Salud, Ciencia y Tecnología. 2025; 5:2200
doi: 10.56294/saludcyt20252200

ORIGINAL

Embedding MOMA Digital Learning Media in a Game-Based Learning Framework to Enhance Financial Literacy of Vocational Students

Integración de Medios de Aprendizaje Digital MOMA en un Marco de Aprendizaje Basado en Juegos para Mejorar la Alfabetización Financiera de Estudiantes de Formación Profesional

Agatha Saputri[1], Edi Purwanta[1], Siswanto Siswanto[1]

[1]Accounting Education, Faculty of Economics and Business, Universitas Negeri Yogyakarta. Yogyakarta, Indonesia

Cite as: Saputri A, Purwanta E, Siswanto S. Embedding MOMA Digital Learning Media in a Game-Based Learning Framework to Enhance Financial Literacy of Vocational Students. Salud, Ciencia y Tecnología. 2025; 5:2200. https://doi.org/10.56294/saludcyt20252200

Submitted: 29-04-2025 **Revised:** 25-07-2025 **Accepted:** 13-09-2025 **Published:** 14-09-2025

Editor: Prof. Dr. William Castillo-González

Corresponding author: Agatha Saputri

ABSTRACT

Introduction: financial literacy the ability to manage personal finances is crucial, yet Indonesia's rate remains low, particularly among vocational high school (SMK) students who struggle with budget control and saving. Conventional teaching methods rarely enlace theory to practice, highlighting the need for innovation Game-Based Learning provides a solution through simulations that let students make financial decisions safely. This study introduces MOMA (Money Management), a digital tool that integrates gamification and experiential learning to strengthen financial knowledge and habits.
Method: this study applied a quantitative Pre-Experimental One Group Pretest–Posttest Design involving 632 students from six vocational high schools (SMK) in Yogyakarta province. The independent variable was the learning method (MOMA-based Game-Based Learning compared with conventional methods), while the dependent variable was financial literacy. A pretest measured initial literacy, followed by treatment in experimental classes using MOMA and control classes with traditional methods, and a posttest assessed improvement.
Results: the results showed an overview of students' financial literacy levels based on the analysis of their overall scores. The mean score indicated that most students were at a moderate level of financial literacy, suggesting that they possessed a basic understanding of financial concepts but still lacked depth in certain areas such as investment management and long-term financial planning. The standard deviation value demonstrated a relatively small spread of scores, indicating that most students' performance was clustered around the mean. This consistency reflects a relatively uniform level of financial literacy across the sample, although variations were still observed among individuals.
Conclusions: the MOMA game-based learning approach effectively enhanced students' financial literacy by providing engaging and interactive learning experiences.

Keywords: Game-Based Learning; Financial Literacy; MOMA Games; Student Engagement; Educational Innovation.

RESUMEN

Introducción: la alfabetización financiera la capacidad de gestionar las finanzas personales— es fundamental, aunque la tasa en Indonesia sigue siendo baja, en particular entre los estudiantes de escuelas secundarias vocacionales (SMK), quienes enfrentan dificultades en el control del presupuesto y el ahorro. Los métodos de enseñanza convencionales rara vez vinculan la teoría con la práctica, lo que resalta la necesidad de innovación. *Game-Based Learning* ofrece una solución mediante simulaciones que permiten a los estudiantes tomar decisiones financieras en un entorno seguro. Este estudio presenta MOMA (*Money Management*),

una herramienta digital que integra la gamificación y el aprendizaje experiencial para fortalecer los conocimientos y los hábitos financieros.
Método: este estudio aplicó un diseño cuantitativo Pre-Experimental *One Group Pretest-Posttest* con la participación de 632 estudiantes de seis escuelas secundarias vocacionales (SMK) en provincia de Yogyakarta. La variable independiente fue el método de enseñanza (Game-Based Learning con MOMA comparado con métodos convencionales), mientras que la variable dependiente fue la alfabetización financiera. Se aplicó una prueba inicial (*pretest*) para medir el nivel de alfabetización, seguida por un tratamiento en clases experimentales con MOMA y clases de control con métodos tradicionales, y finalmente una prueba posterior (*posttest*) para evaluar la mejora.
Resultados: los resultados mostraron un panorama del nivel de alfabetización financiera de los estudiantes a partir del análisis de sus puntajes globales. La media indicó que la mayoría de los estudiantes se encontraba en un nivel moderado de alfabetización financiera, lo que sugiere que poseían una comprensión básica de los conceptos financieros, aunque con carencias en áreas como la gestión de inversiones y la planificación financiera a largo plazo. El valor de la desviación estándar reflejó una dispersión relativamente pequeña de los puntajes, lo que indica que la mayoría de los desempeños se concentraban en torno a la media. Esta consistencia refleja un nivel relativamente uniforme de alfabetización financiera en la muestra, aunque todavía se observaron variaciones individuales.
Conclusiones: el enfoque de aprendizaje basado en juegos MOMA mejoró eficazmente la alfabetización financiera de los estudiantes al ofrecer experiencias de aprendizaje interactivas y atractivas.

Palabras clave: Aprendizaje Basado en Juegos; Alfabetización Financiera; Juego MOMA; Participación Estudiantil; Innovación Educativa.

INTRODUCTION

Financial literacy is the cognitive and affective capacity to understand and manage personal finances intelligently, enabling individuals to make informed financial decisions.[1]. Beyond the individual level, financial literacy, understood as the capacity to manage personal finances, has become an essential competency in today's globalized and complex economy.[2] International surveys consistently demonstrate that individuals with stronger financial literacy skills make better financial decisions, such as saving for emergencies, managing debt, and planning for retirement, while those with lower skills are more vulnerable to financial instability. Institutions such as the Organisation for Economic Co-operation and Development (OECD) and the World Bank have emphasized financial literacy as a key determinant of both personal and national economic resilience.[3] Despite its importance, financial literacy levels worldwide remain below expectations. Studies conducted in Europe, North America, and Asia reveal that young people in particular often display only a basic understanding of financial concepts[4] with significant gaps in investment management and long-term financial planning. In Southeast Asia, similar trends are evident. Countries such as Malaysia, Thailand, and the Philippines report moderate levels of financial literacy among youth, while gaps between urban and rural populations persist.[5]

In Indonesia, the situation is even more pressing. Data from the Financial Services Authority (OJK) show that the national financial literacy index[6] although gradually increasing over the past decade, remains relatively low compared to neighboring countries. This gap is especially visible among younger populations, Indonesia's financial literacy rate has only reached 38,03 % vocational high school (SMK) students, who often struggle with managing budgets[7] practicing saving habits, and avoiding excessive spending. Historically, financial education in Indonesian schools has relied on traditional, theory-based instruction, which has not sufficiently prepared students to face real-world financial challenges.

The situation is particularly concerning in vocational education institutions such as SMK, which are designed to prepare students for employment and economic Independence.[8] Students in vocational schools,[9] especially those in accounting and finance programs, are expected not only to understand financial concepts theoretically but also to possess the skills to apply these concepts effectively in real-life contexts.[10] In reality[11] several studies have shown that SMK students still face difficulties in grasping and implementing basic principles of personal financial management. This is partly attributed to the predominance of conventional teaching methods that emphasize rote memorization over meaningful, experiential, and application-oriented learning. [12] Consequently, there is an urgent need to adopt more innovative, interactive, and contextually relevant learning strategies that can bridge the gap between theoretical knowledge and practical financial skills for vocational students.

To address this issue, a more innovative, interactive[13] and contextual learning approach is required. One instructional strategy considered highly effective is *Game-Based Learning* (GBL).[14] GBL is a pedagogical approach that integrates the principles and mechanics of games into the teaching and learning process to

enhance student motivation, engagement, and comprehension.[15] In the context of financial literacy, GBL provides students with opportunities to practice financial decision-making through simulations that closely resemble real-world scenarios, allowing them to learn from the consequences of their choices without facing actual risks. By creating a safe and engaging environment, GBL helps bridge the gap between theoretical knowledge and practical application, making the learning experience both meaningful and enjoyable.[16]

Numerous studies have demonstrated the effectiveness of GBL in enhancing students' financial literacy.[17] Research has shown that the use of financial simulation games can significantly improve students' understanding and skills in managing money.[18] For example, implementing business and accounting-related game simulations has been found to not only strengthen financial knowledge but also foster entrepreneurial motivation. Similar findings have emerged from studies on generation Z is unique as digital natives who prefer interactive, practical, and technology-driven learning experiences compared to previous generations. Studies show that business and accounting-related game simulations not only strengthen their financial knowledge but also foster entrepreneurial motivation, demonstrating the potential of Game-Based Learning to transform conventional financial education into an engaging and impactful process,[9] where game-based approaches have proven effective in developing financial competence through active participation in simulated economic environments. These studies suggest that GBL has the potential to transform conventional financial education into an immersive and impactful learning experience.

In this context, the development and integration of simulation-based digital learning media, such as MOMA (*Money Management*), become particularly relevant. MOMA is an interactive digital learning tool designed to simulate personal financial management activities, including budgeting,[19] expense tracking, and financial evaluation.[20] By engaging students in realistic financial tasks,[13] MOMA encourages critical thinking, problem-solving, and responsible money management habits. Its interactive design allows students to experiment with financial strategies, experience potential outcomes, and reflect on the effectiveness of their decisions all within a safe and controlled learning environment.[21]

What makes MOMA especially powerful is its unique integration of visual elements, interactivity,[22] and real-life case-based scenarios, which together create a rich and engaging learning environment. These combined features not only make the learning process more enjoyable and motivating but also ensure that students acquire practical and transferable skills that they can effectively apply beyond the classroom in both personal and professional contexts.[23] By embedding MOMA into a Game-Based Learning (GBL) framework,[24] educators provide students particularly those in vocational schools with a dynamic, experiential, and practice-oriented approach to financial education that bridges theoretical concepts with real-world applications. This integration supports the development of cognitive understanding while simultaneously nurturing affective and behavioural competencies, such as critical thinking, decision-making, and financial responsibility,[25] which are increasingly essential for navigating today's complex and uncertain financial landscapes.[26] Moreover, MOMA empowers learners to actively participate in simulated financial scenarios that mirror real-life challenges, enabling them to build confidence, resilience, and adaptability as they prepare for future careers and everyday financial responsibilities.

The integration of MOMA into a Game-Based Learning (GBL) framework enables students to go beyond mere cognitive learning and actively engage in financial decision-making processes within scenarios that closely resemble real-world situations.[27] Through game-based learning activities, students are encouraged to design budgets, manage income, make simple investments, and experience the consequences of each decision they take. This approach not only strengthens conceptual understanding but also cultivates responsible habits and attitudes toward personal financial management.[28] By combining theoretical knowledge with experiential practice, MOMA within GBL bridges the gap between knowing and doing an essential step for effective financial education.

MOMA is an interactive digital learning medium that allows users to create budgets, record transactions,[29] and simulate financial decisions in real time[20]. This approach is comparable to well-established economic simulation games, such as MonsoonSIM, which have been shown to be effective in improving students' business and financial literacy. MOMA incorporates gamification elements,[30] including point systems, instant feedback, and progress visualization, which align with proven gamification design principles supported by scientific taxonomies. By integrating these mechanics, MOMA creates a dynamic learning environment that sustains student engagement while reinforcing critical financial concepts. Moreover, the platform does not merely emphasize rote memorization of financial theories, but instead promotes experiential learning where learners actively participate in decision-making processes, analyze consequences, and refine their strategies based on outcomes. Such an approach encourages critical thinking, problem-solving, and adaptive learning, making financial education more relevant, practical, and applicable to real-life contexts where financial decisions are often complex and multifaceted.[31]

The instructional design of MOMA also aligns closely with the principles of *experiential learning* outlined, which emphasize learning through direct, meaningful, and reflective experience.[32] Within this framework,

students learn not only by receiving information but also by actively applying it in practice,[33] reflecting on the outcomes, and adjusting their strategies. For vocational education contexts particularly in *Sekolah Menengah Kejuruan* (SMK) simulation-based learning is especially well suited, as SMK students are typically oriented toward hands-on practice and real-world skill application. By enabling students to engage in realistic financial tasks, MOMA fosters deeper learning and prepares them for the financial challenges of adult life.

This approach is also consistent with the directives of Indonesia's Ministry of Education, Culture,[34] Research, and Technology (*Kemendikbudristek*) on transforming vocational education. Current policy emphasizes strengthening not only technical competencies but also *soft skills* and *life skills*,[35] including financial competence, adaptability, and problem-solving. As part of this vision, vocational graduates are expected to be equipped with the capacity to make informed financial decisions skills that are increasingly vital in today's complex, digital-driven economy.[36] MOMA, when embedded within a GBL framework, offers a scalable and replicable method to achieve these policy objectives.

Students in SMK, particularly those in accounting and finance programs,[37] tend to be more responsive to interactive learning media that are contextually aligned with current workplace realities. Vocational entrepreneurship education has already been recognized as a driver of students' preparedness for the Fourth Industrial Revolution, which demands not only technical knowledge but also adaptive and innovative thinking.[38] Implementing MOMA in a GBL environment aligns directly with the needs of vocational schools to provide students with practical financial skills that extend beyond theoretical understanding, ensuring they can navigate both personal and professional financial challenges effectively.

Given the low levels of financial literacy among SMK students, the limitations of conventional instructional approaches, and the promising potential of digital learning media within a GBL context,[39] there is a clear need for an innovative pedagogical solution that integrates these three dimensions. MOMA offers a powerful blend of financial simulation, gamification, and contextualized learning that can address these challenges. By offering both cognitive and behavioural financial training, it represents an evolution from traditional accounting instruction toward a more comprehensive financial education model.

Despite the growing global interest in game-based financial education, there remains a scarcity of research in Indonesia that directly examines the impact of digital learning media on improving financial literacy among SMK students.[40] This gap underscores the importance of developing and testing a pedagogical model that is both contextually relevant and empirically validated. MOMA's design and implementation within a GBL framework provides an opportunity to contribute to this underexplored area of research while offering practical solutions for vocational educators.[41]

Therefore, the justification of this study lies in addressing Indonesia's urgent need to improve youth financial literacy through innovative pedagogical methods aligned with international best practices. The objective of this study is to examine the effectiveness of the MOMA-based Game-Based Learning approach in improving the financial literacy of vocational high school (SMK) students in Yogyakarta province.

METHOD

This study employed a non-observational, quasi-experimental design, specifically a pre-experimental one-group pretest–posttest design. This approach was chosen to evaluate changes in students' financial literacy before and after the intervention without randomization or an equivalent control group.[42]

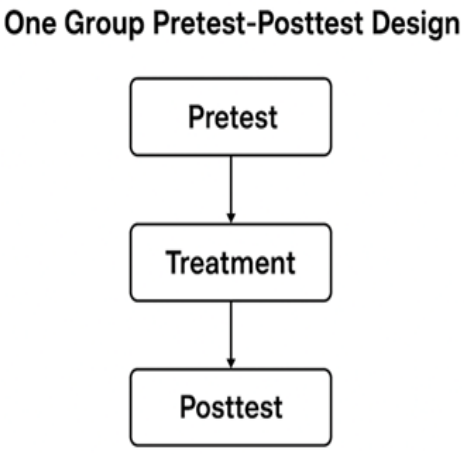

Figure 1. Pre-Experimental One Group Pretest–Posttest Design

The universe of the study consisted of vocational high school (SMK) students in Yogyakarta province, with a sample of 632 students drawn from six SMK. The study was conducted across six vocational high schools (*Sekolah Menengah Kejuruan* / SMK) in the Special Region of Yogyakarta, namely: SMK Negeri 1 Godean, SMK Negeri 1 Depok, SMK Negeri 1 Yogyakarta, SMK Negeri 1 Wonosari, SMK Negeri 1 Bantul, and SMK Negeri 1 Samigaluh. Sampling was conducted using intact classes designated by the schools (non-probability sampling). Inclusion criteria were enrollment in the participating SMK, participation in the MOMA-based learning intervention, and completion of both the pretest and posttest. Students who did not complete both assessments or withdrew from the study were excluded.

The independent variable was the learning method, specifically the use of MOMA-based Game-Based Learning, while the dependent variable was students' financial literacy, measured through the same standardized instrument at both pretest (T0) and posttest (T1). Additional descriptive data, such as school, class, and demographic characteristics, were also recorded.

The procedure consisted of three stages. First, a pretest was administered to assess students' baseline financial literacy. Second, students received the intervention, which involved structured learning activities using the MOMA digital platform integrated into regular lessons. Finally, a posttest was administered using the same instrument to evaluate improvements in financial literacy after the intervention.

Data were obtained using a pretest–posttest system supported by standardized survey instruments. The main instrument was a financial literacy test developed based on indicators from the OECD/INFE (2018) financial literacy framework, covering knowledge, behaviour, and attitudes. The test consisted of multiple-choice and short-answer items designed to capture students' ability to manage budgeting, saving, spending, and basic investment decisions. To ensure validity, the instrument underwent expert judgment by finance and education specialists, and its content validity index (CVI) met the recommended threshold. A pilot test was also conducted with a smaller group of students to evaluate clarity and reliability, yielding a Cronbach's alpha coefficient above 0,70, which indicated acceptable internal consistency.

In addition, questionnaires and observation sheets were used to collect supporting data on student engagement and perceptions of the MOMA platform. The questionnaire employed a five-point Likert scale ranging from "strongly disagree" to "strongly agree," capturing attitudes toward financial learning, motivation, and ease of use of the digital tool. Observation sheets were completed by teachers and researchers during the intervention to document student participation and classroom dynamics.

Table 1. Assessment with a likert scale

Assessment score	Category
4	Strongly Agree
3	Agree
2	Disagree
1	Strongly Disagree

Results showed a statistically significant improvement in financial literacy within the experimental group, as confirmed by a paired samples t-test ($p < 0,05$), while the control group exhibited minimal change. Furthermore, an independent samples t-test indicated that posttest scores of the experimental group were significantly higher than those of the control group ($p < 0,05$). These findings demonstrate that MOMA effectively enhanced students' financial literacy, providing robust empirical support for its integration into vocational accounting and finance curricula.

RESULTS AND DISCUSSION

The results revealed that students in the experimental group experienced a statistically significant increase in financial literacy scores from pretest to posttest, while the control group showed minimal progress. This finding suggests that digital, game-based approaches can bridge the gap between theoretical instruction and practical application, offering a more engaging learning experience than conventional teaching methods.[43] Similar results have been reported in international studies, where business and accounting simulations not only strengthened financial knowledge but also enhanced motivation and entrepreneurial orientation among Generation Z learners. Our results are consistent with these studies, further demonstrating that learners who are digital natives respond more effectively to interactive and immersive educational tools than to traditional lectures. From a pedagogical perspective, the integration of MOMA into the curriculum provides an innovative way to cultivate both knowledge and positive financial habits, which are crucial for preparing students to navigate real-world financial challenge.[44]

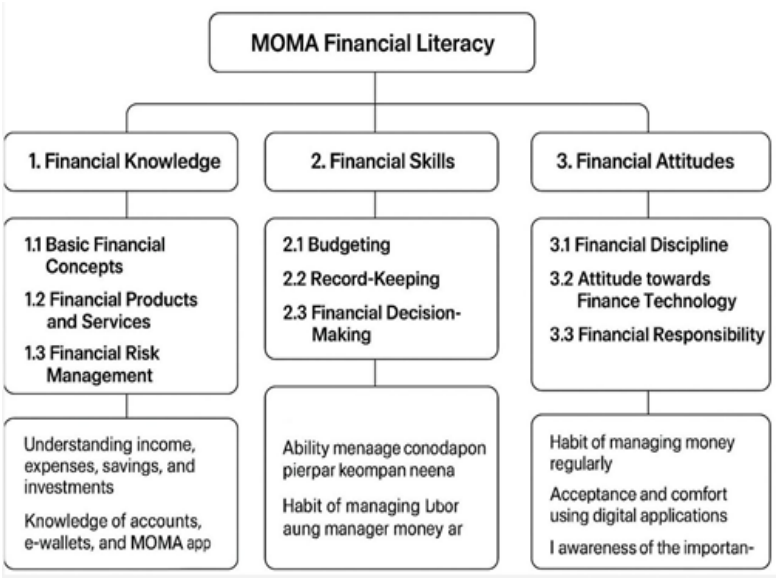

Figure 2. MOMA Game-Based Learning

The Game-Based Learning (GBL) approach in this context refers to the integration of interactive games within the MOMA application, designed to serve as a dynamic platform for students to engage in exercises,[45] challenges, and quizzes after completing the learning modules provided in the application. Rather than simply functioning as a digital textbook, MOMA offers an immersive learning environment where students can reinforce their understanding of financial concepts through engaging and interactive gameplay. These game elements are not only designed to test knowledge but also to create a stimulating learning atmosphere that motivates students to continuously improve their skills.[16] The inclusion of immediate feedback in the game mechanics ensures that students can identify and correct mistakes in real-time, turning each activity into a constructive learning experience.

Unlike traditional learning methods that often focus heavily on passive content delivery, MOMA integrates GBL to create an active learning cycle that combines knowledge acquisition with practical application.[46] Students are not merely reading or listening to financial literacy concepts they are actively using them in simulated decision-making scenarios that mirror real-life financial challenges. By embedding financial problem-solving tasks within a game format, MOMA fosters both cognitive engagements, where students actively process information, and emotional engagement, where students enjoy the process and feel motivated to participate fully. This dual engagement approach increases the likelihood of deep and long-lasting learning outcomes.

The results of this study revealed that the integration of the MOMA application with Game-Based Learning effectively improved students' financial literacy while simultaneously enhancing their motivation and participation. These outcomes align with the platform's unique features, such as adaptive difficulty levels that kept students engaged within their optimal learning zone and real-time feedback that reinforced understanding while fostering confidence. The observed significant increase in posttest scores among the experimental group can therefore be attributed not only to the gamified structure of MOMA but also to its ability to create an interactive and personalized learning experience, which traditional teaching methods failed to provide.

From a pedagogical perspective, the instructional impact of MOMA refers to its measurable influence on achieving specific learning objectives, particularly the improvement of students' financial literacy skills.[45]

Table 2. Pretest and posttest results

No	School Name	Pretest	Posttest
1	SMK Negeri 1 Depok	7,01	8,35
2	SMK Negeri 1 Yogyakarta	8,20	8,55
3	SMK Negeri 1 Godean	7,00	7,75
4	SMK Negeri 1 Bantul	6,87	7,85
5	SMK Negeri 1 Gunungkidul	6,89	7,60
6	SMK Negeri 1 Samigaluh	6,63	7,95

The results of the financial literacy evaluation indicate an overall increase in average scores across all participating schools. At SMK Negeri 1 Depok, the mean score rose from 7,01 in the pretest to 8,35 in the

posttest. SMK Negeri 1 Yogyakarta recorded the highest improvement, increasing from 7,20 to 8,55. A more moderate gain was observed at SMK Negeri 1 Godean, from 7,00 to 7,75, while SMK Negeri 1 Bantul improved from 6,87 to 7,85. Similarly, SMK Negeri 1 Gunungkidul showed an increase from 6,98 to 7,60, and SMK Negeri 1 Samigaluh rose from 6,63 to 7,95. Overall, these results demonstrate that the implementation of the MOMA game-based learning approach successfully enhanced students' financial literacy across all research sites, although the degree of improvement varied among schools.

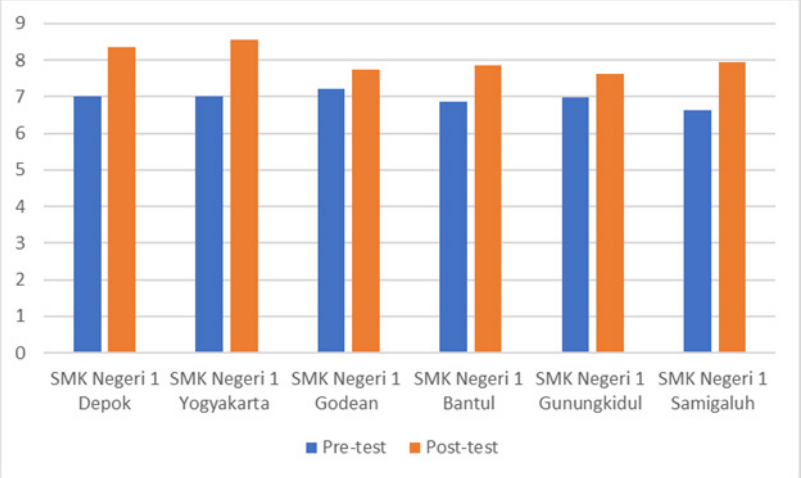

Figure 3. Improving Students' Financial Literacy

In this sense, the integration of MOMA with Game-Based Learning is not merely a technological enhancement but a strategic educational innovation. It bridges the gap between theory and practice, transforming abstract financial principles into lived experiences within a safe, virtual environment. Students are encouraged to take calculated risks, explore alternative strategies, and reflect on the outcomes of their decisions—all without the real-world consequences of financial mistakes. By doing so, the approach not only improves measurable financial literacy but also cultivates essential 21st-century skills such as critical thinking, problem-solving, and responsible decision-making, ultimately fostering financial competence and confidence.

The implementation of the Android-based learning media MOMA ("Money Management") demonstrated a significant improvement in students' financial literacy. Designed to provide interactive, engaging, and contextually relevant learning experiences, MOMA enabled students to better understand concepts such as saving, budgeting, and responsible spending. Its gamified features encouraged active participation and self-directed learning, while the interactive exercises and real-life scenarios allowed students to apply financial concepts directly, contributing to deeper comprehension and better retention.[44]

The results of the effectiveness test showed that students' posttest performance was consistently higher than their pretest scores, indicating substantial learning gains. For instance, the experimental group's mean score increased from 7,11 (minimum = 6,63; maximum = 7,20) in the pretest to 8,17 (minimum = 7,60; maximum = 8,55) in the posttest. These descriptive statistics provide a clear snapshot of student performance, revealing both the overall improvement and the relatively small variation across participants.

Beyond numerical results, improvements were also evident in students' decision-making skills when confronted with financial scenarios embedded in the MOMA platform. This suggests that the integration of technology-based learning tools can serve as an effective strategy to enhance financial literacy in formal education while addressing limitations of traditional instruction. These findings are further analyzed in the discussion section, where they are interpreted in relation to the study's objectives and compared with results from previous research on game-based financial learning.

Table 3. Descriptive Test Results Table

Descriptives								
Financial literacy								
	N	**Mean**	**Std. Deviation**	**Std. Error**	**95 % Confidence Interval for Mean**		**Min**	**Max**
					Lower Bound	**Upper Bound**		
Pre-Test	316	7,007	0,3521	0,0198	6,968	7,046	5,8	8,0
Post-Test	316	8,084	0,4894	0,0275	8,030	8,138	7,5	9,5
Total	632	7,546	0,6870	0,0273	7,492	7,599	5,8	9,5

The descriptive analysis provides an overview of students' financial literacy performance before and after the intervention. As shown in table 3, the mean score for the pretest was 7,01 (SD = 0,35), while the mean score for the posttest increased to 8,08 (SD = 0,49). This indicates a substantial gain in performance, with scores ranging from 5,8 to 8,0 in the pretest and from 7,5 to 9,5 in the posttest. The 95 % confidence interval also confirmed the reliability of these results, with no overlap between the lower and upper bounds of pretest and posttest scores. These descriptive findings provide strong evidence that the use of MOMA-based Game-Based Learning significantly enhanced students' financial literacy.

The mean score, or average, for both the control and experimental classes was 7,546. This figure suggests that most students obtained results within a relatively strong range, although several students scored either slightly below or above the average. The mean value provides a general picture of the distribution of learning outcomes, indicating that most students achieved satisfactory results. The relatively high mean also suggests that the learning process, regardless of group, was generally effective in facilitating understanding of the material.

A mean score of 7,546 can be interpreted as an indication that, overall, student performance was at a reasonably good level. The score range of 5,8 to 9,5 highlights the variation in students' ability to comprehend the material, which is an important factor for further analysis. This variation allows researchers to examine the extent to which the teaching method applied in the experimental class impacted learning outcomes compared to the control class. While there were students who achieved lower scores, the majority performed well, with many results approaching a score of 8. This descriptive analysis therefore serves as a crucial foundation for evaluating the overall effectiveness of the intervention in the experimental class and determining whether the applied method led to measurable improvements in student achievement.

Table 4. Test of Homogeneity

Test of Homogeneity of Variances					
		Levene Statistic	**df1**	**df2**	**Sig.**
Financial literacy	Based on Mean	59,835	1	630	0,000
	Based on Median	40,713	1	630	0,000
	Based on Median and with adjusted df	40,713	1	610,912	0,000
	Based on trimmed mean	54,891	1	630	0,000

The results of the homogeneity test presented below indicate that the variances among the tested groups are uniform. The homogeneity test results confirmed that the data distributions across groups were consistent, with no significant differences in variance. This outcome not only validated the reliability of subsequent analyses but also aligns with patterns reported in similar research on digital and game-based financial literacy interventions. For instance, studies in both Southeast Asia and Europe have shown that when homogeneity assumptions are met, post-intervention improvements in financial literacy tend to be robust and statistically significant, particularly among vocational and secondary school populations. The average trend in the published literature indicates that game-based learning interventions typically produce moderate to strong gains in financial literacy, often ranging from a 10 % to 20 % increase in posttest scores compared to pretest scores or control groups. The results of this study fall within that range, suggesting that the MOMA application is consistent with international findings while also contributing novel evidence from the Indonesian vocational education context. This value indicates that the variances among the groups tested in this research are homogeneous or uniform. In other words, there is no statistically significant difference in variances between the compared groups. A significance value of 0,00 reflects highly consistent data, allowing subsequent analyses to be conducted with a high level of confidence. Homogeneity of variances is one of the essential prerequisites for conducting an ANOVA test, ensuring that the following statistical procedures can be carried out validly and reliably.

With homogeneous variance in the dataset, it can be concluded that the effect of the MOMA application on students' financial literacy can be evaluated more accurately. The study demonstrates that all student groups had similar baseline conditions, meaning that any differences in outcomes are most likely due to the intervention provided by the MOMA application. This finding also affirms that MOMA exerts a significant and measurable impact on improving students' financial literacy. Consequently, MOMA can be regarded as an effective and dependable learning tool within the context of financial education in vocational high schools. Overall, the study provides a strong foundation for the continued development and broader implementation of the MOMA application among vocational students.

The results of the paired sample t-test presented below indicate a statistically significant difference between the groups being compared. This finding suggests that there is a considerable variation among the variables analyzed, as demonstrated in the table below.

Table 5. Paired Samples t-test

Paired Samples Statistics					
		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Pretest	7,0070	316	0,35207	0,01981
	Posttest	8,0842	316	0,48938	0,02753

The results indicate that the implementation of the MOMA "Money Management" learning media, integrated with game-based learning, had a strong and positive effect on improving students' financial literacy. The pretest average score of 7,0070 shows that before the intervention, students already had a moderate understanding of financial concepts, though there was still room for improvement. The relatively low standard deviation in the pretest (0,35207) indicates that students' scores were consistent, with not much variation in their initial literacy levels.

After the intervention, the posttest mean score rose significantly to 8,0842, accompanied by a slightly larger standard deviation (0,48938). This suggests that while overall performance improved, there was a slightly wider range of individual differences in achievement. The increase of more than one full point in the mean score demonstrates a meaningful and measurable gain in students' financial literacy, reflecting the effectiveness of MOMA as both a learning tool and a motivational platform.

The paired sample t-test analysis strengthens this conclusion by providing statistical evidence of the significance of the improvement. A mean difference of -1,07722, with a narrow 95 % confidence interval (-1,14541 to -1,00902), indicates that the observed improvement is not due to random chance but is a consistent outcome across the sample. The very large negative t-value (-31,080) and the extremely low p-value (0,000) confirm that the probability of this improvement occurring by coincidence is practically zero.

From an educational perspective, these results suggest that the intervention successfully enhanced students' knowledge, skills, and attitudes towards financial management. The increase in scores indicates not just rote memorization of concepts but likely deeper comprehension and application of financial literacy principles within the interactive and engaging environment provided by MOMA.

Overall, the findings validate the integration of digital learning tools like MOMA with game-based learning strategies in vocational education. The significant and consistent gains observed imply that such approaches can be scaled up for broader use, potentially benefiting other schools and educational settings seeking to improve students' real-world financial competencies.

The results of the independent sample t-test in the table below indicate a significant difference between the groups tested. These findings suggest that there is a considerable variation among the variables analyzed, as presented in the following table 6.

Table 6. Results of Independent Sample t-test

	Treatment	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Financial literacy	Pre-Test	316	7,007	0,3521	0,0198
	Post-Test	316	8,084	0,4894	0,0275

Based on the results of the financial literacy data analysis conducted on 316 respondents, there was a clear improvement in the mean score from the pre-test to the post-test. In the pre-test, the average financial literacy score was 7,007, with a standard deviation of 0,3521 and a standard error of the mean of 0,0198. After the intervention was implemented, the post-test results showed a marked increase in the mean score to 8,084, accompanied by a standard deviation of 0,4894 and a standard error of the mean of 0,0275. This represents an increase of 1,077 points in the average score, indicating a substantial and measurable improvement in the respondents' financial literacy. The magnitude of this improvement not only reflects the overall progress made by the participants but also demonstrates the effectiveness of the intervention in enhancing students' understanding and application of financial concepts.

Statistical testing using the t-test for financial literacy scores further supports this conclusion. Levene's Test for equality of variances yielded an F-value of 59,835 with a significance level of 0,000, indicating that the assumption of equal variances was not met, as shown in the attached statistical outputs. Nevertheless, in both the "equal variances assumed" and "equal variances not assumed" conditions, the t-test results consistently demonstrated a t-value of -31,763, with degrees of freedom (df) of 630 and 572,172, respectively, and a two-tailed significance level of 0,000. The mean difference between pre-test and post-test scores was -1,0772, with a standard error of the difference of 0,0339. The 95 % confidence interval for this difference ranged from -1,1438 to -1,0106, reinforcing that the observed improvement is both statistically significant and reliable.

The combination of descriptive statistics and inferential testing provides robust evidence that the MOMA

"Money Management" application, integrated with game-based learning, had a pronounced and positive effect on students' financial literacy. The experimental group demonstrated a mean increase from 7,01 to 8,08, while the control group showed only marginal improvement, highlighting the effectiveness of the intervention compared to conventional methods. This finding is consistent with international studies, such as those by Putri[9] and Vitaly[17] which reported that digital and simulation-based approaches often yield significantly higher gains in financial knowledge than traditional classroom instruction. Regionally, similar outcomes have been observed in Southeast Asian contexts, where game-based financial learning has led to measurable improvements in budgeting and saving behavior among adolescents.

When comparing the different stages of cluster evolution, the results clearly show stronger improvements during the posttest phase for the experimental group, while the control group's progression remained relatively flat. This suggests that the intervention was directly responsible for the observed gains, rather than external factors. At the same time, limitations must be acknowledged. The study was conducted in a limited number of schools within Yogyakarta province, which may affect the generalizability of the findings. In addition, the reliance on short-term pretest–posttest data means that the long-term sustainability of improved financial literacy was not assessed. Despite these constraints, the results provide compelling evidence that MOMA can serve as an effective and replicable tool for strengthening financial literacy among vocational school students, while also opening avenues for future research into its long-term impact and adaptability in broader educational contexts.

CONCLUSIONS

This study set out to examine the effectiveness of integrating the MOMA "Money Management" application with Game-Based Learning to strengthen financial literacy among vocational high school students. The findings confirm that technology-enhanced and interactive approaches can provide meaningful educational value, positioning digital gamified tools as a strategic alternative to conventional financial education methods. Beyond improving knowledge acquisition, such interventions also contribute to shaping students' attitudes, skills, and motivation toward responsible financial behaviour outcome that is crucial in preparing Generation Z for participation in increasingly complex economic environments. From a broader perspective, the study highlights the role of innovative, technology-based learning models in bridging the gap between theory and practice, with potential applicability not only in Indonesia but also across diverse educational contexts globally. At the same time, the work opens pathways for further research, particularly in assessing the long-term impact of such interventions, exploring additional variables that may influence learning outcomes, and testing scalability in varied cultural and institutional settings. Taken together, these insights underscore the importance of integrating digital innovation into pedagogy while providing valuable implications for educators, curriculum designers, and policymakers seeking to advance financial literacy education.

REFERENCES

1. Gaddam DR. The Effects of Financial Literacy on the Well-Being of a Community. IJFMR - Int J Multidiscip Res. 2025;7. https://doi.org/10.36948/ijfmr.2025.v07i02.39200

2. Rajesh RJ, Giridhar KV. Financial Literacy and Personal Financial Management: Smart Moves Towards Personal Finance. Shanlax Int J Arts Sci Humanit. 2024;12:62–7. https://shanlaxjournals.in/journals/index.php/sijash/article/view/8285

3. Tashtamirov M. Financial Innovation and Digital Technology in the Banking System: An Institutional Perspective. SHS Web Conf. 2023;172:02004. https://www.shs-conferences.org/articles/shsconf/abs/2023/21/shsconf_shcms2023_02004/shsconf_shcms2023_02004.html

4. Abbes M, Julien A, Hao S, Touzani M. Adopting Digital Signatures for Complex Financial Products in the French Banking Sector: How Technology Acceptance and User Literacy Matter. IEEE Trans Eng Manag. 2024;71:5536–46. https://ieeexplore.ieee.org/document/10420522

5. Salsiati. The Development of Financial Inclusion and Digital Financial Literacy in Indonesia. J Multi-Discip Sci. 2025;3:51–6. https://journal.e-ice.id/index.php/icecomb/article/view/47

6. Suleiman A, Dewaranu T, Anjani NH. Creating Informed Consumers: Tracking Financial Literacy Programs in Indonesia. 2022. https://repository.cips-indonesia.org/publications/358319/

7. Rochendi T, Rita R, Dhyanasaridewi ID. Pentingnya Literasi Keuangan Bagi Masyarakat. Kompleksitas. 2022;11:27–35. https://www.neliti.com/publications/555255/

8. Lantara IWN, Kartini NKR. Financial Literacy Among University Students: Empirical Evidence From Indonesia. J Indones Econ Bus. 2015;30:247–56. https://www.neliti.com/id/publications/72102/

9. Putri RA, Ishak K. Strategies To Improve Financial Technology Literacy For Millennials And Generation Z. JPS J Perbank Syariah. 2024;5:304–18. https://ejournal.isnjbengkalis.ac.id/index.php/jps/article/view/2017

10. Sakum, Mamun S, Ahmad AN, Edy S, Ainulyaqin H. Peningkatan Literasi Keuangan Syariah Melalui Pelatihan dan Pendampingan Masyarakat Kabupaten Bekasi. El-Mal J Kaji Ekon Bisnis Islam. 2024;5:5066–75. https://journal-laaroiba.com/ojs/index.php/elmal/article/view/4824

11. Aliah N, Rizkina M. Sosialisasi Literasi Keuangan pada Siswa/i SMK Negeri 1 Medan. J Pengabdi Bukit Pengharapan. 2024;4:100–6. https://journal.bukitpengharapan.ac.id/index.php/JURDIAN/article/view/630

12. Rahmadi R, Natali Y, Cahyadi N, Hafiza L, Sularso AN. Developing Financial Literacy Among Students of SMK Telkom Jakarta. Multifinance. 2024;2:26–32. https://altinriset.com/journal/index.php/multifinance/article/view/185

13. Oktaviani DI, Gusnardi G, Caska C, Suarman S, Indrawati. Enhancing Financial Literacy Through Educational Game-Based Learning Materials. Al Qalam J Ilm Keagamaan Dan Kemasyarakatan. 2025;19. https://jurnal.stiq-amuntai.ac.id/index.php/al-qalam/article/view/3994

14. Lisana L, Dinata H, Valencia Tanudjaja G. Playing to learn: Game-based approach to financial literacy for generation Z. Entertain Comput. 2025;52:100896. https://www.sciencedirect.com/science/article/pii/S1875952124002647

15. Platz L, Jüttler M. Game-Based Learning as a Gateway for Promoting Financial Literacy – How Games in Economics Influence Students' Financial Interest. In: Citizenship, Social and Economics Education. SAGE Publications Ltd; 2022. p. 185–208. https://doi.org/10.1177/14788047221135343

16. Platz L, Jüttler M, Schumann S. Game-Based Learning in Economics Education at Upper Secondary Level: The Impact of Game Mechanics and Reflection on Students' Financial Literacy. In: Game-based Learning Across the Disciplines. 2021. p. 25–42. https://doi.org/10.1007/978-3-030-75142-5_2

17. Vitaly K, Yaroslavovich SD, Sergeevna BS, Aleksandrovich FM, Aleksandrovich PD. Using Interactive Learning Methods to Build Students' Financial Skills: Integrating Economic Games and Simulations. 2024;9. https://ecience.ru/en/nauka/article/85573/view

18. Santosa DSS. Game Based Financial Planning Simulator for Elementary School Students. Ournal Educ Learn Innov ELIa. 2024;4. https://journal.shantibhuana.ac.id/index.php/elia/article/view/960

19. Manaf SMA, Ismail F, Azmin NAM, Abdullah S, Hamzah SFM, Azlan NNA, et al. MoneyWise Cash-Flow Simulation Module: Improving Students' Grade Through Enhanced Personal Financial Planning System. E-J Penyelid Dan Inov. 2022;24–41. https://ejpi.uis.edu.my/index.php/ejpi/article/view/77

20. Imawan R, Putra WP, Alqahtani R, Milakis ED, Dumchykov M. Enhancing Financial Literacy in Young Adults: An Android-Based Personal Finance Management Tool. J Hypermedia Technol-Enhanc Learn. 2025;3:64–89. https://edutech-journals.org/index.php/j-hytel

21. Ghasemi F, Kucharski R. MoMaS: Two-sided Mobility Market Simulation Framework for Modeling Platform Growth Trajectories. Transp Res Part C Emerg Technol. 2025;171:104990. https://www.sciencedirect.com/science/article/pii/S0968090X24005114

22. Yang T, Jing Y, Wu H, Xu J, Sima K, Chen G, et al. MOMA-Force: Visual-Force Imitation for Real-World Mobile Manipulation. In: IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2023. http://arxiv.org/abs/2308.03624

23. Huang HH, Shu J, Liang Y. MUMA: A Multi-Omics Meta-Learning Algorithm for Data Interpretation and Classification. IEEE J Biomed Health Inform. 2024;28:2428–36. https://ieeexplore.ieee.org/document/10432939

24. Pathak A, Tiwari V, Arya KV. MOMA introduces the Multi-Object Multi-Actor Framework for Decoding Heterogeneous Activities in Complex Environments. In: 2024 IEEE International Conference on Computer Vision and Machine Intelligence (CVMI). 2024. p. 1–5. https://ieeexplore.ieee.org/document/10781566

25. Skagerlund K, Lind T, Strömbäck C, Tinghög G, Västfjäll D. Financial literacy and the role of numeracy–How individuals' attitude and affinity with numbers influence financial literacy. J Behav Exp Econ. 2018;74:18–25. https://www.sciencedirect.com/science/article/pii/S2214804318301241

26. Bai R. Impact of financial literacy, mental budgeting and self control on financial wellbeing: Mediating impact of investment decision making. PLOS ONE. 2023;18:e0294466. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0294466

27. Riska R, Ali M, Erwing E. Penggunaan Model Pembelajaran Game Based Learning Berbantuan Media Interaktif Wizer.me terhadap Hasil Belajar Biologi Siswa Kelas X di MAN 2 Bone. BIOPENDIX J Biol Pendidik Dan Terap. 2025;11:177–84. https://ojs3.unpatti.ac.id/index.php/biopendix/article/view/16017

28. Fathahillah F. Educational Game Development for Improving Student Learning Outcomes in Vocational High School. In Atlantis Press; 2022. p. 315–9. https://www.atlantis-press.com/proceedings/w-share-21/125972668

29. l Azis FA, Juhana A, Nurhidayatulloh N. The Effect of Game Development-Based Learning on the Development of Problem Solving Skills of Multimedia Vocational Students. DIAJAR J Pendidik Dan Pembelajaran. 2025;4. https://journal.yp3a.org/index.php/diajar/article/view/3405

30. Febrianto I, Kusdiyanti H, Tsong CK. Game Based Entrepreneurship Learning for Vocational High School Students in Facing Industry 4.0. J Disruptive Learn Innov JODLI. 2021;2:55–71. https://journal2.um.ac.id/index.php/jodli/article/view/17083

31. Chinengundu T. Simulated Work-Based Learning in Technical and Vocational Education and Training: An Innovative Pedagogy. Handb Res Transform Innov Pedagog Educ. 2022;2:18–27. https://www.igi-global.com/gateway/chapter/www.igi-global.com/gateway/chapter/297594

32. Dahalan F, Alias N, Shaharom MSN. Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review. Educ Inf Technol. 2023;1–39.

33. Hao Y, Liu S. Research on the Construction Path of Vocational Education Virtual Simulation Training Base Combining Multi-source Data. Appl Math Nonlinear Sci. 2023;9. https://sciendo.com/article/10.2478/amns.2023.2.01096

34. Rosina H, Virgantina V, Ayyash Y, Dwiyanti V, Boonsong S. Vocational Education Curriculum: Between Vocational Education and Industrial Needs. ASEAN J Sci Eng Educ. 2021;1:105–10. https://ejournal.upi.edu/index.php/AJSEE/article/view/33400

35. Hefni H. Vocational Education Transformation Toward Maturity and Business Motivation. J Ilmu Sos Mamangan. 2019;8:1–7. https://ejournal.upgrisba.ac.id/index.php/jurnal-mamangan/article/view/4155

36. Pranita D, Musthofa BM, Kusumastuti H, Haidlir BM. Transforming vocational higher education on the path toward Golden Indonesia 2045. Vocat Technol Educ. 2025;2. https://www.hksmp.com/journals/vte/article/view/806

37. Suharno, Pambudi NA, Harjanto B. Vocational education in Indonesia: History, development, opportunities, and challenges. Child Youth Serv Rev. 2020;115:105092. https://www.sciencedirect.com/science/article/pii/S0190740920301134

38. Ayuningtyas A, Widati ST, Suparno. The Effectiveness of Social Media in Increasing Financial Literacy Among MSME Actors in Indonesia. Int Stud Conf Bus Educ Econ Account Manag ISC-BEAM. 2025;3:1–10. https://journal.unj.ac.id/unj/index.php/isc-beam/article/view/50760

39. Astuti RD, Purwiyanta P, Ediningsih SI, Tugiyo T. How Digital and Financial Literacy Strengthens Financial Inclusion in Indonesia? SHS Web Conf. 2025;212:01007. https://www.shs-conferences.org/articles/shsconf/

abs/2025/03/shsconf_icarsess2024_01007/shsconf_icarsess2024_01007.html

40. Boseke RE, Meiryani M. Strategic Entrepreneurship Mediating the Impact of, Financial Literacy and Use of Social Media on MSMEs' Entrepreneurial Orientation in Indonesia. J Entrep Bus. 2025;6:1–19. https://journal.ubaya.ac.id/index.php/jerb/article/view/6919

41. Fitriah N, Degeng MDK, Degeng INS, Praherdhiono H. Enhancing Early Childhood Financial Literacy Through FinSOLEkid Indonesia: A Comparative Study of Digital Platforms. Gold Age J Ilm Tumbuh Kembang Anak Usia Dini. 2023;8:171–81. https://ejournal.uin-suka.ac.id/tarbiyah/goldenage/article/view/7695

42. Fauziah R, Ghufron A, Muhtadi A, Fauzi MR. Effectiveness of Animated Simulation Video Media in Promoting Higher-Order Thinking Skills in Grade 10 High School Physics Material. Salud Cienc Tecnol. 2025;5:1905–1905. https://sct.ageditor.ar/index.php/sct/article/view/1905

43. Wang JS. Enhancing Finance Students' Learning Effectiveness and Motivation: Application of Financial Simulation Game. Int J Emerg Technol Learn IJET. 2023;18:102–12. https://online-journals.org/index.php/i-jet/article/view/43917

44. Hamidah N, Supadi S. Project-Based Learning to Improve Financial Literacy in the Digital Era for Vocational School Students. J Ilm Rumpun Ilmu Pendidik. 2025;2:75–91. https://journal.yayasancmw.or.id/index.php/JIRIP/article/view/34

45. Platz L, Zauner M. Financial Literacy Games—Increasing Utility Value by Instructional Design in Upper Secondary Education. Educ Sci. 2025;15:227. https://www.mdpi.com/2227-7102/15/2/227

46. Hartt M, Hosseini H. Game On: Exploring the Effectiveness of Game-based Learning. Plan Pract Res. 2020;35. https://www.tandfonline.com/doi/full/10.1080/02697459.2020.1778859

FINANCING

No financing.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Agatha Saputri.
Data curation: Agatha Saputri.
Formal analysis: Agatha Saputri.
Research: Agatha Saputri, Edi Purwanta, Siswanto.
Methodology: Agatha Saputri.
Project management: Edi Purwanta, Siswanto.
Methodology: Agatha Saputri.
Resources: Edi Purwanta, Siswanto.
Methodology: Agatha Saputri, Edi Purwanta, Siswanto.
Software: Agatha Saputri.
Supervision: Edi Purwanta, Siswanto.
Validation: Edi Purwanta, Siswanto.
Display: Agatha Saputri.
Drafting - original draft: Agatha Saputri.
Writing - proofreading and editing: Agatha Saputri, Edi Purwanta, Siswanto.