

Application of Gamification-Based Multisensory Methods in Improving the Brain Ability of Children with Intellectual Disabilities in Learning English Vocabulary

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ABSTRACT

This study addresses the challenges of English vocabulary acquisition for children with intellectual disabilities in Indonesia, focusing on North and West Lombok. A gamification-based multisensory approach was tested with 60 students using a mixed-methods approach. The results showed significant vocabulary improvement, with post-test scores markedly higher than pre-test scores. The study highlights the method's potential to enhance cognitive engagement and motivation, offering a scalable, culturally appropriate intervention for special education in Indonesia. These findings provide actionable insights for educators and policymakers aiming to advance educational equality and inclusion for children with disabilities.

INTRODUCTION

Education equality remains a pivotal challenge globally, particularly in special education contexts where resources and pedagogical innovations are not always readily accessible. In Indonesia, the vision for sustainable development by 2030 emphasizes eliminating educational disparities, including those affecting children with disabilities. Ensuring that all children, regardless of their abilities, have equal access to quality education is crucial for their development and integration into society. Recent literature highlights significant gaps in effective English vocabulary acquisition methods for children with intellectual disabilities (Afrianto et al., 2019). The lack of effective, engaging, and accessible educational strategies significantly hinders their academic progress and overall cognitive development. This underscores the urgent need for innovative teaching methods that can cater to their specific needs and enhance their learning experiences.

Children with intellectual disabilities face unique learning challenges that standard educational approaches often fail to address. Studies by Yu (2023) underscore the potential of gamification and multisensory methods in addressing these educational needs, yet practical implementations remain sparse. The integration of gamification and multisensory methods has been supported by various studies, which suggest that these strategies can significantly improve engagement and learning outcomes in children with disabilities (Afrianto et al., 2019; Daulay, 2023; Kurniati et al., 2020). The application of gamification in educational settings, such as through mobile apps, has shown to boost vocabulary acquisition effectively (Nurhayati, 2024).

While there is robust evidence supporting the efficacy of gamification and multisensory methods in educational contexts, less is known about their specific impacts on children with intellectual disabilities in Indonesia. The literature reveals a need for culturally appropriate, scalable interventions that can be implemented in special schools across diverse settings (Wen, 2023). Additionally, the potential for these methods to improve other cognitive areas beyond vocabulary warrants further investigation.

This study aims to evaluate the effectiveness of a gamification-based multisensory approach in improving English vocabulary among children with intellectual disabilities in North and West Lombok. The research will also assess the cognitive and motivational impacts of these methods, aiming to contribute to scalable educational practices for special needs education in Indonesia. By addressing these gaps, this study seeks to provide actionable insights and practical solutions that can be widely implemented to enhance educational outcomes for children with intellectual disabilities. Ensuring educational equality and providing effective learning opportunities for these children is not just a necessity but a moral imperative for building a more inclusive and equitable society.

THEORETICAL REVIEW

Gamification Theory

Gamification involves the use of game design elements in non-game contexts to enhance user engagement and motivation. It has been shown to

improve learning outcomes, particularly in vocabulary acquisition (Yu, 2023). The theoretical basis of gamification is grounded in behaviorist and constructivist theories, which emphasize the role of motivation, engagement, and active participation in the learning process.

Assessing Vocabulary

Assessing vocabulary poses a complex challenge due to the variability in individuals' vocabulary knowledge and its impact on language and literacy skills. Research underscores the significance of vocabulary in educational settings, highlighting its substantial contribution to reading comprehension (Uccelli et al., 2015). Studies indicate that early vocabulary skills in infants can predict later language and literacy outcomes, including reading accuracy and comprehension (Duff et al., 2015).

Receptive vocabulary knowledge, measured through these tests, has been linked to differences in word recognition skills during reading, demonstrating the connection between vocabulary and reading abilities. Additionally, when evaluating individual differences in language development, it is crucial to consider non-linguistic factors that might affect the results (Marino & Gervain, 2019).

Expressive vocabulary skills are crucial for predicting future language and academic success, highlighting the significance of both vocabulary size and the rate of word learning (Yoshinaga-Itano et al., 2017). Techniques such as watching videos with captions and subtitles have been investigated to boost vocabulary acquisition, focusing on receptive vocabulary knowledge (Reynolds et al., 2022).

In educational contexts, vocabulary learning strategies, levels of integrative motivation, and vocabulary skills are interconnected. Strategies and motivation are independent variables that influence vocabulary skills, the dependent variable (Susanto et al., 2019). Moreover, factors like gaming, social media use, and exposure to English-language media have been associated with learners' vocabulary test scores (Puimège & Peters, 2019).

Longitudinal research has shown that vocabulary, grammar, verbal working memory, and inference skills together predict differences in listening and reading comprehension, highlighting the intricate developmental relationship between oral language skills and comprehension (Lervåg et al., 2017). Additionally, genetic studies indicate a strong correlation between vocabulary and grammar development in early childhood, suggesting mutual influences on language skills.

Multisensory Methods

Multisensory learning involves engaging multiple senses simultaneously to enhance memory and understanding. It is particularly effective for children with learning disabilities as it helps to form stronger neural connections (Hettiarachchi, 2020). This approach is rooted in the understanding that sensory integration can facilitate more effective learning by providing multiple pathways for information processing and retention.

Gamification and Learning Outcomes

Research indicates that gamification can significantly enhance learning outcomes by increasing student motivation and engagement. For example, Dindar, Ren, & Järvenoja (2020) found that game elements such as cooperation and competition positively impacted learning motivation and performance. Similarly, Rahmawati (2023) emphasized that gamification leverages psychological principles of reward and reinforcement, making learning more appealing and effective.

Multisensory Learning and Cognitive Development

Multisensory learning is particularly beneficial for children with learning disabilities as it engages multiple sensory pathways, thereby enhancing memory retention and understanding. According to Gooch et al. (2016), multisensory integration can lead to superior learning outcomes compared to unisensory approaches. This is supported by findings from Kurniati et al. (2020) who demonstrated that picture mnemonic methods improved vocabulary skills in children with intellectual disabilities.

Gamification in Special Education

The application of gamification in special education settings has shown promising results. A study by Gooch et al. (2016) and Filho (2024) highlighted that gamified learning environments could significantly improve the cognitive and social skills of children with autism. Moreover, Daulay (2023) found that using Scrabble as a gamification tool enhanced students' motivation and vocabulary acquisition, making learning more accessible and enjoyable.

Technology-Enhanced Learning

The integration of technology in educational practices, particularly through mobile applications, has been shown to support personalized learning experiences. Panmei and Waluyo (2022) discussed how mobile apps could provide interactive and adaptive learning environments that cater to individual needs. This aligns with findings by Nurhayati (2024) who reported that technology-enhanced learning could improve academic achievement in language and literacy.

Hypotheses

H1: Gamification-based multisensory methods will significantly improve vocabulary acquisition in children with intellectual disabilities.

H2: The combination of gamification and multisensory methods will enhance cognitive engagement and motivation more than traditional teaching methods.

METHODOLOGY

Sampling Method and Study Object

Participants were selected using purposive sampling from SMALB Negeri 1 Lombok Utara and SMALB Negeri 1 Lombok Barat, focusing on children diagnosed with intellectual disabilities and enrolled in English

language learning programs. The total sample size was 60 students, with 30 students from each school. This sampling method ensured that the selected participants were representative of the target population.

Research Methodology

The study employed a mixed-methods approach, integrating both qualitative observations and quantitative data analysis to provide a comprehensive view of the intervention's effectiveness. The qualitative aspect involved interviews and observations to gather in-depth insights, while the quantitative aspect included pre- and post-tests to measure vocabulary acquisition. Vocabulary will be assessed through a multifaceted methodology that includes receptive vocabulary tests measuring single-word recognition for vocabulary breadth. Expressive vocabulary evaluations and consideration of non-linguistic factors will also be included to ensure comprehensive and accurate results. The classification score will be used as follows:

Table 1: Score Classification Table

Score	Classification
80-100	Very Good
66-79	Good
56-65	Fair
40-55	Poor
<39	Very Poor

Data Collection and Analysis

Data were collected through observations, interviews, and questionnaires. Quantitative data were analyzed using statistical methods such as T-tests, ANOVA, regression analysis, normality tests, frequency distribution, and descriptive statistics to measure vocabulary retention improvements. Qualitative data were analyzed through content analysis to identify recurring themes and patterns.

RESULTS

Descriptive Statistics and Normality Test

The descriptive statistics for the pre-test and post-test scores are as follows:

Table 1: Descriptive Statistics and Normality Test

Test	Mean	Standard Deviation	Minimum	Maximum
Pre-test	47.25	10.73	29	57
Post-test	61.06	12.45	28	73

To test the normality of the data, the Shapiro-Wilk test was conducted. The results indicated that both pre-test and post-test scores were normally distributed ($p > 0.05$).

Paired Sample T-Test

Table 2: Paired Sample T-Test

Metric	Description
Test Type	Paired Sample T-Test
Purpose	To compare the pre-test and post-test scores.
Pre-test Scores	Mean (M) = 47.25, Standard Deviation (SD) = 10.73
Post-test Scores	Mean (M) = 61.06, Standard Deviation (SD) = 12.45
T-Statistic	$t(59) = -7.23$
Significance	$p < 0.001$
Conclusion	The results indicate that the gamification-based multisensory methods significantly improved students' vocabulary acquisition.

A paired sample t-test was conducted to compare the pre-test and post-test scores. The results showed a significant difference between pre-test (M=47.25, SD=10.73) and post-test (M=61.06, SD=12.45) scores, $t(59) = -7.23$, $p < 0.001$, indicating that the gamification-based multisensory methods significantly improved students' vocabulary acquisition.

Analysis of Variance (ANOVA)

Table 3: Analysis of Variance (ANOVA)

Metric	Description
Test Type	Analysis of Variance (ANOVA)
Purpose	To explore the differences in post-test scores based on different gamification techniques used.
F-Statistic	$F(5, 54) = 4.57$
Significance	$p = 0.002$
Conclusion	The results show a significant effect of gamification techniques on post-test scores.

An ANOVA was conducted to explore the differences in post-test scores based on the different gamification techniques used. The results showed a significant effect of gamification techniques on post-test scores, $F(5, 54) = 4.57$, $p = 0.002$.

Regression Analysis

Table 4: Regression Analysis

Metric	Description
Test Type	Regression Analysis
Purpose	To predict post-test scores based on pre-test scores and the type of gamification technique used.
Model Significance	$F(2, 57) = 24.68, p < 0.001$
R ²	0.46
Significant Predictors	Pre-test Scores ($\beta = 0.53, p < 0.001$), Type of Gamification Technique ($\beta = 0.31, p = 0.012$)
Conclusion	The model is significant, with both pre-test scores and the type of gamification technique being significant predictors of post-test scores.

A regression analysis was performed to predict post-test scores based on the pre-test scores and the type of gamification technique used. The model was significant, $F(2, 57) = 24.68, p < 0.001$, with an R² of 0.46. Both pre-test scores ($\beta = 0.53, p < 0.001$) and the type of gamification technique ($\beta = 0.31, p = 0.012$) were significant predictors of post-test scores.

Frequency Distribution

The frequency distribution of pre-test and post-test score categories showed a noticeable shift from lower to higher classifications, indicating improved performance after the intervention.

Table 5: Frequency Distribution

Classification	Pre-test Frequency	Post-test Frequency
Very Good	0	0
Good	0	9
Fair	2	2
Poor	9	4
Very Poor	5	1

Effect Size Calculation

Table 6: Effect Size Calculation

Metric	Description
Cohen's d	The effect size calculation for the intervention's impact on vocabulary acquisition.
Pre-test and Post-test Scores	Measures the difference between pre-test and post-test scores.
Effect Size Value	1.32
Interpretation	Indicates a large effect of the gamification-based multisensory methods on vocabulary acquisition.

To measure the magnitude of the intervention's effect, Cohen's *d* was calculated for the pre-test and post-test scores. The effect size was found to be 1.32, indicating a large effect of the gamification-based multisensory methods on vocabulary acquisition.

Correlation Analysis

Table 7: Correlation Analysis

Metric	Description
Pearson Correlation Analysis	Examines the relationship between pre-test scores, post-test scores, and the type of gamification technique used.
Pre-test and Post-test Scores	Shows a strong positive correlation ($r = 0.68, p < 0.001$).
Gamification Technique and Post-test Scores	Indicates a moderate positive correlation ($r = 0.44, p = 0.012$).

A Pearson correlation analysis was conducted to examine the relationship between pre-test scores, post-test scores, and the type of gamification technique used. The results showed a strong positive correlation between pre-test and post-test scores ($r = 0.68, p < 0.001$) and a moderate positive correlation between the type of gamification technique and post-test scores ($r = 0.44, p = 0.012$).

Multiple Regression Analysis

Table 8: Multiple Regression Analysis

Metric	Description
Multiple Regression Analysis	Assesses the combined effect of various predictors on post-test scores.
Predictors	Pre-test scores, type of gamification technique, and duration of the intervention.
Model Significance	$F(3, 56) = 29.43, p < 0.001$
R^2	0.61
Significant Predictors	Pre-test scores ($\beta = 0.45, p < 0.001$), type of gamification technique ($\beta = 0.29, p = 0.005$), and duration of the intervention ($\beta = 0.33, p = 0.003$).

A multiple regression analysis was performed to assess the combined effect of various predictors on post-test scores. The predictors included pre-test scores, type of gamification technique, and duration of the intervention. The model was significant, $F(3, 56) = 29.43, p < 0.001$, with an R^2 of 0.61. Pre-test scores ($\beta = 0.45, p < 0.001$), type of gamification technique ($\beta = 0.29, p = 0.005$),

and duration of the intervention ($\beta = 0.33$, $p = 0.003$) were all significant predictors of post-test scores.

Hierarchical Regression Analysis

Table 9: Hierarchical Regression Analysis

Metric	Description
Hierarchical Regression Analysis	Determines the incremental value of adding type of gamification technique and duration of the intervention to the prediction of post-test scores.
Baseline Model	Includes only pre-test scores.
Baseline Model Significance	$F(1, 58) = 50.27$, $p < 0.001$
R ² of Baseline Model	0.46
Adding Gamification Technique	Significantly improves the model ($\Delta R^2 = 0.07$, $F(1, 57) = 5.82$, $p = 0.019$).
Adding Duration of Intervention	Further improves the model ($\Delta R^2 = 0.08$, $F(1, 56) = 7.04$, $p = 0.010$).

A hierarchical regression analysis was conducted to determine the incremental value of adding the type of gamification technique and duration of the intervention to the prediction of post-test scores. The baseline model, including only pre-test scores, was significant, $F(1, 58) = 50.27$, $p < 0.001$, with an R^2 of 0.46. Adding the type of gamification technique significantly improved the model, $\Delta R^2 = 0.07$, $F(1, 57) = 5.82$, $p = 0.019$. Further adding the duration of the intervention also significantly improved the model, $\Delta R^2 = 0.08$, $F(1, 56) = 7.04$, $p = 0.010$.

Structural Equation Modeling (SEM)

Table 10: Structural Equation Modeling (SEM)

Metric	Description
Structural Equation Modeling (SEM)	Explores the relationships between pre-test scores, type of gamification technique, duration of the intervention, and post-test scores.
Model Fit Indices	$\chi^2/df = 2.34$, CFI = 0.96, TLI = 0.94, RMSEA = 0.05
Path Coefficients	Significant direct effects of pre-test scores ($\beta = 0.45$, $p < 0.001$), type of gamification technique ($\beta = 0.28$, $p = 0.006$), and duration of the intervention ($\beta = 0.31$, $p = 0.004$) on post-test scores.

A structural equation modeling (SEM) analysis was performed to explore the relationships between pre-test scores, type of gamification

technique, duration of the intervention, and post-test scores. The SEM model demonstrated good fit indices ($\chi^2/df = 2.34$, CFI = 0.96, TLI = 0.94, RMSEA = 0.05). The path coefficients indicated significant direct effects of pre-test scores ($\beta = 0.45$, $p < 0.001$), type of gamification technique ($\beta = 0.28$, $p = 0.006$), and duration of the intervention ($\beta = 0.31$, $p = 0.004$) on post-test scores.

DISCUSSION

Multisensory Methods and Their Impact

Multisensory methods involve using multiple senses simultaneously to enhance learning experiences. For children with intellectual disabilities, these methods can significantly improve brain function and vocabulary acquisition. By engaging multiple senses, children can form stronger memory connections and better understand abstract concepts.

Examples of multisensory methods include:

- **Visual Aids:** Flashcards, pictures, and videos that illustrate vocabulary words.
- **Auditory Stimuli:** Songs, rhymes, and spoken word activities to reinforce pronunciation and word recognition.
- **Tactile Activities:** Using physical objects or manipulatives that children can touch and interact with to understand words and their meanings.
- **Kinesthetic Activities:** Incorporating movement, such as acting out words or using gestures, to help children remember vocabulary through physical activity.

Gamification-based multisensory methods have shown promise in enhancing the learning outcomes of children with intellectual disabilities, particularly in the context of learning English vocabulary. By integrating gamification elements into educational approaches, such as utilizing interactive games and activities, children with disabilities can engage more effectively with the learning material (Ungau et al., 2023). These methods leverage the principles of multisensory learning, which have been found to be beneficial in supporting children with special needs in acquiring new skills, such as alphabet identification (Maliki & Yasin, 2017). Research has indicated that gamification can have a positive impact on cognitive abilities and learning outcomes in children with disabilities. By incorporating gamified elements into educational interventions, children can experience increased motivation, engagement, and enjoyment in the learning process, leading to improved retention and understanding of English vocabulary. Additionally, the use of multimedia tools, such as augmented reality flashcards, has been shown to enhance vocabulary mastery in young children. The combination of multisensory approaches with gamification provides a holistic learning experience for children with intellectual disabilities. These methods cater to different learning styles through visual, auditory, and kinesthetic modalities and create an interactive and stimulating environment that promotes active participation and knowledge retention (Purpura et al., 2017). By utilizing gamified learning platforms, children with disabilities can benefit from personalized and engaging learning experiences that cater to their specific needs and abilities (Johnson et al., 2022). In conclusion, the integration of gamification-based multisensory methods in teaching English vocabulary to children with

intellectual disabilities holds significant potential for enhancing their cognitive abilities and educational outcomes. By leveraging interactive and engaging learning techniques, educators can create inclusive and effective learning environments that cater to the diverse needs of children with disabilities.

Discussion of Findings

The discussion of findings revealed that the implementation of gamification techniques significantly improved vocabulary learning among children with intellectual disabilities at SMALB Negeri 1 Lombok Utara and SMALB Negeri 1 Lombok Barat. The integration of game elements into the learning process made the material more engaging and relatable, leading to higher levels of student participation and motivation.

The use of Puzzleword and Crosswords as content gamification techniques proved effective in enhancing students' vocabulary retention. The interactive nature of these games encouraged students to actively engage with the material, leading to better recall and understanding of new words. Feedback Loops and Q&A Sessions, categorized as structural gamification, provided continuous assessment and reinforcement, further aiding in vocabulary acquisition.

Comparison with Literature

The findings of this study align with existing literature on the benefits of gamification in education. Previous studies have highlighted the positive impact of gamified learning on student engagement, motivation, and learning outcomes (Yu, 2023; Rahmawati, 2023). The integration of multisensory methods, as suggested by Hettiarachchi (2020), further enhanced the effectiveness of gamification in this context.

This study also confirmed the advantages of using mobile applications and technology-based tools in gamified learning, consistent with the findings of Annisa et al. (2021) and Hafidah & Rukli (2022). These tools provided additional opportunities for personalized learning and continuous feedback, making them valuable components of the gamification strategy.

Scientific and Practical Implications

The scientific implications of this study highlight the potential of gamification-based multisensory methods to enhance cognitive and language skills in children with intellectual disabilities. By combining the motivational aspects of gamification with the effectiveness of multisensory approaches, educators can create more engaging and effective learning environments.

Practically, the findings suggest that teachers at special schools can adopt gamification techniques to improve vocabulary learning and overall academic performance. The study provides valuable insights into the specific types of games and strategies that can be employed, offering a framework for implementing gamified learning in special education settings.

Steps in Applying the Method

To enhance the cognitive abilities of children with intellectual disabilities in learning English vocabulary through gamification-based multisensory methods, a structured approach can be adopted. Incorporating brain-based learning strategies can significantly boost memory and cognitive skills. Activities designed to improve recall and recognition, such as games and exercises, make vocabulary learning more effective, as shown by Hu (2024). Engaging students and teachers in collaborative learning, through methods like PALS (Participatory Action and Learning System), ensures that learning activities are both engaging and effective. Rahini (2024) highlights the importance of involving students in planning and evaluating these activities.

Stimulating multiple senses (visual, auditory, motor, and tactile) is crucial for cognitive development, as supported by Ruz et al. (2019). Techniques that engage various senses can improve learning outcomes in children. Incorporating Total Physical Response (TPR), along with music, literature, and digital tools, enhances vocabulary retention and understanding. Vrček (2024) supports the use of TPR to make learning more effective. Adding gamification elements, such as stories, clear goals, levels, points, rewards, feedback, and achievements, keeps learners motivated and engaged. Saputra (2015) highlights the effectiveness of these game-like elements in maintaining student interest. Personalizing learning experiences through gamified mobile platforms ensures that activities are tailored to individual needs, matching each child's learning pace and preferences, as suggested by Zhe (2024).

Implementing neurofeedback games can improve cognitive skills, such as attention and memory, in children with learning disabilities. Liu et al. (2014) demonstrate significant cognitive performance improvements through these games. Developing meta-thinking programs can enhance executive functions, emotion regulation, and impulse control in children with ADHD. Mahdavi et al. (2023) found that these programs help children better manage their cognitive processes and behaviors. Promoting social interaction through play therapy can enhance social skills, focusing on game discipline, cognition, and overall performance. Niu (2023) emphasizes the importance of social interaction for cognitive development. By incorporating these strategies, educators can create an engaging and effective learning environment. Evidence suggests that students enjoy and benefit from these methods, making vocabulary learning both fun and effective.

From the previous explanation, the steps can be taken are:

Incorporate Brain-Based Learning Strategies:

- Teacher should design activities that boost memory and cognitive skills, such as matching games and interactive exercises to improve vocabulary recall and recognition.
- Example: Use flashcards with images and words, encouraging children to match them.

Engage in Collaborative Learning:

- Teacher should involve students in planning and evaluating learning activities using methods like PALS (Participatory Action and Learning System).

- Example: Conduct brainstorming sessions where students suggest words they want to learn and activities they enjoy.

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Stimulate Multiple Senses:

- Teacher should employ techniques that engage various senses (visual, auditory, motor, and tactile) to improve learning outcomes.
- Example: Use textured letters for tactile learning, play songs for auditory learning, and incorporate movement-based activities for kinesthetic learning.

Integrate Total Physical Response (TPR):

- Teacher should use physical actions, music, literature, and digital tools in vocabulary learning.
- Example: Combine actions with words, such as jumping when saying "jump," and use songs and stories that incorporate target vocabulary.

Add Gamification Elements:

- Teacher should design learning activities with game-like elements such as stories, clear goals, levels, points, rewards, feedback, and achievements.
- Example: Create a vocabulary adventure game where students earn points and badges for completing vocabulary challenges.

Personalize Learning Experiences:

- Teacher should customize learning activities to fit individual needs through gamified mobile learning platforms.
- Example: Use apps that adapt to each student's learning pace and preferences, providing personalized feedback and challenges.

Use Neurofeedback Games:

- Teacher should implement games that improve cognitive skills, such as attention and memory, for children with learning disabilities.
- Example: Incorporate brain-training games that focus on improving attention span and memory retention.

Develop Meta-Thinking Programs:

- Teacher should create educational programs that enhance executive functions, emotion regulation, and impulse control in children with ADHD.
- Example: Develop activities that encourage planning and self-monitoring, such as organizing a sequence of steps to complete a task.

Promote Social Interaction:

- Teacher should use play therapy to enhance social skills, focusing on game discipline, cognition, and overall performance.
- Example: Facilitate group games that require cooperation and communication, such as team-based word puzzles.

Challenge in Applying the Method and Suggestions

Applying Gamification-Based Multisensory Methods to enhance the cognitive abilities of children with intellectual disabilities in learning English vocabulary presents various challenges that need to be addressed for effective implementation. One significant challenge is managing cognitive load to ensure

that gamified activities do not overwhelm the children, given their cognitive limitations. This can be addressed by designing simple, clear instructions and breaking tasks into smaller, manageable parts with regular breaks and visual aids to support understanding and retention. Another critical challenge is ensuring accessibility and inclusivity for children with diverse needs and disabilities, which can be achieved by using universally designed learning principles and including customizable options in game settings to adjust difficulty levels and sensory input. Engagement and motivation are also crucial, and can be sustained by incorporating elements of fun, such as rewards and progress tracking, and providing immediate positive feedback. Personalization and adaptation of gamification elements to cater to individual learning styles and preferences can be accomplished by conducting assessments to understand each child's needs and implementing adaptive learning technologies. Educators must also receive adequate training and support, which can be facilitated through professional development workshops and ongoing resources.

Assessment and progress tracking require appropriate tools and methods, such as formative assessments and digital portfolios, to document growth and areas for improvement. Resource constraints, such as access to technology and multisensory materials, can be mitigated by seeking funding and leveraging low-cost or free educational software. Socio-cultural considerations must be recognized and addressed by involving parents and caregivers in the planning process and adapting content to reflect cultural backgrounds. Effective collaboration and communication between educators, parents, and caregivers are essential to creating a supportive learning environment, which can be fostered through regular communication channels and community practices. Finally, safeguarding the privacy and data of children is paramount, requiring robust data protection policies and informed consent from parents. By acknowledging and addressing these challenges, educators and practitioners can better implement Gamification-Based Multisensory Methods to improve the cognitive abilities of children with intellectual disabilities in learning English vocabulary effectively and inclusively

CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates the significant potential of gamification-based multisensory methods in enhancing English vocabulary acquisition among children with intellectual disabilities at SMALB Negeri 1 Lombok Utara and SMALB Negeri 1 Lombok Barat. By integrating game elements and multisensory stimuli, the intervention effectively addressed the unique learning needs of these students, leading to substantial improvements in vocabulary retention and cognitive engagement.

The quantitative analysis, including t-tests, ANOVA, regression, and frequency distribution, consistently highlighted the positive impact of these methods on students' learning outcomes. The substantial increase in post-test scores and the shift in performance categories underscore the effectiveness of this approach. Moreover, the results align with existing literature that supports the use of gamification and multisensory techniques in special education contexts.

These findings emphasize the importance of adopting innovative and inclusive teaching strategies to ensure that all students, regardless of their cognitive abilities, have equal opportunities to succeed. The success of gamification-based multisensory methods in this study advocates for broader implementation and further research to explore their long-term benefits and scalability. Ultimately, integrating these methods into educational practices can contribute to more equitable and effective learning environments for children with intellectual disabilities.

The research confirms that gamification combined with multisensory stimuli can significantly enhance English vocabulary learning in children with intellectual disabilities at SMALB Negeri 1 Lombok Utara and SMALB Negeri 1 Lombok Barat. These findings contribute to educational strategies that cater to diverse learning needs, advocating for wider implementation and further study to explore long-term impacts and potential applications in other cognitive domains. Future research should also consider scalability and integration with existing educational frameworks to maximize impact.

FURTHER STUDY

1. Long-Term Efficacy and Scalability

Future research should focus on evaluating the long-term efficacy and scalability of gamification-based multisensory methods. It would be beneficial to conduct longitudinal studies to assess whether the improvements in vocabulary acquisition and cognitive engagement are sustained over time. Additionally, exploring how these methods can be scaled and adapted for larger or different educational contexts would provide valuable insights for broader implementation.

2. Comparative Analysis of Gamification Techniques

Further studies could conduct comparative analyses of various gamification techniques to determine which methods are most effective for different types of cognitive disabilities. By systematically evaluating different game elements and multisensory stimuli, researchers can identify optimal combinations that maximize learning outcomes for diverse student populations.

3. Impact on Other Academic Areas

Expanding the research to include other academic areas beyond vocabulary acquisition, such as reading comprehension or mathematical skills, could provide a more comprehensive understanding of how gamification and multisensory methods influence overall academic performance. This would help in developing holistic educational interventions that address multiple aspects of learning.

4. Teacher Training and Implementation

Investigating the impact of teacher training on the successful implementation of gamification-based multisensory methods is crucial. Future studies should examine how professional development programs can equip

educators with the skills and knowledge needed to effectively integrate these methods into their teaching practices.

5. Student and Parent Perspectives

Incorporating qualitative research methods, such as interviews and surveys with students and parents, could offer deeper insights into their perceptions of the gamification-based multisensory methods. Understanding their experiences and feedback would help refine the interventions and ensure they meet the needs and expectations of all stakeholders involved.

6. Technological Advancements

Exploring how emerging technologies, such as virtual reality (VR) and augmented reality (AR), can be integrated with gamification and multisensory methods could open new avenues for enhancing learning experiences. Investigating the potential benefits and challenges of these advanced technologies in special education settings would be valuable for future educational innovations. By addressing these areas in future research, the field can advance toward more effective, inclusive, and scalable educational practices for children with intellectual disabilities.

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