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NEKOMO, Development of Educational Digital Media to Improve Adolescent Mental Health through Gamification

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Abstract

Adolescent mental health is an important issue that is often overlooked, particularly in relation to silent anxiety or hidden anxiety, which can be difficult to detect. This study aims to develop NEKOMO (Development of Educational Digital Media to Improve Adolescent Mental Health through Gamification), a gamification-based digital educational medium designed to help adolescents recognize, manage, and reduce anxiety symptoms through interactive activities. The research employed a Research and Development (R&D) approach using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The DASS-21 (Depression Anxiety Stress Scale–21 Items) instrument was used to measure anxiety levels before and after using the application. Validation by subject matter experts and media experts was conducted to evaluate the feasibility of the application's content and interface. Of the 128 students who participated as initial respondents, 45 students completed both the pre-test and post-test assessments. The results of the Wilcoxon Signed-Rank Test showed a significance value of $p < 0.05$ across all DASS-21 domains, indicating a significant difference between scores before and after the use of the application. The average expert validation score ranged from 3.5 to 3.6 out of 4.0, categorized as "Suitable for use with minor revisions." Therefore, the NEKOMO application was considered valid and feasible and was associated with reduced anxiety levels and increased mental health awareness among adolescents at Al-Azhar 1 Jakarta Islamic High School. Further studies using a controlled experimental design are recommended to confirm the effectiveness of the application.

INTRODUCTION

Adolescent mental health is currently a critical issue, particularly among adolescents. Based on the Indonesia-National Adolescent Mental Health Survey, approximately one-third of Indonesian adolescents experience mental health problems, with anxiety being one of the main concerns (Wiguna et al., 2021). Anxiety, stress, and excessive worrying are common emotional experiences among adolescents; however, these experiences are often not expressed verbally or openly (Burnley et al., 2024; Fusar-Poli et al., 2024; Ludot-Grégoire et al., 2022; Meng et al., 2025; Palmer & Francis, 2024; Sun et al., 2025). A prevalent manifestation among adolescents is anxiety, which may occur when individuals appear outwardly well while experiencing emotional burdens internally. Anxiety often remains unnoticed by teachers, parents, and peers. If left unaddressed, anxiety may negatively affect academic achievement, adolescents' social relationships, and overall psychological well-being, potentially contributing to more serious mental health difficulties. According to Erikson (1968), adolescents are in the stage of Identity vs. Role Confusion, a period of self-exploration that is vulnerable to

psychosocial conflicts. Recent research findings support this theoretical perspective, demonstrating that healthy psychosocial development influences emotional health outcomes later in life (Malone et al., 2016). This explains why adolescents are particularly vulnerable to experiencing anxiety when academic and social demands become unbalanced, indicating that the findings of I-NAMHS regarding adolescent mental health concerns align with developmental vulnerabilities during adolescence.

Research shows that digital behaviors among adolescents, including online interaction patterns and the duration of nighttime digital device use, may reflect aspects of their psychological conditions (Naslund et al., 2020; Bashir & Bhat, 2017). Meanwhile, social media platforms and digital applications represent some of the most common online activities among adolescents today (Ezeji & Uwizeyimana, 2025; Lu et al., 2022; Marciano et al., 2022; Marengo et al., 2022; Matthews et al., 2025; Orgilés et al., 2025). The high level of adolescent engagement with digital platforms creates opportunities for developing gamification-based anxiety management interventions that are visually engaging, functionally interactive, and capable of encouraging positive habits through enjoyable experiences. The integration of gamification elements, such as point systems, level progression, activity streaks, and daily challenges, has been widely explored in educational and psychological interventions. Several studies have demonstrated that gamification can enhance user engagement and support psychological practices, including mindfulness activities and anxiety management strategies.

Therefore, this research focuses on the development of a gamification-based educational digital application designed to help adolescents understand and manage anxiety, particularly among students at SMA Islam Al Azhar 1 Jakarta. The NEKOMO application does not function as a diagnostic tool; instead, it provides a safe, engaging, and supportive platform for increasing emotional awareness, practicing coping strategies through journaling activities, developing present-moment awareness (mindfulness), and establishing self-care routines through daily challenges and missions. Through this approach, the application is expected to serve as an alternative intervention aligned with the digital lifestyle of contemporary adolescents. Based on I-NAMHS findings, approximately one-third of Indonesian adolescents experience mental health problems, with anxiety identified as one of the primary concerns. This condition encourages further investigation into adolescent anxiety through the development of gamification-based digital media as an innovative approach to supporting adolescent mental health (Amer et al., 2023; Ibrahim et al., 2025; İzci, 2025; Perez-Jorge et al., 2024).

Based on the previous background, the research problems and questions are formulated as follows: What is the level of anxiety among adolescents at SMA Islam Al Azhar 1 Jakarta based on the measurement results of the DASS-21 instrument? What is the feasibility of NEKOMO as an educational digital medium designed to improve adolescent mental health through gamification? How effective is NEKOMO in supporting anxiety management among adolescents at SMA Islam Al Azhar 1 Jakarta? The urgency of this research is strengthened by the increasing recognition of adolescent mental health challenges and the limited availability of accessible, non-stigmatizing, and engaging digital-based mental health support. This article is structured as follows. The first section discusses the theoretical foundations of adolescent mental health, gamification, and digital interventions. The second section explains the development process of the NEKOMO application using the ADDIE model. The third section presents the findings from the feasibility and effectiveness evaluations. Finally, the article

discusses theoretical and practical implications, research limitations, and recommendations for future studies.

Based on the formulated research questions, the objectives of this study are as follows: To identify the level of anxiety among adolescents at SMA Islam Al Azhar 1 Jakarta based on the measurement results of the DASS-21 instrument. To evaluate the feasibility of NEKOMO as an educational digital medium designed to improve adolescent mental health through gamification. To examine the effectiveness of NEKOMO in supporting anxiety management among adolescents at SMA Islam Al Azhar 1 Jakarta.

This research provides several benefits. Generally, this study contributes to efforts to support adolescent mental health through the utilization of gamification-based digital media, enriches academic discussions regarding technology-assisted psychological interventions, and supports innovation in educational applications that respond to the needs of younger generations. The development of NEKOMO provides adolescents with a simple, engaging, and non-stigmatizing medium to explore and manage emotions, thereby supporting improved social relationships and psychological well-being. Furthermore, this research provides empirical insights into the development of gamification-based educational media and enhances understanding of adolescent anxiety dynamics using the DASS-21 instrument. The application may also provide schools with an alternative medium for indirectly and non-invasively supporting awareness of students' psychological conditions, enabling more responsive approaches to adolescent mental health support.

METHOD

Research Time and Place

This research was conducted from May to September 2025. The study was carried out at the Al Azhar Islamic Education Foundation School, Kebayoran Lama, Jakarta, as the site for application trials and data collection from student respondents. Meanwhile, the development of the gamification-based digital media and application design process was conducted at the researcher's residence. The application development, feature testing, and data analysis processes were completed within 16 weeks

Tools and Materials

The tools used in this study include the application of NEKOMO and SPSS/STATA for DASS-21 data analysis. The research instruments used are the DASS-21 questionnaire to measure the level of anxiety of adolescents, application feasibility test questionnaires for media and material experts.

Research Design and Procedure

Research Approach

This research uses an experimental pre-post test approach. Meanwhile, the NEKOMO design is based on the Research and Development (R&D) approach using the ADDIE model, which consists of five stages:

1. Analysis: Identify adolescent mental health problems, especially the phenomenon of anxiety, as well as the need for adolescent-friendly digital media. This stage also includes literature analysis and survey of application feature needs.
2. Design: Designing application flows, gamification features (points, levels, streaks, daily challenges, journaling, mindfulness), as well as compiling research instruments in the form of questionnaires, knowledge tests, and open-ended questions.

3. Development: Develop NEKOMO application prototypes with Python language and Streamlit/Tkinter framework, complete chatbot features, and validate instruments to experts.
4. Implementation: Carry out application trials to respondents. This stage consists of pre-test, intervention (use of the NEKOMO application during a certain period), and post-test.
5. Evaluation: Conducting formative evaluations based on input from experts and pilot tests, as well as summative evaluations based on quantitative and qualitative data analysis from respondents.

Research Variables

The research variables in this study consist of independent and dependent variables. Variable X (independent) is the application of NEKOMO as a gamification-based educational digital media. Variable Y (dependent) is the level of adolescent mental health, with indicators of emotional awareness, ability to manage anxiety, and understanding of mental health based on the results of DASS-21 scores.

Research Subject

This study uses a purposive sampling technique, which is the selection of respondents based on certain criteria that are relevant to the purpose of the study. The sample consisted of adolescents of Al-Azhar 1 Islamic High School 1 Jakarta aged 15–17 years old who had used the NEKOMO application for 7 consecutive days and filled out the DASS-21 instrument in the Indonesian version of the pre-test and post-test in full. A total of 128 students registered and obtained access to the application, but only 45 students (35.2%) met the inclusion criteria as full active users. The rest consisted of inactive participants (46.9%), one-day users (14.1%), and participants who only registered without activity (3.9%). This purposive selection was carried out so that the analyzed data truly represented the group of users with adequate intervention exposure and met the completeness of the research instrument.

Data Processing and Analysis

The data of this study was quantitative obtained from three instruments, namely DASS-21, SUS, and expert validation questionnaires. Data from the DASS-21 questionnaire was processed by scoring according to the guidelines, then categorized into normal, mild, moderate, severe, and very severe levels. Next, a normality test was carried out with Shapiro-Wilk, then a different test using a paired sample t-test if the data was normally distributed or the Wilcoxon signed-rank test if the data was abnormal, to see the effectiveness of the NEKOMO application in reducing the level of anxiety in adolescents.

System Usability Scale (SUS) data was obtained from users after trying the application. The score was calculated based on the standard SUS formula with a range of 0–100, then interpreted in categories (score ≥ 68 = good/feasible). The validation data of media experts and subject matter experts was analyzed in a quantitative descriptive manner by calculating the average score of each aspect, then converted to the feasibility category (very feasible, feasible, moderately feasible, less feasible). The results of the analysis from the three data sources were presented in the form of tables, graphs, and narrative descriptions so as to provide a comprehensive picture of adolescent anxiety conditions, application feasibility, and the effectiveness of NEKOMO as a gamification-based intervention medium.

RESULTS AND DISCUSSION

Respondent Characteristics

This study included a number of adolescent respondents from Al-Azhar 1 Islamic High School Jakarta who had used the NEKOMO application for 7 days (1 week). Most of the respondents in this study were in the age range of 15–17 years, with the majority coming from class XII, while classes XI and X were minority groups. All participants participated voluntarily to participate in pre-test and post-test activities using the Indonesian version of the DASS-21 instrument and were given an explanation of the purpose of the research and the use of the data collected. By involving a total of 128 respondents who registered and used the NEKOMO application. Based on application usage activities, respondents were divided into several categories as shown in Table 2 below:

Table 2: Distribution of Respondents

Respondent Categories	Quantity (n)	Percentage (%)
Inactive (register but not use the app)	60	46,9
Fully active (using the app and filling out the full pre-post test)	45	35,2
One day (using the app only 1 day)	18	14,1
Enter email only (no advanced activity)	5	3,9
Total	128	100

Source: Primary Data (processed), 2025

A total of 45 respondents (35.2%) were fully active and had complete pre-post test data, so it became the main sample in the analysis of the effectiveness of the NEKOMO application. Meanwhile, the other 83 respondents did not complete all stages (pre-test or post-test), so they were not included in the statistical analysis, but were still counted in the respondents' characteristics to show the overall participation

Test Research Instruments

Reliability Test

Research by Hakim and Aristawati (2023) in the Journal of Psychology Ulayat explains that the Indonesian version of the Depression Anxiety Stress Scale-21 (DASS-21) instrument is valid and reliable. The test determined good construct reliability, with a score of 0.88 for the depression scale, 0.86 for anxiety, and 0.77 for stress. Thus, the Indonesian version of DAS-21 can be a legitimate measuring tool for assessing the level of depression, anxiety, and stress in the adolescent population in Indonesia

Validity Test

Based on the results of research by Hakim and Aristawati (2023) in the Journal of Psychology Ulayat, the construct validity test of the Indonesian version of the DASS-21 instrument was carried out using Confirmatory Factor Analysis (CFA). The results of the analysis showed that the three-factor model of DASS-21 (depression, anxiety, stress) was in accordance with the theoretical structure and had a factor loading value above 0.50 and a model fit index (CFI > 0.90; RMSEA < 0.08). Thus, the Indonesian version of DASS-21 can be declared valid and suitable for use as a measure of stress, anxiety, and depression levels in adolescents.

Analysis of Anxiety Level in Adolescents of Al Azhar 1 Islamic High School Jakarta based on the Measurement Results of the DASS-21 Instrument

The analysis was conducted to determine changes in the level of anxiety, depression, and stress of adolescents before and after using the NEKOMO application. Based on the results of the descriptive statistical test, there was a decrease in the average score in all three domains, as shown in Table 3 below:

Table 3: Statistical Description of the Pre-Post Test DASS-21

Domain	Red Pre	Mean Post	Std. Dev Pre	Std. Dev Post
Anxiety	14.22	9.02	8.73	8.78
Depression	11.73	9.16	8.51	9.76
Stress	14.84	10.44	8.59	9.46

Source: Primary Data (processed), 2025

The results of the analysis showed a decrease in mean scores from pre to post-test in all three domains, which indicated a decrease in anxiety, depression, and stress levels after using NEKOMO's educational digital media for 7 days. This decrease is in line with the theory of Emotional Regulation (Gross, 1998) that reflective/relaxation activities stabilize emotions; the Zen Garden and Breathing Exercises features support these mechanisms. In addition, the theory of Self-Determination (Deci & Ryan, 2000) explains that gamification elements increase intrinsic motivation and self-control so as to help manage anxiety. Psychometrically, DASS-21 has proven to be valid and reliable in the Indonesian context (Hakim & Aristawati, 2023), so the change in scores in this study reflects real changes in psychological conditions.

NEKOMO as an Educational Digital Media to Improve Adolescent Mental Health through Gamification

Media Expert Validation Test

The validation test of media experts was carried out to see the aspects of appearance, interactive design, and suitability of NEKOMO application features as an educational digital media. The validation process was carried out by Indri Yunita Suryaputri, S.Psi., M.Si., a lecturer and practitioner of educational psychology. The three main aspects were assessed, namely, material, media feasibility, and media effectiveness.

Table 4: Media Expert Validation Results

Assessment aspects	Average Score (1-4)	Categories
A. Material (Dass-21 Anxiety Level Condition)	3,5	Good
B. NEKOMO Media Qualification	3,6	Excellent
C. Media Effectiveness	3,5	Good
Total Average	3,5/4	Suitable for use with minor revisions

Source: Primary Data (processed), 2025

The validator noted that the language in the application should be more adapted to the communication style of adolescents, such as the word "you" to "you", and simplify the sentence "daily entry calendar" to make it easier to understand. Overall, the NEKOMO application was declared suitable for use with minor revisions, especially in minor language aspects without

changing the content content or gamification mechanism. These findings are consistent with the principle of Multimedia Learning (Mayer, 2001) that language-visual-interaction compatibility increases user acceptance and understanding of educational media.

Subject Matter Expert Validation Test

The validation of the subject matter expert intends to assess the suitability of the content, the accuracy of the psychological concepts used, and the integration of the material with the learning objectives of adolescent mental health. The assessment contains aspects of the suitability of the DASS-21 indicators, the integration of content, language, and educational value that depends on the application. The results of the material validation are shown in the following Table 5 (recap results based on the attached validation sheet):

Table 5: Validation Results of Subject Matter Experts

Assessment Aspects	Average Score (1-4)	Categories
Fit of the Material with the Purpose	3,7	Excellent
Content and Context Integration	3,5	Good
Accuracy of Psychological Concepts	3,6	Good
Language	3,4	Good
Educational and Non-Violent Values	3,8	Excellent
Total Average	3,6 / 4,0	Suitable for use with minor revisions

Source: Primary Data (processed), 2025

The validator suggested that explanations of features such as Mood Color and Zen Garden be added with a brief psychological context so that users understand their relationship with emotion management. Based on the results of the validation, the NEKOMO application is stated to be a screen in terms of material and media, and can be used in the implementation stage as an educational digital media to support the improvement of adolescent health. Theoretically, this is in line with Reigeluth (1999) that relevant and structured materials increase the effectiveness of digital learning, as well as the findings of Hamari et al. (2016) that gamification strengthens user motivation and retention.

Product Feasibility Analysis

Qualitative analysis of 43 Feedback showed good satisfaction in terms of ease (M=3.8) and visual design (M=3.7). High user recommendation scores (average ≈8.7; 73% of promoters), indicating positive product acceptance. The most appreciated features were an emotion tracker/questionnaire, followed by AI chatbots and breathing exercises. On the other hand, daily benefits obtained the lowest score (M=3.4), indicating the need for habit-forming mechanisms (notifications, streaks) and activity variations. The most dominant complaints were related to bugs and difficulties in Zen Garden, slow chatbot response, and games that were perceived as less attractive. These findings directed improvement priorities to Zen Garden's stability and chatbot optimization, along with the enrichment of game variations and the addition of retention features (notifications/streaks and character customization) to improve engagement and the impact of daily use. The results of this acceptance are in line with Self-Determination Theory (Deci & Ryan, 2000): a sense of autonomy and active involvement through gamification drives engagement and the perception of benefits.

Table 6: Summary of Satisfaction and NPS (n=43)

Indicator	Key Statistics	Notes
Ease of use	M = 3.8	Height
Visual design	M = 3.7	Height
Daily benefits	M = 3.4	Lowest → need habit-forming features
Recommendations (0-10)	Average ≈ 8.7	Positive insignia
NPS	73% Promoter	High satisfaction indicators

Source: Primary Data (processed), 2025

Table 7: Feature Appreciation Theme

Ratings	Features/Topics	Summary of Findings	Product Implications
1	Emotion Tracker/Questionnaire	Most appreciated; helps quick reflection	Maintain and strengthen user insights
2	Chatbot AI	Helpful, but need more response Fast	Latency & response quality optimization
3	Breathing exercises	Preferred for short relaxation	Add variations & quick guides

Source: Primary Data (processed), 2025

Analysis of NEKOMO's Effectiveness in Reducing Anxiety Levels in Adolescents of Al Azhar 1 Islamic High School Jakarta

Before conducting the effectiveness test, a data normality test was carried out using the Shapiro-Wilk method, because the sample size was less than 50 respondents (n = 45). This test aims to see whether the pre-test and post-test score data from each domain are normally distributed or not.

Table 8: Normality Test (Shapiro Wilk)

Variable	Statistics	df	Sig. (p)	Remarks
Anxiety_pre	0.950	45	0.051	Normal
Anxiety_post	0.854	45	0.000	Abnormal
Depression_pre	0.939	45	0.019	Abnormal
Depression_post	0.826	45	0.000	Abnormal
Stress_pre	0.970	45	0.283	Normal
Stress_post	0.888	45	.000	Abnormal

Source: Primary Data (processed), 2025

Based on the results of the normality test, most of the post-test data was abnormal ($p < 0.05$), then the non-parametric Wilcoxon Signed-Rank Test was used.

Table 9: Wilcoxon Signed Rank Test

Domain	Z	p (Asym. Sig. 2-tailed)	Remarks
Anxiety	-3.586	0.000	There is a significant difference
Depression	-2.178	0.029	There is a significant difference
Stress	-2.834	0.005	There is a significant difference

Source: Primary Data (processed), 2025

Based on statistical analysis (Wilcoxon Test), it was found that there was a statistically significant change ($p < 0.05$) in students' scores before and after using the NEKOMO application> This change was confirmed by a negative Z value. A negative sign specifically showed that the score after using the application (post-test) was indeed lower than the previous

score. In other words, the NEKOMO application was proven to be effective in lowering the three domains in students of Al-Azhar 1 Islamic High School Jakarta. These findings are consistent with Lovibond & Lovibond (1995) regarding the sensitivity of DASS-21 to post-intervention psychological changes, as well as with Gross (1998) regarding the role of emotion regulation in lowering stress responses. In terms of design, the gamification element in NEKOMO supports motivation and self-control (Deci & Ryan, 2000), which contributes to a decrease in post-intervention scores.

CONCLUSION

Based on the results of the research entitled "NEKOMO: Development of Educational Digital Media to Improve Adolescent Mental Health through Gamification" and the analysis of the collected data, conclusions were obtained to answer the research questions and evaluate the proposed hypothesis. The anxiety levels of adolescents at SMA Islam Al Azhar 1 Jakarta, based on measurements using the DASS-21 instrument, showed that most respondents were within the normal to moderate categories. The average anxiety score decreased from 14.22 to 9.02 after the intervention. These findings indicated a reduction in anxiety scores and psychological distress following the use of the NEKOMO application. However, of the 128 students initially registered, only 45 active respondents completed both the pre-test and post-test assessments; therefore, the findings represented the conditions of the participants who completed the full research procedure.

The feasibility evaluation of NEKOMO as an educational digital medium, based on validation results from media experts and subject matter experts, obtained average scores ranging from 3.5 to 3.6 out of 4.0, categorized as "Suitable for use with minor revisions." The application was considered to have fulfilled the required aspects of content quality, language, visual design, and interactivity, indicating its suitability as an educational digital medium within the context of adolescent mental health support.

The effectiveness evaluation of the NEKOMO application showed statistically significant differences based on the Wilcoxon Signed-Rank Test results, with p-values < 0.05 across all DASS-21 domains (anxiety, depression, and stress). These results indicated significant differences between pre-test and post-test scores, suggesting that the use of NEKOMO was associated with improved psychological outcomes among adolescents at SMA Islam Al Azhar 1 Jakarta. However, further research with larger samples, control groups, and longer observation periods is recommended to examine the sustained effects of the application.

Future development of NEKOMO may include the addition of user engagement features, such as notifications and character customization, as well as longer intervention periods to evaluate medium-term outcomes. The study may also be expanded to include respondents from various schools to improve the generalizability of the findings. The NEKOMO application may serve as a supportive counseling medium to assist students in managing mild stress and anxiety. Recommended improvements include optimizing the functions of the Zen Garden and AI chatbot features, increasing game variety, and implementing user retention strategies to enhance engagement and interactivity. The use of the NEKOMO application is recommended to be conducted regularly and reflectively rather than only during periods of anxiety. Daily interaction with mood-tracking features, questionnaires,

and relaxation-based games may support the development of positive emotional regulation habits and psychological well-being.

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