Applying the Vietnamese Version of VRapeutic Software for Children with ADHD in Hanoi: A Case Study.

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ABSTRACT

Virtual reality technology (VR) was growing strongly and applied in education in general and special education in particular. Many studies have shown the benefits of using virtual reality in the education of children with disabilities. By using experimental methods and case studies, the article presents in detail how to conduct as well as the results of 09 experimental sessions for 02 students with Attention Deficit – Hyperactivity Disorder (ADHD) in Hanoi. Experimental results show that both children showed improvement in concentration at the end of the sessions, but 09 training sessions are too short because each session lasts for only 7-20 minutes; therefore, it is not enough to conclude the progress for 02 children with ADHD. Hence, this study proposes that a longer experimental period is needed in combination with educational therapies for children with ADHD. Additionally, VRapeutic software also needs to be further improved in both quality and price adjustment in order to match with the Vietnamese context.

KEYWORDS: *virtual reality, vrapeutic, attention deficit hyperactivity disorders, ADHD, Hanoi.*

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a type of Neurodevelopmental Disorder, characterized by ongoing attention deficiency, hyperactivity, and impulsivity that interfere with functionality (APA, 2013). It is estimated that 8.4% of children and 2.5% of adults have ADHD (Danielson, et al., 2018; Simon, et al., 2009). This show that ADHD is one of the most common mental disorders affecting children. There are many methods to treat children with ADHD, including an advanced method using virtual reality technology. Many studies have applied different types of virtual reality technologies, such as virtual classrooms, virtual games, and virtual reality traffic distance selection for diagnosing, monitoring, evaluating, and providing treatment and education for children with ADHD from 6-18 years old (Rose et al., 2005; Bioulac et al., 2012; Rodríguez, García, & Areces, 2017; Neguţ et al., 2017; Areces et al., 2016). Other studies have shown difficulties in the cognitive functioning of children with ADHD, such as working memory, executive function, and attention in children with ADHD (Rizzo et al., 2000; Rose et al., 2005). Besides, numerous studies confirmed the advantages of virtual reality in cognitive performance, such

as working memory, executive function, and attention (Rizzo et al., 2000; Knight & Titov, 2009; Bashiri et al., 2017). Other studies showed the significant role of virtual reality in reducing behavioral symptoms and problems (Gongsook, 2012; Rose et al., 2005). These studies' findings indicated that virtual reality technology is useful for evaluating, educating and ameliorating these conditions (Othmer & Kaiser, 2000; Rose et al., 2005; Schwebel et al., 2008; Bashiri et al., 2017). VR technologies allow people with disabilities related to brain damage to experience anything that is difficult or impossible for them in reality (Rose, 2001; Gongsook, 2012; Bashiri et al., 2017). Rehabilitation of children with ADHD is based on behavior and physical patterns and is thus suitable for VR interventions (Bashiri et al.,2017).

VRapeutic is also one of the types of virtual reality technology in the form of games (VR Game), VRapeutic modules target three types of attention, which are sustained, selective and adaptive attention for children between the ages of 6 and 12 years old. Previously, the software had two language options (English and Arabic), now there is a Vietnamese version as well. VRapeutic has been developed and utilised for children with developmental disorders in several countries around the world. All performance data is continuously stored in the cloud, allowing professionals to refer to it for designing recovery plans on top of the database.

This article points out the experimental result of using VRapeutic virtual reality software for children with ADHD aged 6-12 years old, funded by UNICEF Viet Nam and carried out in Hanoi. This is the first published study on the application of virtual reality technology software – Vrapeutic in Vietnam. From the experimental results on 02 children with ADHD, the article will suggest further research directions to increase the quality of the software as well as use it in a useful way for students with ADHD in Vietnam.

2. Research Methodology

This study reviewed some articles published in English that were available as full texts through databases and e-journals. The keywords for the search included "ADHD", "virtual reality", and "virtual reality for ADHD". Besides, this study uses an experimental method in applying VRapeutic software for 2 students with ADHD (a 7-year-old and an 11-year-old) in 9 sessions. Each experimental session lasted from 10 to 20 minutes. In each experimental session, there was a teacher or a special education expert, who provided guidance and wrote full reports of both students' performance.

3. Research results

3.1. Case 1: L.A 11 years old.

L.A was born on 21st July 2011. He is the first child in a family with two sons. There were no problems with L.A's mother's pregnancy and postpartum process. When he was about three years old, his parents recognised some signs of attention deficit in L.A such as: he moved a lot, he faced difficulties in sitting in the same seat for a long time, and he was easily distracted by surrounding factors. L.A was selected for the study because the results of his intelligence test (based on the WICS-IV assessment)

are at a medium-high level. The test results of attention deficit (according to the Conners-3) showed that L.A belongs to the group of children with ADHD.

Table 1. Conners - 3 Assessment Results

Scale	Raw Score	T-Score (Percentile)	Guideline	Common Characteristics of High Scores
Inattention	22	81 (99)	Very Elevated Score	May have poor concentration/attention or difficulty keeping his/her mind on work. May make careless mistakes. May be easily distracted. May give up easily or be easily bored. May avoid schoolwork.
Hyperactivity/ Impulsivity	10	57 (74)	Average Score	High activity levels, may be restless and/or impulsive. May have difficulty being quiet. May interrupt others. May be easily excited.
Learning Problems	20	89 (98)	Very Elevated Score	Academic struggles (reading, writing, and/or math). May have difficulty learning and/or remembering concepts. May need extra explanations.
Executive Functioning	23	81 (99)	Very Elevated Score	May have difficulty starting or finishing projects, may complete projects at the last minute. May have poor planning or organizational skills.
Defiance/ Aggression	1	48 (59)	Average Score	May be argumentative; may defy requests from adults; may have poor control of anger and/or aggression; may be physically and/or verbally aggressive; may show violent and/or destructive tendencies; may bully others; may be manipulative or cruel.
Peer Relations	6	79 (98)	Very Elevated Score	May have difficulty with friendships, may have poor social connections. May seem to be unaccepted by group.

Note:

- T-score <40: Low Score (fewer concerns than typical children)

- T-score 40-59: Average Score (typical levels of concern)

- T-score 60-64: High Average Score (slightly more concerns than are typically reported)

- T-score 65-69: Elevated Score (more concerns than are typically reported)

- T-score ≥70: Very Elevated Score (many more concerns than are typically reported)

- The percentile score shows the child's position relative to peers of the same age and gender.

Conner Assessment Results:

L.A. expressed a wide range of symptoms of decreased concentration (inattention) at a very elevated level. This reflects L.A.'s difficulties in focusing, paying attention, or keeping his mind on work; he is prone to careless mistakes; easily distracted; easily gives up or gets bored easily; tending to avoid doing homework at school.

The assessment results also reflected a number of other LA's difficulties, which should be concerned to his parents and teachers: learning difficulties (very elevated), executive functioning (very elevated) and peer relationships (very elevated).

Table 2. Experimental results VRapeutic – 9 sessions

Day	Time	Module of VRapeutic	Child's expressions	Comments
10th Feb 2022	10 minutes	GardenDo – session 1	L.A concentrated and performed tasks correctly and quickly. He was so happy to do the watering activity at the GardenDo Module.	L.A focused on the teacher's tasks and instructions. Therefore, L.A could do the task properly and quickly.
11th Feb 2022	10 minutes	GardenDo – session 2	During the process of watering the plants, L.A turned his head to look at the mountain twice.	L.A was distracted in the process of performing the task.
3rd March 2022	20 minutes	GardenDo – session 3	L.A. was distracted while looking at the scenery, so he left the intended position (indicated by the in-app footprints) while performing the task three times. L.A. did not make efforts to flexibly solve the difficulties in order to pour water on the flowers. He simply shook the water pot instead of trying to position it differently.	L.A was distracted in the process of performing the task.

4th March 2022	15 minutes	GardenDo – session 4	L.A. seemed to lose focus a lot, he turned to look around more: looking at trees, the boy in VR, butterflies and birds. When watering the first 2 pots, L.A lost his attention: turned and looked around 2-3 times while watering a pot. After being reminded, he watered more concentratedly.	L.A was distracted from the surrounding features: trees, the boy in VR, butterflies and birds. L.A was distracted in the process of performing the task.
4th March 2022	20 minutes	Viblio – session 5	The first time: L.A played Viblio level 1, he focused on completing the task: put the books on the shelves. The second time: L.A played Viblio level 2: while arranging books, the robot broke its leg. After that, L.A repaired the robot's leg, he continued to look at how the robot was structured. He was distracted by the robot constantly while stacking books.	L.A. was distracted strongly by distractions in Viblio Module. (robots)
7th March 2022	10 minutes	Viblio – session 6	The first time: LA also looked out of the bookshelf, at the parrot (1 time) and the robot (1 time). The second time: After listening to the instructions, he went to see the robot and then returned to work. During the time dealing with the task requiring him to arrange the books, L.A forgot the task totally. He sometimes looked, played with the robot, and then returned to the task. It took him a few minutes to understand the rules of book arrangement.	L.A. completed the task but was distracted by the surrounding factors (especially the movement and interference of the robot).
8th March 2022	10 minutes	Archeeko – session 7	L.A. understood the task, learned how to hold a bow and shot well. He was focused on performing the task and hit 5 gift boxes	L.A had good concentration and completed the task well.
9th March 2022	8 minutes	Archeeko – session 8	L.A focused well on the task, hitting 13 with 15 arrows.	L.A had good concentration and completed the task well.
16th March 2022	10 minutes	Archeeko – session 9	L.A. focused on completing the task. He got hit by the ball once. He shot all the gift boxes and had 4 arrows left.	L.A had good concentration and completed the task well.

Observations about the 1ˢᵗ case study: According to Conner's assessment, L.A had a Very Elevated Score of Inattention, which coincided with his results while performing the tasks in GardenDo and Viblio Module. In session 1, L.A. paid attention and completed the task of watering flowers well. From session 2 to session 6, L.A. was distracted by external factors such as the child character, mountains, and trees in GardenDo. In Viblio, L.A. was distracted by the parrot's voice and especially the robot in the software; so, he often tried to look for the robot and even sat down to see the robot closer. However, in the last 3 sessions, L.A was attentive to and could perform well the archery task in Archeeko Module. After 9 sessions performed on Vrapeutic software, L.A had some improvement in the attention ability. This result is similar to previous studies (Rizzo et al., 2000; Knight & Titov, 2009; Bashiri et al., 2017)

Case 2: M.T - 7 years old: M.T was born on October 19th 2015. He is the first child in a family with two children. During pregnancy, his mother had pre-eclampsia, so she gave birth early in the 36th week of pregnancy. When he was about five years old, his family found that M.T had mild symptoms of poor concentration and hyperactivity such as: he talked a lot, he had difficulty waiting for his turn, he loved running and jumping. In class, his teachers shared that M.T often talked too much. He hated to participate in activities that required sitting for a long time. M.T was selected for the study because the results of his intelligence test (based on the WICS-IV tool) were at an average level. However, the test results of ADHD clearly showed that M.T belongs to the group of children with ADHD.

Table 3. Conner - 3 Assessment Results

Scale	Raw Score	T-score (Percentile)	Guideline	Common Characteristics of High Scores
Inattention	11	61 (87)	High Average Score	May have poor concentration/attention or difficulty keeping his/her mind on work. May make careless mistakes. May be easily distracted. May give up easily or be easily bored. May avoid schoolwork.
Hyperactivity/ Impulsivity	13	57 (75)	Average Score	High activity levels, may be restless and/or impulsive. May have difficulty being quiet. May interrupt others. May be easily excited.
Learning Problems	9	57 (78)	Average Score	Academic struggles (reading, writing, and/or math). May have difficulty learning and/or remembering concepts. May need extra explanations.

Scale	Raw Score	T-score (Percentile)	Guideline	Common Characteristics of High Scores
Executive Functioning	9	55 (83)	Average Score	May have difficulty starting or finishing projects, may complete projects at the last minute. May have poor planning or organizational skills.
Defiance/ Aggression	5	73 (95)	Very Elevated Score	May be argumentative; may defy requests from adults; may have poor control of anger and/or aggression; may be physically and/or verbally aggressive; may show violent and/or destructive tendencies; may bully others; may be manipulative or cruel.
Peer Relations	3	58 (87)	Average Score	May have difficulty with friendships, may have poor social connections. May seem to be unaccepted by group.

Note:

- T-score <40: Low Score (fewer concerns than typical children)

- T-score 40-59: Average Score (typical levels of concern)

- T-score 60-64: High Average Score (slightly more concerns than are typically reported)

- T-score 65-69: Elevated Score (more concerns than are typically reported)

- T-score ≥70: Very Elevated Score (many more concerns than are typically reported)

- The percentile score shows the child's position relative to peers of the same age and gender.

Conner Assessment Results

M.T has symptoms of poor concentration and attention at a "medium-high" level. This reflects some of M.T's specific difficulties in maintaining focus, attention, or keeping his mind focused on his tasks; he is prone to careless mistakes; is easily distracted; easily gives up or gets bored; or tends to avoid doing homework at school.

The evaluation results also reflect some other issues that his parents and teachers need to pay attention to him: hyperactive behaviors (high average), Defiance/ Aggression (very elevated).

Table 4. Experimental results VRapeutic – 9 sessions

Day	Time	Module of VRapeutic	Child's expressions	Comments
10th Feb 2022	20 minutes	GardenDo – session 1	When performing GardenDo Module, M.T dropped the watering pot 4 times and had difficulty in watering the 3rd and 4th flower pots (The water did not pour out). During the watering process, M.T sometimes looked around and talked about the things in VR.	T clearly showed a lack of concentration while performing the task. He often looked around to observe the environment in VR and talked constantly about what he was seeing in VR.
11th Feb 2022	20 minutes	GardenDo – session 2	While taking the water bottle, M.T put the water bottle down and looked at the mountains and trees. He said, "I see mountains and trees, too". When M.T finished watering the second pot, T looked around and saw a boy in VR. M.T had a hard time getting the water out of the bucket so it took a long time for the therapy session.	M.T was distracted when doing the task of pouring water into the bucket and watering the flowers.
16th Feb 2022	15 minutes	GardenDo – session 3	M.T focused on the task. He looked at the boy in VR (once) while watering the flowers. When the bird came, M.T chased the birds away and continued to water all the flower pots. Software error: Today sometimes water did not come out.	M.T focuses on the task of watering flowers, when the bird came, he chased the bird and continued to water 4 flower pots. M.T was just distracted a little while looking at the boy in VR while watering the flowers (once).
11th March 2022	15 minutes	GardenDo – session 4	When taking water into the bottle, M.T put the pot on the ground to let the water flow in and then looked around to see what the scene was in VR (He said "I see the stairs, I want to go there"). The water took a long time to fill up; so, while waiting , he kept saying twice (He said "Today I will win, I will become a pirate").	M.T was distracted at first, but when he watered the 4 flower pots, he focused on the task. Confounding factors are birds and butterflies but M.T was not distracted. He completed his work well.

Day	Time	Module of VRapeutic	Child's expressions	Comments
14th March 2022	15 minutes	Viblio – session 5	The first time: M.T heard the bird's singing, he turned his head to look for it and asked: "Is it a bird's voice?" (once). Then, he turned round to look for the character who did not appear in this module and asked, "Where is the boy?" (once) The second time: While putting the books on the shelf, M.T turned his head to look for the robot and asked, "Is the robot about to come back to life again?" (once)	M.T was distracted by surrounding factors such as the bird, the robot and the disappearance of the boy.
16th March 2022	10 minutes	Viblio – session 6	M.T concentrated on completing the task of arranging books, not being distracted by the robot or the birds in the VR	M.T showed good attention; then completed the task well.
14th March 2022	12 minutes	Archeeko – session 7	M.T played archery for the first time, he was very attentive and persistent in shooting even though he missed a lot. He hit 3 gift boxes.	M.T showed good attention; then completed the task well.
16th March 2022	7 minutes	Archeeko – session 8	M.T was highly attentive and hit 10 out of 15 arrows	M.T showed good attention; then completed the task well.
18th March 2022	15 minutes	Archeeko – session 9	M.T concentrated well and shot 3 gift boxes, avoided the ball 2 times	M.T showed good concentration; then completed the task well.

Observations about the 2nd case study: According to the results of the Conners-3 assessment, M.T had a high, moderate level of inattention. This is evident in the experimental process: he talked a lot about his family, about the movie that he watched while waiting for the teacher to open the software, or when he was about to start the session. From session 1 to session 5, M.T was distracted by surrounding factors such as narration voices, trees, mountains, and stairs in GardenDo module. In Viblio module, M.T was distracted by the bird and the robot but only mildly. From session 6 to session 9, M.T paid good attention to the tasks, and completed the tasks well. After 9 sessions performed on Vrapeutic software, M.T had an improvement in the attention ability. This result is similar to previous studies (Rizzo et al., 2000; Knight & Titov, 2009; Bashiri et al., 2017).

4. Discussion

On the child's progress through the 9 sessions of therapy: Both children showed improvement in concentration at the end of the sessions. This result is similar to previous studies (Rizzo et al., 2000; Knight & Titov, 2009;Bashiri et al., 2017). L.A. focused very well in the last 3 sessions of archery to hit the target/hit the gift box and avoid the ball in Archeeko. M.T focused well in session 6 on the task of putting books on the shelf in Viblio and in 3 sessions on archery missions to hit the targets/ hit the gift boxes and avoid the ball in Archeeko. According to Conner's assessment, L.A has a very elevated level of inattention, which is evident when L.A performs the tasks in the GardenDo and Viblio. However, in the last 3 sessions of archery, L.A was extremely focused on completing the tasks. Regarding M.T, he has an average high level of inattention. However, in the last 4 sessions, M.T absolutely focused on completing the tasks.

The 3 archery sessions of Archeeko do not have a distraction task that forces you to stop what you are doing in the middle of the main task. Instead, only after hitting the target is the task of avoiding the ball introduced sequentially. Additionally, the time to perform the tasks was relatively short, the tempo was fast compared to the previous episodes; Hence, both boys enjoyed the activity so much. The aforementioned factors may partially explain the two students' good performance in the last module.

Regarding software: In the initial period, the software expressed a wide range of problems when starting up and connecting to the glasses. Sometimes the software did not run and it took multiple restarts of both the app in the headsets and the desktop app on the laptop to open the application. This led to a waste of time and made the students bored. To illustrate, they went back and forth in the room, got up from their chairs from time to time, and asked repeatedly about the problem (When can I work? Why does it take so long? I'm so tired! etc.). Other problems can be described, such as watering from the watering pot in GardenDo, the water did not come out, or the data log could not be saved at level 3 of Viblio. It took multiple updates for the software to run better and save the data correctly. Additionally, certain sessions were designed with activities that are too short; so, the students could do the tasks too quickly, like in GardenDo (Session 1) or in the Archeeko (Session 8).

However, from the beginning to the end of the 9 experimental sessions, both students got excited and enjoyed participating in each experiment and looked forward to receiving the next one.

5. Conclusions

Experimental results show that both students were interested in and looked forward to using the VRapeutic virtual reality software. Experimental results showed that both children had improved their concentration in the last sessions. However, the special features of the last sessions compared to other ones may lead to good results at the end. Therefore, it is difficult to conclude that both children's improvement in

concentration resulted from the nine sessions of therapy. Hence, the research team reached a conclusion: the experimental time of 9 sessions is not enough to prove the reliability and efficiency of the software application.

To gain more valuable data to evaluate the software, experimental studies with more sessions and a longer duration of each activity should be carried out in the near future. In addition, experimental VRapeutic should be combined with educational therapies, and a control group is required to demonstrate the effectiveness of the software. If future modules are introduced, they should be tested thoroughly to avoid the technical difficulties as experienced with the first three modules. Module levels should be richer in design, increase in difficulty, and add stronger distractions according to different levels. Moreover, the price to buy a toolkit including 1 computer and 1 virtual reality headset is really high with the family with ADHD children. With the current price, many families in Vietnam cannot afford the tools personally. Therefore, UNICEF Vietnam should consider supporting ADHD students in terms of equipping the tools in some school locations for their better access opportunities.

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