

Applying the Gamification Approach as a Learning Strategy to Improve Early Childhood Literacy Abilities

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Abstract

This study examines the effectiveness of applying a gamification approach as a learning strategy to improve literacy. The research focuses on 15 children aged 5-6 years enrolled at the Doa Ibu Makassar Early Childhood Education Center in South Sulawesi Province, Indonesia. This study uses a pre-experimental research design with a one-group pretest-posttest design to analyze the development of children's literacy skills. Data were collected through observation and literacy skill assessment sheets. The results were analyzed using the N-Gain Score Test. The study showed that the effectiveness of gamification implementation increased to 0.7188, with a percentage value of 71.88%, placing the intervention in the “moderately effective” category with a range of 56-75%. These findings suggest that gamification is a promising strategy for improving early literacy skills. This study has limitations, including a small sample size, and the absence of a control group prevents definitive causal conclusions about the impact of the intervention. Future research should involve larger and more diverse samples and include a control group to strengthen the validity of the results.

Keywords : *early childhood, gamification approach, learning strategies, kindergarten, literacy*

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Introduction

According to Marsh et al. (2018), literacy is essential for humans because it helps them understand and participate in an increasingly complex and globally connected society. Literacy is necessary for understanding information, communicating, and participating in social and economic life. Literacy is also essential for obtaining a good job and developing a successful career. In addition, literacy also plays a vital role in improving individuals' health, well-being, and ability to make the right decisions in daily life (Fau & Yasmeeen, 2018).

Literacy is vital in life, especially in today's digital era. According to UNESCO (2005) Literacy is “the ability to read, write, and count, as well as the ability to understand, use, and process information necessary to participate effectively in social, economic, and political life.” Literacy is also necessary to access information and understand the world around us. For example, literacy helps a person understand product instructions, access health information, and understand news and social issues. Therefore, literacy must be developed early in children so that they can develop the skills necessary to participate effectively in society (Missall et al., 2008)

However, the results of PISA 2018 show that literacy levels, especially in Indonesia, are relatively low compared to other participating countries. Meanwhile, countries such as Singapore, Hong Kong, Canada, and Finland show high literacy ability levels. Improving literacy skills in Indonesia remains a significant focus in efforts to improve the quality of education in the country (OECD, 2019)

Low literacy can hurt a person's life. According to Wright and Neuman (2014) low literacy can affect a person's ability to participate effectively in social, economic, and political life. In addition, low literacy can also affect a person's health and well-being, such as difficulties in understanding health information and accessing health services (Zubrick et al., 2015) Ozturk & Ohi (2018) also found that low literacy can affect children's attitudes and interest in reading. Therefore, it is essential to develop literacy early on in children to help them develop the skills necessary to participate effectively in society (Missall et al., 2008)

Several factors can cause low literacy, namely lack of access and opportunities to read and write (UNESCO, 2005), lack (UNESCO, 2005) (Zubrick et al., 2015), lack of practical

learning skills and strategies (Zubrick et al., 2015)(Ozturk & Ohi, 2018)(Wright & Neuman, 2014)(Ozturk & Ohi, 2018), environmental factors such as poverty, family instability, and lack of access to educational resources (Zubrick et al., 2015) All of these factors can have an impact on low literacy in individuals. Therefore, it is important to develop practical learning approaches and strategies to improve literacy in children.

The development of practical learning approaches and strategies for children can also affect the improvement of their literacy skills from an early age (Teale et al., 2020) The storytelling approach, and digital storytelling can be practical in supporting the development of digital literacy and literacy in early childhood, but between the two, the digital storytelling approach shows slight superiority in digital literacy (Maureen et al., 2020)

Some ways that can be done to improve literacy in early childhood are for parents to accompany children to read books regularly (Krcmar & Cingel, 2014), (Krcmar & Cingel, 2014) (Beschorner & Hutchison, 2013)(Beschorner & Hutchison, 2013; Dorouka et al., 2020; Neumann, 2018; Oakley et al., 2020; Roberts et al., 2018; Rogowsky et al., 2018) et al., 2018), improving literacy skills through interaction with applications on tablets (Crescenzi et al., 2014) (Leonard et al., 2016), improving literacy skills through developing teachers' digital skills (Leonard et al., 2016)(Marsh et al., 2018)

Teacher skills are essential in implementing practical learning approaches and strategies to engage children actively and provide attention and feedback (Lamrani & Abdelwahed, 2020). Teachers can apply gamification learning approaches and strategies proven to increase learning motivation, active engagement and learning (Dicheva et al., 2015; Kapp, 2012; Nehring et al., 2018)including literacy-related learning motivations (Janeth & Cano, 2023).

Gamification is the application of game elements in a non-game context by incorporating elements such as rules, challenges, rewards, and social interactions typically found in games into non-gaming situations such as educational, business, or work environments (Baptista & Oliveira, 2019; Kapp, 2012). Gamification has emerged as a pedagogical approach with the potential to enhance young children's motivation, engagement, and literacy outcomes. By embedding game elements such as points, challenges, rewards, and feedback into instructional design, gamification transforms learning experiences into interactive and stimulating processes (Kassymova & Pratama, 2024).

Allee-Herndon et al. (2022) demonstrated that purposeful play within kindergarten classrooms significantly enhanced children's literacy outcomes. Their findings support the integration of play-based approaches with systematic literacy instruction to maximize literacy gains. Rashid (2021) similarly argued that in Bangladesh's government pre-primary classrooms, play-based approaches can support school readiness and academic literacy development despite systemic challenges. Batooli (2018) highlights, the potential of gamification and game-based learning for advancing information literacy and early literacy remains an emerging area.

Although studies such as those by Tassone (2023) underscore the growing emphasis on measurable literacy outcomes in early childhood education, there is still a relative paucity of research providing empirical evidence of how play-based games can yield demonstrable gains in specific literacy skills such as phonological awareness, letter recognition, and early writing. Many existing studies focus on engagement or social outcomes, rather than offering robust, quantitative measures of literacy progress. Most of the literature on the gamification approach has been conducted in Western contexts (e.g., Australia, USA). Therefore, it is very important to research the gamification approach on literacy development in non-Western educational settings, such as Indonesia. The present study seeks to address these gaps by designing and evaluating a structured gamification approach (Looking for Letters, Syllables, and Words) that explicitly targets early literacy abilities.

Gamification has four core elements that contribute to the formation of learning experiences (Kapp, 2012) as in the following table:

Table 1. *Gamification Elements*

Element	Description
Purpose	Set goals to be achieved or challenges to overcome.
Rules of the game	Create rules that govern interactions and give structure to the game.
Feedback	Provide feedback or rewards given to participants as a result of their efforts.
Challenge	Provide challenges to generate a sense of enthusiasm and present an adequate level of difficulty.

Goals that teachers can set using gamification learning approaches and strategies include increasing motivation and engagement (Kapp, 2012; McGonigal, 2016; Chou, 2016) and motivating creativity and problem-solving (Chou, 2016; Schwartz et al., 2023). Based on this description, a goal can be set, namely to increase children's literacy ability as one of the goals of increasing learning and mastery of skills (McGonigal, 2016)

Teachers can arrange game rules according to the choice of game type to improve literacy skills. Some games, such as literacy, improve children's literacy. Game rules are developed by connecting feedback that can be given to the child who completes the game. The feedback teachers can use in a gamification approach is points or scores, levels or levels, awards or medals, and positive feedback. Meanwhile, according to McGonigal, (2016) feedback can be in the form of challenges and missions, mutual successes, and reward schedules. According to Chou (2016) It provides rewards through badges or achievements, level upgrades, and social influence. Meanwhile, according to Werbach (2014), it offers rewards through progression mechanics, reward schedules, and social rewards.

Game rules are combined with providing feedback to provide challenges that can arouse children's learning motivation (Kapp, 2012) including increasing children's motivation in literacy learning (Janeth & Cano, 2023). Rules that can be determined, such as the game's rules, "looking for letters, syllables can help children recognize and name letter symbols. Activities can be packaged as games, such as searching for treasure, being a detective looking for missing letters, or obstacle courses taking word cards. Tools and materials needed include letter toys, syllable cards, and word cards. The game step "looking for letters, syllables and words" in the classroom is carried out in the following way, as in the following table:

Table 2. *Steps Game Play "Looking for Letters, Syllables, and Words"*

Step	Description
Preparation	The teacher provides cards or toys of letters, syllables, and words and then spreads them in several places.
Implementation	The teacher gives instructions to the child to look for certain letters.
Valuation	The teacher invites the child to mention together after the child has successfully found a letter, syllable, or word.

The game steps of “looking for letters, syllables, and words” (Novrani et al., 2021)) when combined with gamification elements (Kapp, 2012) can produce the following game rules:

Table 3. *Game Steps with a Gamification Approach*

Gamification Elements	Description
Set Clear Learning Goals	Set specific, measurable goals for indoor alphabetical search activities. For example, such goals may include recognizing letters of the alphabet, syllables and words.
Create rules according to the game choices, for example: the game “looking for letters, syllables, and words”.	- The teacher provides cards or toys of letters, syllables, and words and then spreads them in several places. - The teacher gives instructions to the child to look for certain letters. - The teacher invites the child to mention together after the child has successfully found a letter, syllable, or word.
Give feedback or rewards as a result of their efforts.	Implement a points system that allows children to earn points when they manage to find hidden letters, syllables and words. These points can be exchanged for small rewards or used as a counter of achievement in learning. The points system can provide additional motivation for children to be active in their quests and increase their engagement.
Provide challenges to generate a sense of enthusiasm and present an adequate level of difficulty	Create challenges that are appropriate to your child's developmental level. Start with easier levels, starting with letters, then looking for syllables and finally looking for words. Gradually, increase the difficulty by mixing the letters in random order or inserting visually similar letters to improve letter identification skills.

By following the rules of this game, teachers can create a fun learning experience through indoor alphabet search. This activity is assumed to improve literacy skills because it can help strengthen children's understanding of letters, syllables, and words, develop reading skills, and identify letters interactively and entertainingly. So, this study will measure the application of gamification learning approaches and strategies in improving early childhood literacy skills.

Method

This study used a pre-experimental research design with a one-group pretest-posttest

design. The study subjects were children aged 5-6 years, totaling 15 people in the kindergarten of PAUD Doa Ibu Makassar, South Sulawesi Province, Indonesia. Data were collected through direct classroom observations, the structured literacy abilities rubric, and analysis of children's written work produced during the gamified activities. Observational data captured children's behavioral engagement and verbal interactions during gameplay, while rubric scores provided quantitative measures of literacy abilities progression. Cross-checking these data sources enabled the researchers to corroborate findings and obtain a more comprehensive understanding of how the gamification approach influenced literacy development. Data analysis techniques use data tabulation and hypothesis testing. The form of research design is as follows:

Tabel 4. *One-Group Pretest-Posttest Design*

Pretest	Perlakuan	Posttest
O1	X	O2

(Sugiyono, 2018)

Keterangan:

X = Application of the gamification approach

O1= Observations are made before application

O2= Observations are made after application

Literacy abilities indicators based on the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 137 of 2014 concerning the National Standards for Early Childhood Education. Literacy abilities indicators are also based on established practices in early literacy assessment (Newman, 2016; Wohlwend, 2008; Allee-Herndon et al., 2022). To enhance content validity, the rubric was reviewed by two early childhood literacy experts as an expert judgment and piloted with a small sample of children before the treatment. Based on their feedback, descriptors were refined to improve observability and alignment with the literacy abilities in early childhood, as follows:

Table 5. *Early Childhood Literacy Assessment Rubric*

No	Indicators	Score			
		1 (Not Yet Developed)	2 (Emerging)	3 (Developing)	4 (Mastery)
1	The child can name the symbols of familiar letters	The child is unable to name the symbols of familiar letters	The child can name the symbols of known letters with adult assistance	The child can name the symbols of letters known independently	The child can name familiar letter symbols fluently and with confidence
2	The child identifies initial letter sounds in objects around them	The child is unable to identify the initial letter sounds of objects around them	The child can identify initial letter sounds of objects around them with adult assistance	The child can identify the initial letter sounds of objects around them independently	The child can identify the initial letter sounds of objects around them fluently and accurately
3	The child can categorize pictures by initial sounds/letters	The child is unable to categorize pictures by initial sounds/letters	The child can categorize pictures by initial sounds/letters with adult assistance	The child can categorize pictures by initial sounds/letters independently	The child can categorize pictures by initial sounds/letters fluently and with confidence
4	The child understands the relationship between letter shapes and sounds	The child is unable to understand the relationship between letter shapes and sounds	The child can understand letter-sound relationships with adult assistance	The child can understand letter-sound relationships independently	The child demonstrates accurate and fluent letter-sound relationships
5	The child can read their name	The child is unable to read their name	The child can read their name with adult assistance	The child can read their name independently	The child can read their name fluently and with confidence
6	The child can write their name	The child is unable to write their name	The child writes their name with adult assistance	The child writes their name independently	The child writes their name fluently and legibly
7	The child understands the meaning of words in stories	The child is unable to understand the meaning of words in stories	The child can understand the meaning of words in the stories with assistance	The child can understand the meaning of words in the stories independently	The child demonstrates fluent and confident understanding of the meaning of words in the stories

Notes:

Score 1: Not Yet Developed

Score 2: Emerging (With Assistance)

Score 3: Developing (Independent)

Score 4: Mastery (Fluent and Confident)

The gamification approach (Looking for Letters, Syllables, and Words) was implemented across six structured learning sessions over three consecutive weeks. Each week included two sessions, scheduled on non-consecutive days to allow for consolidation of learning. Each session lasted approximately 60 minutes, consistent with recommended durations for focused, play-based literacy activities in early childhood settings (Allee-Herndon et al., 2022; Newman, 2016). The session structure followed a progression model in which children were first introduced to target literacy abilities through game-based exploration, followed by scaffolded practice, and concluded with opportunities for reflection and feedback. The three-week duration was selected to ensure sufficient exposure to the game and literacy content, while remaining developmentally appropriate for the attention span and stamina of children aged 5-6 years.

Systematic classroom observations were conducted throughout the six treatment sessions to document children's literacy abilities during gamified play activities. The observations focused on how children engaged with the target aligned to the rubric indicators. For example, for letter naming, observers recorded whether children pointed to or verbally identified familiar letters during the game (Indicator 1). For initial sound identification, children's verbal responses when asked to match letters to object names were documented (Indicator 2). During categorization of pictures by sound/letter, behaviors such as sorting cards or placing objects into labeled categories were noted (Indicator 3). For letter-sound correspondence, observations captured whether children spontaneously linked sounds with written symbols during gameplay (Indicator 4). For reading their name and writing their name, children's attempts to decode or write their name during game prompts were recorded (Indicators 5 and 6). Finally, to assess vocabulary understanding in stories (Indicator 7), children's responses to comprehension questions and discussions during literacy-related storytelling were observed. Observers used structured observation checklists aligned to the rubric, with space for anecdotal notes to capture qualitative nuances of children's performance.

This study was conducted following ethical standards for research involving human participants. Ethical approval was obtained from the Research Ethics Committee of Universitas Negeri Makassar. Before data collection, written informed consent was obtained from the parents or legal guardians of all participating children. Throughout the study, all data collected were treated confidentially.

Result

The pre-intervention observations, in which the teacher implemented the “Looking for Letters, Syllables, and Words” game without the gamification approach, indicated that children's literacy abilities were relatively low. As presented in Table 7, the pretest results showed that the average literacy score of children aged 5-6 years was $(\bar{X}) = 10.7$, which falls within the “low” category. In contrast, during the intervention phase, the teacher applied the same “Looking for Letters, Syllables, and Words” game integrated with the gamification approach. This included the use of structured game elements such as points, levels, feedback, and progressive challenges. Following this treatment, as shown in Table 7. The posttest results demonstrated a substantial improvement in children's literacy abilities. The average literacy score increased to $(\bar{X}) = 16.3$, which corresponds to the “high” category. These results indicate that the gamification-based play approach had a positive and significant effect on improving literacy abilities in early childhood. The observed increase in scores from the “low” to the “high” category highlights the potential of incorporating gamification elements into play-based literacy instruction to enhance early literacy development. Comparison of pretest and posttest data results can be seen in the following diagram:

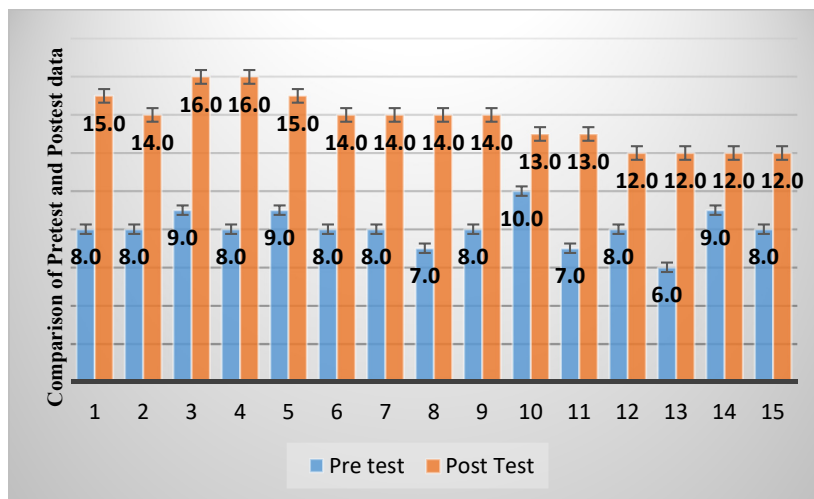


Diagram 1. Comparison of pretest and posttest data

Based on diagram 1. It can be seen that the comparison of children's literacy skills before and after the application of the gamification approach to the game “looking for letters, syllables, and words” as an effort to increase the literacy of children aged 5-6 years. Furthermore, the data obtained will be tested for normality.

Normality Test

A normality test is performed to determine whether the data obtained comes from a normally distributed population or not. The paired *sample t test* normality test uses the Shapiro-Wilk statistic, which is categorized as normal if *Sig.* > 0.05 . Based on the normality test results for data before treatment, *Sig. (2-tailed)* was obtained, which is 0.067, so that it can be concluded that the data is normally distributed, because $0.067 > 0.05$. The normality test after treatment obtained *Sig. (2-tailed)* which is 0.081, so it can be concluded that the data is normally distributed, because $0.081 > 0.05$.

Table 6. *Pretest and Posttest Data Normality Test Results*

Kelompok	Sig. (2-tailed)	Conclusion
<i>Pretest</i>	.067	Normal
<i>Posttest</i>	.081	Normal

Hypothesis Test

After the data meet the normality requirements, hypothesis testing is carried out using t-test statistics on data obtained through observation for pretest and posttest data. The results of this t-test are obtained in the following table:

Table 7. *Hypothesis Test Results with t-Test*

No	Data	Average rating	T _{hitung}	T _{tabel}	Keterangan
1	Pretest	10,7	4,084	2,131	There is a significant influence
2	Pretest	16,3			

The data from the hypothesis test obtained a value of $T_{\text{calculate}} = 4.075$, and because $dk = 15$ with a confidence level of $\alpha = 0.05$, and $T_{\text{table}} = 2.131$. So $T_{\text{calculate}} > T_{\text{table}}$ ($4.084 > 2.131$) means that H_0 is rejected and H_1 is accepted, so it is concluded that there is a significant impact on the application of the gamification approach as a learning strategy on the literacy ability of children aged 5-6 years.

Effectiveness Test

After testing the hypothesis and showing that there is a difference in average scores before and after the application of the gamification approach as a learning strategy in increasing the literacy of children aged 5-6 years. To see the effectiveness of the gamification approach in increasing child literacy, an *N Gain* test was carried out as in table 7 below:

Table 8. *Descriptive Statistics N Gain Score*

	N	Minimum	Maximum	Mean	Std. Deviation
N_Gain_Score	15	.41	1.00	.7188	.18214
N_Gain_Score_Persen	15	41.18	100.00	71.8800	18.21358
Valid N (listwise)	15				

The *Mean* N Gain Score value is 0.7188 based on the division of the *N Gain* score value category in the “high” category with a g range value of $0.7 >$. While the percentage value is 71.8800%, rounded to 72% based on the estimated percentage category, *N Gain* is included in the “quite effective” category with a range of 56-75%. Based on the results of this effectiveness test, it can be concluded that the application of the gamification approach as a learning strategy is “quite effective” in increasing the literacy of children aged 5-6 years.

Discussion

Based on the findings of the study, it proves that the literacy ability of children aged 5-6 years increases quite effectively, this is due to the application of the gamification approach

which is a learning strategy that effectively involves children actively, provides attention, provides feedback (Lamrani & Abdelwahed, 2020). The efforts made by teachers in improving children's literacy so far are through games “looking for letters, syllables, and words” (Novrani et al., 2021) The results of observations made before the application of the gamification approach, found that some children were less enthusiastic in following the game, children were less motivated to follow the flow of the game. This is different from the application of gamification approach as a learning strategy that is proven to increase learning motivation, active involvement in learning (Dicheva et al., 2015; Kapp, 2012; Nehring et al., 2018)

The application of gamification in the game “looking for letters, syllables, and words” begins with the determination of learning objectives. The learning objective that the teacher determines is that children are able to recognize letters of the alphabet, syllables and words. Next, the teacher creates a learning step containing the rules of the game. The learning steps begin with the teacher's activities in providing cards or toys of letters, syllables, and words and then distributing them in several places in the classroom. Next, the teacher gives instructions to the child to look for letters that have been spread before. The cards, letters, syllables and words that the child finds, are mentioned together and pasted on the prepared board. The teacher provides feedback in the form of giving points to the child's success in finding and pasting the letter cards on the word that has one of the missing letters. The teacher does learning by increasing the level of difficulty as in the next level, which is looking for missing syllables to the level of looking for missing words in simple sentences. (Kapp, 2012; Novrani et al., 2021)

Giving feedback to children in the form of points that successfully find missing letters, syllables and words. Points accumulated in a certain amount, can be exchanged for stars. The teacher also prepares a storyboard to record the success of each child containing photos, children's names and the number of stars collected. The child who has the most stars will occupy the top position (Werbach, 2014). Feedback as a learning strategy in the gamification approach in the form of giving points or scores, levels or levels, awards or medals, is proven to motivate children (Kapp, 2012;Novrani et al., 2021)

The challenge given to children in the game is looking for letters, syllables and words,

which is a tiered game design with 3 levels. Level-1 looks for missing letters in words, level-2 looks for missing syllables in one or two words, and level-3 looks for missing words in simple sentences. Each level has 5 letters, syllables and missing words. The success of the child in finding the missing 5 letters will lead the child to level-2 and so on (Chou, 2016; McGonigal, 2016).

The analysis suggests that specific gamification elements played a critical role in fostering children's literacy gains. Immediate feedback was particularly effective in reinforcing correct responses and motivating further participation. The game's clear rules and structured progression helped scaffold children's understanding of literacy concepts. Incremental challenges sustained engagement, prompting children to persist in more complex tasks, such as writing their names or categorizing pictures by sounds. These findings align with previous studies emphasizing the value of responsive feedback and optimal challenge in gamified learning environments (Wohlwend, 2008; Allee-Herndon et al., 2022). Maintaining a balance between structured game elements and the social, intrinsically motivating nature of play was key to the success of this intervention.

These findings are consistent with Aini et al. (2023), who reported significant improvements in phonemic awareness through gamified literacy interventions in Indonesian kindergartens. Similarly, Hewi (2020) and Nirwana (2021) found that integrating play-based and game-based learning fosters literacy motivation and performance in early childhood contexts. The present study contributes to this growing body of evidence by demonstrating how a structured, culturally adapted gamification approach can support early literacy development within the Indonesian early childhood education system.

The application of the gamification approach as a learning strategy in improving the literacy of children aged 5-6 years through the game "looking for letters, syllables and words". Play activities carried out by children are objects of observation of measuring children's literacy skills based on literacy indicators which are part of aspects of language development of children aged 5-6 years contained in the Child Development Achievement Level Standards (Kemendikbud, 2014)

The ability of children to understand the meaning of words in the story can be seen when children correctly carry out the teacher's instructions at the beginning of the game. The child's

ability to name familiar letter symbols, the ability to recognize the sound of the initial letter from the names of objects around him, and the child's ability to understand the relationship between sounds and letter shapes can be seen when the child finds the missing letter and mentions it correctly. The ability of children to name groups of pictures with the same initial sound/letter can be seen when they find the missing letters so that they form several words and then group them according to the initial letter of the same word. Like the letter “j” in the words citrus fruit and guava. The ability of children to read and write their names can be seen when children imitate their respective names on the storyboard, where they attach points and stars that children manage to get (Kapp, 2012; Kemendikbud, 2014; Novrani et al., 2021)

The literacy indicators, which consist of 7 indicators, can all be observed through the game “looking for letters, syllables, and words” by applying a gamification approach as a learning strategy in improving the literacy of children aged 5-6 years. In conclusion, the test results show that applying the gamification approach as a learning strategy has proven to be quite effective in improving the literacy ability of children aged 5-6 years.

Conclusion

Based on the results of the hypothesis test after passing the fulfillment of the normality test, showing the value of $T_{\text{calculate}} (4.084) > T_{\text{table}} (2.131)$ means that H_0 is rejected and H_1 is accepted, so it is concluded that there is a significant impact on the application of the gamification approach as a learning strategy on increasing the literacy ability of children aged 5-6 years. Furthermore, the effectiveness test results with a Mean N Gain Score value of 0.7188 based on the division of the *N Gain score* value category are included in the “high” category with a *g* range value of > 0.7 . While the percentage value is 71.8800%, rounded to 72% based on the estimated percentage category, *N Gain* is included in the “quite effective” category with a range of 56-75%. Based on the results of this effectiveness test, it can be concluded that applying the gamification approach as a learning strategy is “quite effective” in increasing the literacy of children aged 5-6 years. This study indicates that integrating gamification elements such as points, feedback, and progressive challenges into play-based

literacy activities enhances young children's literacy skills and engagement. Consistent implementation through regular sessions offers meaningful opportunities for practicing emerging literacy abilities within a structured yet playful context. However, the study is subject to certain limitations. The relatively small sample size and absence of a control group may constrain the generalizability of the findings and limit the ability to draw definitive causal conclusions. Future research should address these limitations by employing larger, more diverse samples and incorporating controlled experimental designs to strengthen the validity and applicability of the results.

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