
Cerebral palsy children's perception of the novel spatial educational video game – A Qualitative analysis

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Abstract

Cerebral palsy children have difficulty with visual perception and visuospatial skills. The visuospatial skills have a direct correlation with academic achievements. Spatial skills and mathematical skills are important in performing daily activities. The novel Structured Spatial Skills training educational video game (SSST edugame) was designed and developed based on the concept of improving spatial skills and mathematical skills of atypically developing children. The child's perception of the game is mandatory to check whether it has the desired outcome. In this qualitative analysis, the children clinically diagnosed with cerebral palsy between the ages group 7-14, both genders, normal IQ, near normal hearing and vision, with MAC levels 1 and 2 are selected. The study has three phases, in phase 1 - the demographic details of the children were collected. In phase 2 - two months training program with the SSST edugame, in phase 3 - the questionnaire was given. It consists of questions related to the game features and the child has to respond either yes or no and descriptive statistics were done. The analysis shows that the children like this game and they are very much motivated to learn the basic shapes, animals, birds, fruits, building blocks, and spatial language. Any novel product must be tested for acceptance by the desired population, the results say that the game is much perceived as a good novel video game and can be used by any children who have problems with visuospatial skills.

Keywords: Spatial skills, video games, cerebral palsy, perception, maths skills

Introduction

"Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that is attributed to non-progressive disturbances that occurred in the developing fetal or infant brain" (Graham et al., 2016). This motor problem are also accompanied with "sensation, perception, cognition, behavior, epilepsy, and secondary musculoskeletal problems" (Pallavi Sharma, Sunil Dutt Sharma, Ashu, Jamwal, Sanjeev Dogra, 2019). The spatial skills are defined as "skills in representing, transforming, generating, and recalling symbolic, non-linguistic information" (Cornu et al., 2017). The spatial skills are delayed in cerebral palsy children due to the damage to the white matter. Numerous pieces of evidence say that there is a relation between the spatial skills and mathematical achievement of cerebral palsy children (Carr et al., 2018). Arithmetic skills are important in daily activities like "finding the correct bus, paying for shopping, setting up dates" (Van et al., 2010). The arithmetic skills are found to be delayed in cerebral palsy children and are most commonly seen (Tajadini et al., 2017). Cerebral palsy children have difficulties in "visual perception, visual short-term memory, visual reasoning, and mental rotation all of which were associated with their mathematical skills"

(Critten et al., 2018). Video games are the latest blooming trend in pediatric rehabilitation. The benefits of playing games are “ progression, increasing difficulty, challenges, engagement, attention, motivation, visual feedback, easy, no boring and intrinsic interest” (Radtka et al., 2013). Technology-based learning will lead to a positive impact on the learning domain (Melero & Hernandez-Leo, 2014). “Edugame is a type of video game that is designed to develop a skill or implemented as a learning exercise while one is playing the game itself” (Marta Rodriguez Jimenez, Francesca Pulina, 2015). The Structured spatial skills training educational video game was developed to improve the spatial skills of the children. The uniqueness of this game is, it is a web-based game played on mobile, tab, laptop, and desktop. The only requirement is the browser and data connection since it is an online game. The features that are added to motivate the children are cartoon characters Sai and Sri, mild colors, scoring system, immediate feedback to grab the interest of the children. To make the educational video game to be therapeutic it is designed to avoid addiction by providing lock system to the duration played on one single day and total number of days to be played. SSST edugame can be played only on Monday, Wednesday, and Fridays and only for 40 minutes in a day. To have better involvement of the child, the games are designed from easy to difficult level. Total of 21 games, 7 games with three levels in each. The child can click the hints and instruction button to understand how to play the game, it also provides the voice over. If the child has difficulty in reading, they can be benefited from the voice over. The determinants of the better outcome of the novel therapeutic approach in the Peadiatric rehabilitation are the user experience, acceptance of the novelty by the children, physiotherapist, parents, educators, and the platform in which the product is used. Of all the above said determinants the acceptance of the game perception by the child stands the most important as they are the one who is going to use it. This study is focused on examining the cerebral palsy children’s perception of the Structured spatial skills training educational video game.

Materials and Methods

Selection process

The study was started after obtaining the approval from ethical committee. The informed consent was laid down along with the child information leaflet and SSST edugame instructions manual. The selection of the children and implementation of the study is divided into three phases. In the first phase, the demographic details of the children were collected.

Inclusion criteria

1. Children clinically diagnosed with cerebral palsy
2. Age group between 7-14 years
3. Both genders
4. MAC levels 1 and 2
5. Who can walk independently
6. With good communication
7. Near normal hearing and vision
8. Normal IQ

9. Able to understand the instructions

Exclusion Criteria are as follows:

1. Cerebral palsy children with epilepsy
2. Cerebral palsy children with mental retardation
3. Those who have problems with hearing, vision, communication, and understanding instructions
4. MAC levels 3, 4, and 5
5. Those who can't be able to walk independently.

The 20 (n=20) children who are under the inclusion criteria were selected for the study. In phase 2 – the informed consent, child information leaflet, and SSST edugame manual was given to the parents of these children. They are given detailed eye-opening on the purpose of the study, the importance of playing educational games, and how to fill out the questionnaire at the end of the play session. They are also instructed that if the child feels any discomfort during the study period, they can leave the protocol at any point of time. The child has to undergo the training session for two months (24 play sessions), where the child plays only on Monday, Wednesday, and Friday and only 40 minutes a day. Since the software is preprogramed in such a way the game will be automatically locked after 40 minutes and 24 plays session. Apart from the above-mentioned days, the other days are maintenance days where the child cannot play the game. In Phase -3, at the end of the 24 play sessions, the questionnaire was given to the parents, they have to fill it after getting the response to each question from their children. The questionnaire consists of 15 questions related to the child's perception of the game. The child has to say either yes or no and the responses will be filled by the parents. Then the descriptive statistics were analysed

Results and Discussion

The frequency distribution of the study variables yes or no for all the 15 questions was calculated. The hypothesis to be tested is whether cerebral palsy children like the game under three categories, playing aspect, Audio-Visual treatment, and overall perception of the game. To test whether the proportion of subjects who responded as yes is greater than 50 %. Null hypothesis H_0 – “proportion of subjects responded as yes” is only 0.50; Alternate hypothesis H_1 “proportion of subjects responded yes” is greater than 0.50. The data shows that the p-value is less than 0.05 for most of the questions, indicating that the proportion of subjects who responded as yes is greater than 50 %. So, the null hypothesis is rejected, indicating the results are statistically significant.

Table 1. Game Perception Questionnaire

Variable	Renamed	Remark
1. SSST edugame is easy to play	Easy play	Game Feature – playing aspect
2. SSST edugame is easy to learn	Easy learn	Game Feature – playing aspect
3. SSST edugame is boring	Boring	
	Enjoyable	

4. SSST edugame is enjoyable	Educational	Game Feature – playing aspect
5. SSST edugame is educational	Like Motivation	Game Feature – playing aspect
6. Do you like the motivation pop-ups	Like cartoon	Game Feature – playing aspect
7. Do you like the cartoon characters Sai and Sri	Like Colors	Game Feature – playing aspect
8. Do you like the colors in the game	Like score	Game Feature – playing aspect
9. Do you like the scoreboard and scoring	Like Sound Like Graphics	Game Feature – Audio Visual Treat
10. Do you like the sound	Understand hint	Game Feature – Audio – Visual Treat
11. Do you like the graphics	Understand Instructions	Game Feature – Audio – Visual Treat
12. Do you understand the hint	Recommend game	Game Feature – Audio – Visual
13. Do you understand the instructions	Like game	Game Feature – Audio – Visual Treat
14. Do you recommend SSST edugame, your friends		Game Feature – Audio – Visual Treat
15. Do you like the SSST edugame		Game Feature – Audio – Visual Treat
		Game Feature – Overall Perception
		Game Feature – Overall Perception

Table 2: Statistical analysis of the Game perception

S.no	Variable	n	No	Yes	% of yes	To test whether	p-value	Reject Ho ?
1.	Easy – Play	20	0	20	100%	$P(\text{Yes}) > 0.50$	0.000	Yes
2.	Easy learn	20	0	20	100%	$P(\text{Yes}) > 0.50$	0.000	Yes
3.	Boring	20	19	1	5%	$P(\text{Yes}) > 0.50$	0.000	Yes
4.	Enjoyable	20	0	20	100%	$P(\text{Yes}) > 0.50$	0.000	Yes
5.	Educational	20	1	19	95%	$P(\text{Yes}) > 0.50$	0.000	Yes
6.		20	0	20	100%	$P(\text{Yes}) > 0.50$	0.000	Yes

7.	Like	20	0	20	100%	P(Yes)>0.50	0.000	Yes
8.	motivation	20	05	15	75%	P(Yes)>0.50	0.013	Yes
9.	Like cartoon	20	10	10	50%	P(Yes)>0.50	0.500	No
10.	Like colors	20	7	13	65%	P(Yes)>0.50	0.090	No
11.	Like scoring	20	0	20	100%	P(Yes)>0.50	0.000	Yes
12.	Link sound	20	11	9	45%	P(Yes)>0.50	0.673	No
13.	Like Graphics Understand hint	20	11	9	45%	P(Yes)>0.50	0.673	No
14.		20	0	20	100%	P(Yes)>0.50	0.000	Yes
15	Understand instructions Recommend game Like game	20	0	20	100%	P(Yes)>0.50	0.000	Yes

Playing specific computer games will improve that specific skill and have an immediate positive result. Most of the studies emphasize that games which are designed to focus on visuals apart from verbal will lead to improvement in visual intelligence skills. The use of computers for playing games resulted in better grades in English and Maths (Simkova, 2014). To improve the functional skills of cerebral palsy children some adaptations were done in the rehabilitation settings, schools, and home (Ballaz et al., 2011). Visual dysfunction is seen as a major disorder occurring in cerebral palsy children. Due to low-level visual information, and deficits in visual perception and integration (visual cognitive disorders) the child will experience problems in the execution of motor performance. There is a correlation between the visual function and motor function. Periventricular leukomalacia is “associated with the visual and motor dysfunction”. Jacy R. Ver Maas et al. (2020) investigated the cortical differences in primary processing in children with cerebral palsy. They used “magnetoencephalography and beamforming methods to image the relative changes in the alpha-beta and gamma occipital oscillations induced by a spatial grating stimulus”. The results showed that the visual processing deficits will affect the ability to perceive visual changes and suggested that “therapeutic strategies that enhances the lower-level visual processes may have cascading beneficial effects on higher-level visual perceptual process”. (VerMaas et al., 2020). The impairments include “visually guided object recognition, eye-hand coordination, language comprehension, visuospatial abilities, and visual memory”. Impairment in the frontal, parietal and temporal regions result in delayed visuospatial abilities in cerebral palsy children. Color vision is impaired and related to the degree of motor problems. Typically, CP children have an IQ greater than 70, “normal verbal comprehension and impaired visual-spatial reasoning and non-verbal intelligence”. This problem worsens when these children enter the schooling. Due to PVL the connectivity seen in temporal-parietal cortex is affected, thus leading to the visuo-spatial impairments. Visuospatial deficits are correlated with the decreased cognition (Stadskleiv, 2020). Cognitive training for these children is necessary to address this type of issue. Most of the studies aim at literacy improvement, but visual-spatial and attention impairment also should be considered (Costa & Pereira, 2014). The literature says that cerebral palsy children attending mainstream school have good math and reading skills when compared with cerebral

palsy children attending special schools. The concept of inclusiveness should be emphasized to improve the participation of these children in normal school and social participation.

Cerebral palsy children are having problems with primary motor impairments and secondary impairments. This game is designed to improve the spatial skills of the typically and atypically developing children, those who have problems in learning and spatial skills. The acceptance of any intervention by the child is of most importance in implementing it for them. Since, this game is novel, the usage of the game by the children was checked after the total training period. Most of the children liked all the game features, and audio-visual treats and the overall perception of the game was good. Whenever a new game is introduced to the children it should have the following features like scoring, pleasant colors and sounds, easy to understand and play, graphics, and good understanding of the hints and instructions. When the child starts to play, it should be easy, new learning, enjoyable, and it serve the educational purpose. The child should be very happy even to recommend the game to other children. To conclude, since all the game features are seen the SSST edugame, it is liked by most of the cerebral palsy children.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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