research*, 26(3):235-243
- Oei, A.C. and Patterson, M.D. (2013). Enhancing Cognition with Video Games: A Multiple Game Training Study. *PLoS ONE*, 8(3). <https://doi.org/10.1371/journal.pone.0058546>
- Rachel L Hawe, Andrea M. Kuczynski, Adam Kirtan, Sean Dukelow (2020). Assessment of bilateral motor skills and visuospatial attention in children with perinatal stroke using a robotic object hitting task. *Journal of NeuroEngineering and Rehabilitation*, 17(18) <https://doi.org/10.1186/s12984-020-0654-1>
- Ricardo Basso Garcia, Irene C Mammarella, Dorian Tripodi, Cesare Cornoldi (2013). Visuospatial working memory for locations, colors, and binding in typically developing children and in children with dyslexia and non-verbal learning disability. *British journal of developmental psychology*. <https://doi.org/10.1111/bjdp.12019>
- Romona Cardillo, Claudio Vio, Irene C Mammarella (2020). A comparison of local-global visuospatial processing in autism spectrum disorder, nonverbal learning disability, ADHD and typical development. *Res Dev Disabil.* doi: 10.1016/j.ridd.2020.103682
- Shazia Haq, Tahir Nazeer, Muhammed Zia ul haq, 2020. Perception of the parents, Physiotherapist, and Allied health professionals about the role of physiotherapy in the rehabilitation of the children with cerebral palsy. - A case study of District Bhakkar. *Sir Syed Journal of Education and Social Research*. [https://doi.org/10.36902/sjesr-vol3-iss2-2020\(354-359\)](https://doi.org/10.36902/sjesr-vol3-iss2-2020(354-359))
- Nebel, S., Schneider, S., Schledjewski, J., and Rey, G.D. (2017). Goal-Setting in Educational Video Games: Comparing Goal-Setting Theory and the Goal-Free Effect. *Simulation & Gaming*, 48(1):98-130. <https://doi.org/10.1177/1046878116680869>
- Sun, H., and Gao, Y. (2016). Impact of an active educational video game on children's motivation, science knowledge, and physical activity. *Journal of Sport and Health Science*, 5(2):239-245. <https://doi.org/10.1016/j.jshs.2014.12.004>
- Thierry Olive, Jean-Michel Passerault (2012). The visuospatial dimensions of writing. *Written communication*. DOI 10.1177/0741088312451111
- Trabacca, A., Vespino, T., Di Liddo, A. and Russo, L. (2016) Multidisciplinary rehabilitation for patients with cerebral palsy: Improving long-term care. *J. Multidiscip. Healthc.*, 9:455-462
- Trajkovik, V., Malinovski, T., Vasileva-Stojanovska, T. and Vasileva, M. (2018). Traditional games in elementary school: Relationships of student's personality traits, motivation and experience with learning outcomes. *PLoS One*, 13:1-15
- Vahlo, J. and Karhulahti, V. M. (2020). Challenge types in gaming validation of video game challenge inventory (CHA). *International Journal of Human Computer Studies*, 143(February):102473. <https://doi.org/10.1016/j.ijhcs.2020.102473>
- Valerie Critten, Emma Campbell, Emily Farran, David Messer (2018). Visual perception, visual-spatial cognition and mathematics: Associations and predictions in children with cerebral palsy. *Research in Developmental Disabilities*, 80:180-191. <https://doi.org/10.1016/j.ridd.2018.06.007>
- Weizman, Z.O. and Snow, C.E. (2001). Lexical output as related to children's vocabulary acquisition: Effects of sophisticated exposure and support for meaning. *Developmental Psychology*, 37(2):268-279. <https://doi.org/10.1037/0012-1649.37.2.265>
- Zhang, X., Chen, C., Yang, T. and Xu, X. (2020). Spatial Skills Associated With Block-Building Complexity in Preschoolers. *Front. Psychol.*, 11:1-11
- Xue, J. et al., (2017). Uncovering the cognitive processes underlying mental rotation: An eye-movement study. *Sci. Rep.*, 7:1-12
- Young, C.J., Levine, S.C., and Mix, K.S. (2018). The connection between spatial and mathematical ability across development. *Frontiers in Psychology*, 9(JUN). <https://doi.org/10.3389/fpsyg.2018.00755>