ENHANCING VOCABULARY KNOWLEDGE IN STUDENTS WITH LEARNING DISABILITIES THROUGH DIGITAL GAME-BASED LEARNING

[1]Nur Ain Binti Mohamead Hafiez Shah,
1,2 Faculty of Education, Languages, Psychology and Music, SEGi University, Kota Damansara

*[2]Nurul Salwana Mohd Multazam Khair
[1,2] Faculty of Education, Languages, Psychology and Music, SEGi University, Kota Damansara

* Corresponding Author email: nurulsalwanakhair@segi.edu.my

ABSTRACT

This study examines the effectiveness of Digital Game-Based Learning (DGBL) in enhancing vocabulary acquisition and student engagement among lower primary students with learning disabilities. Four students aged 7 to 9 years, with Malay and English as primary languages, participated in the study. All were diagnosed with either autism spectrum disorder (ASD) or attention deficit hyperactivity disorder (ADHD), with comorbid dyslexia, and each had an Individualised Education Plan (IEP). An action research design incorporating pre- and post-assessments was employed using the Vocabulary Knowledge Scale (VKS) and the Student Engagement Observation Checklist (SEOC). Two interactive games from *Games to Learn English*, aligned with the KSSR syllabus, were implemented over two weeks. Results showed a significant improvement in vocabulary acquisition, with 75% of participants reaching the highest competency level on the VKS ($M = 4$). A paired samples t-test revealed a statistically significant difference between pre- and post-test scores ($t = -8.081$, $p < .001$). Engagement levels varied, with some students demonstrating increased focus, while others were distracted due to behavioral variability. Findings support DGBL as an effective strategy for vocabulary development in learners with disabilities. Future research should explore long-term retention, adaptive scaffolding, and scalability across diverse educational settings.

Keywords: Digital Game-Based Learning, Learning Disabilities, Vocabulary Knowledge, Student Engagement, Special Education.

1.0 Introduction

In today's rapidly evolving technological landscape, students frequently perceive required content as unmotivating and "boring" due to ineffective teaching methods and a lack of engagement from educators (Prensky, 2003). Although students are often described as ‘digital natives’ adept at navigating technology, they may not receive the pedagogical stimulation needed to sustain their engagement. Digital game-based learning (DGBL) addresses this gap by incorporating gaming elements that enhance engagement and motivation, thereby appealing to students and fostering critical thinking skills (Nussbaum & Beserra, 2014; Hauge et al., 2013; All et al., 2015). Research indicates that DGBL not only improves learning quality but also enhances student attitudes compared to traditional methods. Specifically, educational and interactive games have been shown to positively influence students' learning outcomes relative to conventional instructional approaches (Erhel & Jamet, 2013). However, there remains a lack of comprehensive understanding regarding the effectiveness of DGBL interventions, particularly in the context of special education.

Special education aims to assist differently abled students in mainstream classrooms to promote their independence and participation in socialization. (Kavale, 1990; Tlili et al., 2022) DGBL allows differently abled students to experience e-learning while mastering knowledge and skills. (Prensky, 2003) In addition, it helps to support the development of reasoning and problem-solving skills, and self-directed learning, which is essential for students with disabilities. Not to mention, vocabulary and comprehension are likewise vital to their language and cognitive development (Longo & Curtis, 2008). Traditional school curricula opt for conventional teaching methods that often fail to support students with learning disabilities, hence hindering their overall progress without any adequate support. Therefore, this study aims to investigate the effectiveness of digital game-based learning interventions in improving vocabulary knowledge and engagement, and to address the limitations of conventional teaching methods in supporting the academic progress of lower primary students with learning disabilities.

2.0 Background of Study

Despite the increased use of technology in classrooms, there is a lack of research reviewing its effectiveness among students with learning disabilities. (Yudintseva, 2015) Vocabulary knowledge is crucial for language acquisition and academic success. Digital platforms can help to

increase engagement and promote successful knowledge acquisition, but students with learning disabilities may often struggle with memorization, information retrieval, and applying vocabulary in appropriate contexts. (Tubele & Landrate, 2021) Thus, conventional instructional methods are not as effective or engaging for them as they do not cater to their diverse needs. While there are benefits of technology in teaching, it also poses some challenges. Addressing these challenges is essential to ensure effective learning for students with disabilities.

2.1 The Role of Digital Game-Based Learning (DGBL)

To address this gap, this research aims to investigate the potential effectiveness of Digital Game-Based Learning (DGBL) in improving students' motivation, engagement, and vocabulary skills (Ragni et al., 2023). Additionally, it seeks to identify the potential benefits and limitations of DGBL in supporting students with learning disabilities in achieving academic success.

DGBL utilizes various game-based instructional strategies, including operant conditioning, where students receive rewards and challenges to motivate them (Adams, 2014). Games enhance motivation by allowing students to learn through experiences, solve cognitive tasks, and apply problem-solving skills with self-determination (Huang et al., 2022). This fosters intrinsic motivation, promoting self-autonomy and self-efficacy, where students learn from their mistakes independently. Similarly, DGBL encourages active participation and engagement, creating a positive learning environment that makes students more receptive to learning new vocabulary (Prensky, 2003).

Compared to conventional teaching methods, DGBL offers greater flexibility and accessibility (Ronimus et al., 2019). However, while technology presents opportunities for personalized learning experiences, it also comes with challenges that must be addressed to ensure successful knowledge acquisition. This study will explore both the benefits and challenges of implementing DGBL for vocabulary acquisition among students with learning disabilities.

3.0 Problem Statement

Students with learning disabilities often struggle with reading, writing, reasoning, and attention, hindering vocabulary acquisition and academic performance. Conventional, 'one-size-fits-all' instruction, which emphasizes teacher-led delivery and rote memorization, limits creativity and critical thinking, proving ineffective for many students, especially those with learning

disabilities. (Graphy, 2022) Students with dyslexia or auditory processing difficulties struggle with word differentiation, decoding, and retention. (Avianita, 2008)

Limited vocabulary knowledge significantly hinders academic achievement. Students with learning difficulties may experience phonological problems, reading and comprehension difficulties, limited written expression, and attention deficits due to behavioural or cognitive issues. (Walda et al., 2012) Thus, inadequate support can lead to frustration, communication skill decline, and reduced self-esteem.

This addresses how schools often lack resources and training, favouring conventional methods as cheaper and simpler alternatives. However, these methods fail to address the specific needs of students with learning disabilities. This highlights the importance of innovative approaches such as DGBL, though in-depth research on its effectiveness is still emerging.

This study aims to assess the effectiveness of DGBL in improving vocabulary knowledge among lower primary students with learning disabilities while also examining students' level of engagement during digital game-based vocabulary acquisition. Specifically, this research seeks to answer the following questions:

1. To what extent does using DGBL help improve the vocabulary knowledge of students with learning disabilities?
2. How does DGBL impact students' engagement in vocabulary acquisition?

This study seeks to evaluate the impact of Digital Game-Based Learning (DGBL) on vocabulary acquisition and student engagement among lower primary students with learning disabilities. By addressing these research questions, the study aims to provide insights into the effectiveness of DGBL as an instructional tool, potentially offering a more engaging and inclusive approach to language learning.

4.0 Literature Review

4.1 Digital Game-Based Learning in Special Education

Digital Game-Based Learning (DGBL) utilizes interactive games and simulations to enhance student's learning outcomes, presenting positive effects on behaviours and attitudes

compared to conventional methods. (Erhel & Jamet, 2013) There are also positive effects of the approach on differently abled children, such as improvements in their ability to retain information, levels of motivation, and participation in social activities. (Gallud et al., 2021)

Beyond engagement, DGBL is associated with improvements in problem-solving, critical thinking, knowledge retention, decision-making, and deeper learning through active engagement in the educational content. (All et al., 2015; Erhel & Jamet, 2013) Likewise, it improves reading skills, including letter, syllable, and word identification, as well as pronunciations of vocabulary. (Salgarayeva et al., 2021) Consequently, DGBL goes beyond simply boosting engagement but helps to strengthen cognitive skills, character development, and student's motivation.

Students with reading difficulties often lack motivation. Hence, educational games can encourage engagement compared to conventional methods. (Chapman et al., 2000; Morgan & Fuchs, 2007; Ronimus et al., 2019) Student engagement, fostered by DGBL, is linked to positive outcomes in their academic progress, which also includes improvement in their reading skills development. (Finn & Zimmer, 2012; Fredricks et al., 2004; Ronimus et al., 2019) DGBL can be tailored to accommodate individual needs of students, promoting various areas of development such as social, academic, and executive functioning skills. In summary, the use of digital and interactive games as educational tools can help to foster engagement and motivation more effectively, which leads to positive academic progress for students with learning difficulties. (All et al., 2015) Despite the potential benefits of DGBL, it hasn't fully been adopted in education as research has not shown consistent positive outcomes. (James, 2020) Denham, et al. (2016) highlighted several reasons for this limited integration, including lack of time and resources for teachers, lingering perceptions that "play" is not considered serious learning, and absence of evidenced guidelines for using such games effectively in the classroom.

4.2 Challenges in Vocabulary Development for Students with Learning Disabilities

Students with learning disabilities often face challenges in building and acquiring new vocabulary. Susanto et al. (2019) stated that students with learning difficulties display difficulties in memorizing vocabulary and comprehending phrases when it comes to learning new vocabulary. Without proper support and resources for the students to acquire new information and skills, it results in a lack of attention, thus potentially leading to issues with behaviours and disruptions in the classroom. Students with learning disabilities often struggle with phonological awareness,

decoding, spelling, word recognition, and comprehension. (Gillon, 2004, cited in Cassar & Jang, 2010; Adams, 1990; Torgesen & Wagner, 1998)

Students with learning disabilities typically experience these challenges at a much greater extent than developmentally typical children. Students with learning disabilities require additional support and interventions, such as through special education, tailored to their specific needs. This may include support such as instructional techniques, specialized materials and resources, and special equipment or facilities. (Susanto, 2018) While developmentally typical students acquire new vocabulary quickly, students with learning disabilities require more targeted interventions and explicit instruction. (Longo & Curtis, 2008) Thus, engaging contexts are vital to help retain phonological information and educators must take into consideration determining suitable instructional practices. (Cassar & Jang, 2010).

Vocabulary development is one of the key components of the Malaysian Kurikulum Standard Sekolah Rendah (KSSR). Digital game-based learning (DGBL) has shown significance in enhancing student's learning experiences and presents an effective tool to reinforce objectives in the KSSR curriculum. Chin (2014) highlights incorporating interactive elements, visual aids, audio cues as well as the contextual usage of the target vocabulary in a game design to grasp student's attention and allow them to engage in vocabulary acquisition in a positive and exciting manner. Rabu and Talib (2017) recommends integrating a specific list of vocabulary and exercises to align with the curriculum goals and reinforcing their understanding and retention of the target vocabulary. Consequently, DGBL aligns with the KSSR curriculum's vocabulary focus transforming learning from rote memorization and drills into a fun and engaging learning experience.

However, there are potential challenges of ensuring game content is aligned with the curriculum, such as the concepts and vocabulary items, as well as the instructional goals, are properly outlined according to the requirements of the curriculum. (Rabu and Talib, 2017) Ramli et al. (2022) also indicate that technical difficulties, limitations of resources, sufficient teacher support, and continuous updates are potential obstacles with the advancements in technology. Despite the challenges, DGBL offers an optimistic approach to enhancing student's vocabulary acquisition following the KSSR curriculum. By carefully planning for an effective implementation of the approach while considering the challenges, teachers can use this approach to create a more effective and beneficial student learning experience within the KSSR framework.

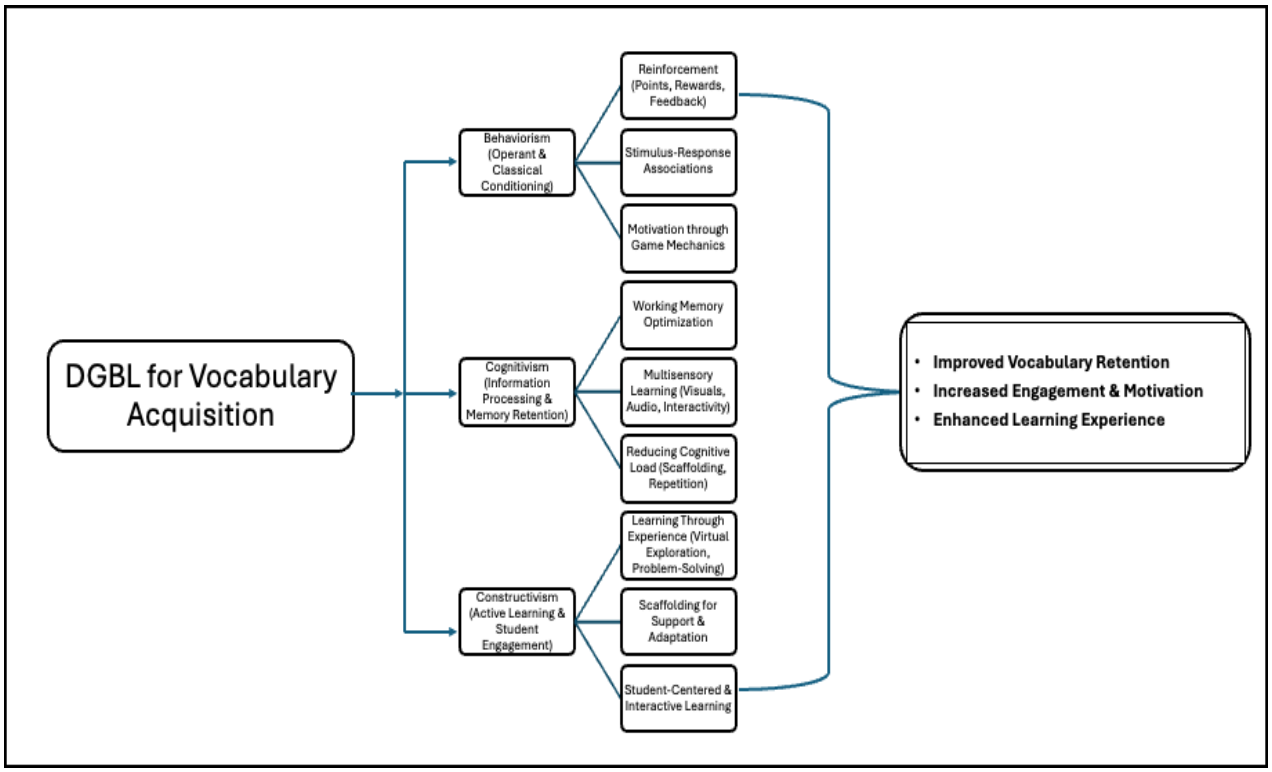
5.0 Theoretical Framework

This study is grounded in Behaviorism, Cognitivism, and Constructivism, which provide a comprehensive foundation for understanding how Digital Game-Based Learning (DGBL) enhances vocabulary acquisition among students with learning disabilities. Behaviorism, particularly Operant Conditioning (Skinner, 1953), emphasizes the role of external reinforcements in shaping learning behaviors. DGBL integrates positive reinforcement techniques, such as points, rewards, and immediate feedback, to motivate students and strengthen learning retention (Algahtani, 2017). These principles align with studies highlighting the effectiveness of behaviorist strategies in improving learning experiences for students with disabilities (McMahon et al., 2016, as cited in Algahtani, 2017). Furthermore, Classical Conditioning Theory suggests that associating new vocabulary with positive stimuli can reinforce memory retention (Siang & Rao, 2003). By leveraging these behaviorist principles, DGBL transforms vocabulary learning into an engaging, structured, and rewarding process, helping students form stronger connections between words and their meanings.

Cognitivism emphasizes the internal mental processes involved in learning, particularly in terms of information processing and memory retention (Lakha, 2023). The Information Processing Theory explains how students acquire, store, and retrieve knowledge, making interactive and multisensory game elements crucial for supporting working memory (Gathercole & Baddeley, 1990). DGBL can be designed with clear instructions, repetitive practice, visual cues, and adaptive feedback to reduce cognitive load, particularly for students with learning disabilities who struggle with information processing (Huang, 2010). Additionally, Constructivist Learning Theory (McLeod, 2024) highlights the importance of active learning, where students build knowledge through experiences and interactions. DGBL fosters this by allowing students to explore vocabulary concepts through virtual environments and problem-solving tasks (Padirayon et al., 2019; Bakhsh et al., 2022). Scaffolding techniques, such as adaptive feedback, examples, and structured prompts, help support students with learning disabilities, ensuring that they progress at an individualized pace (Melero et al., 2011). However, while scaffolding aids learning, overreliance on support can hinder students' ability to develop independent learning skills (Barzilai & Blau, 2013). Thus, a balance between structured guidance and autonomous exploration is essential to maximize the benefits of DGBL for vocabulary acquisition.

Figure 5.1

DGBL for Vocabulary Acquisition



The theoretical framework illustrates how Digital Game-Based Learning (DGBL) integrates Behaviorism, Cognitivism, and Constructivism to enhance vocabulary acquisition for students with learning disabilities. By incorporating positive reinforcement, interactive engagement, and cognitive processing strategies, DGBL creates a structured, motivating, and student-centered learning experience. While behaviorist principles help reinforce learning through rewards and feedback, cognitivist strategies support memory retention and processing, and constructivist approaches encourage active exploration and deeper understanding. By balancing these three learning theories, DGBL offers a comprehensive approach to vocabulary instruction, ensuring that students with learning difficulties stay engaged, retain new words effectively, and develop confidence in their learning abilities.

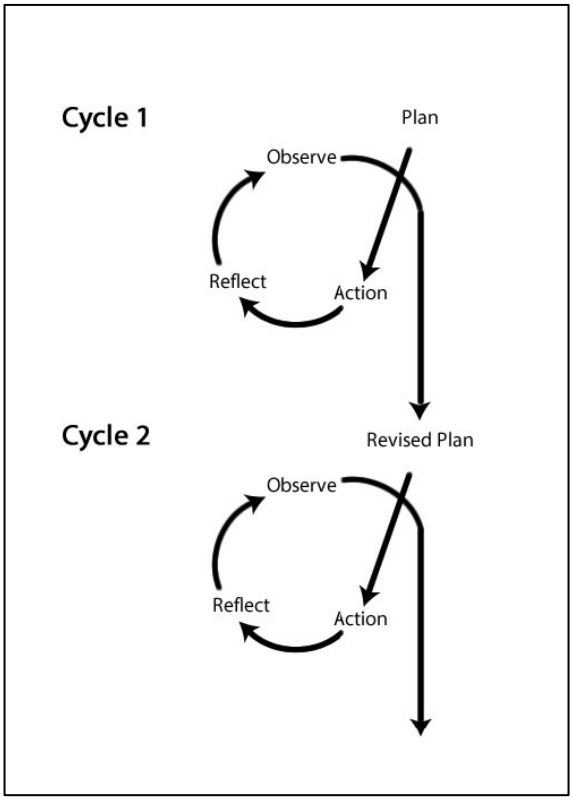
6.0 Research Design

The research design involves an analytical approach to investigate various components thoroughly. The paper employs the action research framework to explore and investigate the effects of DGBL on students with learning disabilities' vocabulary knowledge. (De Vaus, 2001, cited in USC Libraries, 2024) Apart from the benefits of a DGBL approach for students, it can also enhance teacher skills and competencies. (Ragni et al., 2023) The approach allows students to actively participate in the learning content and deepens the understanding of target vocabulary. (Reinders & Wattana, 2012; Setiadi, 2018)

The action research model, as introduced by Kurt Lewin, emphasizes problem solving for continuous improvement and learning, which involves; identifying the problem of the research, action planning, implementing of the strategies and interventions, observing and data collecting during the pre-assessment and observation period, analyzing collected data, refining the plan based on the feedback, and re-implement the revised plan. (Onkar, 2023; Adelman, 1993; Zentis, 2019; MacIsaac, 1996) The process will continue in a repeated cycle until the desired outcome is achieved.

Figure 6.1

Action Research Model (Hopkins, 1985; MacIsaac, 1996).



6.1 Participants and Setting

This research targeted lower primary students with learning disabilities from a special education school in Shah Alam, Malaysia. Purposive sampling was employed to select participants for this study. This sampling technique involves selecting individuals based on specific characteristics and qualities required for the study. It also made participant recruitment more efficient for small, targeted populations, such as students with learning difficulties (Nikolopoulou, 2022). Learning disabilities were defined as neurodevelopmental disorders that affect language, arithmetic, coordination, and attention (Cavendish, 2012).

The selected school had a relatively small population of lower primary students with learning disabilities, primarily diagnosed with autism or other conditions (e.g., cerebral palsy, speech impairment, developmental delay). The use of purposive sampling provided direct access

to the target population, simplifying both participant selection and data collection (Campbell et al., 2020).

The study consisted of four male participants, aged 7 to 9 years, with Malay and English as their primary languages. The participants had been diagnosed with autism spectrum disorder (ASD) or attention deficit hyperactivity disorder (ADHD), with a comorbidity of dyslexia. Each participant had received an Individualized Education Plan (IEP) developed by the school. The participants' background information provided essential context for understanding potential challenges in vocabulary acquisition and assisted in the analysis of research findings.

Table 6.1

Participant Demographics and Literacy Concerns

Name	**Student A**	**Student B**	**Student C**	**Student D**
Age (years)	8	9	9	9
Gender	Male	Male	Male	Male
Primary Language	English	Malay	English	Malay
Diagnosis	ASD, Dyslexia	ASD, Dyslexia	ADHD, Dyslexia	ASD, Dyslexia
Literacy Concerns	Difficulties with comprehension; Deficit in processing information; Difficulties in decoding and spelling.	Difficulties with comprehension; Deficit in processing information; Difficulties in scanning and recognizing texts; Weak in spelling.	Deficit in phonological processing; Difficulties with comprehension; Weak in decoding and spelling.	Confusion with similar letter shapes; Difficulties with comprehension; Difficulties in scanning and recognizing texts.
Individual Educational Plan	Yes	Yes	Yes	Yes

6.2 Data Collection Methods

This research utilizes a combination of instruments to assess the effectiveness of DGBL on vocabulary knowledge. The Vocabulary Knowledge Scale (VKS), adapted from Wesche & Paribakht (1996), will serve as a pre- and post-assessment to measure vocabulary knowledge. The scale provides a structured approach in measuring student's knowledge of targeted words (Meara, 1996), allowing for comparison of the participant's learning progress after the implementation of the DGBL approach. Two sets of interactive vocabulary games from the website "Games to Learn English", aligned with the KSSR syllabus, were utilized during the intervention session. Each set consisted, an introduction to a new vocabulary game, story time with targeted words, followed by a review game. The games serve primarily as a learning tool to assess the participant's understanding, knowledge retention, and engagement over a span of two weeks. A Student Engagement Observation Checklist (SEOC), adapted from Cassar and Jang (2010), was utilized to assess the participant's level of engagement using a five-point Likert scale. This checklist evaluates areas, such as effort, initiative, disruptive behaviour, and inattentive behavior. Observational notes were recorded on the participant's physical, social, and cognitive behaviours during the game interaction (Cassar and Jang, 2010).

Prior to the intervention, informed consent was obtained from both the school and the participating students. A simplified briefing session was conducted with the students to ensure they understood the purpose of the study and their participation. Table 6.2 presents an overview of the research plan for the entire study.

Table 6.2

Research Plan, Instruments, and Data Collection Process

Week	Cycle	Stage	Steps	Research Instruments	Data Collection
Week 1	**Cycle 1**	**Plan**	Identify targeted participants. Plan Activity 1.	-	-
		Action	Conduct pre-assessment and implement Activity 1.	VKS (Pre-assessment) Vocabulary Game 1	VKS (Pre-assessment)

		Observe	Collect data. Observe students' engagement.	SEOC	SEOC
		Reflect	Analyze data from pre-assessment and engagement checklist.	-	-
Cycle 2	**Plan**	Plan activity. Make adjustments if needed.	-	-	
		Action	Implement Activity 2. Conduct post-assessment.	Story Time Vocabulary Game 2	-
		Observe	Collect data.	SEOC VKS (Post-assessment)	SEOC VKS (Post-assessment)
		Reflect	Analyze data from post-assessment and engagement checklist.	-	-
Week 2	**Cycle 1**	**Plan**	Plan activity. Make adjustments if needed.	-	-
		Action	Implement Activity 3. Monitor progress.	VKS (Pre-assessment) Vocabulary Game 3	VKS (Pre-assessment)
		Observe	Collect data.	SEOC	SEOC
		Reflect	Analyze data from pre-assessment and engagement checklist.	-	-
Cycle 2	**Plan**	Plan activity. Make adjustments if needed.	-	-	
		Action	Implement Activity 4. Conduct post-assessment.	Story Time Vocabulary Game 4	-
		Observe	Collect data.	SEOC VKS (Post-assessment)	SEOC VKS (Post-assessment)
		Reflect	Analyze data from post-assessment and engagement checklist.	-	-

7.0 Data Analysis and Findings

In this study, data from the VKS and SEOC were analyzed using descriptive statistics to assess vocabulary progression and engagement levels after the DGBL intervention. The VKS mean scores measured vocabulary improvement on a 4-point scale, while SEOC scores categorized student engagement based on effort, initiative, and attentiveness. The findings provide insights into the effectiveness of DGBL in enhancing vocabulary knowledge and student participation.

7.1 Vocabulary Knowledge Improvement

Table 7.1

Paired Samples t-Test Results for Vocabulary Knowledge Improvement

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_A - Post_A	-6.250	2.188	.773	-8.079	-4.421	-8.081	7	.000

The results of the paired samples t-test indicate a statistically significant improvement in students' post-assessment scores compared to their pre-assessment scores. The mean difference of -6.250 suggests that, on average, students performed better after the intervention. The standard deviation of 2.188 reflects some variation in score improvements, but overall, the results appear consistent. Additionally, the 95% confidence interval (-8.079, -4.421) confirms that the true mean difference falls within this range, reinforcing the reliability of the observed improvement. The t-value of -8.081 and a p-value of < .001 indicate a highly significant difference between the pre- and post-assessment scores. Since the p-value is well below 0.05, we reject the null hypothesis, confirming that the Digital Game-Based Learning (DGBL) intervention had a significant positive impact on students' vocabulary acquisition. These findings suggest that DGBL can be an effective tool for enhancing learning outcomes, particularly for students with learning disabilities.

7.2 Student Engagement Patterns

Table 7.2.1 reveals varying student engagement patterns. In the first cycle of the first week, Student C presented the highest effort (31 pts, M = 4.43) and initiative (18 pts, M = 4.5), while Student A presented the lowest in effort (17 pts, M = 2.28) and initiative (6 pts, M = 1.5). Student C demonstrated more enthusiasm, while Student A required additional prompts and presented high inattention (13 pts, M = 4.33). Student B presented moderate engagement despite the highest disruptive behaviour (10 pts, M = 2.5).

In the second cycle of the first week, Student A's engagement improved with an increase of 2 points in his effort (19 pts, M = 3). Whereas 75% of students maintained their effort. However, the initiative category decreased from 46 to 43 points, and the disruptive behaviour category increased from 31 to 43 points. External factors prior to the intervention may have affected student's engagement, leading to strategy adjustments.

Engagement decreased during the second week's first cycle, with scores dropped for all students (Student A: 19 to 15 points; Student B: 28 to 25 points; Student C: 31 to 28 points; Student D: 25 to 24 points). Although 75% of students presented increased effort and initiative in the second cycle, disruptive and inattentive behaviour remained. Overall, students demonstrated moderate engagement, indicating room for improvement to increase interest and motivation of students in DGBL.

Table 7.2.1

Student Engagement Observation Checklist Data.

Activity	Scale	Student A Pts (M)	Student B Pts (M)	Student C Pts (M)	Student D Pts (M)	Total Pts (M)
Vocabulary Game 1	E	17 (2.28)	28 (4)	31 (4.43)	25 (3.28)	101 (13.99)
	I	6 (1.5)	9 (2.25)	18 (4.5)	13 (4.33)	46 (12.58)
	D	9 (2.25)	10 (2.5)	8 (2)	4 (1.33)	31 (8.08)
	N	13 (4.33)	8 (2)	4 (1.33)	9 (2.25)	34 (9.88)
Story time; Vocabulary Game 2	E	19 (3)	28 (4)	31 (4.43)	25 (3.28)	103 (14.71)
	I	5 (1.25)	10 (2.5)	19 (3)	9 (2.25)	43 (9)
	D	16 (4)	10 (2.5)	11 (2.75)	6 (1.5)	43 (9)

	N	13 (4.33)	8 (2)	4 (1.33)	9 (2.25)	34 (9.88)
Vocabulary Game 3	E	15 (2.14)	25 (3.28)	28 (4)	24 (3.42)	92 (12.84)
	I	4 (1.33)	8 (2)	18 (4.5)	5 (1.25)	35 (9.08)
	D	13 (4.33)	4 (1.33)	8 (2)	10 (2.5)	35 (9.08)
	N	11 (2.75)	3 (1)	3 (1)	11 (2.75)	28 (7.5)
Story time; Vocabulary Game 4	E	21 (3)	26 (3.71)	29 (4.14)	21 (3)	97 (13.85)
	I	6 (1.5)	9 (2.25)	18 (4.5)	5 (1.25)	38 (9.5)
	D	10 (2.5)	4 (1.33)	10 (2.5)	11 (2.75)	35 (9.08)
	N	8 (2)	3 (1)	3 (1)	14 (4.67)	28 (7.5)

E = Effort I = Initiative D = Disruptive Behaviour N = Inattentive Behaviour

Figure 7.4

Week 2, Cycle 2, Student Engagement Observation Checklist Data.

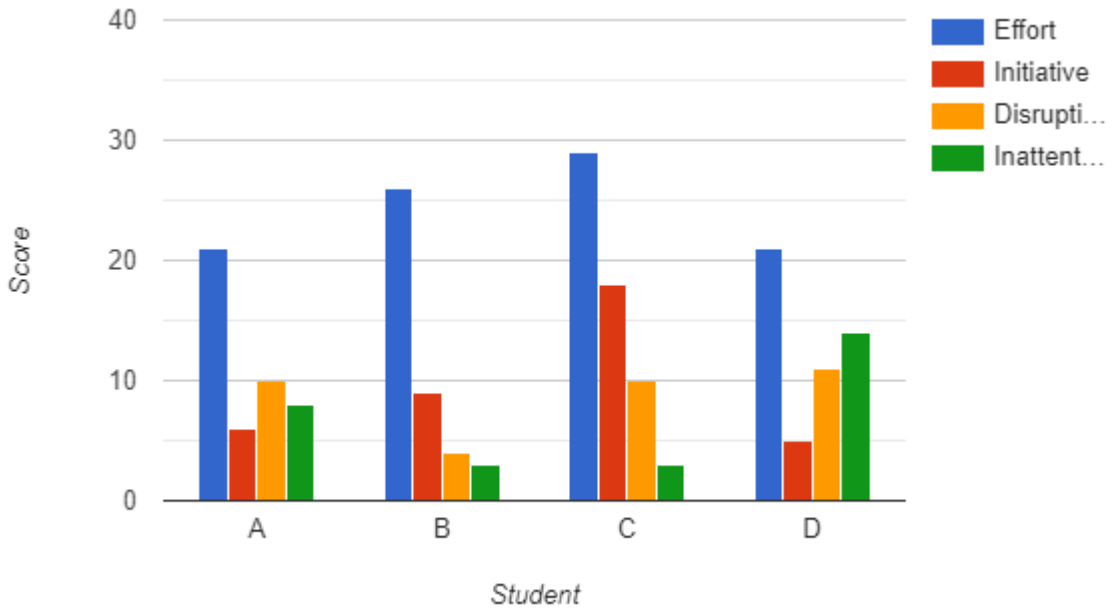


Figure 7.4 suggests a trend of moderate engagement in the second week's second cycle. Students B and C scored the highest effort (26 pts, M = 3.71; 29 pts, M = 4.14). However, student A's inattentive scored an additional 2 points, while students C and D maintained. Student D displayed an increase in disruptive and inattentive aspects, suggesting the potential need for

improvement in behaviour management. Potential external factors may play a part in affecting the student's engagement. Overall, the second week's second cycle activities were potentially less engaging compared to the first cycle, with slight increase in disruptive behaviour despite moderate to high in effort.

8.0 Discussion

The findings of this study highlight the effectiveness of Digital Game-Based Learning (DGBL) in improving vocabulary acquisition among lower primary students with learning disabilities. The results from the Vocabulary Knowledge Scale (VKS) indicate a significant increase in post-assessment scores, suggesting that DGBL supports word recognition and vocabulary retention. Data from the Student Engagement Observation Checklist (SEOC) revealed that while engagement levels varied among students, most demonstrated moderate participation and effort throughout the intervention. Despite the overall improvement in vocabulary knowledge, fluctuations in student engagement were observed, with some students requiring additional scaffolding to stay motivated. These findings align with previous research, which suggests that interactive digital tools can enhance learning but must be adapted to meet individual student needs (Barzilai & Blau, 2013; Gallud et al., 2021). The SEOC indicates that some students showed high effort and initiative, benefiting the most from the intervention, while others displayed frustration or inattentiveness and required additional prompts to stay engaged. This variation reinforces the importance of personalized support and adaptive gameplay elements in sustaining motivation and participation. The study confirms that while DGBL is an effective instructional approach, engagement and comprehension levels differ based on individual learning profiles, highlighting the need for structured scaffolding and differentiated instruction in digital learning environments (Aguilera & Roock, 2022). Hence, student engagement levels in DGBL varies due to individual learning profiles influencing the amount of effort and initiative demonstrated by the students, with some requiring scaffolding to maintain motivation and participation.

The VKS results confirm that interactive elements in digital games promote long-term learning acquisition by improving word retrieval and comprehension (Aguilera & Roock, 2022). Additionally, the adaptability of DGBL allows educators to modify game content, ensuring that scaffolding techniques are embedded within learning tasks to enhance retention and accessibility

(Barzilai & Blau, 2013). However, the SEOC results suggest that student engagement varies, reinforcing the need for differentiated strategies to maintain active participation (Gallud et al., 2021). Research by Erhel and Jamet (2013) supports the claim that DGBL fosters positive learning behaviors by improving critical thinking, decision-making, and intrinsic motivation. These findings align with the principles of behaviorism, cognitivism, and constructivism, reinforcing the significance of digital tools in inclusive education. By considering these implications, DGBL can be further refined to maximize its impact on students with learning disabilities.

10.0 Conclusion

This study explored the effectiveness of DGBL in enhancing vocabulary knowledge and student engagement among lower primary students with learning disabilities. The VKS results demonstrated notable improvement in vocabulary acquisition, while SEOC data indicated moderate engagement levels. Although some students displayed variations in effort and attentiveness, the scaffolding techniques embedded in DGBL contributed to knowledge retention and active learning participation. These findings suggest that while DGBL is a valuable instructional tool, its success depends on how effectively it is tailored to individual learning needs (Cassar & Jang, 2010).

Despite the positive outcomes, limitations such as external distractions, varying motivation levels, and technical constraints must be acknowledged. Future research should investigate the long-term impact of DGBL on vocabulary retention, examine a larger and more diverse student sample to validate the findings, compare DGBL with alternative teaching methods to assess its relative effectiveness, and develop adaptive game-based scaffolding models that cater to individual learning needs (Tlili et al., 2022; Salgarayeva et al., 2021). With further refinements, DGBL can be optimized as an innovative tool for inclusive education, supporting Sustainable Development Goal 4 (SDG 4) by promoting equitable learning opportunities for all students (United Nations, 2015). By addressing these challenges, DGBL has the potential to significantly enhance vocabulary learning, engagement, and long-term educational outcomes for students with learning disabilities.

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