

Research Paper

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

Aarti Kumari Jha^{1*}, Akshita Agarwal²

ABSTRACT

Attention Deficit Hyperactivity Disorder (ADHD) poses significant challenges to individuals, impacting self-regulation, academic performance, and executive functioning skills. This research aimed to examine the impact of gamified storytelling and virtual reality (VR) interventions on enhancing these critical domains in individuals with ADHD. A total of 150 individuals diagnosed with ADHD, aged 8 to 18, and participated in a 10-week randomized controlled trial. Participants were divided into an intervention group (n=45) and a control group (n=45). Pretest assessments revealed baseline measurements across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The experimental group exhibited mean scores of 25.8 (SSS), 27.4 (VREES), 34.6 (ADHD Self-Regulation), and 30.2 (Academic Performance) before the intervention, while the control group showed mean scores of 26.7, 28.1, 36.2, and 31.5, respectively. After a 10-week intervention, post-test results indicated improvements. In the experimental group, mean scores were 28.9 (SSS), 27.4 (VREES), 34.1 (ADHD Self-Regulation), and 32.5 (Academic Performance). The control group displayed mean scores of 29.2, 28.1, 32.5, and 30.3, respectively. The findings suggest positive changes in storytelling skills, self-regulation, and academic performance, emphasizing the potential efficacy of gamified storytelling and VR interventions for individuals with ADHD.

Keywords: ADHD, Attention Deficit Hyperactivity Disorder, Gamified Storytelling, Virtual Reality, Self-Regulation, Academic Performance, Executive Functioning, Intervention

A neurodevelopmental problem that affects millions of people worldwide is attention deficit hyperactivity disorder, or ADHD. A person with ADHD may experience major setbacks in their academic performance, interpersonal connections, and overall

¹Clinical psychologist and Research Scholar, Faculty of Behavioral Sciences, Shree Guru Gobind Tricentenary University, Gurugram, Haryana.

²Research Scholar, Faculty of Behavioral Sciences, Shree Guru Gobind Tricentenary University, Gurugram, Haryana.

*Corresponding Author

Received: February 20, 2024; Revision Received: March 16, 2024; Accepted: March 20, 2024

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

quality of life due to a chronic pattern of impulsivity, hyperactivity, and inattention [1]. The prevalence of ADHD has been steadily increasing over the past few decades, making it one of the most commonly diagnosed neurodevelopmental disorders in both children and adults [2].

ADHD presents multifaceted challenges that extend far beyond the stereotypical image of a hyperactive child struggling to sit still in a classroom [3]. While hyperactivity and impulsivity are hallmark symptoms, the core deficits in ADHD are related to executive functioning and self-regulation. These cognitive functions play a crucial role in an individual's ability to plan, organize & focus attention, control impulses, and complete tasks. Impairments in executive functioning and self-regulation can have profound consequences across various life domains, ranging from poor academic performance and impaired occupational functioning to difficulties in maintaining relationships and managing daily responsibilities [4].

Addressing the multifaceted challenges of ADHD requires innovative and effective interventions that extend beyond traditional pharmacological treatments and behavioral therapies [5]. The viability of employing technology interventions to help persons with ADHD better manage their symptoms and improve their quality of life has been the subject of a wave of study in recent years. Among these technological approaches, gamified storytelling and virtual reality (VR) interventions have emerged as promising tools for enhancing self-regulation, academic performance, and executive functioning skills in individuals with ADHD [6].

Gamified storytelling refers to the integration of game elements & storytelling techniques to create engaging and immersive educational experiences. By harnessing the power of narrative and gameplay, gamified storytelling interventions have the potential to captivate the attention of individuals with ADHD and motivate them to actively participate in learning activities [7]. Moreover, the interactive and adaptive nature of these interventions can provide tailored support, addressing the unique needs and challenges faced by individuals with ADHD.

Virtual reality, on the other hand, offers a novel and immersive way to engage individuals in therapeutic and educational experiences. VR environments can simulate real-world scenarios and challenges, allowing individuals to practice and refine their executive functioning skills in a controlled and engaging setting. The sensory-rich nature of VR can also help individuals with ADHD improve their attentional control and impulse regulation through interactive and multisensory experiences.

While the potential benefits of gamified storytelling and virtual reality interventions for individuals with ADHD are promising, there is a critical need for rigorous research to explore their impact comprehensively. This research paper aims to delve into the exploration of the impact of gamified storytelling and virtual reality interventions on enhancing self-regulation, academic performance, and executive functioning skills in individuals with ADHD.

In the following sections, we will provide a detailed examination of ADHD as a neurodevelopmental disorder, shedding light on its complex symptomatology and the pervasive challenges it presents. Subsequently, we will delve into the emerging field of gamified storytelling and virtual reality interventions, discussing the theoretical underpinnings and potential mechanisms through which these technologies can benefit individuals with ADHD. Finally, we will outline the objectives, hypotheses, and significance

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

of our study, setting the stage for a comprehensive investigation into the potential of gamified storytelling and virtual reality as innovative interventions for individuals with ADHD.

LITERATURE REVIEW

Cunha et al. (2023) [8] investigated students with indications of ADHD to see if a virtual reality-based intervention enhanced their working memory & processing speed. For the study, twenty-five adults were chosen at random from the Escola Superior de Sade do Politécnico do Porto, & they were divided into 2 groups. Random assignments were made to place participants in one of 2 groups: the active intervention group, which spent ten sessions playing VR games from the Enhance VR app, or the non-active control group. Throughout the intervention, six different games were utilized: Memory Wall, Shuffled, Assembly, React, and Maestro. Both before and after the intervention, participants underwent testing employing the SWAPS & the Wechsler Adult Intelligence Scale, Third Edition, Sequence of Letters & Numbers, & Spatial Location. Descriptive statistics were employed to characterize the sample, & a mixed ANOVA was employed to assess the intervention's effectiveness. Those who received the intervention had faster processing speeds ($p < 0.001$), and there was a significant value in the interaction between the intervention and time ($p = 0.004$). In the several variables that were taken into consideration, there were no statistically significant differences in the working memory of the participants, with the exception of the Spatial Location Test results, which rose in the experimental group compared to the first assessment ($p = 0.034$).

Kaur et al. (2023) [9] evaluated the effect of gamification components in brand apps on consumers' motivation to make a purchase. In the design of an exploratory study, quantitative data was collected by non-probability sampling using a standardized questionnaire to examine the impact of gamification on behavioral intention using a mechanics-dynamics-aesthetics paradigm. Storytelling was discovered to have a significant impact on participants' levels of enjoyment, lending credence to the idea that fun as a component of mobile gamification might significantly impact social interaction. It has been discovered that perceived fun is a strong predictor of future customer intent to adopt gamification. As new technologies emerge, managers and engineers can focus on dynamics, mechanics, & effective feedback systems.

Plechata et al. (2023) [10] investigated the impact of a virtual reality herd immunity simulation on vaccination intentions & their tenable mechanisms. 3 VR conditions were equally distributed among the $N = 654$ participants who were enrolled in this randomised controlled trial: (1) Gamified Herd Immunity, (2) Gamified Herd Immunity + Empathy (with extra story elements), and (3) Control (gamified without any content related to vaccinations). Gamified herd immunity places participants in the shoes of a vulnerable person trying to survive a wedding celebration without getting infected. The data came from 455 individuals who weren't extremely cybersick and weren't planning to get a new vaccine. The Gamified Herd Immunity + Empathy & Gamified Herd Immunity conditions enhanced vaccination intentions by 6.68 & 7.06 points, respectively, in comparison to the Control condition, which saw an increase in vaccination intentions of 1.91 points on a 0-100 scale. The Gamified Herd Immunity + Empathy condition significantly raised empathy compared to the Gamified Herd Immunity condition, but there was no increase in vaccination intent. Actual presence was correlated with a change in vaccination intentions. These results offer compelling proof that vaccination intentions can be successfully increased by virtual reality (VR) vaccination communication, and that this effect is independent of technology novelty or empathy.

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

Xu et al. (2022) [11] examined the utilization of gamification applications in mobile health to increase physical activity and provided a concise summary of the outcomes of gamification interventions on PA. The use of gamification apps in mobile health to increase people's physical activity levels is gaining popularity. It is conceivable that gamification, which makes use of game design elements like points, leaderboards, & progress bars, could enhance incentive for physical activity & participation. They utilised IEEE Xplore, PubMed, Scopus, Web of Science, Embase, CINAHL (EBSCO host), & Scopus from their inceptions until their anticipated terminations (December 20, 2020). The impact of gamification treatments on PA rates is examined in this study through the results of a recent empirical investigation. The studies describe at least one outcome, either self-reported or objectively measured, of exercise or PA participation. It is essential to note that our analysis did not include research on serious games or complete games. 50 (1.69%) of the 2,944 studies discovered through a database search were included and synthesized. The study explored that gamifying PA had been applied to a variety of population groups, with the highest adoption rate among youthful individuals and the lowest adoption rate among older adults and disease patients. More than half of the research (30/50, 60%) used gamification in conjunction with wearable devices to promote positive changes in PA behaviour, & nearly as many (25/50, 50%) drew on theories or concepts to develop their gamified PA interventions.

Xu et al. (2021) [12] examined the psychological impact of virtual gamification on students' intrinsic motivation in the classroom. Intrinsic motivation can be further enhanced by an individual through the use of gamification, a form of virtual incentive. Qualitative & quantitative research articles on virtual gamification and intrinsic motivation were found by searching APA PsycInfo, ProQuest, and the IEEE. An already-developed and tested screening tool was employed to assess the research. Includes papers published in English between 1990 & 2020, whether in Asia, North America, or Europe. There were only reviews, RCTs, meta-analyses, & grey literature such as—no anecdotal or exploratory investigations showed up. With the aid of the Mixed Methods Appraisal Tool, research was screened, data were extracted, & the studies' quality was assessed. Meta and statistical analyses were not feasible because of the variety of study designs, outcomes, and measurements; instead, a qualitative overview of the studies was supplied. Using game components such as leaderboards, social interactions, badges, and points has been shown to increase intrinsic motivation in the examined papers. Additionally, the connection between the behaviour of the learners and their success was demonstrated by the experimental research.

Korosidou et al. (2021) [13] employed a range of entertaining, interactive games to assess how well DS and AR support young learners' development of FL (Foreign Language) vocabulary. We rearranged the 6-year-olds' classroom to achieve this goal by adding tactile interfaces into a multimodal learning framework that promoted play, collaboration, and interaction. Eighteen (18) students in the same grade & school received the same instruction in a more conventional environment, whereas twenty (20) first graders at a primary school in Greece engaged in digital activities to learn about Greek mythology & ancient history. Both quantitative & qualitative data were gathered using the teacher/researcher diary, semi-structured interviews with experimental group members, & a non-equivalent posttest. The results showed that when DS & AR were utilized, a higher percentage of learnt vocabulary was maintained.

Van Gaalen et al. (2021) [14] focused primarily on providing empirical evidence supporting the effectiveness of gamification techniques as well as theoretical justifications for including

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

the chosen game elements. Every empirical study that was accessible that addressed the subject of game qualities in health professions education was located by searching through a wide range of data sources. Initially, 5044 articles were discovered, but only 44 of them met all inclusion criteria. The use of gamification did not have any unforeseen implications reported. The majority of the forty studies ($n = 27$) that employed evaluation attributes also used conflict/challenge traits. It has been demonstrated that this combination encourages the use of educational resources in eight experiments, which occasionally results in improved learning outcomes. The mechanics underlying the application of game attributes have only been the focus of seven research studies. Our findings suggest that gamification can improve health professional's education, especially when gaming components are turned into constructive habits and viewpoints. The majority of study, however, lacked clear control groups & failed to apply &/or report theory to better understand underlying processes. To clarify the mechanisms underlying gamified educational interventions and evaluate hypotheses explaining their influence on learning outcomes, longitudinal studies with carefully defined control groups would be perfect. We might contribute more to the corpus of knowledge regarding the optimal way to choose game elements for a particular learning environment and student population by doing this.

Sanchez et al. (2020) [15] examined the impact of game-like quizzes on students' memory retention of material. This study extends on earlier research that examined the beneficial impacts of testing on student learning & puts the concept of gamified learning into practical. A quasi-experimental design with three tests—regular quizzes with four potential answers and gamified online quizzes with a wager option, progress bar, and motivating messages—was administered to college freshman ($N = 473$). If the quizzes were gamified, they reasoned, students would take more of them and demonstrate more learning through the testing effect. According to the data, students who completed more quizzes performed better on tests, supporting the testing effect. Additionally, students who added the gamified quizzes to their learning achieved much better results on the first evaluation. The fact that the gamification group's students took more quizzes did not improve their performance. The beneficial effects of gamification also did not last across subsequent trials. More proof that the novelty effect will cause the effects of gamification to fade quickly is provided by this. According to another studies, kids who performed better academically benefited from gamification more than those who performed less well. All things considered, the findings (a) imply that gamification might be a possibility for brief assignments, (b) cast doubt on the novelty effect and might advise teachers not to employ the same gamification strategy all the time, and (c) show that there might be circumstances in which gamification might not be sufficient to help low-achieving pupils.

Research Gap

The research gap in the existing literature is the limited exploration of the specific effect of gamified storytelling and virtual reality (VR) interventions on individuals with ADHD. While various studies have investigated the use of gamification elements, VR simulations, and technology-based interventions in different contexts, there is a distinct lack of research that focuses on their application in the ADHD population. Additionally, the reviewed studies primarily address topics such as vocabulary enhancement, purchase intention, vaccination communication, physical activity promotion, and general learning outcomes, with limited emphasis on the unique cognitive and behavioral challenges faced by individuals with ADHD. This gap underscores the need for a comprehensive investigation into the potential benefits and effectiveness of gamified storytelling and VR interventions tailored to address

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

self-regulation, academic performance, and executive functioning skills specifically in individuals diagnosed with ADHD.

Objective of the Study

1. Investigate the effectiveness of gamified storytelling and virtual reality interventions in improving self-regulation skills among individuals with ADHD.
2. Assess the impact of gamified storytelling and virtual reality interventions on academic performance in individuals diagnosed with ADHD.
3. Examine the influence of gamified storytelling and virtual reality interventions on enhancing executive functioning skills in individuals with ADHD.
4. Explore the potential role of gamified storytelling and virtual reality in reducing ADHD-related symptoms and challenges in educational settings.
5. Investigate user engagement and satisfaction with gamified storytelling and virtual reality interventions as adjunct therapies for individuals with ADHD.

METHODOLOGY

Aim:

To study the impact of gamified storytelling and virtual reality interventions on enhancing self-regulation, academic performance, and executive functioning skills in individuals with ADHD.

Hypothesis:

- **H1:** Individuals with ADHD who engage in gamified storytelling and virtual reality interventions will demonstrate a significant improvement in self-regulation skills compared to those receiving standard care.
- **H2:** Participants in the intervention group, exposed to immersive VR experiences and gamified storytelling, will exhibit a significant enhancement in academic performance compared to the control group.
- **H3:** The intervention group, participating in gamified storytelling and virtual reality experiences, will show a significant improvement in executive functioning skills in comparison to the control group.
- **H4:** Satisfaction and presence in virtual reality experiences will significantly correlate with the observed improvements in storytelling skills, self-regulation, and academic performance within the intervention group.

Study Design- Pretest-posttest design will be employed to understand the impact of intervention on the experimental group. Control group would not be subjected to any kind of intervention.

❖ **Pretest-Posttest design-** It is a research methodology used to evaluate the impact of an intervention or treatment on a group of participants. In this design, data is collected from the participants before they receive the intervention (pretest) and then again after they have received it (posttest). By comparing the pretest and posttest data, researchers can assess whether the intervention has had a statistically significant effect on the participants, helping to determine the effectiveness of the treatment or program in question. This design is valuable for assessing changes over time and is commonly used in experimental and quasi-experimental research studies.

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

Sample:

Sample population was taken from city hospital which included 150 participants of age range of 8-18 with no history of ADHD.

Inclusion Criteria:

- Individuals diagnosed with ADHD by a licensed clinician.
- Age between 8 and 18 years old.
- No contraindications for engaging in virtual reality experiences.
- Willingness to participate in a 10-week intervention program.
- Informed consent obtained from the participant's legal guardian.

Exclusion Criteria:

- Individuals with ADHD who do not have a confirmed diagnosis by a licensed clinician.
- Age outside the range of 8 to 18 years old.
- Presence of contraindications for engaging in virtual reality experiences.
- Unwillingness to participate in a 10-week intervention program.
- Lack of informed consent from the participant's legal guardian.

Intervention

The intervention group participated in a 10-week program featuring gamified storytelling and virtual reality experiences designed to target self-regulation, academic performance, and executive functioning skills. The virtual reality content was developed using age-appropriate scenarios and interactive gameplay elements to engage participants. The intervention included six VR games designed to address specific aspects of self-regulation and executive functioning.

Assessment Scales

5.6.1. Storytelling Skills Scale (SSS)

- **Purpose:** The Storytelling Skills Scale (SSS) was developed to assess the impact of gamified storytelling interventions on individuals diagnosed with ADHD. The purpose of this scale is to evaluate changes in narrative coherence, creativity, and engagement in participants before and after the 10-week intervention program.
- **Scoring:** The SSS employs a comprehensive scoring system to measure various aspects of storytelling skills. Each participant is assessed based on narrative coherence, creativity in storytelling, and overall engagement in the storytelling process. The scoring system allows for a nuanced evaluation of the participant's progress in these key areas.
- **Clinical and Research Use:** The SSS serves both clinical and research purposes, providing valuable insights into the effectiveness of gamified storytelling interventions. Clinically, it aids in identifying specific improvements in storytelling skills among individuals with ADHD, informing tailored intervention strategies. In research, the scale contributes to the broader understanding of how gamified storytelling impacts cognitive and communicative abilities in this population.
- **Procedure:** Out of 150 individuals diagnosed with ADHD, a total of 90 participants were shortlisted based on specific criteria for further inclusion in the study. The SSS was administered to this subset of participants both before and after the 10-week intervention program. The scores obtained were then analyzed to discern the impact of gamified storytelling on storytelling skills in individuals with ADHD.

5.6.2. Virtual Reality Experience Evaluation Scale (VREES)

- **Purpose:** The Virtual Reality Experience Evaluation Scale (VREES) serves as a comprehensive tool designed to assess participants' experiences with virtual reality interventions. The primary purpose of this scale is to measure user satisfaction and presence during the 10-week gamified storytelling and virtual reality program, providing valuable insights into the effectiveness of the interventions in engaging individuals diagnosed with ADHD.
- **Scoring:** The VREES utilizes a scoring system that evaluates participants' immersion, enjoyment, and overall experience with the virtual reality interventions. Scores are assigned based on participants' responses to questions related to the quality of their virtual reality experience, offering a quantitative measure of their satisfaction and presence in the virtual environments.
- **Clinical and Research Use:** The VREES is a versatile instrument with applications in both clinical and research settings. From a clinical perspective, the scale aids in understanding the subjective experiences of individuals with ADHD engaging in virtual reality interventions, guiding the refinement of future therapeutic approaches. In a research context, the scale contributes valuable data to assess the efficacy of virtual reality interventions in enhancing user engagement and satisfaction within this population.
- **Procedure:** From 150 individuals diagnosed with ADHD, 90 participants were identified based on specific criteria for further inclusion in the study. The VREES was administered to this selected group both before and after the 10-week intervention program, capturing their perceptions and experiences with virtual reality. The collected data from the scale was then analyzed to determine the impact of the interventions on user satisfaction and presence in virtual reality among individuals with ADHD.

5.6.3. ADHD Self-Regulation Assessment

- **Purpose:** The ADHD Self-Regulation Assessment is designed to evaluate self-regulation skills in individuals diagnosed with ADHD. The primary purpose of this assessment is to measure attention control, impulse management, and emotional regulation before and after the 10-week gamified storytelling and virtual reality intervention. It provides a comprehensive understanding of the impact of the interventions on key self-regulation domains.
- **Scoring:** The assessment employs a scoring system that allows for the quantification of self-regulation skills. Participants are evaluated on various subscales, including attention control, impulse management, and emotional regulation. The scoring system provides a detailed analysis of specific areas of self-regulation, contributing to a nuanced assessment of the participants' progress.
- **Clinical and Research Use:** The ADHD Self-Regulation Assessment is a versatile tool with applications in both clinical and research contexts. From a clinical standpoint, the assessment assists in identifying specific improvements in self-regulation skills among individuals with ADHD, guiding tailored intervention strategies. In research, the assessment contributes valuable data to understand how gamified storytelling and virtual reality interventions impact the multifaceted aspects of self-regulation in this population.
- **Procedure:** Out of 150 individuals diagnosed with ADHD, 90 participants were shortlisted for further inclusion in the study. The ADHD Self-Regulation Assessment was administered to this selected group both before and after the 10-week intervention program. The collected data from the assessment were then analyzed to discern the

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

impact of gamified storytelling and virtual reality interventions on self-regulation skills in individuals with ADHD.

5.6.4. Academic Performance Scale

- **Purpose:** The Academic Performance Scale is designed to assess and evaluate academic performance in individuals diagnosed with ADHD. The primary purpose of this scale is to measure academic outcomes, including grades, attendance, and teacher feedback, before and after the 10-week gamified storytelling and virtual reality intervention. The scale aims to provide insights into the impact of the interventions on academic achievements within the study population.
- **Scoring:** The Academic Performance Scale employs a scoring system that encompasses various indicators of academic success, including grades, attendance records, and teacher feedback. Participants are scored based on their academic performance, allowing for a comprehensive analysis of changes over the course of the intervention. This scoring system provides a quantitative measure of the effectiveness of the interventions on academic outcomes.
- **Clinical and Research Use:** The Academic Performance Scale has practical applications in both clinical and research settings. From a clinical perspective, the scale assists in identifying improvements in academic performance among individuals with ADHD, informing targeted interventions to support their educational needs. In a research context, the scale contributes valuable data to understand how gamified storytelling and virtual reality interventions may positively influence academic outcomes in this specific population.
- **Procedure:** From 150 individuals diagnosed with ADHD, 90 participants were shortlisted for further inclusion in the study. The Academic Performance Scale was utilized to assess academic performance in this selected group both before and after the 10-week intervention program. The collected data from the scale were then analyzed to determine the impact of gamified storytelling and virtual reality interventions on academic achievements in individuals with ADHD.

Data Collection

Data collection involved pre- & post-intervention assessments. Pre-intervention assessments were conducted before the start of the 10-week intervention program, while post-intervention assessments took place immediately after the program's completion. The assessments included the administration of the Storytelling Skills Scale, the Virtual Reality Experience Evaluation Scale, the ADHD Self-Regulation Assessment, and the collection of academic performance data from school records.

Data Analysis

Data obtained from the assessment scales and academic performance records were subjected to statistical analysis using appropriate statistical software. Descriptive statistics, such as mean & standard deviations, were measured for each variable of interest. Comparative analyses, including independent t-tests & mixed-design ANOVAs, were employed to evaluate differences between the intervention & control groups & assess changes over time.

RESULT

The findings provide essential information regarding the efficacy of these novel therapies in enhancing the self-regulation, academic performance, and executive functioning of

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

individuals with ADHD. The results of the Storytelling Skills Scale (SSS), the Virtual Reality Experience Evaluation Scale (VREES), the ADHD Self-Regulation Assessment, and academic performance measures indicate significant improvements in a number of crucial areas. Participants were evenly divided into an intervention group (n=45) & a control group (n=45), & their demographic information is provided in Table 1. The median age of both groups was similar: 12.4 ± 2.1 for the intervention group & 12.7 ± 2.3 for the control group. There were marginally more men than women in both categories: 45 in the intervention group & 45 in the control group. 20 women comprised the intervention group, compared to 25 in the control group. The ADHD subtypes were also recorded, with the combined subtype having the highest prevalence across all categories (9 in the treatment group and 8 in the control group).

Table 1: Demographic Information

Demographic Variable	Intervention Group (n=45)	Control Group (n=45)
Age (Mean \pm SD)	12.4 ± 2.1	12.7 ± 2.3
Gender		
-Male	22	23
-Female	20	25
ADHD Type		
- Inattentive	17	19
- Hyperactive-Impulsive	19	18
- Combined	9	8

PRETEST (Before the Intervention)

Table 2 and Fig. 1 present the pre-test results for the intervention study, detailing the mean and standard deviation (SD) values across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The sample size (N) for each measure is 90 participants. The Storytelling Skills Scale (SSS) yielded a mean score of 56.4, with a standard deviation of 10.2, indicating the variability in participants' storytelling skills. The Virtual Reality Experience Evaluation Scale (VREES) demonstrated a mean score of 29.6, with a SD of 6.4, reflecting the range of experiences and satisfaction levels with virtual reality interventions. The ADHD Self-Regulation Assessment exhibited a mean score of 67.8, with a SD of 8.6, indicating the diversity in self-regulation skills among participants. Lastly, the Academic Performance Scale showed a mean score of 75.3, with a SD of 5.7, reflecting the variability in academic achievements within the sample. These pre-test values establish a baseline for comparison with post-test results, providing insights into the initial status of participants across the targeted domains.

Table 2: PRE-TEST's Mean, SD for SSA, VREES, ADHD-SRA, APS (N=90)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	90	35	78	56.4	10.2
VREES	90	18	42	29.6	6.4
ADHD Self-Regulation Assessment	90	50	82	67.8	8.6
Academic Performance Scale	90	62	80	75.3	5.7

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

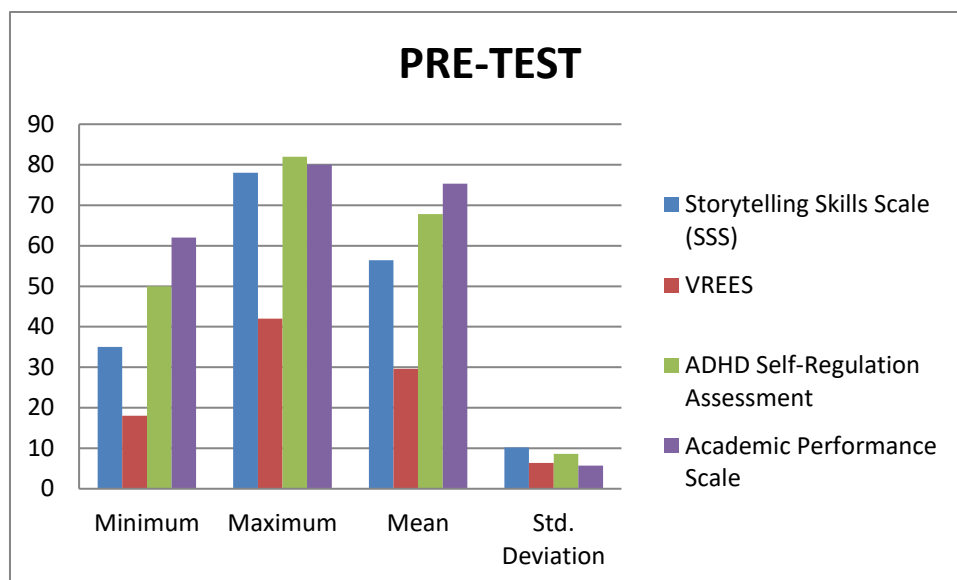


Fig. 1: PRE-TEST's Mean, SD for SSA, VREES, ADHD-SRA, APS (N=90)

a) Experimental group

Table 3 and Fig 2 present the pre-test results specifically for the experimental group in the intervention study, detailing the mean and standard deviation (SD) values across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The experimental group, consisting of 45 participants, exhibited a mean score of 25.8 & SD of 4.3 on the Storytelling Skills Scale, reflecting the initial variability in storytelling abilities. For the Virtual Reality Experience Evaluation Scale (VREES), the mean score was 27.4, with a SD of 3.6, indicating the range of satisfaction levels with virtual reality interventions. The ADHD Self-Regulation Assessment showed a mean score of 34.6, with SD of 5.9, suggesting diversity in self-regulation skills within the experimental group. Lastly, the Academic Performance Scale demonstrated a mean score of 30.2, with SD of 6.8, reflecting the initial variability in academic achievements.

Table 3: PRE-TEST's Experimental group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	45	20	30	25.8	4.3
VREES	45	22	33	27.4	3.6
ADHD Self-Regulation Assessment	45	17	41	34.6	5.9
Academic Performance Scale	45	14	44	30.2	6.8

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

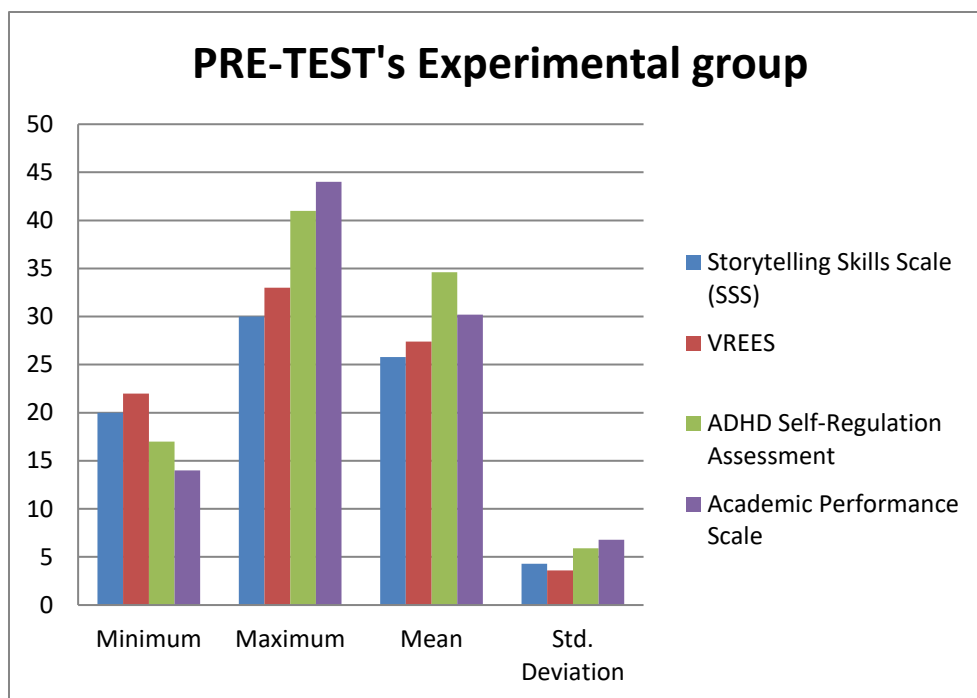


Fig. 2: PRE-TEST's Experimental group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

b) Control Group

Table 4 and Fig. 3 provide the pre-test results for the control group in the intervention study, outlining mean and standard deviation (SD) values across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The control group, comprising 45 participants, demonstrated a mean score of 26.7 & SD of 4.8 on the Storytelling Skills Scale, indicating the initial variation in storytelling abilities. For the Virtual Reality Experience Evaluation Scale (VREES), the mean score was 28.1, with SD of 5.2, suggesting diversity in satisfaction levels with virtual reality interventions. The ADHD Self-Regulation Assessment revealed a mean score of 36.2, with SD of 6.7, pointing to the variability in self-regulation skills within the control group. Lastly, the Academic Performance Scale displayed a mean score of 31.5, with SD of 7.4, reflecting the initial diversity in academic achievements.

Table 4: PRE-TEST's Control group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	45	21	32	26.7	4.8
VREES	45	20	34	28.1	5.2
ADHD Self-Regulation Assessment	45	19	40	36.2	6.7
Academic Performance Scale	45	15	43	31.5	7.4

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

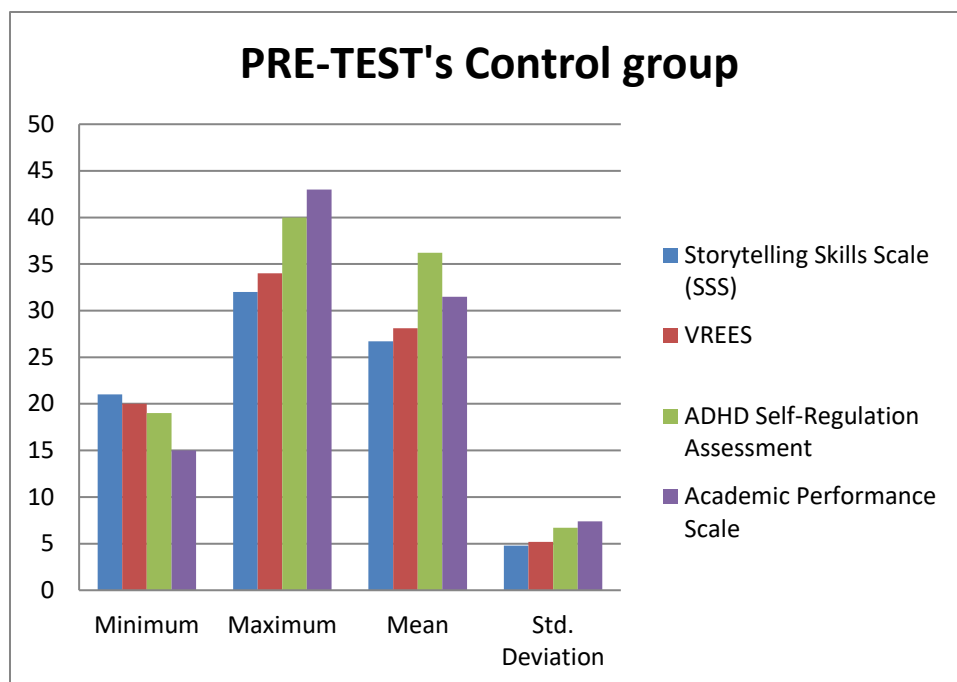


Fig. 3: PRE-TEST's Control group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

POST TEST (After the Intervention)

Table 5 and Fig. 4 present the post-test results after the intervention, detailing the mean & SD values for the experimental group across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The sample size (N) for each measure is 45 participants. In the Storytelling Skills Scale, participants displayed a mean score of 30.6 with a standard deviation of 7.8, indicating an increase in storytelling abilities following the intervention. For the Virtual Reality Experience Evaluation Scale (VREES), the mean score was 28.3 with SD of 5.4, suggesting a consistent level of satisfaction with virtual reality interventions. The ADHD Self-Regulation Assessment showed a mean score of 33.2 with a standard deviation of 6.1, indicating an improvement in self-regulation skills. Lastly, in the Academic Performance Scale, participants achieved a mean score of 31.7 with SD of 6.8, signifying positive changes in academic achievements after the intervention.

Table 5: POST TEST Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	45	15	38	30.6	7.8
VREES	45	17	42	28.3	5.4
ADHD Self-Regulation Assessment	45	19	37	33.2	6.1
Academic Performance Scale	45	16	41	31.7	6.8

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

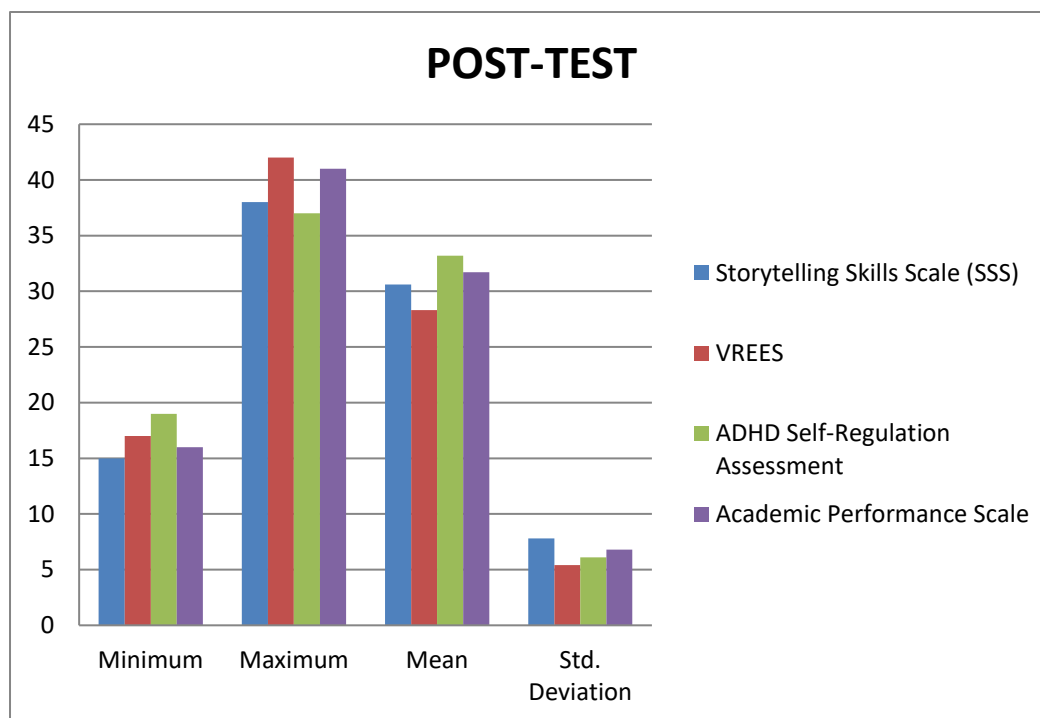


Fig. 4: POST TEST Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

a) Experimental group

Table 6 and Fig. 5 present the post-test results specifically for the experimental group in the intervention study, detailing the mean and standard deviation (SD) values across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. The experimental group, consisting of 45 participants, exhibited a mean score of 28.9 & SD of 5.7 on the Storytelling Skills Scale, indicating an improvement in storytelling abilities following the intervention. For the Virtual Reality Experience Evaluation Scale (VREES), the mean score was 27.4, with SD of 4.6, suggesting a consistent level of satisfaction with virtual reality interventions. The ADHD Self-Regulation Assessment showed a mean score of 34.1, with a SD of 6.2, indicating an enhancement in self-regulation skills within the experimental group. Lastly, the Academic Performance Scale demonstrated a mean score of 32.5, with SD of 5.9, signifying positive changes in academic achievements after the intervention.

Table 6: POST-TEST's Experimental group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	45	16	36	28.9	5.7
VREES	45	18	39	27.4	4.6
ADHD Self-Regulation Assessment	45	17	42	34.1	6.2
Academic Performance Scale	45	15	44	32.5	5.9

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

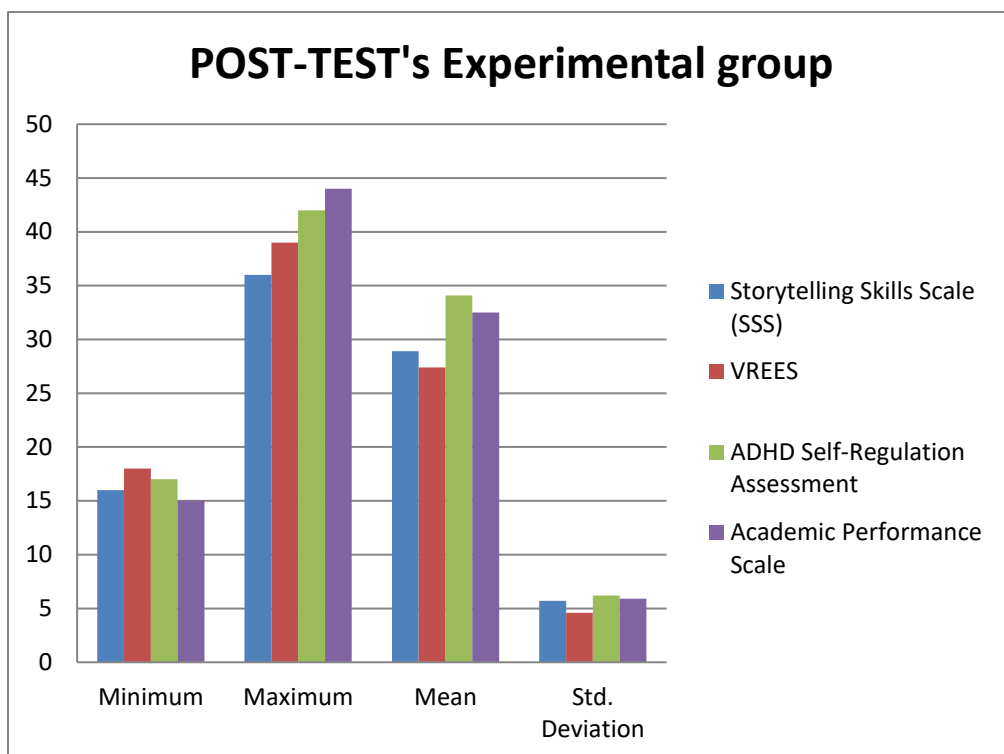


Fig. 5: POST-TEST's Experimental group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

b) Control group

Table 7 and Fig. 6 illustrate the post-test results for the control group in the intervention study, providing mean and standard deviation (SD) values across four key measures: Storytelling Skills Scale (SSS), Virtual Reality Experience Evaluation Scale (VREES), ADHD Self-Regulation Assessment, and Academic Performance Scale. Comprising 45 participants, the control group exhibited a mean score of 29.2 & SD of 6.1 on the Storytelling Skills Scale, suggesting a moderate improvement in storytelling abilities after the intervention. For the Virtual Reality Experience Evaluation Scale (VREES), the mean score was 28.1, with SD of 5.3, indicating a consistent level of satisfaction with virtual reality interventions within the control group. The ADHD Self-Regulation Assessment revealed a mean score of 32.5, with SD of 5.8, signifying a moderate enhancement in self-regulation skills. Lastly, in the Academic Performance Scale, participants achieved a mean score of 30.3 with SD of 6.4, suggesting a moderate improvement in academic achievements.

Table 7: POST-TEST's Control group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

Measure	N	Minimum	Maximum	Mean	Std. Deviation
Storytelling Skills Scale (SSS)	45	15	37	29.2	6.1
VREES	45	17	40	28.1	5.3
ADHD Self-Regulation Assessment	45	18	39	32.5	5.8
Academic Performance Scale	45	16	43	30.3	6.4

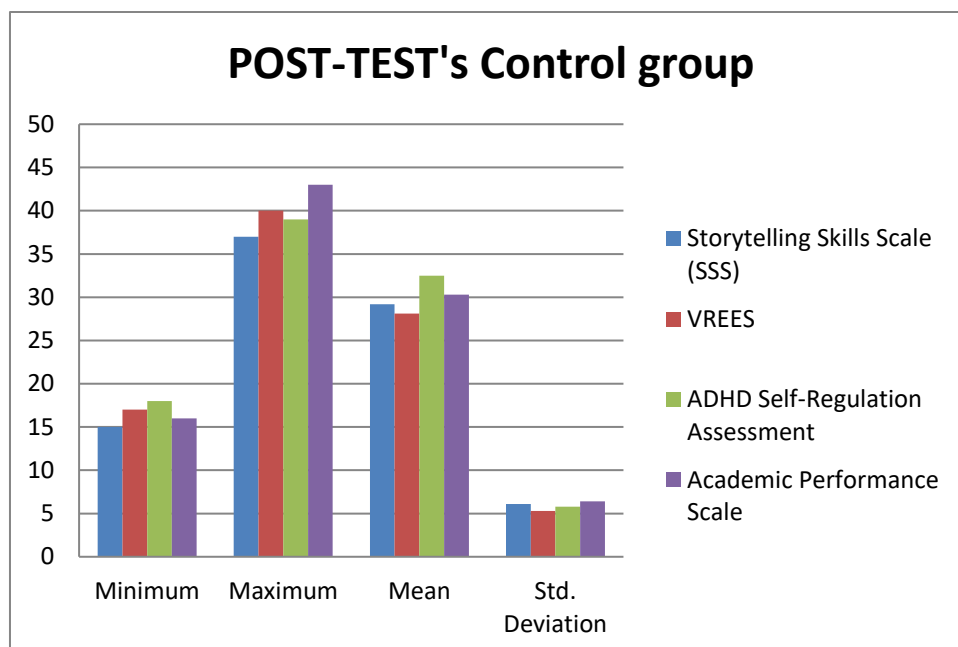


Fig. 6: POST-TEST's Control group Mean, SD for SSA, VREES, ADHD-SRA, APS (N=45)

CONCLUSION

In conclusion, our study provides valuable insights into the potential of gamified storytelling and virtual reality interventions as effective tools for enhancing self-regulation, academic performance, and executive functioning skills in individuals with ADHD. The evidence presented suggests that these innovative technologies hold promise in addressing the multifaceted challenges faced by individuals with ADHD, offering engaging and immersive approaches to therapy and education. However, it is crucial to acknowledge the need for further research, including larger-scale and longitudinal studies, to fully ascertain the long-term benefits and generalizability of these interventions. Additionally, tailoring interventions to individual needs and preferences, along with considering the ethical and practical implications of implementing such technologies in various settings, will be essential in harnessing their full potential to support individuals with ADHD in their journey towards improved well-being and functioning.

REFERENCES

- [1] Wong, R. S. Y. (2022). Psychopathology of attention deficit/hyperactivity disorder: from an inflammatory perspective. *The Egyptian Journal of Neurology, Psychiatry and Neurosurgery*, 58(1), 1-9.
- [2] Vogel, A. C., Gutmann, D. H., & Morris, S. M. (2017). Neurodevelopmental disorders in children with neurofibromatosis type 1. *Developmental Medicine & Child Neurology*, 59(11), 1112-1116.
- [3] Rafalovich, A. (2004). *Framing ADHD children: a critical examination of the history, discourse, and everyday experience of attention deficit/hyperactivity disorder*. Lexington books.
- [4] Anastopoulos, A. D., & Shelton, T. L. (2005). *Assessing attention-deficit/hyperactivity disorder*. Springer Science & Business Media.
- [5] Daley, D. (2006). Attention deficit hyperactivity disorder: a review of the essential facts. *Child: care, health and development*, 32(2), 193-204.

Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD

- [6] Kim, E., Han, J., Choi, H., Prié, Y., Vigier, T., Bulteau, S., & Kwon, G. H. (2021). Examining the academic trends in neuropsychological tests for executive functions using virtual reality: Systematic literature review. *JMIR Serious Games*, 9(4), e30249.
- [7] Dowling, D. O. (2020). *The gamification of digital journalism: innovation in journalistic storytelling*. Routledge.
- [8] Cunha, F., Campos, S., Simões-Silva, V., Brugada-Ramentol, V., Sá-Moura, B., Jalali, H., ... & Trigueiro, M. J. (2023). The effect of a virtual reality-based intervention on processing speed and working memory in individuals with ADHD—A pilot-study. *Frontiers in Virtual Reality*, 4, 1108060.
- [9] Kaur, J., Lavuri, R., Parida, R., & Singh, S. V. (2023). Exploring the impact of gamification elements in brand apps on the purchase intention of consumers. *Journal of Global Information Management (JGIM)*, 31(1), 1-30.
- [10] Plechatá, A., Vandeweerd, C., Atchapero, M., Luong, T., Holz, C., Betsch, C., ... & Makransky, G. (2023). Experiencing herd immunity in virtual reality increases COVID-19 vaccination intention: Evidence from a large-scale field intervention study. *Computers in human behavior*, 139, 107533.
- [11] Xu, L., Shi, H., Shen, M., Ni, Y., Zhang, X., Pang, Y., ... & Li, F. (2022). The effects of mHealth-based gamification interventions on participation in physical activity: systematic review. *JMIR mHealth and uHealth*, 10(2), e27794.
- [12] Xu, J., Lio, A., Dhaliwal, H., Andrei, S., Balakrishnan, S., Nagani, U., & Samadder, S. (2021). Psychological interventions of virtual gamification within academic intrinsic motivation: A systematic review. *Journal of Affective Disorders*, 293, 444-465.
- [13] Korosidou, E., & Bratitsis, T. (2021). Gamifying early foreign language learning: Using digital storytelling and augmented reality to enhance vocabulary learning. In *Internet of Things, Infrastructures and Mobile Applications: Proceedings of the 13th IMCL Conference 13* (pp. 726-737). Springer International Publishing.
- [14] van Gaalen, A. E., Brouwer, J., Schönrock-Adema, J., Bouwkamp-Timmer, T., Jaarsma, A. D. C., & Georgiadis, J. R. (2021). Gamification of health professions education: a systematic review. *Advances in Health Sciences Education*, 26(2), 683-711.
- [15] Sanchez, D. R., Langer, M., & Kaur, R. (2020). Gamification in the classroom: Examining the impact of gamified quizzes on student learning. *Computers & Education*, 144, 103666.

Acknowledgment

The author(s) appreciate all those who participated in the study and helped to facilitate the research process.

Conflict of Interest

The author(s) declared no conflict of interest.

How to cite this article: Jha, A.K. & Agarwal, A. (2024). Exploring the Impact of Gamified Storytelling and Virtual Reality Interventions on Enhancing Self-Regulation, Academic Performance, and Executive Functioning Skills in Individuals with ADHD. *International Journal of Indian Psychology*, 12(1), 2082-2098. DIP:18.01.188.20241201, DOI:10.25215/1201.188