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Development and Evaluation of the *PIKIBAR* Game: A Gamified Approach to Reducing Math Anxiety in University Students

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Abstract: Math anxiety is not a simple thing that can be ignored because it has an impact on not maximizing the achievement of mathematics learning outcomes. Based on the condition, the *PIKIBAR* game was developed to reduce math anxiety in algebra learning. This research aims to describe the process and results of developing the *PIKIBAR* game to reduce mathematical anxiety among University students. This development research utilized the ADDIE model and pre-service mathematics students from Universitas Islam Jember as the research sample. Data collection methods included interviews, observations, questionnaires, tests, and documentation, as well as data analysis methods that utilize percentages. The research results indicate that the development of the *PIKIBAR* game progressed through the ADDIE stages, which encompass analysis, design, development, implementation, and evaluation. Several parts need revision, with a score of 3.03 out of a maximum score of 4. At the same time, the practicality is very high, namely at a value of 86.25%. In terms of its effectiveness, it is said to be effective in reducing mathematical anxiety, as evidenced by a lower percentage among students who use it, specifically 40%, compared to the group of students who do not use it, at 80%. Judging from the average score of the questionnaire results given before using the game and after using the game. This game was designed with simple language and gradually guided the user from the beginning, starting with an easy level, then progressing to a medium level, and concluding with a difficult level, all without the user realizing it directly. For further research, if you want to use the same application to develop test and non-test instruments, avoid using the short form model because differences in writing can affect the results. For mathematical anxiety, it should be considered for monitoring material because it has a significant impact on learning outcomes and achievement, especially in mathematics.

Keywords: *PIKIBAR* game, math anxiety, algebra.

▪ INTRODUCTION

Mathematics is the queen of sciences, where mathematics plays an important role in all aspects of life, especially in improving human thinking power, which can later be applied to overcome problems in everyday life (Milaturrahmah et al., 2017; Pujiastuti et al., 2020). Mathematics is an axiomatic, abstract, deductive, and symbolic science with its elements being interrelated and inseparable (Öztaş, 2023; Purwanto et al., 2020; Siskawati & Chandra, 2017). Mathematics cannot be learned solely by memorization, but this does not mean that students cannot or should not memorize concepts in the learning process. When learning mathematics, memorization can be facilitated by a strong understanding of what is to be memorized. Because memorizing something does not necessarily mean understanding it, and vice versa, understanding something does not necessarily mean memorizing it (Idris & Jamil, 2025). Based on these conditions, it has resulted in the perception that learning mathematics is not easy, feels complicated, drains energy and thought, and is boring, which does not motivate learning (Cahyani & Irwan, 2020; Ozuna et al., 2023; Siskawati et al., 2024).

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Based on this explanation, it gives rise to bad assumptions when studying mathematics. This condition has an impact on the emergence of feelings of anxiety when studying mathematics, which ultimately results in the inability to solve problems, and not understanding basic symbols and concepts, resulting in learning outcomes that cannot be maximized due to the inability to take tests (Azizah et al., 2019; Ley, 2024), such feelings are often known as math anxiety. Mathematics anxiety can simply be seen as a feeling of fear of mathematics, both when taking mathematics classes, when studying and solving mathematics problems, or when facing mathematics exams (Juniati & Budayasa, 2020b)

Anxiety in mathematics cannot be considered normal. Mathematics anxiety in a person occurs due to an inability to adapt when dealing with mathematics. The presence of anxiety in learning mathematics will potentially cause difficulties when participating in mathematics learning. If this situation is ignored, it will ultimately lead to poor results and achievements. Thus, attention is necessary when addressing mathematics anxiety (Akkaya & Polat, 2022; Brewster & Miller, 2023; Juniati & Budayasa, 2020a).

Supported by the results of observations in the field, especially students in the Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Islam Jember, who took the algebraic structure course, it appears that they understand the material being studied. Students were able to solve the given questions; some wrote answers sequentially and correctly, some conveyed answers orally, and some presented mature arguments using existing concepts. The Algebraic Structures courses are highly abstract because they focus on fundamental concepts, such as sets, binary operations, groups, rings, and fields (Alam & Mohanty, 2024), which often lack concrete visual or contextual representations. Students often struggle to relate these concepts to concrete experiences, increasing cognitive load (Chen et al., 2023). In addition, many definitions and proofs in algebraic structures require a high level of logical thinking and formal precision, which can trigger greater mathematical anxiety than other, more procedural or applied courses such as calculus or statistics. However, when faced with tests, whether in the form of Mid-Semester Exams or Final Semester Exams, or even regular quizzes, conditions become unstable. Only around 25 percent of students can answer verbally or in writing the tests they face. When they are helped to feel calmer when facing tests, things start to become more under control. Students are gradually able to complete their tests better.

Based on this explanation, it is necessary to have relaxed conditions that are not stressful and cause feelings of fear when facing tests, especially mathematics. Supported by the opinion that states that (1) games can help overcome stress and anxiety in a person; (2) games can help someone manage anxiety through activities to relax tense thoughts; (3) games can reduce anxiety and depression in a person (Bossenbroek et al., 2020; Lobel et al., 2016; Pallavicini et al., 2021; Schoneveld et al., 2020; Weerdmeester et al., 2017), thus inspiring the development of the *PIKIBAR* game to reduce mathematical anxiety in students when facing tests.

PIKIBAR is an extension of Algebra Picnic, so this game contains a collection of questions in several forms, except for long descriptions, which are packaged into problem packages that can be done like playing a game. Every time you successfully pass a set of questions, the game will move up to the next, more complex level. The questions in the game are presented in simple language that is neither complicated nor boring. *PIKIBAR*, as an extension of Algebra Picnic, is designed not only as a learning tool but also as a

stress-reducing game. Its effectiveness lies in the way mathematical problems are presented as playful, engaging challenges rather than as formal, intimidating exercises (Haryono et al., 2024). By using a level-based progression system, players experience a sense of achievement and curiosity, which motivates them to continue. Each level offers a set of questions in various formats (excluding long texts) with simple, approachable language, making it accessible and enjoyable for students of different abilities.

This game can significantly reduce math anxiety by transforming the learning atmosphere into a relaxed, game-like environment. Instead of feeling pressured, learners are immersed in a playful exploration of mathematical concepts. The gamified structure fosters intrinsic motivation, while the incremental difficulty ensures continuous cognitive engagement without overwhelming the learner. Compared to other educational games, *PIKIBAR* has several superior features: (1) Stress-Reducing Design, unlike many math games that retain a test-like format, *PIKIBAR* emphasizes fun, simplicity, and low-pressure engagement. The display is presented attractively with a picture of the subject walking in the forest looking for treasure, not as rigid as exam questions in general; (2) Adaptive Complexity, the game's gradual increase in difficulty matches the learner's pace, making it ideal for differentiated learning, the questions are presented from easy, medium to difficult levels, not just difficult; (3) Language Accessibility, questions are written in straightforward, non-technical language or easy to be understand, which supports better comprehension and encourages sustained focus; (4) Package Based Problem Sets, instead of isolated questions, problems are grouped into meaningful packages, encouraging deeper cognitive processing and thematic understanding; (5) Motivational Progression, like a video game, *PIKIBAR* rewards progress, which reinforces a positive learning cycle and helps maintain interest, students that can finish the question fast will give more score and if not yet will decrease the score. In essence, *PIKIBAR* introduces a novel approach to learning mathematics by blending cognitive and emotional elements, bridging pedagogical strategies with game mechanics to create a more holistic and effective learning experience. Based on the explanation above, the aim of this research is to describe the process and results of developing the *PIKIBAR* game to reduce anxiety.

▪ METHOD

Participants

The subjects used in this research were selected using purposive techniques, taking into account students' needs and level of mathematical ability in the algebra structure subject. The subject was divided into three groups: the small group, the medium group, and the large group. The small group consisted of two students with low abilities, two students with medium abilities, and two students with high abilities. The medium group consisted of all students taking the algebra course. The large group consisted of six representatives from the second semester, six from the fourth semester, and six from the sixth semester.

Research Design and Procedures

The type of research was development research, utilizing the ADDIE development model (Ngussa, 2014; Spatioti et al., 2022). This model included five steps: analysis, design, development, implementation, and evaluation. To describe the process of

developing the *PIKIBAR* game by presenting the five steps of the ADDIE model. (1) In the analysis steps, the instructional problem was identified, along with the learners' characteristics, the learning context, and the goals of instruction. This stage included conducting needs assessments and identifying constraints and available resources. The purpose was to understand what needs of students. (2) In the design steps, the activities carried out were selecting applications that would be used, then the questions were designed that would be used both in various forms and at an even cognitive level. Apart from designing the questions, the background design for the game's appearance was also carried out. (3) The development steps according to the game were tested on three lecturers with qualifications, namely an algebra lecturer, a computer-assisted learning lecturer, and a counseling lecturer. During this stage, internal reviews or limited pilot trials are conducted to ensure the materials are effective and ready for use. (4) The implementation steps refer to the delivery of the developed product to the learners. This included preparing instructors or facilitators, distributing materials, ensuring access to necessary tools or platforms, and providing support throughout the learning process. Successful implementation requires careful logistical planning and training to ensure that the instructional experience runs smoothly. Finally, (5) the evaluation steps involve assessing the effectiveness and practicality of the game *PIKIBAR*.

Instruments

The data collection method in this research was carried out through (1) Interviews with an interview guide as an instrument, and interviews were used to get the data about students' needs. (2) Observation as an instrument in the form of an observation sheet, observations were used to get the data about the class condition. (3) A questionnaire with an instrument in the form of a questionnaire was used to get the data about math anxiety. (4) Tests with an instrument in the form of test questions, test were used to get the data bout mathematical ability in the algebra structure subject. (5) Documentation in the form of data on names and grades, as well as photos of activities, was used to get the data about students' grades in the algebra structure subject.

Data Analysis

The data analysis method then used percentages to assess the validity of the media developed, based on the criteria presented in Tables 1, 2, and 3. Additionally, the image of the model used is shown in Figure 1. The first table is used to measure the feasibility of the *PIKIBAR* game development results, where the criteria presented in the table will be used to answer the second problem formulation. To describe the feasibility of the *PIKIBAR* game, including distributing questionnaires to validators, the total number of validators is 6, and the validators are divided into three groups. The first group consists of 2 mathematics lecturers; these validators measure the feasibility of questions related to algebraic structure material. Then, the second group consists of two computer experts' lectures, which validate the feasibility of the media display and the system used. The last group consists of 2 psychology lecturers, and these validators measure the relationship between questions and math anxiety. The questionnaire given is presented in 3 different types, namely (1) a questionnaire related to mathematics material; (2) a questionnaire related to the appearance and workings of the game, especially in the IT field; (3) a questionnaire related to psychological material. Each questionnaire consists of 25 positive statements, with a score range of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4

(strongly agree), for a maximum score of 100. After all validators had filled out the questionnaire and the results were averaged, adjust the results according to the criteria in Table 1.

Table 1. Feasible criteria

Score	The feasible criteria	Information
$3.26 < \bar{x} \leq 4.00$	Valid/fit for use	No revision
$2.51 < \bar{x} \leq 3.26$	Valid enough/fit for use	Partial revision
$1.76 < \bar{x} \leq 2.51$	Lessivalid/fit for use	Partial revision & re-assessment
$1.00 < \bar{x} \leq 1.76$	Not valid/fit for use	Revision in all parts

Table 2 was used to categorize the practicality of the *PIKIBAR* game development results, where the criteria presented in the table will be used to answer the third problem formulation. To describe the practical of the *PIKIBAR* game, includes distributing questionnaires to lecturers and students. The lecture chosen is from all the lectures in the Mathematical Learning Program, and it is intended for all students who follow the algebra structure subject. They were asked to use the *PIKIBAR* game and then complete the questionnaire. The questionnaire consists of 25 positive statements, each with a score range of 1 (strongly disagree) to 4 (strongly agree), with a maximum score of 100. A practicality questionnaire contains indicators that assess the ease of use of features in the *PIKIBAR* game, the ease of understanding statements in the *PIKIBAR* game, the usefulness of the *PIKIBAR* game in measuring user success, and the openness in providing scores. After all subjects have completed the questionnaire and the results are averaged, adjust the results according to the criteria outlined in Table 2.

Table 2. Practical criteria

Score	Practically Criteria
$80\ \% < x \leq 100\ \%$	Very practice
$60\ \% < x \leq 80\ \%$	Practice
$40\ \% < x \leq 60\ \%$	Practice enough
$20\ \% < x \leq 40\ \%$	Less practice
$0\ \% < x \leq 20\ \%$	Not practice

The questionnaire was administered to students before and after they learned the algebra structure using the *PIKIBAR* game for the quiz. The Anxiety Questionnaire used was the Math Anxiety Scale developed by Nurkarim & Rifki (2023). This questionnaire consisted of indicators for physiological, psychological, behavioral, and cognitive symptoms. There were a total of 30 statements included in these indicators, and divided into 13 positive statements and 17 negative statements. The physiological symptoms consisted of seven statements. The psychological symptoms consisted of 12 items, comprising five positive statements and seven negative statements. For behavioral symptoms consisted of six statements. The last indicator is cognitive symptoms, which consists of three positive statements and two negative statements. This instrument used a Likert scale with 5 rating categories: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). If the student's score on the questionnaire decreases, it can be said that the student's math anxiety has decreased. To describe this condition, a t-test was used to obtain a p-value greater than 0.05, indicating that H1 is

rejected and H0 is accepted. Then, if the p-value is less than 0.05, H1 is accepted and H0 is rejected. The effectiveness criteria are presented in Table 3.

Table 3. Effectiveness criteria

Score	Effectiveness Criteria
75 % ≤ x ≤ 100 %	Very Effective
50 % ≤ x < 75 %	Effective enough
25 % ≤ x < 50 %	Ineffective
0 % ≤ x < 25 %	Very Ineffective

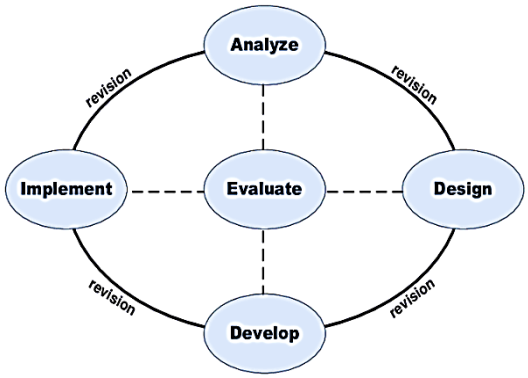

Figure 1. The design model ADDIE

▪ RESULT AND DISSCUSSION

This research was a type of development research that uses the ADDIE model. The development intended here is in the form of developing a test question instrument with the help of the Quiz Whizzer application to reduce students' mathematics anxiety when facing tests and dealing with lecturers. The questions used were presented in several forms, with varying cognitive levels. The questions were presented in a game display equipped with musical sounds, which can help reduce boredom. The test instrument developed was subsequently named the *PIKIBAR* Game. The stages that went through in developing this *PIKIBAR* game include the following:

Analysis

Analysis is the initial step carried out in the development of the *PIKIBAR* game. In analysis activities, the analysis carried out includes subject analysis, material analysis, and learning conditions analysis. In a more sequential, complete, and clear manner, the following is a presentation of the analysis results obtained

Analysis of Learning Conditions

Analysis of learning conditions was conducted through interviews and observation activities, utilizing instruments such as interview guides for the interviews and observation sheets for the observations. Interview activities were conducted to gather lecturers' opinions on the learning process, including planning, implementation, and evaluation. Meanwhile, observation activities were conducted to directly observe the learning process, as an effort to identify learning problems.

The interview and observation activities were conducted, and the results obtained from these activities were used in the learning planning process. The lecturer always prepared tools in the form of Lecture Contracts, RPS (Semester Learning Plan), LKM (Student Worksheet), RTM (Student Assignment Plan), test sheets for Quiz, UTS (Midterm Exam), and UAS (Final Examination). In the learning process, lecturers used PjBL, where every meeting included a discussion activity to convey the progress of their project and gather responses and suggestions from the audience. The learning approach was student-centred; the lecturer acted as a facilitator to direct, guide, and motivate students to achieve success. The evaluation activities were conducted in three stages, and at each meeting, a quiz was always administered. Then, in the middle of the semester, a midterm exam was administered, and at the end of the semester, a final examination was held. In planning, process, and evaluation activities, everything can be done well; howeve, evaluation is often hindered by the lack of optimal learning outcomes. This situation occurs to the existence of math anxiety in students when dealing with tests and lectures.

This assumption is supported by observation results, which show that when students are not taking a test, they understand the material being studied. Students were able to solve the given questions; some wrote answers sequentially and correctly, some conveyed answers orally, and some presented mature arguments using existing concepts. However, when they were helped to feel calmer in facing the test, things began to become more controllable. Students are gradually able to complete their tests better. Apart from that, when students discuss a topic without a lecturer's guidance, it is based on existing concepts. However, when they are asked to take responsibility for conveying it to the lecturer, the situation becomes chaotic again. From the results of the interviewing activity, students stated that they need an instrument that can be completed without a lecture; they will calm down and enjoy the task. However, when the teacher is present, it makes them feel nervous or anxious. It means that students need tests that do not make them stressed and burdened, they will not do the examination, but feel like playing a game.

Subject Analysis

Subject analysis was conducted using observation and unstructured interviews to collect data on students' conditions. The conditions to be studied are adjusted to indicators that lead to mathematical anxiety. Based on the results of observations, it shows that, (1) Some students often neglect learning, especially in the algebra structure course, for no other reason than because the material is considered difficult, they have achieved many assignments, they are anxious when given oral exams, they are anxious when they are given additional assignments when they meet with their lecturers; (2) This triggers students to break the rules by not coming to class on time, taking permission when there is a quiz or when they have to make presentations and discussions in front of the class; (3) Most of them are not enthusiastic about the learning process so they do not understand the material presented in the presentation; (4) Apart from that, they are also lazy to study independently by looking for further information regarding material that they do not understand because often the material on Google is more complex, while the reading material available on campus is still limited.

Based on the analysis results obtained, the solution that can be offered to overcome the existing problems is none other than the development of the *PIKIBAR* game, where students do not need to meet directly with the lecturer, do not need to convey their

arguments, and do not need to take long and tiring tests, just use a cellphone or laptop. The questions are designed to be simple, so they do not cause stress or depression when reading them

Design

At the design stage, the activities carried out included selecting applications to be used in developing the *PIKIBAR* game. The application chosen is Quiz Whizzer, considering that it is free to use, easy to use, and its appearance is attractive. Then, questions are designed that will be used both in various forms and at an even cognitive level. Apart from designing the questions, the background design for the game's appearance is also carried out. The specialty of the application chosen to develop the *PIKIBAR* game is that the game background does not need to be created from scratch, but can simply be chosen from the available collection. There is no need to worry about the appearance being unattractive because the appearance provided is very good and varied, and can make users interested in playing. Furthermore, the game's accompanying music is also selected to make users comfortable playing and not get bored. Apart from that, it is also necessary to design a scoring system that determines which player will become the champion if they successfully go through all stages of the game. The following illustrates the appearance of the *PIKIBAR* game in Stage I, prior to proceeding to the validation stage. Figure 2 shows the initial appearance of the game, which contains the profile and playing area map. Then, in Figures 3, 4, and 5, the various types of questions that must be answered are illustrated, allowing the game to progress until it reaches the completion stage.

Pedagogically Aligned Question Design

Unlike many educational games that focus solely on entertainment or drill-style repetition, *PIKIBAR* is carefully designed with questions that vary not only in format but also in cognitive levels, ensuring alignment with learning objectives and promoting higher-order thinking. This makes *PIKIBAR* more than just a game—it becomes a structured learning journey.

Integrated Anxiety Reduction Purpose

PIKIBAR is explicitly designed with a psychological objective: to reduce test anxiety and fear of interaction with lecturers, which is not a common focus in most educational games. Its tone, pacing, and feedback mechanisms are intentionally crafted to create a relaxed and reassuring experience for learners.

Ease of Development with High Visual Quality

By leveraging the Quiz Whizzer platform, *PIKIBAR* combines ease of development with high-quality visual output, enabling efficient game creation without sacrificing user appeal. The choice to use platform-provided templates ensures a polished aesthetic while allowing focus to remain on pedagogical content and game mechanics.

Minimal Cognitive Load in Navigation and Play

PIKIBAR's user interface is clean and intuitive, reducing unnecessary complexity often found in more elaborate games. This low cognitive barrier encourages students who

may be hesitant or overwhelmed by conventional games to participate fully and confidently.

Real-Time Competitive Scoring for Motivation

The scoring system in *PIKIBAR* is designed to promote healthy competition, maintain motivation throughout the game. Unlike many other games that provide individual progress feedback, *PIKIBAR* allows visible progression and competition among players in a way that encourages perseverance and peer learning.

Cultural and Contextual Relevance

PIKIBAR is developed with an understanding of the local educational context, student behavior, and classroom dynamics. This makes it more relatable and effective compared to imported or general-purpose educational games.

Figure 2. The figure of the game profile

☐	Monoid sudah pasti semigrup tetapi semigrup belum tentu monoid	True/False
☐	Grupoid dapat dikatakan sebagai grup asal memiliki sifat assosiatif, memiliki identitas, serta invers	True/False
☐	Semigrup yang tidak assosiatif maka dikatakan sebagai grupoid	True/False
☐	Grup adalah monoid yang memiliki invers	True/False

Figure 3. The figure of the true/false question

☐	Hasil penjumlahan modulo 5 dari 3 dengan 4 adalah...	Multiple Choice	furrr	A. 2 ✓ B. 3 C. 4 D. 7

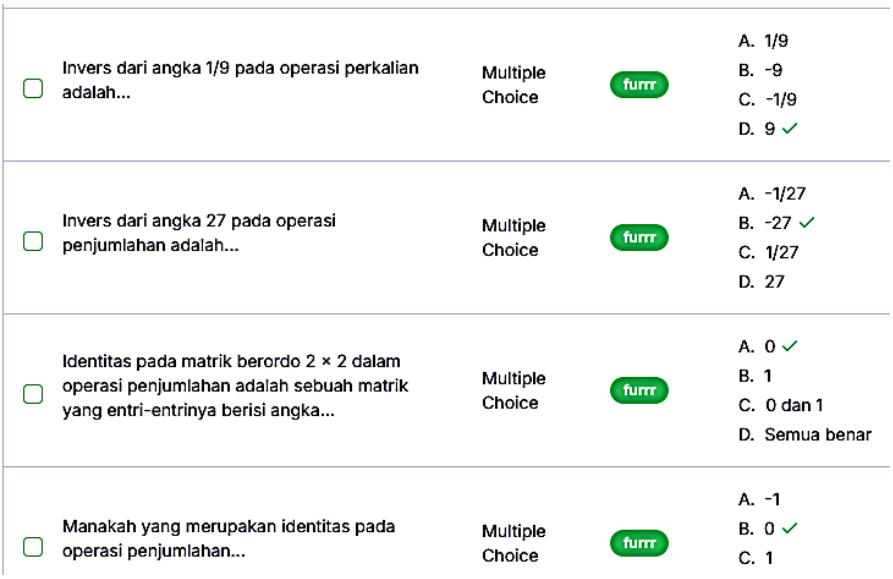

Figure 4. The figure of a multiple-choice question

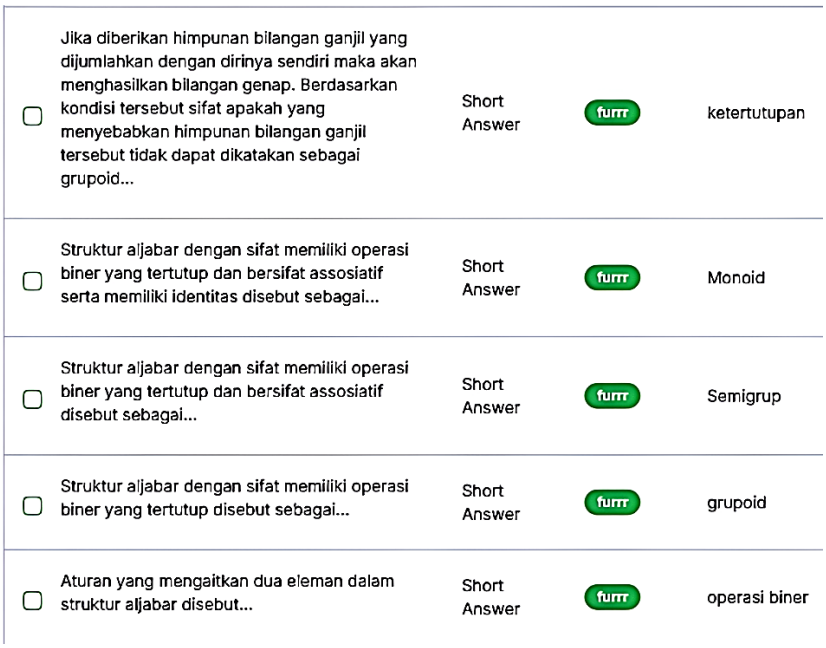

Figure 5. The figure of the short answer question

Develop

After the *PIKIBAR* Game was finished, it was tested on three lecturers with relevant qualifications, namely an algebra lecturer, a computer-assisted learning lecturer, and a counseling lecturer. The scores given were 2.55 for the algebra lecturer, 3.75 for the computer-assisted learning lecturer, and 2.80 for the counseling lecturer, with an average of 3.03. The criteria were deemed quite adequate, but several parts required revision. These criteria are derived from the methodology section, specifically Table 1, which outlines the eligibility criteria. Next, the complete validation results obtained from the validators are presented

Table 4. The value of validator validation

No	Qualification	Input	Information
1	Algebra	1. If you can display a model question that can measure the solution in the form of a long essay question, it will have more weight 2. The material is appropriate, but the quality of the questions does not represent the cognitive level at C4, C5, and C6	Feasible enough, but needs to be rethought regarding the input given (2.55)
2	Computer	1. The display is good 2. The system is also working well	Feasible without revision (3.75)
3	Psychology	Avoid using long and rambling sentences	Feasible enough (2.80)

Implementation

At the implementation stage, the product has been validated by the validators and refined according to their suggestions. It is then tested on students in semesters 4 and 6 to determine the practicality percentage of the *PIKIBAR* Game. Apart from being tried on students, this game was also tested on lecturers in the mathematics education study program at FKIP Jember Islamic University. Based on the experimental results, the average percentage given by lecturers was 89.17%, while the rate for students was 83.33%. If you average the percentage gains from teachers and students, the result is 86.25%, which is an efficient criterion. In more detail, the results obtained are presented below.

Table 5. The value of response

No	Qualification	Percen
1	Lecture	80%. 75%. 85%. 90%. 80%. 90% Average = 83.33 %
2	Students	80%. 90%, 85%. 90%. 80%. 90% 85%. 90%. 95%. 95%. 95%. 95% Average = 89.17 %

Apart from measuring feasibility and practicality, this development research also measures the effectiveness of games in reducing students' mathematical anxiety. This measurement is carried out by comparing the results of the questionnaire between *PIKIBAR* game users and non-*PIKIBAR* game users before facing the test. To determine the comparison between the results of the *PIKIBAR* game users and non-users, a questionnaire was administered to one class, which was asked to complete an anxiety questionnaire after completing a written or oral test. This group was subsequently referred to as non-users of the *PIKIBAR* game. Subsequently, the subjects were given a test using the *PIKIBAR* game and then asked to complete the anxiety questionnaire. This group was subsequently referred to as users of the *PIKIBAR* game. In this study, there were no experimental or control groups. There was only one group that was given treatment in the form of a test using the *PIKIBAR* game. Furthermore, based on the results obtained,

namely for students who use the *PIKIBAR* game, the average score obtained is 45, with 40% of students getting a score below 50, while in the group of students who do not use the *PIKIBAR* game, the average score obtained is 87, with 80% of students getting a score above 50. Thus, it can be said that the *PIKIBAR* game is effective in reducing students' mathematical anxiety. Nevertheless, it should be noted that this study has limitations in terms of presenting the results, as it only presents preliminary findings because there were no statistical tests were conducted. The data obtained was only presented to provide an overview of users' anxiety levels before and after playing the game *PIKIBAR*.

Table 6. The value of effectiveness

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 PRE - POS	34.762	11.562	2.523	29.499	40.025	13.777	20	.000

Based on the results of the anxiety questionnaire completed by a sample of 21 students, a significance level of 0.000 was obtained, indicating that the result is statistically significant at the 0.05 level. Returning to the hypothesis testing, the alternative hypothesis (H1) is accepted and the null hypothesis (H0) is rejected if the significance level is less than 0.05. Thus, there is consistency with the statistical test results. It can be concluded that there is a significant difference in students' math anxiety before and after taking the exam using the *PIKIBAR* game, or between users and non-users of the *PIKIBAR* game.

Evaluation

At the evaluation stage, an analysis is carried out regarding existing findings to be used as material for improvement in further research. Based on the results of the application of the *PIKIBAR* game, findings were obtained that could be improvements for further research, the findings are as follows: (1) Questions presented in short description form have alternative answers that are less valid, where even though the answer is correct if the letters are written incorrectly then the answer is wrong, so if you want to make another question, avoid using the short answer question form. (2) Achieving the highest-ranking result as champion in the game is less concrete in the scoring. If you want to create another question package, please consider the scoring carefully. This involves reducing the score if an answer is incorrect and increasing the score if it is correct and completed quickly, as well as exploring other possible alternatives. (3) For students who have a high level of laziness and minimal interest in tests, it is necessary to carry out alternative assessment methods so that their abilities can be measured clearly and with certainty. Not only based on reviewing test results on the *PIKIBAR* Game.

Based on the research results, the *PIKIBAR* game has been successfully developed, with feasibility criteria that are quite feasible and require improvement, and practicality criteria that are very practical. This game was created as an effort to reduce students' anxiety when taking tests and dealing with lecturers. Supported by relevant research results, the use of games can overcome mathematics anxiety, where games can relax tired minds so that they can reduce stress and depression, which in turn can manage mathematics anxiety (Eve et al., 2024; Schoneveld et al., 2016).

The similarities between *PIKIBAR* and previous games include: (1) the use of gamification elements (levels, rewards, challenges) to create a motivating learning environment; (2) A focus on reducing emotional tension associated with mathematics through engaging and playful experiences; (3) Support for stress relief and emotional regulation. However, *PIKIBAR* differs from those games in several key aspects that emphasize its novelty: (1) Structure and Language Simplicity: Unlike many existing games that often include complex narratives or instructions, *PIKIBAR* deliberately uses simple, concise language and avoids long descriptions. This makes it especially suitable for students with low confidence or reading fatigue; (2) Package-Based Problem Solving: *PIKIBAR* is designed with problem packages rather than isolated questions, enabling a more coherent cognitive flow and thematic learning experience; (3) Targeted Focus on Test and Lecturer Anxiety: While previous games generally address general math anxiety, *PIKIBAR* specifically targets anxiety related to test-taking and interactions with lecturers a niche yet critical domain in academic stress; (4) Contextual and Cultural Relevance: *PIKIBAR* is developed with attention to the local educational context, making it more relatable and applicable for the students it aims to serve. Therefore, while *PIKIBAR* aligns with previous research findings on the benefits of educational games in reducing math anxiety, it also brings unique contributions by offering a simpler, more focused, and contextually grounded game design. This distinction strengthens the novelty of the product and its relevance to contemporary educational needs.

Starting with knowing the student's thinking process allows us to know how they feel when they are thinking. Of course, this can be obtained through in-depth interview activities. Based on the opinion (Zayyadi et al., 2019, 2020) that a communication tool for understanding students' thinking processes is to ask them questions. From there, it can help us determine how students' mathematics anxiety levels are.

Another opinion suggests that reducing mathematical anxiety can be achieved by making mathematics more accessible, engaging, and less boring (Aini et al., 2025; Darmayanti et al., 2023; Furner & Gonzalez-Dehass, 2011). Another opinion was also expressed that to reduce mathematics anxiety, teachers must be able to create an engaging learning atmosphere. One way that can be done is by using games or direct practical learning in the form of playing activities (Kamid et al., 2022). Thus, reducing mathematical anxiety can be facilitated by making learning more enjoyable and meaningful, an approach that can be effectively supported through educational games. Based on the presentation of research results and expert opinions, the development of the *PIKIBAR* game shows potential in reducing mathematical anxiety. This is because games can transform mathematics learning into a less intimidating and more enjoyable experience, helping students feel more relaxed, confident, and engaged, which are key factors in reducing mathematical anxiety.

Games can reduce mathematical anxiety by creating a safe, engaging, and low-stress environment for learners to explore mathematical concepts. Emotional and motivational states significantly influence how students engage with learning materials. The *PIKIBAR* game incorporates several psychological principles that help reduce anxiety: (1) Immediate Feedback, the game provides instant feedback on performance, which helps students identify and correct mistakes without fear of judgment, thereby reducing anxiety associated with failure. (2) Progressive Challenge, through gradual difficulty levels, the game maintains an optimal balance between challenge and skill,

keeping students in a comfortable state where they are fully absorbed and less likely to feel overwhelmed. (3) Positive Reinforcement, points, rewards, or encouraging messages within the game act as positive reinforcement, increasing motivation and decreasing fear of negative evaluation. (4) Active Engagement, the interactive and playful nature of games fosters active participation, which can shift the learner's focus away from fear and toward curiosity and enjoyment. (5) Safe Learning Space, unlike traditional testing environments, games create a non-threatening context where making mistakes is part of the learning process, not a source of embarrassment. From a psychological standpoint, games help reframe mathematics as a source of enjoyment rather than a source of stress. Lowering affective games allows students to engage more freely and confidently, thereby reducing the intensity and frequency of anxiety responses. As a result, educational games like *PIKIBAR* can serve as effective tools in transforming students' emotional attitudes toward mathematics.

The qualitative findings derived from student interviews further reinforce the effectiveness of the *PIKIBAR* game in addressing mathematics anxiety. Prior to the intervention, students predominantly described mathematics as a subject that provoked worry, fear of failure, and feelings of low self-efficacy. These perceptions were frequently expressed through statements portraying mathematics as "difficult," "boring," or "stressful," which aligns with the common characteristics of math anxiety. After engaging with *PIKIBAR*, however, students articulated a notable change in their attitudes. They emphasized that the game's interactive and playful nature created a more enjoyable learning environment, allowing them to engage with mathematical concepts in a less intimidating way. Students also reported feeling less pressured when solving problems within the game context, which contributed to a decrease in anxiety and an increase in confidence. The shift from perceiving mathematics as threatening to viewing it as approachable and even enjoyable illustrates the potential of *PIKIBAR* not only as an instructional medium but also as a tool for emotional regulation. This change in perception suggests that the integration of game-based learning can play a meaningful role in reducing mathematics anxiety and fostering more positive dispositions toward mathematics learning

▪ CONCLUSION

Based on the research results, it can be concluded that the development of the *PIKIBAR* game has been completed through all steps of the ADDIE development model, which includes analysis, design, development, implementation, and evaluation, with a high level of feasibility. There are several parts that need revision: the score obtained was 3.03. At the same time, its practicality was efficient, with the value being 86.25%. The effectiveness of *PIKIBAR* game was said to be effective in reducing mathematical anxiety because it gave a lower percentage of users with an average score 45, with 40% of students getting a score below 50 from a maximum score of 100, while in the non-user student group, the average score obtained was 87, with 80% of students getting a score above 50 from a maximum score of 100. For further research, if you want to use the same application to develop test and non-test instruments, avoid using the short-form model because the differences in writing can influence the results. For mathematical anxiety, it should be considered for monitoring material because it has a significant impact on learning outcomes and achievement, especially in mathematics. However, these findings

should be interpreted with caution, given the limitations of the study design, including the lack of strict control for external variables and the absence of instruments with truly equivalent formats. Therefore, further research with a more rigorous approach is needed to strengthen these findings.

▪ REFERENCES

Aini, S. D., Zayyadi, M., & Surahmi, E. (2025). Characterization of errors and math anxiety in solving differential equation problems. *Jurnal Pendidikan Matematika Indonesia*, *10*(1), 76.

Akkaya, S., & Polat, K. (2022). An investigation of the relationship between the parents' math literacy self-efficacy and their math anxieties. *Educational Policy Analysis and Strategic Research*, *17*(2), 246–265. https://doi.org/10.29329/epasr.2022.442.11

Alam, A., & Mohanty, A. (2024). Unveiling the complexities of 'Abstract Algebra' in university mathematics education (UME): fostering 'conceptualization and understanding' through advanced pedagogical approaches. In *Cogent Education* (Vol. 11, Issue 1). Taylor and Francis Ltd. https://doi.org/10.1080/2331186X.2024.2355400

Azizah, L. N., Mahmudi, A., & Retnawati, H. (2019). Profile of students' mathematics anxiety. *Journal of Physics: Conference Series*, *1320*(1). https://doi.org/10.1088/1742-6596/1320/1/012105

Bossenbroek, R., Wols, A., Weerdmeester, J., Lichtwarck-Aschoff, A., Granic, I., & Van Rooij, M. M. J. W. (2020). Efficacy of a virtual reality biofeedback game (deep) to reduce anxiety and disruptive classroom behavior: Single-case study. *JMIR Mental Health*, *7*(3). https://doi.org/10.2196/16066

Brewster, B. J., & Miller, T. (2023). Reflections on mathematics ability, anxiety, and interventions. *International Electronic Journal of Mathematics Education*, *18*(2), em0729. https://doi.org/10.29333/iejme/12822

Cahyani, F. P., & Irwan. (2020). The development of mathematics teaching media based on problem-based instruction to enhance grade X high school students' critical thinking. *Journal of Physics: Conference Series*, *1554*(1). https://doi.org/10.1088/1742-6596/1554/1/012016

Chen, O., Paas, F., & Sweller, J. (2023). A cognitive load theory approach to defining and measuring task complexity through element interactivity. In *Educational Psychology Review* (Vol. 35, Issue 2). Springer. https://doi.org/10.1007/s10648-023-09782-w

Darmayanti, R., Rachma Nisfi Laila, A., Khan, S., Dien Fitriyah, I., Bausir, U., Setio, A., Muhammadiyah Malang, U., Bendungan Sutami No, J., Malang, K., Timur, J., Wali Khan University Mardan, A., Pakhtunkhwa, K., Negeri, S., Payudan Timur No, J., Sumenep, K., Raya Sidorejo No, J., Pagelaran, K., Malang, K., Raya No, J., … Tirtoyudo, K. (2023). Students' attitudes towards learning mathematics: "too soft attitudes-very difficult-boring-in a good way." In *Indonesian Journal of Learning and Educational Studies* (Vol. 1, Issue 1). www.jurnal.piramidaakademi.com/index.php/ijles

Eve, Z., Turner, M., Di Basilio, D., Harkin, B., Yates, A., Persson, S., Henry, J., Williams, A., Walton, G., Jones, M. V., Whitley, C., & Craddock, N. (2024). Therapeutic

games to reduce anxiety and depression in young people: A systematic review and exploratory meta-analysis of their use and effectiveness. In *Clinical Psychology and Psychotherapy* (Vol. 31, Issue 1). John Wiley and Sons Ltd. https://doi.org/10.1002/cpp.2938

Furner, J. M., & Gonzalez-Dehass, A. (2011). How do students' mastery and performance goals relate to math anxiety? *Eurasia Journal of Mathematics, 7*(4), 227–242.

Haryono, H. E., Jatmiko, B., Prahani, B. K., Zayyadi, M., Kaniawati, I., & Kurtuluş, M. A. (2024). E-Learning-Based collaborative as an effort to reduce high school students' misconceptions of heat. *JPII, 13*(4), 538–550. https://doi.org/10.15294/jpii.v13i4.13222

Idris, J., & Jamil, N. (2025). Exploration of preschool teachers' views towards VAK's learning style in pre-number skills. *Southeast Asia Early Childhood Journal*, *14*, 33–47. https://doi.org/10.37134/saecj.vol14.1.3.2025

Juniati, D., & Budayasa, I. K. (2020a). The mathematics anxiety: Do prospective math teachers also experience it? *Journal of Physics: Conference Series*, *1663*(1). https://doi.org/10.1088/1742-6596/1663/1/012032

Juniati, D., & Budayasa, I. K. (2020b). Working memory capacity and mathematics anxiety of mathematics undergraduate students and its effect on mathematics achievement. *Journal for the Education of Gifted Young Scientists*, *8*(1), 279–291. https://doi.org/10.17478/jegys.653518

Kamid, K., Rohati, R., Hobri, H., Triani, E., Rohana, S., & Pratama, W. A. (2022). Process skill and students' interest for mathematics learning: playing traditional games. *International Journal of Instruction*, *15*(3), 967–988. https://doi.org/10.29333/iji.2022.15352a

Ley, J. (2024). *Reducing mathematics and examination anxiety using the five question approach*. 319–326.

Lobel, A., Gotsis, M., Reynolds, E., Annetta, M., Engels, R. C. M. E., & Granic, I. (2016). Designing and utilizing biofeedback games for emotion regulation: The case of Nevermind. *Conference on Human Factors in Computing Systems - Proceedings*, *07-12-May-2016*, 1945–1951. https://doi.org/10.1145/2851581.2892521

Milaturrahmah, N., Mardiyana, M., & Pramudya, I. (2017). Mathematics learning process with science, technology, engineering, and mathematics (STEM) approach in Indonesia. *Journal of Physics: Conference Series*, *895*(1). https://doi.org/10.1088/1742-6596/895/1/012030

Nurkarim, A. W., & Rifki, A. (2023). *Pengembangan perangkat pembelajaran kooperatif tipe two stay-two stray dengan pendekatan problem posing dan media pohon matematika. Nuris Journal of Education and Islamic Studies*, *3*(1), 6–16.

Ngussa, B. M. (2014). Application of ADDIE Model in instruction in teaching-learning transaction among teachers of Mara Conference Adventist secondary school, Tanzania. *Journal of Education and Practice*, *5*(25), 99–105.

Öztaş, E. T. (2023). Investigation of the learning outcomes of the 2018 middle school mathematics curriculum in terms of mathematical communication skills 3. *International Journal of Curriculum and Instructional Studies*, *13*(1), 224–248. https://doi.org/10.31704/ijocis.2023.010

Ozuna, S., Challoo, L., Jones, D., & Huskin, P. (2023). Teacher perceptions of academic functioning in children raised by grandparents during a pandemic. *Journal of Instructional Pedagogies*, *29*. http://www.aabri.com/copyright.html

Pallavicini, F., Pepe, A., & Mantovani, F. (2021). Commercial off-the-shelf video games for reducing stress and anxiety: Systematic review. In *JMIR Mental Health* (Vol. 8, Issue 8). JMIR Publications Inc. https://doi.org/10.2196/28150

Pujiastuti, H., Utami, R. R., & Haryadi, R. (2020). The development of interactive mathematics learning media based on local wisdom and 21st century skills: Social arithmetic concept. *Journal of Physics: Conference Series*, *1521*(3). https://doi.org/10.1088/1742-6596/1521/3/032019

Purwanto, W. R., Waluya, S. B., Rochmad, & Wardono. (2020). Analysis of mathematical critical thinking ability in student learning style. *Journal of Physics: Conference Series*, *1511*(1). https://doi.org/10.1088/1742-6596/1511/1/012057

Schoneveld, E. A., Malmberg, M., Lichtwarck-Aschoff, A., Verheijen, G. P., Engels, R. C. M. E., & Granic, I. (2016). A neurofeedback video game (MindLight) to prevent anxiety in children: A randomized controlled trial. *Computers in Human Behavior*, *63*, 321–333. https://doi.org/10.1016/j.chb.2016.05.005

Schoneveld, E. A., Wols, A., Lichtwarck-Aschoff, A., Otten, R., & Granic, I. (2020). Mental health outcomes of an applied game for children with elevated anxiety symptoms: a randomized controlled non-inferiority trial. *Journal of Child and Family Studies*, *29*(8), 2169–2185. https://doi.org/10.1007/s10826-020-01728-y

Siskawati, F. S., & Chandra, F. E. (2017). *Pengembangan leker gabel dengan hot potatos untuk meningkatkan hasil belajar mahasiswa universitas islam jember* [Development of eggshell with hot potatoes to improve student learning outcomes at jember islamic university]. *Gammath*, *2*.

Siskawati, F. S., Irawati, T. N., & Salsabila, S. Z. (2024). The development of learning videos with the problem-solving approach by using screencast o matic. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(1), 25. https://doi.org/10.24127/ajpm.v13i1.8478

Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A comparative study of the ADDIE instructional design model in distance education. *Information (Switzerland)*, *13*(9), 1–22. https://doi.org/10.3390/info13090402

Weerdmeester, J., Van Rooij, M., Harris, O., Smit, N., Engels, R. C. M. E., & Granic, I. (2017). Exploring the role of self-efficacy in biofeedback video games. *CHI PLAY 2017 Extended Abstracts - Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play*, 453–461. https://doi.org/10.1145/3130859.3131299

Zayyadi, M., Nusantara, T., Hidayanto, E., Sulandra, I. M., & As'ari, A. R. (2019). Exploring prospective student teachers' questions on mathematics teaching practice. *Journal of Technology and Science Education*, *9*(2), 228–237. https://doi.org/10.3926/jotse.465