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LE-Probale Model through Nila's Edumath Interactive Mobile Learning to Improve Mathematical Literacy

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Abstract

Creating a supportive learning environment through psychological well-being is an important indicator in achieving true happiness in the learning process, and also through project-based learning so that it plays an important role in the learning environment and the results are very real. The aim of this research is to produce the LE-Probale model syntax. The learning model components used adopt Joyce and Weil. The quality of the product developed is evaluated based on product development evaluations developed by Plomp and Neeven, which include validity by validators, practicality and effectiveness of field trials by observers. The realization of the model syntax consists of ten stages, namely: 1) Preparing an adequate learning environment; 2) Delivery of learning objectives; 3) Selecting learning materials and determining topics that students must study inductively (from examples then generalizing); 4) Meaningful understanding is linked to everyday life; 5) Provide trigger questions to observe and solve; 6) Group formation; 7) Design and complete projects related to other subjects with the help of Nila's Islamic Edumath Interactive Mobile Learning; 8) Rearrange and compare representations of project results; 9) Evaluate the resulting projects; 10) Teacher and student reflection to look back at the learning that has taken place.

Keywords: LE-Probale, NEIMoL, mathematical literacy

INTRODUCTION

Students must be able to compete with other students in various countries. Ramadhani, Mariani, & Waluya (2015) stated that the development of an increasingly modern era, especially towards the current era of society 5.0, requires quality human resources. Meanwhile, Sumarni, Sugiarto & Sunarmi (2016: 110) stated that in the era of globalization, humans need to develop their knowledge, skills, and creativity in obtaining, selecting, and managing information. The quality of human resources is one of the determining factors for the progress of a nation, while the quality of human resources depends on the quality of education, which was concluded by Manah, Isnarto, &

Wijayanti (2017). Continuous communication in both written and oral forms is important in the mathematics classroom because it represents the ability to build Mathematical Literacy skills that are important for improving overall mathematics understanding and performance (Thompson & Chappell, 2017; Turner, 2011; Wood, Jones, Stover, & Polly, 2011).

Murray (2014) states that students must use the word at least 30 times to use it themselves fluently and comfortably. Therefore, increasing mathematical literacy is highly dependent on communication opportunities created by teachers (Özgen & Bindak, 2011; Thompson & Chappell, 2017). Recognizing the important role of communication in successful mathematics learning, even though widely accepted standards in mathematics practice and research support communication as an important part of learning, many mathematics teachers overlook opportunities to combine communication and skills in building mathematical literacy in students (Phillips et al., 2019 ; Seibert & Draper, 2018; Thompson & Chappell, 2011; Applying strategies, modeling them flexibly in various situations, is not enough just to teach strategies, but students need to develop a well-connected representation of the natural number system that allows them to notice when and which strategies are applied (Baroody, 2023; Brezovszky et al., 2015 ; Lehtinen et al., 2015; Threlfall, 2019; The definition of mathematical literacy according to the draft PISA 2021 mathematics framework is an individual's capacity to reason mathematically and formulate, use and interpret mathematics to solve various problems in real-world contexts (Jensen et al., 2019).

In line with the Decree of the Minister of Education, Culture, Research and Technology of the Republic of Indonesia Number 262/M/2022 concerning Amendments to the Decree of the Minister of Education, Culture, Research and Technology Number 56/M/2022 in Indonesia concerning Guidelines for Implementing Curriculum in the Context of Learning Recovery which is a reference current school learning in Indonesia, so it is hoped that it will be able to improve learning loss and loss behavior that occurred during the recovery period from the Covid 19 pandemic early on. In 2020, schools need to develop a curriculum with the principle of diversity in accordance with the conditions of the educational unit, potential, region and students (Kepmendikbudristek, 2022).

Creating a supportive learning environment through psychological well-being for students is an important indicator in achieving true happiness in the learning process, so it plays an important role in the learning environment. This well-being is not happiness that leads to hedonic activities or unlimited satisfaction. Well-being is defined as a state of well-being that includes positive emotions and moods (e.g. contentment, happiness), the absence of negative emotions (e.g. stress, depression, anxiety), satisfaction with life, and the ability to evaluate life positively and positively. feel good. Well-being can affect mental health, because the positive emotions produced by a person will make their mental condition better and more optimistic.

Habits of maintaining classroom cleanliness (there are picket officers and active officers) and the environment, including throwing rubbish in its place (organic/non-organic rubbish), being involved in waste management (reduce, reuse, recycle), actively participating in environmental education in school activities (community work, health day, environment day, etc.), and being involved in planting and cultivating plants at school (Chin YL, et al., 2023; Zaenuri et al., 2017). Deaf students' curiosity about computer science must be developed from an early age because this will be a stepping stone for students to find out many things about themselves or their environment (Sugiman et al., 2022).

Computer-assisted project-based learning to help students develop complex problem-solving skills (Belland, Walker, Kim, & Lefler, 2017; Gerber et al., 2023; NJ Kim et al., 2018; Santi, et al., 2023), as a way to provide the assistance students need to succeed amidst the rigors of problem-centered curricular activities (Chinn & Duncan, 2021; NJ Kim et al., 2018; Reiser, 2014). Computer-based learning environments often include a variety of representation formats such as animation, video, and graphics (Devolder et al., 2022).

Technological developments in the last ten years have been very rapid, especially in the form of mobile devices and have the potential to influence educational pedagogy (Ally & Palalas, 2011; Kukulska-Hulme & Traxler, 2015; Liestøl, 2011; Peters, 2019; Rekkedal & Pewarna, 2019). An example of a mathematical literacy methodology is an open source mixed reality application framework called ARLearn, which supports mobile applications for Android smartphones (Ternier, Klemke, Kalz, mobil van Ulzen, & Specht, 2022). Meanwhile, the results of the study of the current state of mathematics learning are as follows. (1) Learning tends to be teacher-centered, (2) Mathematics teachers often start the learning process by discussing definitions, or simply presenting formulas related to certain topics, followed by discussing example problems and ending by asking students to do exercises, (3) Students are less trained in solving open-ended problems that represent everyday life, (4) In providing training, teachers only give questions that are routine and closed.

The LE-Probale model is the author's attempt to implement a learning environment with project-based learning so that it is intertwined with synergy and collaboration between educators and students to improve students' learning experiences from the surrounding environment through the products they produce. produce. The LE-Probale model explores differentiated learning that prioritizes 3 important indicators, namely: (1) Content differentiation, which takes into account students' learning needs: learning readiness, interest aspects, and learning profile aspects; (2) Process differentiation, preparing various teaching and learning activities: group or independent; and (3) Product differentiation, which is related to the products that students will produce: writing, test results, student work, performances, presentations, speeches, recordings, diagrams. Students enrich their learning experiences and make them meaningful by experimenting and evaluating various strategies. and continue to improve through technology integration. According to Sutopo (as quoted in Aslamiyah et al., 2019) the project-based learning model improves the quality and quantity of human interaction in the classroom. It combines technology and good interaction, and produces social support, constructive feedback, and learning experiences. Furthermore, this approach can be implemented effectively and successfully if educators and students collaborate in achieving learning goals (Saputri et al., 2021). Learning components complement each other to achieve the goals of the learning system to create a conducive environment for students to maximize their potential (Ramadania & Aswadi, 2020; Ubaidah et al, 2019).

Research conducted prior to the LE-Probale model through technology-based scaffolding from Nila's Edumath Interactive Mobile Learning can help overcome the problem of a learning environment that cannot accommodate different student characteristics in an adequate way (Hapizah, 2015; Hendrik et al., 2021 ; Kharisna et al., 2023 Sutianah et al., 2022 , Ubaidah et al., 2022). Students have more time flexibility to study by participating in blended learning. This strategy encourages them to exercise self-control and improve learning abilities. The LE-Probale model through technology-based scaffolding from Nila's Edumath Interactive Mobile Learning is very accommodating for students to receive material explanations from teachers using Nila's Edumath Interactive Mobile Learning facilities which can be accessed from anywhere and at any time using an Android smartphone. The learning process does not directly show superior quality in student motivation, interest and learning outcomes (Usman, 2019). Therefore, this strategy can be a suitable and effective alternative to use in the learning process. In line with this, previous research found that the quality of education can be improved through the learning process and thinking practice with appropriate models (Diani et al., 2019; Hapizah, 2015; Mask et al., 2020).

The LE-Probale model through scaffolding is based on technology from Nila's Edumath Interactive Mobile Learning in natural learning. This aims to increase students' creativity and mathematical literacy which is very important in learning mathematics. According to Ojose (2011), and Stacey and Turner (2015), literacy is related to mathematics with an understanding of geometric ideas that every student should have to increase their creativity. This should be developed from school-based mathematics learning. In addition, abstract mathematical objects and materials are difficult to identify and understand, resulting in low student interest in learning. (Haryanti et al., 2021; Priatna, 2017). This has several pedagogical advantages, especially mathematics learning (Gunawan et al., 2017; Hayati et al., 2016). This model has been adopted in junior and senior high school education environments, some experts argue that students at this age have reached the formal thinking stage (Priatna & Sari, 2022; Zaenuri et al., 2017). Piaget's theory states that students are considered mature at the formal operations stage when they receive updates using a learning model, so it is easy to apply the model. The following are the findings of the LE-Probale model syntax.

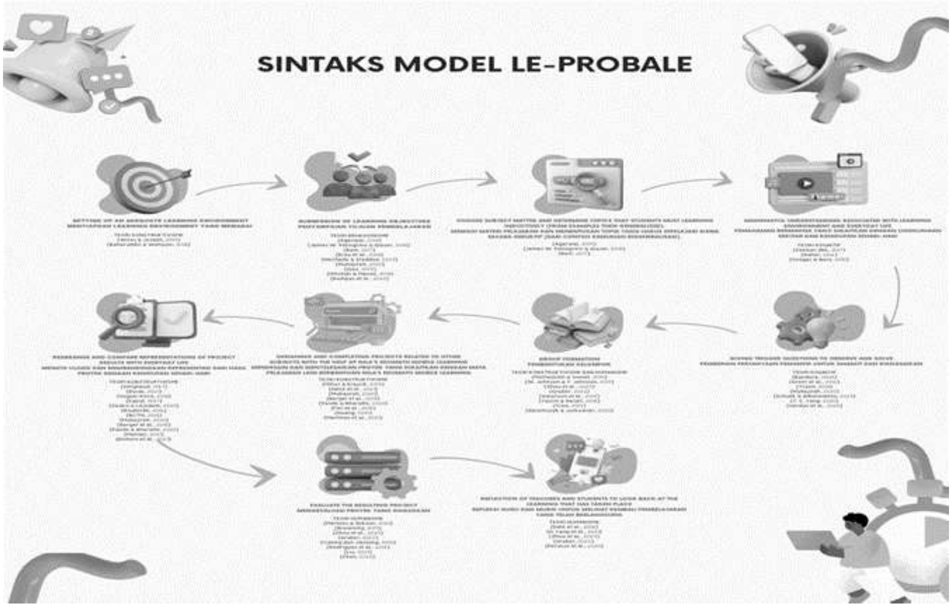

Figure 1. LE-Probale Syntax

Nila's Edumath Interactive Mobile Learning Islami offers technology-based scaffolding in the form of online content in the LE-Probale learning model by carrying out a learning environment that introduces the culture of several regional local wisdoms in Indonesia through a brief history of local wisdom including the traditional cuisine of each region which is combined and collaborated with a number of trigger questions, evaluation using project-based learning, and reflection for students and teachers. The following are tools and examples of interactive mobile learning content from Edumath Nila which can be accessed via an Android smartphone.

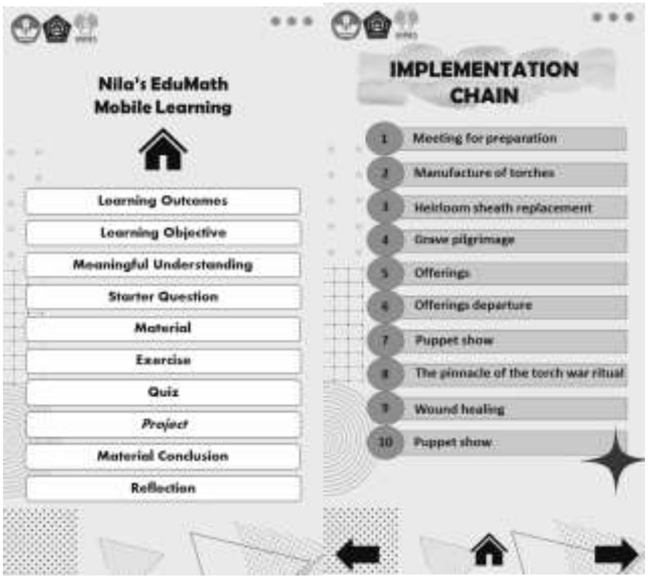

Figure 2. Display of content from Nila's interactive mobile Islamic Learning edumath
https://drive.google.com/drive/folders/1RpQiLZULIWGe3D_tc6XCKyYHs_f6j_tW?usp=sharing

The LE-Probale model involves students solving problems by investigating, designing, making decisions, and creating a product. The teacher's role is to supervise and guide student activities (Nazarenko, 2015). The LE-Probale model through technology-based scaffolding in the form of Nila's Islamic Edumath Interactive Mobile Learning is provided at the beginning of the learning material. This is because some students are not ready to learn, so teachers must foster their interest and motivation by conveying something new, contradictory or complex (Zetriuslita et al., 2017); C. Herodotou, M. Aristeidou, E. Scanlon & S. Kelley (2022).

Based on the explanation above, it is necessary to develop the LE-Probale model to increase students' creativity and mathematical literacy through Nila's Islamic interactive mobile learning edumath. Nila's interactive mobile learning edumath which I later named NEIMoL.

METHODS

Materials and Methods must be described in sufficient detail to enable others to replicate and build on published results. The type of research used is development research, namely the development of the LE-Probale learning model through technology-based scaffolding in the form of Edumath Mobile Learning Nila to foster valid, practical and effective mathematical literacy. The design of the development model used to develop the LE-Probale learning model uses the Plomp (2013) development model, which consists of five stages, namely, (1) initial investigation stage, (2) design stage, (3) realization stage, (4) stage testing, evaluation and revision, and (5) implementation stage. Product quality assessment to see the quality of the model that has been created using Neeven (2013). The three qualities seen from the development of this product are validity, practicality and effectiveness of the model that has been created.

Product validity is determined by validators. A product is said to be valid if it gets a minimum score of 2.5. A product is said to be practical if it meets three criteria, namely: (1) Product implementation is in the high category ($T \geq 2.5$); (2) Minimum student activity is in the active category ($X \geq 2.5$), and (3) Class response is in the positive category ($Y \geq 2$). A product is said to be effective if: (1) The average classical student learning outcomes are classified as minimal ($O \geq 75$), and at least 75% of students obtained a minimum score of 75. (2) Classically student creativity is in the minimum high category ($C \geq 2.25$), and at least 75% of student creativity is in the high category. (3) Classically students' mathematical literacy is in the minimum high category ($D \geq 2.25$), and at least 75% of students' mathematical literacy is in the high category.

RESULTS AND DISCUSSION

Results

The realization of the model syntax consists of ten stages, namely: 1) Preparing an adequate learning environment; 2) Delivery of learning objectives; 3) Selecting lesson material and determining topics that students must study inductively (from examples then generalizing); 4) Meaningful understanding is linked to everyday life; 5) Provide trigger questions to observe and solve; 6) Group formation; 7) Design and complete projects related to other subjects with the help of Nila's Edumath Interactive Mobile Learning (NEIMoL); 8) Rearrange and compare representations of project results; 9) Evaluate the resulting projects; 10) Teacher and student reflection to look back at the learning that has taken place.

The model that has been realized is then validated. After being declared valid, a product trial is carried out.

Validation Results

There are two aspects measured in model validation, namely the theoretical basis and model components. The learning model prototype that has been prepared is validated by three validators. A recap of the model validation results is presented in Table 1.

Table 1. Recap of Model Validation Results

Aspect	Average of each aspect	Total Average	Remark
Theoretical basis	3.15	3.28	Valid
Model Components	3.33		

(Source: researcher, 2023)

Product Trial Results

The LE-Probale model which has been declared valid by the validator is then tested to see its practicality and effectiveness. The practicality and effectiveness of the model were obtained after 3 (three) trials. The results of the first experiment showed that the practicality and effectiveness criteria had not been achieved because students' classical activity and creativity had not been maximized. In the second experiment, the practical criteria were achieved: (1) high learning completeness; (2) active students; and (3) positive student responses. However, the effectiveness criteria have not been achieved because the percentage of students in the high category still does not meet expectations. In the third experiment, the practicality criterion was achieved. Effectiveness criteria were also obtained: (1) classical student learning outcomes have met the criteria; (2) student creativity is also high; and (3) the percentage of students who have high creativity also meet the criteria.

A recapitulation of the practical results of trial product III can be seen in table 2. Meanwhile, the effectiveness of trial product III can be seen in table 3.

Table 2. Recap of Test Product Practicality Results III

Practical Aspect	Average score	Criteria
Product implementation (T)	3.26	Tall
Student Activities (X)	3.33	Active
Student Response (Y)	2.46	positive

(Source: researcher, 2023)

Table 3. Recap of Product Trial Effectiveness Results III

Aspect	Average of each Aspect	% of Students who meet the Criteria
Student Learning Outcomes (O)	93.15	100% (≥75%)
Student Creativity (C)	2.65	93% (≥75%)
students' mathematical literacy (D)	2.64	93% (≥75%)

(Source: researcher, 2023)

The results are in the form of images, or data made from images/schemes/graphs/diagrams/similar, the presentation also follows existing rules; The title or name of the image is placed below the image, from the left, and given a distance of 1 space from the image. If there is more than 1 line, single space between lines. For example, it can be seen in Figure 1.

Discussion

The discussion focuses on two things: (1) product trials, and (2) the advantages of the LE-Probale model.

(1) Product Trial

Implementation of the LE-Probale Model

Overall, the average implementation of the LE-Probale model in trial I was 2.93, which means that according to the criteria that have been determined, the application of the LE-Probale model is included in the high category, but if studied in more depth for each teacher's activity in implementing the LE-Probale model , it turns out that only teacher activities at the stages of preparing an adequate learning environment, conveying learning objectives, forming groups, and reflecting on teachers and students to look back at the learning that has taken place are all categorized as high. Selection of subject matter and determining topics that students must study inductively (from examples then generalizing), meaningful understanding related to everyday life, providing trigger questions to be observed and solved, designing and completing projects related to other subjects with the help of Nila's Edumath Interactive Mobile Learning, as well as rearranging and comparing the representation of project results, most of the teacher's activities are in the low category because the average implementation is less than 2.5.

The results of this first trial at stage (5) Providing trigger questions to observe and solve, the teacher, in responding to students' difficulties when solving problems, provides more answers to the problems being solved. Teachers should provide sufficient assistance to students who experience difficulties, and with the assistance provided in the problem-solving process, students do not have to take over the problem that the students are working on. This may happen because of the teacher's habit of always giving answers to students when students cannot solve a problem. Teacher control is also not optimal. This can be seen from the lack of teachers in reminding students to solve problems with more than one answer or more than one solution. In other words, the practicality of the model still does not meet the desired criteria. This means that further trials need to be carried out. In the next trial, improvements were made. Improvements are focused on aspects of the implementation of each stage, namely providing guidance and attention to teachers regarding the implementation of the LE-Probale model. Coaching is carried out after each meeting by paying attention to aspects whose level of implementation does not meet the criteria (aspects that require improvement).

In the second trial, there was an increase in the average teacher activity score in answering students' questions, but the score was still below 2.5. This shows that there has been an increase in teachers in applying the reaction principle but it is still not optimal. In other words, the practicality of the model still does not meet the desired criteria. That means further tests need to be done. Because the reasons for implementing the LE-Probale model which was in the low category in this second trial were still the same, improvements were also focused on providing guidance and attention to teachers in implementing the LE-Probale model. Coaching and mindfulness are carried out after each meeting by paying attention to aspects whose level of implementation does not meet the criteria (aspects that require improvement).

Student Activities

The average student activity in all meetings from trial I was 2.49. This means that student activity in trial I was still within the criteria of being less active. The criteria for less active student activity indicates that the model developed does not meet the practical aspects that have been determined. This is a special condition that students demonstrate in learning. When answering questions at the Meaningful Understanding stage that relate to everyday life, students are still hesitant to answer because they are afraid of making mistakes, so they often ask the teacher. This causes the allocated time to be wasted. Not all students are used to discussing to solve problems, so there are students who just write answers without giving ideas, some even chatter.

In the second trial the average student activity was 2.81. This means that student activity is included in the active criteria. However, there was still one activity that received a score of less than 2.5, namely the activity of asking questions or commenting when discussing the results of the presenter group's answers. This shows that students' activities in designing and completing projects related to other subjects with the help of Nila's Edumath Interactive Mobile Learning Islami, reconstructing and comparing the representation of project results still need to be improved. Therefore, improvements need to be made so that the social system can run well. Improvements made are by providing input to partner teachers on how to develop a social system in classroom learning.

Student Response

Student responses to both trial I and trial II were all positive. He showed that students were happy with the LE-Probale model through Nila's Edumath Interactive Mobile Learning which was used in learning.

Learning outcomes

In the first trial, only 21 percent of students achieved a minimum learning outcome of 75. This shows the effectiveness of the model seen from the learning outcomes of students who did not meet the desired criteria. In trial II, 75% of students obtained learning outcomes above 75. This means that the effectiveness of the model seen from student learning outcomes has met the desired criteria.

Student Creativity

In trial I, only 26% of creativity was included in the high category. This means that students' classical creativity is still in the "low" category. This shows the effectiveness of the model seen from the creativity of students who still do not meet the desired criteria. In trial II, 63.5% of all students were in the high category. This shows that student creativity still needs to be improved so that the effectiveness of the model seen from student creativity is fulfilled.

Students' Mathematical Literacy

In trial I too, only 26% of mathematical literacy was in the high category. This means that students' mathematical literacy is still in the "low" category. This shows the effectiveness of the model seen from students' mathematical literacy which still does not meet the desired criteria. In trial II, 63.4% of all students were in the high category. This shows that students' mathematical literacy still needs to be improved so that the effectiveness of the model seen from students' mathematical literacy is met.

Advantages of the LE-Probale Model

The advantages of the LE-Probale model are: (1) familiarizing students with preparing an adequate learning environment, (2) familiarizing students with conveying learning objectives, (3) familiarizing students with selecting learning materials and determining the topics that must be studied. inductively (from examples then generalized), 4) familiarize students with meaningful understanding related to everyday life; 5) familiarize students with trigger questions to observe and solve; 6) familiarize students with forming groups; 7) familiarize students with designing and completing projects related to other subjects with the help of Interactive Mobile Learning Edumat Nila; 8) familiarize students with rearranging and comparing representations of project results; 9) familiarize students with evaluating the resulting projects; 10) familiarize students with self-reflection to look back at the learning that has taken place.

CONCLUSION

Conclusions can be generalizations of findings according to the research problem, and can also be recommendations for next steps.

The LE-Probale model development process is based on Plomp's (2013) development theory, which consists of five stages, namely: (1) initial investigation stage, (2) design stage, (3) realization stage, (4) testing, evaluation and revision, and (5) implementation stage. The result of the development of this research is the application of a learning environment and project-based learning model that can develop student creativity (LE-Probale Model) through Nila's Edumath Interactive mobile Learning (NEIMoL) which meets the criteria of valid, practical and effective. The validity criteria for the LE-Probale model obtained a score of 3.23, which means the model is included in the valid category. The LE-Probale model which has been declared valid is then tested to determine its practicality and effectiveness. In trial III the criteria for practicality and effectiveness were met, resulting in the syntax of the LE-Probale model which consists of ten stages, namely: 1) Preparing an adequate learning environment ; 2) Delivery of learning objectives; 3) Selecting learning materials and determining topics that students must study inductively (from examples then generalizing); 4) Meaningful understanding is linked to everyday life; 5) Provide trigger questions to observe and solve; 6) Group formation; 7) Design and complete projects related to other subjects with the help of Nila's Islamic Edumath Interactive Mobile Learning; 8) Rearrange and compare representations of project results; 9) Evaluate the resulting projects; 10) Teacher and student reflection to look back at the learning that has taken place.

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