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Effectiveness of Gamification-Based Learning Application to Prevent Bullying Behavior in Elementary School

Noer Intan Oktavia[1], Sutarno[2], Khusnul Khotimah[3]
[1, 2, 3] Department of Elementary School Teacher Education, Malang State University, Malang, Indonesia

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ABSTRACT

Purpose of the study: The purpose of this study was to assess the effectiveness of a gamification-based learning application in improving elementary school students' understanding and awareness of bullying prevention

Methodology: A quantitative method using a quasi-experimental one-group pretest and posttest design was used. The study included 49 fifth-grade students from an elementary school in Malang. Data was gathered through pretest and posttest tools consisting of 25 questions. The pretest was administered before the intervention and the posttest after. Data analysis used IBM SPSS Statistics version 26, including normality tests, paired sample t-tests, and N-gain analysis to assess statistical significance and effect size.

Main Findings: The results indicate that there was a significant improvement in students' understanding following the intervention. The average pretest score was 52.33, rising to 87.51 in the posttest. The paired sample t-test produced a significance value of $p < 0.001$, indicating strong effectiveness. Furthermore, the N-gain analysis yielded a value of 0.71 indicated high effectiveness. Therefore, the gamification-based application serves as a valuable educational tool for increasing bullying prevention awareness in elementary schools.

Novelty/Originality of this study: This study provides the first empirical evidence for the effectiveness of a gamification-based mobile application specifically designed to teach bullying prevention to elementary school students. It bridges a critical research gap by quantitatively validating how tailored game mechanics (combines quizzes, mini-games, and role-playing scenarios) enhance comprehension of bullying dynamics and addressing the absence of methodologically rigorous evaluations in context-specific gamified learning for child safety education.

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Corresponding Author:
Khusnul Khotimah,
Department of Elementary School Teacher Education, Faculty of Education, Malang State University,
Jl. Semarang 5, Malang, 65145, Indonesia
Email: khusnul.khotimah.fip@um.ac.id

1. INTRODUCTION

Bullying is a form of repeated violence in the form of physical, verbal, or digital (cyberbullying) aggression motivated by an imbalance of power between the perpetrator and the victim [1]. This behavior generally occurs due to an imbalance of power, where the perpetrator dominates the victim psychologically or physically without resistance [2]. This phenomenon poses a significant challenge in the field of education, particularly at the elementary school level, as it has the potential to hinder students' emotional development, academic performance, and social relationships [3]. Meanwhile, perpetrators may face behavioral issues in the future [4]. The main contributing factors include a discriminatory school environment and insufficient teacher supervision [5]. Bullying

in school settings is often unrecognized or normalized, despite its long-term effects, including the risk of psychological trauma and social withdrawal [6]. Bullying that occurs repeatedly can have a lifelong impact on victims of bullying [7]. One of the real impacts of bullying behavior is the reduced ability of social interaction of bullying victims with the surrounding environment, so that it hampers the learning process at school [8]. In addition, students who are victims of bullying tend to experience anxiety, emotional disturbances, and decreased motivation to learn [9]**.** Ironically, many incidents of violence and bullying in school settings are not taken seriously (visty, 2021)[10]**.** Many schools choose to cover up such cases out of concern that the institution's reputation in the community could be damaged if the case becomes public knowledge [1].

The latest data shows that cases of violence in schools, including bullying, have increased significantly in Indonesia. Based on data from the Indonesian Child Protection Commission (KPAI), around 3,800 bullying cases were recorded in Indonesia throughout 2023. In early 2024, 141 cases were also reported. Of all these complaints, approximately 35 percent occurred within schools or educational institutions [11]. According to data from the Jaringan Pemantau Pendidikan Indonesia (JPPI), during 2024 there were 573 cases of violence in educational settings, a twofold increase compared to 2023. Of these cases, 64% occurred in public schools, with the remainder spread across madrasah and pesantren [12]. Meanwhile, a report by the Forum Serikat Guru Indonesia (FSGI) revealed that from January to September 2024, there were 36 cases of bullying involving 144 student victims. Of the total cases, the highest form of violence was physical (55.5%), followed by other forms of violence such as sexual violence, psychological violence, and policies containing elements of violence [13]. According to the 2024 OECD survey, Indonesia, particularly the Kudus region, is categorized as a country with high bullying rates, with approximately 40% of 15-year-old students involved as victims, perpetrators, or both [14]. This fact highlights that bullying has become a systemic issue requiring serious and measured intervention.

In addition, data from the OECD shows that both perpetrators and victims of bullying generally have lower levels of personal responsibility, emotional control, and self-confidence than other students. They also tend to show low levels of empathy and stress resilience, reinforcing the urgency of implementing learning programs that help build strong social and emotional skills. A safe, inclusive, and supportive school environment is an important prerequisite for creating a learning climate free from violence [14]. However, in some areas with high bullying prevalence, such as Kudus, schools' awareness of the actual conditions is still relatively low, resulting in prevention efforts not being implemented optimally. Bullying also frequently occurs among elementary school students, particularly among male students, with the dominant form being physical violence such as hitting, kicking, or fighting. This behavior typically occurs within school premises, including classrooms, recess periods, and outside classrooms, and is often regarded as normal by school authorities. This dismissive perception allows bullying practices to continue and become an iceberg phenomenon that is difficult to detect in its entirety [15] Therefore, early intervention is needed through an educational approach tailored to the developmental stage and learning needs of elementary school students, namely learning that is visual, interactive, and based on concrete experiences.

One approach that is considered relevant to modern learning is gamification, which is the integration of game elements such as points, quizzes, daily challenges, badges, and interactive materials into the learning process. This approach not only fosters student motivation but also creates a more enjoyable and meaningful learning experience. Earlier research indicates that incorporating gamification into educational settings can boost student encourage positive behavioral patterns [16]**,** enhance learning motivation [17], and improve understanding of the material. Mohammed [18] states that gamification can encourage motivation, engagement, and academic achievement among students, especially if the game elements are tailored to their individual characteristics and social context. Currently, students' learning spaces are no longer limited to physical classrooms but have expanded digitally, enabling access to global information with just one click or voice command [19]. While various studies have developed applications aimed at bullying prevention, most of these applications present limited and repetitive content, emphasizing only the reporting of students' bullying experiences without thoroughly exploring the emotional and social dimensions of the problem [20].

A relevant study that measures how effective of gamification-based learning media is titled "The Effectiveness of the Stop Bullying Educational Game in Increasing Anti-Bullying Awareness Among Elementary School Children Using Construct 2 and the MDLC Method," which shows that gamified learning media such as bullying simulation quizzes are effective in enhancing students' awareness and understanding of bullying behavior [21]. This is reinforced by the findings titled "Gamified interactive e-books for bullying prevention: enhancing knowledge and motivation in Chinese primary schools," which show that using gamified interactive e-books is much better than regular lectures at helping primary school students in China learn about and stay motivated to understand bullying issues. The GIEB group achieved a higher average score (24.103) compared to the lecture group (20.753), with $F = 63.530$, $p < 0.001$, $\eta^2 = 0.527$, indicating the positive impact of the gamification approach on students' social-emotional learning [22]. While these studies provide valuable contributions, their scope remains limited to certain formats, such as e-books and simulation quizzes, and within specific cultural contexts. Furthermore, research evaluating gamification applications that incorporate a comprehensive set of game mechanics, consisting of interactive quizzes, mini-games, and role-playing scenarios, specifically designed for

bullying prevention in Indonesian elementary schools is still scarce. Consequently, the effectiveness of such applications within Indonesia's unique sociocultural and educational context has not yet been empirically verified.

This study seeks to address this gap by introducing and evaluating a gamification-based mobile application specifically designed for Indonesian elementary school students. The application, named UNIGUARD, features learning materials, interactive daily quizzes, role-playing simulations of bullying scenarios, and mini-games that are contextually aligned with students' school experiences to teach bullying prevention. The urgency of this research stems from the lack of prior studies that empirically examine the effectiveness of culturally and contextually adapted gamified applications for bullying prevention in Indonesia. While school bullying rates remain high and existing programs have yet to fully engage digital-native students, no research to date has specifically tested the effectiveness of the UNIGUARD application in enhancing students' understanding and awareness of bullying prevention. By assessing its impact, this study makes an original contribution to the development and implementation of gamified learning interventions for child safety in a largely unexplored area of educational research. Based on this, the researchers conducted a study on "Effectiveness of Gamification-Based Learning Applications to Prevent Bullying Behavior in Elementary Schools" with the aim of assessing the effectiveness of gamification-based learning applications in improving elementary school students' understanding of the concept and prevention of bullying behavior. This study uses a quantitative approach with a quasi-experimental one-group pretest-posttest design, employing pre- and post-intervention understanding tests as instruments. This study provides empirical evidence on the effectiveness of gamification-based media in character education, specifically in bullying prevention, thereby enriching the literature on educational technology applications in Indonesian primary school contexts.

2. RESEARCH METHOD

2.1. Research type and design

This study used a quasi-experimental quantitative approach and involved one group that was tested before and after the intervention [23]. The design used in this study can be seen in Table 1.

Table 1. Research Design One Group Pretest-Posttest

Pre-test	Treatment	Post-test
O_1	X	O_2

The design in this study allows researchers to measure the effectiveness of gamification-based learning application interventions by comparing pretest (before intervention) and posttest (after intervention) results in the same group. The score disparity between the two assessments is examined to evaluate the impact of the intervention on students' comprehension of bullying prevention.

2.2. Population and sample

The population in this study encompassed all fifth-grade students at an elementary school in Malang, totaling 49 students. The sampling technique applied in this study was saturated sampling [23], where the whole of the population was selected as a sample given given the homogeneous characteristics of the group (uniform age and education level) and the manageable population size.

2.3. Validity and reliability test

In this study, the validity of the test items was tested using the Pearson Bivariate Correlation technique through the IBM SPSS Statistics version 26 program, taking into account all student responses. An item was considered valid if the Sig. (2-tailed) value was less than 0.05 [24]. Items that met the validity criteria were then tested for reliability using the Cronbach's Alpha method. The test instrument was considered to have high reliability if the Cronbach's Alpha value was above 0.70 [25].

Table 2. Cronbach's Alpha Reliability Classification

Cronbach's alpha value range	Reliability qualification
> 0.90	Very high
0,70 – 0,90	High
0,50 – 0,70	Fair
< 0,50	Low

2.4. Data collection technique

Data was collected through written tests, specifically pre-tests and post-tests, designed to assess the extent to which students understood bullying prevention. The procedure began with a pre-test to assess initial

understanding, followed by a gamification-based intervention in one learning session, and ended with a post-test to measure final understanding after the intervention. The test instruments consist of multiple-choice questions, matching questions, and true-false questions that have been validated by pedagogical experts, with content covering the identification of bullying behaviors and preventive response strategies.

2.5. Data analysis technique

Researchers conducted data analysis through three fundamental stages. The first stage was a prerequisite test in the form of a Kolmogorov-Smirnov normality test ($\alpha = 0.05$), which was a prerequisite test before conducting a hypothesis test. In accordance with the requirements of the Paired sample t-test, the assumption of normality is applied to the distribution of score differences (posttest - pretest), not to individual scores [26]. The second stage is hypothesis testing through statistical testing using the Paired sample t-test if the data meets the assumption of normality, with the Wilcoxon Signed-Rank Test as an alternative for non-normal data. The third stage involves the N-gain test, which evaluates how effective the gamification-based learning app is by comparing the results from the pretest and posttest. The criteria for the effectiveness of this medium refer to the N-gain standards proposed by Meltzer [27] as shown in Table 3. All analyses were processed using IBM SPSS Statistics software version 26 for Windows.

Table 3. Standard Indikator of N-gain Criteria

N-gain	Criteria
0,7 ≤ N-gain ≤ 1	High
0,3 ≤ N-gain ≤ 0,7	Medium
N-gain < 0,3	Low

Several hypotheses formulated in this study are as follows:

H_0: There was no significant difference in students' understanding of bullying prevention before and after the implementation of gamification-based learning applications.

H_1: There was a significant difference in students' understanding of bullying prevention before and after the implementation of gamification-based learning applications.

3. RESULTS AND DISCUSSION

3.1. Results

This study applied a quasi-experimental design, specifically a one-group pretest-posttest approach. The purpose was to measure the effect of using gamification-based learning applications on students' understanding of bullying prevention by comparing pretest and posttest results. The study involved 49 students as research subjects.

Before testing the effectiveness of the gamification-based learning application, the researcher first ensured the quality of the test instruments through validity and reliability tests. The validity test was conducted on 50 questions, including multiple choice, pairing, and right-wrong questions, involving 28 fifth-grade students at SDN Sawojajar 1 Malang. The results of the analysis using the Pearson Bivariate Correlation technique are presented in Table 4.

Table 4. Standard Indikator of N-gain Criteria

Question Item	Pearson Correlation	Sig. Value	Conclusion
1	a	0,00	-
2	a	0,00	-
3	a	0,00	-
4	0,355	0,064	Invalid
5	-0,131	0,508	Invalid
6	0,067	0,735	Invalid
7	0,592**	<0,001	Valid
8	a	0,00	-
9	a	0,00	-
10	0,490**	0,008	Valid
11	0,571**	0,002	Valid
12	0,571**	0,002	Valid
13	0,571**	0,002	Valid
14	a	0,00	-
15	0,490**	0,008	Valid

16	0,197	0,315	Invalid
17	0,571**	0,002	Valid
18	0,260	0,181	Invalid
19	0,421*	0,025	Valid
20	0,332	0,084	Invalid
21	0,510**	0,006	Valid
22	0,523**	0,004	Valid
23	0,213	0,277	Invalid
24	0,471*	0,011	Valid
25	0,633**	<0,001	Valid
26	0,334	0,082	Invalid
27	0,528**	0,004	Valid
28	0,340	0,077	Invalid
29	0,734**	<0,001	Valid
30	0,370	0,052	Invalid
31	0,549**	0,002	Valid
32	0,555**	0,002	Valid
33	0,582**	0,001	Valid
34	0,712**	<0,001	Valid
35	0,560**	0,002	Valid
36	0,230	0,240	Invalid
37	0,584**	0,001	Valid
38	0,712**	<0,001	Valid
39	0,424*	0,025	Valid
40	0,499**	0,007	Valid
41	0,293	0,130	Invalid
42	0,376*	0,049	Valid
43	0,532**	0,004	Valid
44	0,080	0,687	Invalid
45	0,783**	<0,001	Valid
46	0,305	0,115	Invalid
47	0,474*	0,011	Valid
48	0,783**	<0,001	Valid
49	0,279	0,150	Invalid
50	0,226	0,226	Invalid

The validity test results showed that 28 items were valid and could be tested for reliability using Cronbach's Alpha method, as presented in Table 5.

Table 5. Reliable Analytics

Cronbach’s Alpha	N of Items
0,9192	28

The test results showed a reliability value of 0.919 with 28 items analyzed, indicating a very high level of reliability. According to Sugiyono, an instrument is considered to have high reliability if its Cronbach’s alpha coefficient exceeds 0.70 [28]. Therefore, the measuring instrument used in this study was deemed feasible and valid for measuring students' understanding of bullying prevention.

After ensuring that the measurement instruments have met the validity and reliability requirements, the next step is to analyze the pretest and posttest results to evaluate the effectiveness of the gamification-based learning application. This level of effectiveness is evaluated through quantitative descriptive analysis of students' comprehension scores before and after the intervention. This analytical procedure examines the increase in conceptual understanding of bullying prevention post-intervention, with the comparative results presented in full in Table 6.

Table 6. Descriptive Pretest and Posttest Results

Data Type	N	Min	Max	Average
Pretest	49	24	76	52,33

Posttest	49	72	100	87,51

Based on the descriptive statistical data presented in Table 6, the average pretest score obtained by students was 52.33, with a maximum score of 76 and a minimum score of 24. Meanwhile, the average posttest score showed a significant increase to 87.51, with a maximum score of 100 and a minimum score of 72. Based on the data, the minimum score increased by 48 points from the pretest to the posttest, the maximum score rose by 24 points, and the average score improved by 35.18 points. These results clearly show a significant improvement in students' understanding of bullying prevention after the implementation of the gamification-based application.

In quantitative research, normality testing is a prerequisite that must be met before performing a paired t-test, given that the paired t-test is a parametric statistic that requires normally distributed data [26]. Research data can be considered to follow a normal distribution when the obtained significance value exceeds 0.05. Conversely, if the significance value falls below 0.05, the data is categorized as not normally distributed. In this research, the assessment of data normality was conducted utilizing the Kolmogorov-Smirnov test processed through SPSS software version 26 for Windows. The results of the normality test analysis are presented in Table 7.

Table 7. Kolmogorov Smirnov Normality Test

Data Type	Statistic	df	Sig.
Pretest	.108	49	.200*
Posttest	.124	49	.056

Based on Table 7, the Kolmogorov Smirnov normality test shows a normal distribution in all data. The calculation results show a pretest significance value of 0.200 ($p > 0.05$) and a posttest significance value of 0.056 ($p > 0.05$). Considering the normality criteria where the significance value is greater than α ($\alpha = 0.05$), it can be determined that both data sets meet the assumption of normal distribution.

After the assumption of normal distribution is met, statistical analysis is continued with a Paired Sample T-Test. This test is used to compare the average values of the same group under two different measurement conditions, specifically before and after an intervention. This procedure tests the significance of the difference through the p-value (Sig. 2-tailed) with a critical limit of $\alpha = 0.05$. If the Sig. (2-tailed) value is ≥ 0.05, this shows that there is not a big difference between the scores before and after the test (failure to reject H_0). Conversely, if the Sig. (2-tailed) value is less than 0.05, it signifies a statistically significant difference between the two sets of measurements (rejection of H_0). The outcome of the paired sample t-test analysis is displayed in Table 8.

Table 8. Paired Sample T-Test

Description	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pretest and Posttest	-35.184	16.753	-14.701	48	.000

Based on the results of the paired sample t-test analysis that has been conducted, the significance value (2-tailed) is 0.000. According to the decision-making criteria, if the significance value is below 0.05, the test results are considered significant. Therefore, H_0 is rejected and H_1 is accepted. Thus, gamification-based learning applications are effective in preventing bullying behavior in elementary schools. The difference in the mean between the pretest and posttest, as shown in the mean column, is -39.510. To complete the effectiveness analysis, the next step is to calculate the N-gain for each student based on their pretest and posttest scores. The N-gain criteria results are presented in Table 9.

Table 9. Reliability Statistics

Data Type	Average N-gain	Category
Pretest and Posttest values	.71000	High

Based on Table 9, which shows the N-gain scores for each student, the average N-gain was 0.71. This value falls into the high category according to Meltzer's criteria presented in Table 3. This shows that gamification-based learning applications are very effective in improving students' understanding of bullying.

3.2. Discussion

This study shows that using gamification-based learning apps greatly helps students better understand key concepts and learn how to prevent bullying in elementary schools. This is reflected in the increase in the average pretest score from 52.33 to 87.51 on the posttest, with a difference of 35.18 points and a significance level of $p < 0.001$ based on the paired sample t-test. Additionally, the average N-gain value of 0.71 falls into the high category according to Meltzer's classification, indicating the effectiveness of the educational intervention provided. These findings reinforce that innovative learning approaches such as gamification can effectively shape

students' conceptual understanding and affective responses in the context of social issues such as bullying. The results of this study align with constructivist learning theory, which highlights the importance of students actively engaging in learning through real-life experiences and social interaction to develop meaningful understanding [29]. In this context, the gamification application developed offers an interactive learning experience through features such as material modules, daily quizzes, role-playing simulations, and mini-games, which collectively strengthen students' cognitive and affective dimensions. As a result, students not only passively acquire knowledge but also participate in decision-making processes through scenarios resembling real-life situations in the school environment.

Several previous studies have shown results consistent with these findings. Yulianti [30] and Muzanni [31] suggest that using gamification in learning materials can greatly boost students' interest and involvement. Elements such as challenges, rewards, and a healthy competitive atmosphere encourage students to be more actively involved in the learning process. These findings also address the urgency of gamification research at the elementary level, which remains limited [18]. This study not only reinforces these results but also reveals that the role-playing feature incorporated into the application plays an important role in enhancing students' empathy and ability to respond appropriately to bullying situations [32]. Muthoharoh states that the effectiveness of educational games in preventing bullying can be enhanced through a role-playing approach, where players take on the roles of victims, perpetrators, or witnesses in bullying situations. Through realistic simulations, players can understand the social and emotional impacts of such actions. Effectively designed games also need to provide clear feedback on each player's response, making learning more reflective and meaningful. This emphasis on the affective aspect is a key advantage that distinguishes the application in this study from previous gamification approaches [33].

Similar research developing educational applications for bullying prevention also shows consistent results. A study by Heryani et al. showed that using applications is more effective than printed materials in preventing bullying among elementary school students in Jambi City, with a p-value of 0. 000 [34]. A similar study by Agustini developed classical guidance media based on the Lectora Inspire application and found that although students understood the term bullying, they still needed further study of the material to be able to respond appropriately to bullying situations. The app presents interactive content such as videos, materials, attitude surveys, reflections, and evaluative quizzes, which significantly improved students' understanding. Statistical tests showed a significance value of 0.000 (< 0.05), indicating that the media is effective in reducing bullying behavior in the school environment [35]. In line with this, Lisabe's research shows that the SafeClick app is effective in improving teenagers' understanding of cyberbullying issues, with an average score increase of 35% after intervention. This app integrates interactive features such as case simulations, mini-games, and quizzes, which not only strengthen cognitive aspects but also build empathy and digital ethics awareness. These findings confirm that educational approaches that are visual, interactive, and mobile-based are highly relevant and effective for the digital generation [36]. Support also comes from Pamungkas' research, which developed the Stop Bullying app for fifth-grade students at SD Negeri Karangwaru 2 Sragen. The app includes prevention materials, educational videos, puzzle games, quizzes, and a bullying incident reporting feature. The results showed a decrease in students' bullying tendency scores from 2.615 to 2.333, indicating that the app is effective in reducing bullying behavior and encouraging students to be more caring toward others [37]. All these findings underscore that interactive digital approaches have significant potential in shaping students' understanding and positive attitudes toward bullying issues, aligning with the approach developed in this study.

The effectiveness of educational media in preventing bullying behavior at the elementary school level is also reflected in various previous studies. Sekarjene developed character-based digital comic media and found an increase in student comprehension scores from 57 to 77, with an N-gain value of 0.57, which is considered quite effective. This media not only improves academic performance but also plays a role in decreasing bullying incidents among fifth-grade elementary students [38]. Meanwhile, Fajriati demonstrated that the sustained use of audiovisual media in the learning process leads to positive changes in students' communication behavior. Through reflective video viewing, students began to recognize forms of bullying behavior that were previously considered normal and demonstrated an increase in social awareness in their interactions [39]. Another study by Makatenni presented the Molly-Polly learning media, designed to enhance students' knowledge and affection regarding bullying. Tests using paired sample t-tests produced a significance value of 0.000, confirming that the media was effective in shaping anti-bullying behavior [40]. Although all of these studies showed positive results, most of the approaches were still limited to the delivery of information or passive visualization. In this regard, the gamification application in this study offers advantages by integrating features such as materials, quizzes, and role-playing simulations, enabling students to actively engage in virtual situations resembling the real world. This approach not only strengthens conceptual understanding but also fosters empathy, social awareness, and decision-making skills in real-world contexts.

In conclusion, the findings of this study not only confirm the effectiveness of the gamification approach in improving students' understanding of bullying issues, but also plays an important role in advancing the design of technology-integrated learning models for elementary education. The integration of role-playing features in the developed application expands the scope of the gamification approach from merely increasing learning motivation

to an educational tool that shapes students' social-emotional understanding and empathy. This marks a shift from information-based media to social experience-based media. Additionally, this research fills a gap in the literature, which has traditionally focused more on the effectiveness of gamification at the secondary and higher education levels. Therefore, this gamification-based learning application not only serves as an instructional medium but also as a preventive character-building tool against bullying behavior. These findings open up opportunities for the development of technology-based educational platforms that are more responsive to the social and emotional challenges faced by elementary school-aged children, and emphasize the importance of innovative learning design that focuses on active and meaningful learning experiences.

The findings of this study provide tangible benefits for the school environment. This application has the potential to be adopted as part of an anti-bullying curriculum to build early awareness among students. Schools can integrate it into thematic learning activities, guidance and counseling programs, or extracurricular sessions. For teachers, the application serves as an engaging and effective tool for teaching bullying prevention without relying solely on conventional lecture-based methods. Nevertheless, this study has several limitations. First, participants were drawn from only one elementary school in Malang, which limits the generalizability of the findings. Second, the relatively short duration of the intervention did not allow for the assessment of long-term impacts. Third, the evaluation of effectiveness focused exclusively on cognitive aspects through comprehension tests and did not include direct observations of behavioral changes in the school environment. Future research is recommended to: (1) involve a larger and more diverse sample of schools, (2) implement longer-term interventions to examine the sustainability of the effects, and (3) combine quantitative data with qualitative methods, such as observations and interviews, to provide a more holistic evaluation of behavioral changes. Overall, these findings open opportunities for the development of technology-based educational platforms that are more responsive to the socio-emotional challenges faced by elementary school children.

4. CONCLUSION

This study concludes that gamification-based learning applications have a significant impact on improving elementary school students' understanding of bullying prevention. This is demonstrated by a significant increase in students' comprehension scores between the pretest and posttest, as well as high N-gain values. These findings indicate that the gamification approach, particularly through interactive features such as role-playing simulations, quizzes, and mini-games, can facilitate learning that is not only cognitive but also shapes students' social awareness and affective responses to bullying behavior. This effectiveness aligns with the constructivist approach, which emphasizes the importance of active student participation in constructing meaning through contextual and reflective learning experiences.

In addition to providing practical contributions to the development of digital learning media that is responsive to social issues, this study also expands the literature on the effectiveness of gamification at the elementary school level, which was previously limited. However, several limitations should be acknowledged. First, the quasi-experimental design (one-group pretest-posttest) without a control group limits causal inference. Second, the sample was restricted to 49 students from one elementary school in Malang, reducing generalizability. Third, the intervention period was insufficient to evaluate long-term behavioral changes. Fourth, reliance on test scores overlooked behavioral and qualitative dimensions of learning. Finally, platforms that are only available on devices may exclude schools that do not have adequate equipment. Therefore, future research should: (1) employ controlled experimental designs to strengthen validity; (2) expand sampling across diverse regions and school types; (3) conduct longitudinal studies to track sustained impact on prosocial behavior; (4) adopt mixed-method approaches, including observations and interviews, to capture affective and behavioral outcomes more comprehensively; and (5) develop multi-platform versions, such as web-based applications, to increase accessibility. Such advances will deepen our understanding of gamification's role in sustainably fostering students' social-emotional competencies.

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