Enhancing Elementary Students' Mathematical Problem-Solving Skills through a Culture-Based Android Application

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***Abstract*—Technological advancements are rapidly transforming various aspects of life, including education. In classroom learning, there is a growing need to develop students' knowledge and problem-solving skills. One effective method to enhance these skills is through the use of an Android-based application, considering students' familiarity with gadgets in their daily lives. These learning applications, which incorporate audio, images, and text, are becoming increasingly essential. To address this need, an Android application was designed to include learning steps such as analyzing, gathering information, asking questions, and solving problems. This study employs a qualitative descriptive approach using ADDIE method (analyzing, designing, developing, implementing, and evaluating). The process involved material analysis, application development using Java, and validity testing by experts in material, media suitability, and local content. The application's trial was conducted by involving third grade elementary school students using questionnaires and interview guidelines as instruments. The Ethnopedagogy-Based Situation (EBS) Apps, validated by experts, was valid and appropriately designed for elementary school students. Upon implementation, the results indicated that the students were engaged with EBS Apps and found it helpful in practicing their skills in information gathering, problem posing, and problem-solving. Therefore, the EBS Apps developed in this study are effective and suitable as a culture-based Android application to enhance the problem-solving skills of elementary school students.**

***Keywords*—Android application, local wisdom, mathematical problem solving, elementary school students**

I. Introduction

Education is an activity carried out in a planned manner to enhance the quality of human resources. It has structured activities aiming to change an individual in terms of knowledge, attitudes and skills [1, 2]. Education is closely related to learning. Interesting and fun learning can be designed to facilitate various students' learning styles [3–5]. Today's elementary school students are generation Z [6, 7] who are highly familiar to various technological tools [8, 9]. Nowadays, the widespread use of technology and devices, particularly mobile technology, highlights the importance for children and adolescents to simultaneously understand the integration of different access modalities based on location and device [10, 11]. In fact, today's children spend more time with gadgets than with their friends. Initially, children have gadgets so they can follow the learning process organized by the teacher and school, and eventually they became proficient in operating the gadgets [12]. Surveys showed that most children use gadgets to search for information, entertain themselves, and maintain online communication. Approximately, 40% of children in Indonesia are familiar with technology and are active internet users [13, 14].

In this context, learning is essential for providing information that supports students' cognitive, affective, and psychomotor development, which will shape their habits in gadget use. However, without proper guidance, gadgets can adversely affect the development and well-being of children and adolescents [15, 16]. For example, excessive gadget use can lead to low levels of perceived self-efficacy in using digital technology, which hinder skills development. It may also negatively affect deeper areas, such as personal identity, emotional development, and self-esteem [17, 18].

As result, there are concerns that if students continue to use gadgets without guidance, their focus on learning may quickly decline and their memory will only be about the games they like [19, 20]. Apart from that, students' motivation will also decrease [21, 22]. Therefore, educational activities must anticipate the challenges of digitalization. Several Android-based applications are now available for students, ranging from game-like applications to educational and learning tools such as QANDA: Mathematics Problem Solver [23], Geogebra Graph Calculator [24], Microsoft Math Solver [25], and etc. All of these Android-based applications are available on the Play Store.

On the other hand, education also aims to develop students to possess adequate knowledge, skills and good characters [26, 27]. This framework for future education ensures that students can compete and create various new innovations. One essential skill that needs continuous development is high-level thinking, particularly problem-solving skills [28, 29].

Problem solving skills are essentially discussed in the literature as part of a broader topic about the nature of thinking [30, 31]. They can be categorized into several levels, namely micro thinking skills (e.g., remembering); critical thinking skills (e.g. detecting bias); and thinking strategies (e.g., problem solving, decision making and conceptualization) [32, 33]. Furthermore, problem-solving skill is emphasized as a thinking skill that spans from the lowest level of remembering (knowledge) to the highest level of evaluation [34, 35].

Problem-solving skills are widely applicable and can be practiced in everyday life. One effective approach in education is culture-based learning, which incorporates local culture into the curriculum aiming to enhance students'

problem-solving skills [36, 37]. Sadly, the local wisdom that many students encounter around them often goes unrecognized as a valuable diversity that should be preserved. Local wisdom in each student's neighborhood is not known as regional identity [38]. As a result, there has not been any efforts to better understand and preserve the existing cultural diversity. However, when implemented in local wisdom learning, this will enhance pride in culture and facilitate the building of knowledge formed from observations.

A study findings by Isrok'atun *et al.* [39] demonstrate that implementing Ethnopedagogy-Based Situations (EBS) does not only enhance critical thinking and problem-posing skills but also contributes to preserving local culture among future generations from an early age. This aligns with the government's initiative to integrate character education, emphasizing values such as love for the country [40]. In accordance, EBS learning can be used as a way to introduce the culture of a region to students from an early age. Through situations presented in EBS learning, students can learn various stories, illustrations, and narratives about the cultural assets present in their region. Incorporating local cultural elements into learning activities enhances the meaningfullness of learning. Therefore, there is a need to integrate local wisdom elements into [41, 42]. From itsprocess, learning that integrates local wisdom can optimize students' understanding of the concepts being taught [43, 44]. This aligns with Appendix IV of Minister of Education and Culture of the Republic of Indonesia in the Regulation Number 81A of 2013, which emphasizes that primary school education should be developed thematically, integrating subjects to cultivate attitudes, skills, and knowledge while fostering an appreciation for the diversity of local culture [45, 46].

However, the current reality is that local uniqueness is increasingly being overshadowed by the influx and development of foreign culture [47]. This trend is further accelerated by the sharp increase in internet use among children. Therefore, it is crucial for the education sector to take immediate action to maintain and preserve regional culture and values. One effective approach is to develop an Android-based EBS learning application, aiming to introduce local cultural values to children, particularly elementary school students, through digital platforms.

One of the solutions that educators can consider is utilizing innovative learning media that align with current technological developments [48, 49]. Practical and innovative learning media are key factors in enhancing students' understanding. The integration of various media elements such as text, images, videos, and audio into one format is commonly referred to as multimedia [50, 51]. Innovative educators have incorporated images, audio, and video into the curriculum to enrich and enliven their teaching to make a fun learning [52, 53].

An innovative learning tool for today's students is Android-based media. One example is the Ethnopedagogy-Based Situation application, which embodies a learning model developed through three stages. Rooted in ethnopedagogical principles, this model begins with observation stage, where users explore diverse cultures presented at each level and select relevant information based on their observations. The second stage encourafes users to pose culturally relevant questions, while the third stage involves evaluation. This mobile application effectively foster students' analytical, problem-posing, and problem-solving skills through engaging multimedia presentations.

This study seeks to answer the following research questions.

- How to conceptualize local wisdom for elementary school students' learning?
- How was the EBS Apps developed?
- What are the validation results of EBS Apps?
- What are the results of the EBS Apps product testing?
- How do students respond to the use of EBS Apps?

II. Literature Review

A. Ethnopedagogy-Based Situation

Ethnopedagogy-Based Situation is a learning that includes elements of local wisdom consisting of four learning stages, namely: 1) creating the situation 2) problem posing; 3) problem solving; and 4) applying the concept [54]. Creating the situation stage that is filled with nuances of local wisdom is a prerequisite for EBS learning.

As an illustration, the design of this EBS learning model is as in Fig. 1 below.

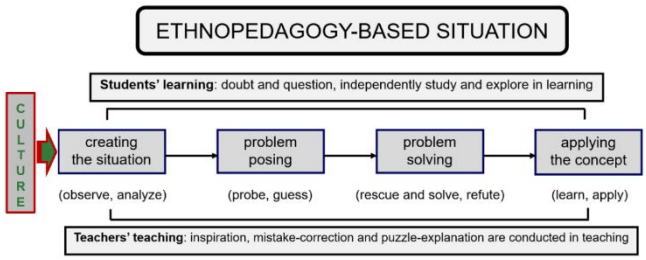

Fig. 1. Ethnopedagogy-based situation.

1) Creating the situation

The first step in EBS learning involves creating a local wisdom-based situation or scenario to stimulate students' thinking. This includes selecting and organizing pictures and descriptions of local wisdom that students will observe. The designed situation must effectively facilitate students in engaging with the learning activities and sparking curiosity. Therefore, the teachers should strive to design engaging situations that motivate students to analyze and explore information thoroughly [55–57]. It is important to note that the level of complexity of the situation created in the app is adjusted to the placement of the material's levels.

2) Problem posing

Problem posing is a stage where students formulate questions or mathematical problems that are based on real situations designed. The activities are carried out to generate or reformulate the given problem, tasks that appear on the spectrum between commonly found problems and complex problems, and metacognitive behavior in the problem posing process [58].

In this stage, students are trained to express several things they want to know based on the situation presented, which is expressed in questions based on students' understanding toward the situation. It is expected that students will be able to hone their skills in asking questions through various forms

of questions. The expected level of question forms starts from low to high levels, starting from unsolved problem questions (cannot be answered), easy questions, to problem solving questions [59]. Through this activity, students will be encouraged to pay more attention to the situation. In line with this, problem posing provides opportunities for students in the lessons to not only generate new problems from the given situation but also to reformulate the given problem and generalize the solution [60, 61].

3) Problem solving

Problem solving stage is the goal of EBS learning, where the students are able to design a strategy for solving a problem. Students must achieve the following skills, such as understanding the problem, preparing a plan to solve the problem, carrying out a solution, and seeing the results and evaluating them [62]. Klegeris and Hurren [63] explain the process of achieving problem solving skills and elaborate them in seven classic steps: 1) understanding the situation/clarifying the terminology, 2) identifying the problem, 3) suggesting possible causes (hypothesizing), 4) connecting the problem and the causes, 5) deciding the type of problem and needed information, 6) obtaining the information, and 7) applying the information.

In practicing problem-solving skills, students and teachers collaboratively analyze complex problem to be solved. It is important for the chosen problems to be varied in order to sharpen students' thinking and strategy development. Problem solving involves identifying which past experiences (schemas) are most relevant to the current problem. Problem solvers must interpret new situations based on these selected schemas and then apply them to find solutions [64]. In this stage, teacher and students have the same contribution, where the teacher must be careful in determining the questions, so that the expected learning outcomes can be achieved. Meanwhile, students are encouraged to be creative in solving problems they find during the learning.

In this stage, students can engage in group discussions to ensure that the strategies used to solve the problem are varied, which benefit from the exchange of ideas among diverse students. Interactive discussions provide students with a more meaningful learning experience, helping them to build knowledge and characters [65, 66]. Learning that provides opportunities to exchange ideas makes students more active and responsive during learning activities [67, 68].

4) Applying the concept

In this stage, students are expected to be able to learn and implement concepts that have been discovered. As the final stage of EBS learning, students are trained to apply the discovered concepts into new or different problems and situations while still using relevant principles. This helps them build their knowledge and adapt it to various contexts.

In addition, students can build their understanding based on their learning activities in problem solving activities with different situations but still within the same concept. Students are invited to draw conclusions based on facts found in the problem solving stage of the situation that has been presented. In this case, students will describe the concepts they have in order to solve new problems they find.

In this process, an inductive thinking process has occurred, namely a way of thinking where conclusions are drawn from concrete facts that have been collected as much as possible from the previous EBS learning stage [69]. Inductive thinking that starts from specific things to general things will train students to collect facts through the observation process so students can gain knowledge [70, 71].

B. Java Programming

Technological advancements are accelerating rapidly, making digital-based learning the standard for today's ideal education. Smartphones are now being integrated into the learning process, and students are adapting to using these ommunication tools. In other words, this presents both a challenge and an opportunity for educators. Effective learning media are crucial for motivating and increasing students' interest in learning, especially with the growing prevalence of distance learning in many schools [72]. Mobile device development is one of the ways for educators to utilize technology in the digital era. One Android-based application that can be used to support the development of digital learning media is Java programming software [73]. Java is a programming language commonly used to develop back-end parts of software, Android applications, and websites [74, 75]. Java is a popular programming language used to develop mobile, desktop and website applications. Several large websites in the world such as Yahoo!, LinkedIn, and Spotify have also used Java to develop their websites [76]. One of the reasons for Java's popularity is its flexibility to be used on many platforms [77].

The advantages of Java applications according to Price [77] are as follows:

- Flexibility in application development
- Complete libraries
- Object-oriented programming
- Simpler coding process

C. EBS Apps

Ethnopedagogy-Based Situation App (EBS App) is an Android-based mobile application that is developed using Java. This application translates EBS content into mobile technology, making it more accessible and interactive for users. This application aims to train elementary school students in problem posing, problem solving and critical thinking skills [39]. Apart from that, this application presents various situations based on local wisdom in Indonesia with various levels of difficulty and includes discussions in the form of a game. The application features sound and animated images to stimulate students and make the learning experience more enjoyable. These approaches simultanously train students' problem posing, problem solving, and critical thinking skills and learning about the diverse local wisdom in Indonesia.

III. METHODS

A. Research Design

This study employs a qualitative descriptive study using ADDIE method. Qualitative descriptive design is used to get a better understanding of research objects. Its stages are analyzing, designing, developing, implementing, and evaluating [78, 79].

Analyzing stage is to conceptualize several local wisdoms

that are crucial to be introduced to elementary school students. The provided situation is easy to analyze and is in accordance with the students' problem solving skills. Next, designing stage is to develop EBS Apps using Java until obtaining a format as planned during the design plan. It consists of embedding local wisdom learning designed for lower grade elementary students. Then, validating is done to review the validity of the material and media by conducting product trial activities on elementary school students. Before the trial, a questionnaire and interview guide were prepared to obtain student feedback. Where this questionnaire was compiled with aspects that refer to the formulation of the problem being proposed. Its result is used as materials to be processed in the next stage. Evaluating stage is to assess the application based on the results from the previpus stage by considering the input obtained to improve the EBS Apps design. The flow is presented in Fig. 2 below.

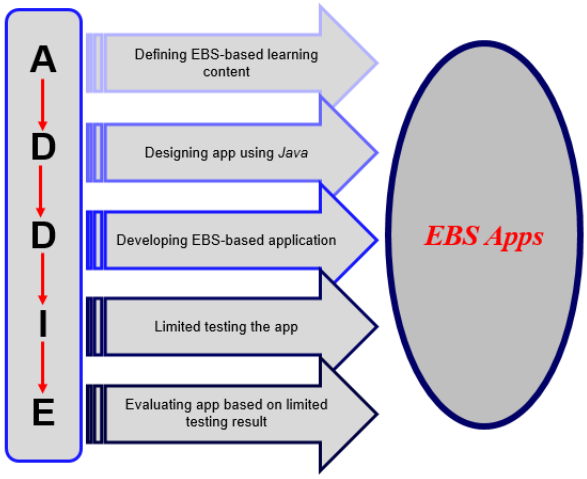

Fig. 2. ADDIE framework.

1) Conceptualizing local wisdom for the lower graders

This stage refers to various cultures in Indonesia. Starting from phenomenal cultures to cultures that are foreign to students' eyes. Various traditional children's games are also presented in the app, such as *congklak* and *engklek*. In selecting the content, EBS Apps teaching materials are also divided into three categories according to the design of the EBS Apps, ranging from easy, medium and hard categories. In each category, four different situations are presented, which are differentiated based on pupular cultures. If the level is easy, then the content contains cultures that students often hear about. Meanwhile, the hard level contains cultures that are rarely exposed to students.

The local wisdoms embeded in teaching material content for EBS Apps include:

- Dances, such as *reog* and *kecak* dance
- Historical buildings, for example Borobudur temple and Prambanan temple
- Traditional games, for example *congklak* and *engklek* games
- Customs such as the cow race, the *sekaten* festival and the *dango* riding ritual
- Traditional houses such as the *Rumah Gadang*
- Musical instruments, for example the *angklung*
- Performing arts such as *wayang golek*

The crucial local wisdom content selected to be appeared in EBS Apps are *congklak* and *engklek* traditional games. By recognizing these games, students will be interested in trying them. In *congklak*, students can learn to calculate addition, subtraction, multiples and so on. This can be done when students interact with their *congklak* seeds. Then, by playing *engklek*, students can start to get to know the shape of Two-dimentional figures as well as the material of reflection. In these ways, apart from introducing them to their cultures, students' mathematical skills can also be trained.

2) Application design using Java

Following is an initial overview of the EBS Apps design concept in Fig. 3.

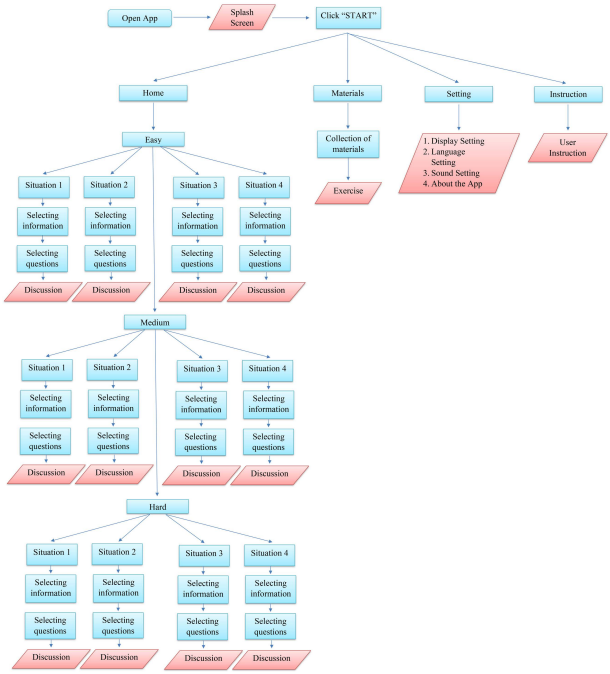

Fig. 3. EBS apps flowchart.

3) Validation of material, media and local wisdom

The app validation was done by 3 people, in which each expert reviewed several different elements for the application. The validators consisted of one material expert, namely an elementary school teacher, assigned to review the suitability of the local wisdom material for elementary school students; one media expert carried out by the application developer; and one cultural expert to review the local wisdom material presented in EBS Apps. The validators were selected according to their respective expertise. The results of this validation became the input and feedback for the EBS Apps design.

4) Product trial

After material, media, and local wisdom validation were carried out and valid results were obtained, the EBS Apps product was then tested on elementary school students. The trial was carried out on 35 students of Sukaraja I State Elementary School, Sumedang, West Java, Indonesia. During the test, interviews were also conducted with some students to accommodate criticism and suggestions from users for the design of EBS Apps.

5) Uploading on Google play store

After validation and testing on elementary school students

resulted positive results, the app was considered ready for release. With positive comments and ease of use, EBS Apps can serve as an innovative tool for students to practice their problem-solving skills. The final step in the development process is to upload EBS Apps to the Google Play Store, making it accessible as an innovative learning medium that enhances students' cultural knowledge and problem-solving skills.

IV. Result and Discussion

A. Conceptualizing Local Wisdom Material

Local wisdom presented on EBS Apps consists of culture in the form of customs, traditional houses, habits, traditional games, musical instruments, regional dances and monuments from certain areas in Indonesia. Its feature has twelve distinct cultures, each originating from a different region. The local wisdom was selected with the consideration of lower grade students development. This was done by having simple sentence structure, gradual difficulty, and detailed explanation of each local wisdom to build students' complete cultural insight.

Then, the images presentation aimed to strengthen the explanation for students, which was modified according to the elements that they often encounter, since the elementary school students are at the concrete thinking stage. Students who are at the concrete operational thinking stage already have logical thinking skills, but only through concrete objects, so all learning components need to be adapted to these skills [80–82].

B. Application Validation

The data obtained revealed validation results from IT experts, elementary school teachers, and cultural experts, showing a very valid category. In addition, the design, readability and visual communication on EBS Apps showed very valid data, as presented in Tables 1–3 below.

Table 1. Media validation

No.	Criteria	Score	Percentage	Percentage Mean
1	Design	16	100 %	95.8%
2	Readability	12	100 %	
3	Visual communication	10.5	87.5 %	

Table 2. Material validation

No.	Criteria	Score	Percentage	Percentage Mean
1	Content Suitability	15	93.75 %	93.47%
2	Implementation	22	91.67%	
3	Evaluation	19	95%	

Table 3. Local wisdom validation

No.	Criteria	Score	Percentage	Percentage Mean
1	Discussion of local wisdom substance	12	100%	100 %
2	Characteristics of local wisdom	12	100%	
3	Feasibility of local wisdom	24	100%	

The development of an Android-based learning application aims to train students' problem-solving skills and introduce new meanings in learning by incorporating mathematical concepts and local wisdom. Utilizing new technology in education makes learning more effective and innovative. Educators must consider how to balance the delivery and convergence strategies based on their learning goals, experiences, and activities [83–85].

C. EBS Apps Development

This app was developed based on Java programming. Java is a general-purpose, concurrent, class-based, object-oriented programming language, specifically designed to have as few dependencies as possible in its implementation. Teachers can deliver material through this application by creating content in the form of text, audio, images and videos that can be operated via a computer or smartphone. An easy-to-use interface will result in an attractive and engaging learning application design.

The development of EBS Apps is a renewal step in the use of learning media. The process of developing digital learning media products paves the way for newer and more powerful ways to ensure better results [86, 87]. The Android-based learning application was developed to be marketed as a readily available and easily accessible resource for technology-minded teachers and parents around the world [88, 89].

The EBS Apps development stages are divided into two. First, the pre-production stage includes a) creating a framework for local wisdom material, where the local wisdom is packaged and sorted with certain reference indicators; b) looking for various references to enrich the explanation of the local wisdom that appears; c) designing the situation that will be displayed in the application; d) sorting each situation to be categorized into three levels; e) making answer for the available choices in analyzing the situation and asking questions; and f) creating a narrative guide at each step. Second, the production stage includes a) creating a background and determining the theme that will be used in the application interface; b) organizing previously designed situations into three different levels; and c) adding music in each step of the application, and d) developing the application using Java. The display in EBS Apps is displayed in Fig. 4 below.

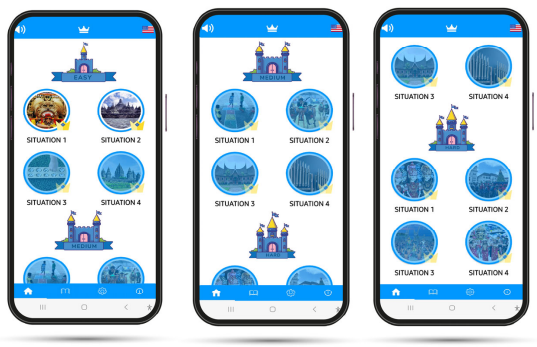

Fig. 4. Home display.

After selecting a situation at a certain level, students go to information selection menu as displayed in Fig. 5, requiring them to observe a picture and select the right information. Analytical skills can train students to formulate new approaches to solving problems or interpreting situations in new ways that are different from previous interpretations [90–92].

If students select the correct information, a display with a big check mark will appear, as diplayed in Fig. 6 below.

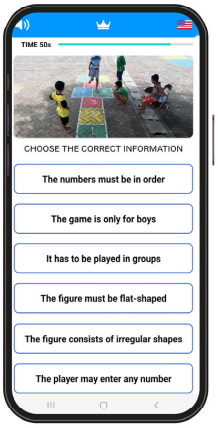

Fig. 5. Selecting information.

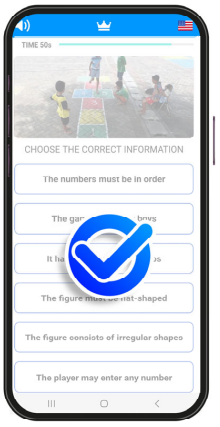

Fig. 6. Display of correct answers.

To contrast, when selecting the wrong information, a big cross will appear, as diplayed in Fig. 7 below.

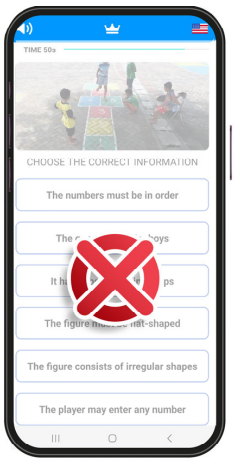

Fig. 7. Display of wrong answers.

After selecting the right information, students will then proceed to select questions that match the image as displayed in Fig. 8. This stage aimed to train students' problem posing skills. Students are invited to ask several problems shown in the picture. Problem posing is an important companion to problem solving, encouraging students' flexible thinking, improving problem solving skills, and sharpening students' understanding of learning material [93–95].

Fig. 8. Selecting a question.

When students select a question that matches the image displayed, the following display will appear, as diplayed in Fig. 9 below.

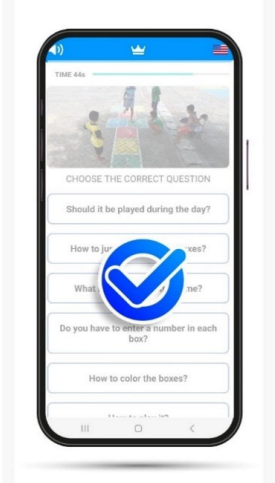

Fig. 9. Correct question display.

In contrast, if students choose a question that does not match the image displayed, it will appear on the screen as diplayed in Fig. 10.

Fig. 10. Display of wrong questions.

After finished selecting questions that match the image display, students proceed to the discussion stage as displayed in Fig. 11. This stage provides material reinforcement to students.

Fig. 11. Discussion.

This application has several features, namely a collection of materials, questions for each material, settings and instructions for usage. This collection aims to help students to understand the material perfectly and includes several questions to practice their skills on, as diplayed in Fig. 12 below.

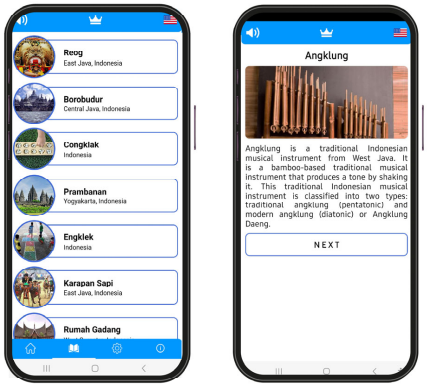

Fig. 12. Collection of materials.

In each material, there are several questions, as diplayed in Fig.13 below.

Fig. 13. Display of practice questions.

Fig. 14 shows the setting's interface, namely languages, sounds, and about applications. The setting have two modes, light and dark mode. There are two languages available, Indonesian and English. Sounds include the background music and the music's volume. Meanwhile, in the about application, the application name, developer name, developer email and application version can be found.

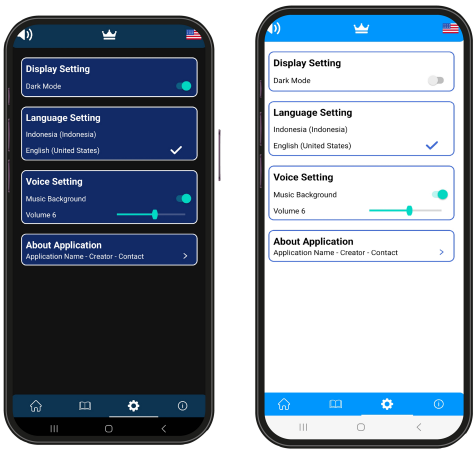

Fig. 14. Application settings.

Fig. 15 below is the App Instructions that serve information for users who are confused about how to use the app.

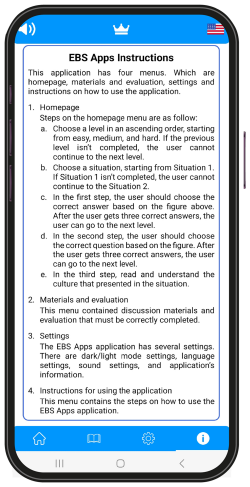

Fig. 15. App instructions.

D. Product Trial

EBS Apps application trial was carried out to evaluate the required improvement. This limited trial was carried out on lower grade elementary school students, namely 3rd grade, totaling 35 students. In this trial, each student was given the opportunity to try all the situations presented at each level. The students started from observing the situation to understanding the explanation. The teacher monitored every step completed by the students to help them understand and remember their learning from EBS Apps.

After students finished using the app, they were invited to a discussion to provide suggestions and feedback about the app to enhance its effectiveness. One identified issue was the lack of accumulated correct or incorrect scores, which needs to be addressed to better motivate students to gather information and analyze each option available in the EBS Apps application. The design has been well-received by its user. Students appreciated the contextual images and the varied, engaging discussions of local wisdom, which enrich their knowledge and enhance their thinking skills. This makes EBS Apps effective in providing meaningful understanding

that can be applied effectively. Additionally, the application's layout and the audio instructions help users navigate and understand the content, creating a positive and user-friendly experience. After the trial, the following data regarding the obstacles are obtained and presented in Table 4 below.

Table 4. Obstacles in using EBS Apps

No.	Statement	Strongly Agree		Agree		Disagree		Strongly Disagree		Total	
		Total	%	Total	%	Total	%	Total	%	Total	%
1	I feel like I need help from other people in using the EBS Apps	6	17.1%	14	40%	7	20%	8	22.9%	35	100%
2	Instructions for using EBS Apps are not clear	1	2.9%	2	5.7%	24	68.6%	8	22.9%	35	100%
3	The situation picture is not clear enough to be observed	0	0%	10	28.6%	17	48.6%	8	22.8%	35	100%
4	The words used in EBS Apps are difficult to understand	1	2.9%	2	5.7%	21	60%	11	31.4%	35	100%
5	The discussion in EBS Apps is not complete enough to explain the existing situation	4	11.4%	6	17.1%	19	54.3%	6	17.2%	35	100%

E. Stages of Uploading the EBS Apps Application to the Google Play Store

After previous validation by media experts, material experts and cultural experts, the results showed that EBS Apps were valid in terms of the content contained and its packaging. Then, after that, a trial was carried out on lower grade elementary school students. After that, we got various responses in terms of its advantages and disadvantages. Therefore, several things were improved to make EBS Apps better. The final version of EBS Apps includes steps for observing situations, selecting appropriate information, formulating relevant questions, and engaging in discussions. To maximize its usefulness and accessibility for educators and elementary school students, EBS Apps have been uploaded to the Google Play Store: https://play.google.com/store/apps/details?id=emcorp.studio.ebsapps

F. Students' Responses to the EBS Apps Application

After validation by material experts, IT experts and cultural experts, the next step is to implement the app for elementary school students's usage. In its implementation, students were given normal learning activities. They were given an explanation about EBS Apps and its instruction. After that, students were allowed to open the EBS Apps application on their cellphones as displayed in Fig. 16. In using the application, students could try all situations at each level up to the discussion.

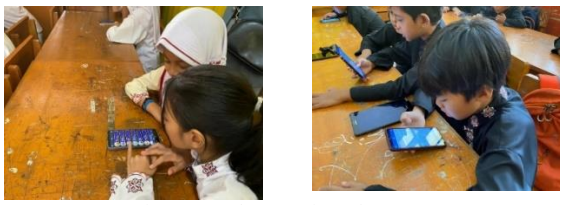

Fig. 16. Implementation of EBS apps.

After using the application, students were given a questionnaire regarding their response to EBS Apps. The questionnaire contain responses to their use, interest, and the impact they feel regarding improving their mathematical problem solving skills after using the app. The details are presented in following Table 5.

Table 5. Data on students feedback to EBS Apps

No.	Statement	Strongly Agree		Agree		Disagree		Strongly Disagree		Total	
		Total	%	Total	%	Total	%	Total	%	Total	%
1	I feel this app is easy to use	17	48.5%	18	51.5%	0	0%	0	0%	35	100%
2	I like using this app in learning	25	71.4 %	10	28.6%	0	0%	0	0%	35	100%
3	I feel happy after using this app	19	54.2%	13	37.1%	2	5.8%	1	2.9%	35	100%

1) Students feedback on EBS Apps

Table 6 presents that students enjoyed using EBS Apps in their learning. The most frequent response indicates that they felt happy to learn using EBS Apps, highlighting its ease of use and strong support for the learning process. Feedback from students as indicated by comfort in using learning media was found to be the strongest predictor of their motivation to learn [96–98].

Table 6. Students' interest in EBS Apps

No.	Statements	Strongly Agree		Agree		Disagree		Strongly Disagree		Total	
		Total	%	Total	%	Total	%	Total	%	Total	%
1	I like the selecting information section on the app	12	34.2%	21	60%	1	2.9%	1	2.9%	35	100%
2	I like selecting question section on the app	20	57.1%	15	42.9%	0	0%	0	0%	35	100%
3	I like discussion section on the app	14	40%	18	51.4%	2	5.7%	1	2.9%	35	100%
4	I like answering question exercise section on the app	19	54.2%	15	42.9%	1	2.9%	0	0%	35	100%

2) Students' interest in EBS Apps

Judging from the results of the questionnaire, it can be concluded that students responded positively to all the stages presented in EBS Apps. Most students agreed and expressed

happiness in trying all the stages. The steps designed in EBS Apps begin with selecting the right information, composing questions, and understanding the discussions. Each step effectively trains their thinking skills by encouraging them to answer questions [99, 100].

3) Critical thinking skills

In this study, critical thinking skills were measured using a questionnaire with the following results in Table 7.

Table 7. Critical thinking skills with the use of EBS Apps

No.	Statement	Strongly Agree		Agree		Disagree		Strongly Disagree		Total	
		Total	%	Total	%	Total	%	Total	%	Total	%
1	With the use of EBS Apps, I find it easier to explain regional culture	23	65.7%	11	31.4%	1	2.9%	0	0%	35	100%
2	The use of EBS Apps helps me become more skilled in understanding	21	60%	13	37.1%	1	2.9%	0	0%	35	100%
3	I feel that using EBS Apps makes it easier to draw conclusions	18	51.4%	17	48.6%	0	0%	0	0%	35	100%

From the data obtained, it is evident that EBS Apps have a positive impact on students' critical thinking skills. The majority of respondents noted that using EBS Apps facilitated easier explanations, enhanced understanding skills, and improved their skill to draw conclusions. Therefore, EBS Apps effectively supports the enhancement of students' critical thinking skills. Learning supported by media encourages recursive learning and can produce higher critical thinking outcomes compared to the passive learning that typically occurs in traditional settings [101–103].

The results of measuring students' problem solving skills are on Table 8.

Table 8. Problem solving skills with EBS Apps

No.	Statement	Strongly Agree		Agree		Disagree		Strongly Disagree		Total	
		Total	%	Total	%	Total	%	Total	%	Total	%
1	I find using EBS Apps helps to be able to ask the right questions based on the situation	20	57.1%	14	40%	1	2.9%	0	0%	35	100%
2	By answering questions on EBS Apps, I understand more about the variety of local wisdom that exists in Indonesia	26	74.2%	8	22.9%	1	2.9%	0	0%	35	100%
3	I feel that using EBS Apps helps to be able to solve the right questions based on the situation	20	57.1%	13	37.1%	1	2.9%	1	2.9%	35	100%

4) Problem solving skills

Based on the students survey result, it can be concluded that students' problem-solving skills have improved with the use of EBS Apps. Almost all students reported that EBS Apps helped them practice posing questions, understand various materials, and become proficient in developing strategies to solve problems. Problem-solving strategies are versatile, adaptable, and holistic approaches to addressing challenges. Generally, these strategies can be applied across all subjects, particularly in various areas of mathematics and even beyond. These strategies are comprehensive, in meaning that they focus on the overall goals, the problem as a whole, and the general direction of the solution [104, 105].

Therefore, based on all the data gathered from students responses, it can be concluded that the EBS Apps application has shown positive benefits for learning. This supports the development of students' learning skills when introduced to technology. Importantly, it enhances students' critical thinking and problem-solving skills through a engaging Android application. With its user-friendly interface, the students to become independent learners. Thus, EBS Apps serves as a valuable Android-based learning tool to cultivate students' thinking skills, particularly in enhancing the problem-solving skills of elementary school students. Activities like these aim to integrate mobile technology into the realm of education, thereby equipping lower-grade elementary school students with essential skills in today's digital era [106–108].

V. Conclusion

The analysis results from validation by media experts, material experts, and cultural experts indicate that the development of culture-based Android applications (EBS Apps) is suitable for elementary school students. The material is coherent, using communicative language, aligning well with students' cultural insights, and supporting the enhancement of problem-solving skills through its application stages. The learning media developed in this study is based on Java Programming. Overall, after implementation, elementary school students responded positively, showing increased interest and improved thinking skills. Based on students feedback, EBS Apps effectively enhance critical thinking skills, particularly in problem-solving. Students find it facilitates their problem formulation, data collection, information analysis, questioning, and conclusion drawing. Therefore, EBS Apps can serve as an effective alternative learning tool for fostering high-quality student development.

A. Limitations

This study was limited to the formal education environment and was conducted on 35 3rd grade elementary school students in Sumedang Regency, West Java, Indonesia. This study only examined the students' affective abilities and

did not measure them through tests.

B. Recommendations and Implications

Based on the aforementioned findings and conclusions, several recommendations are proposed, namely:

1) For education practitioners or teachers

- The use of EBS Apps in learning can encourage students to be active learner and support the improvement of cultural insight and digitalization.
- To develop students' problem-solving skills, teachers should use innovative media and follow appropriate stages to effectively stimulate learning. To encourage interactive learning, it is essential to implement strategies that boost students' motivation.

2) For other researchers

- To enhance students' mathematical problem-solving skills using EBS Apps, several improvements are needed in planning, implementation, and assessment to achieve more optimal and accurate results. Future research can continue to develop this approach, for example, by employing case study methods, action research, and other methodologies.
- In conducting related research to assess problem-solving skills, it is essential to develop valid test instruments to ensure that improvements are measurable. The limitations of this study can serve as reflection or reference material for future research.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors contributed to the writing and revision of the article. The tasks of individual authors. e.g., I. Isrokatun and Rosi Rosmiati contributed to data collection by conducting research; Riana Irawati contributed to instrument development; Nurdinah Hanifah contributed to data analysis and interpretation; Yusuf Abdul Rohman contributed to EBS Apps product development; all authors have approved the final version.

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