International Conference on Islam, Law, and Society (INCOILS)
Conference Proceedings 2024

DEVELOPMENT OF ANDROID-BASED EXPOMATH MEDIA WITH A DIFFERENTIATED APPROACH TO IMPROVE STUDENT LEARNING OUTCOMES AND INTERESTS

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ABSTRACT

The creation of the Android-based *Expomath* media stems from the limited availability of learning resources that leverage technology with a differentiated approach, particularly for ranked number material. Additionally, there is a gap in the utilization of technological advancements to create learning tools tailored to diverse student needs. This study aims to enhance students' learning outcomes and interests by providing engaging, interactive media aligned with various learning styles. The research adopts the *Research and Development* (R&D) approach using the ADDIE model, encompassing Analysis, Planning, Development, Implementation, and Evaluation phases. The study was carried out in grade X of the Private Vocational School of the Padangsidimpuan Campus, employing both quantitative and qualitative data. Data collection methods included observations, interviews, questionnaires, tests, and documentation. The validity and practicality of the media were evaluated using a Likert scale (1-5), yielding a validity score of 92.02% and a practicality score of 92.03%, which were interpreted based on established criteria. The effectiveness test indicated an improvement in student learning outcomes, as shown by the N-Gain test results, with increases of 52.52% and 64.22%, both categorized as medium. *Expomath* media demonstrated a clear distinction in learning outcomes before and after its implementation. Students' understanding of the ranked number concept improved significantly following the use of *Expomath*. This media has been proven valid, practical, and effective, making it a valuable tool for enhancing learning quality and benefiting students, teachers, and schools in improving educational outcomes.

Keywords: Expomath Media, Learning Outcomes, Student Interest

INTRODUCTION

Technological advancements in mathematics in Indonesia are becoming increasingly innovative and digitally oriented, significantly influencing the learning process in schools. (Rohayati, Agustini, and Abdullah, 2020: 371). In performing their duties, teachers must be able to use technological media as a tool to enhance the learning process (Sari and Ahmad, 2021: 2819). The use of learning media in the educational process can spark new interests and motivations in students, while also having a positive psychological effect.

Moreover, the use of learning media can also enhance students' comprehension of the material (Primary, 2021:182). Today's education emphasizes learning that caters to the needs and

characteristics of students, requiring teachers to develop lesson plans that are suited to differentiated learning. However, in practice, at the Private Vocational School Padangsidimpuan Campus, the implementation of learning does not always meet expectations. Teachers often use a single teaching method for the entire class, which leads to students becoming less engaged, causing them to feel bored and fatigued. As a result, the intended goals of mathematics learning are not achieved as expected.

From observations and interviews with teachers at Private Vocational Schools on the Padangsidimpuan Campus during the even semester of the 2023/2024 academic year, researchers gathered insights that students often failed to focus on teachers' explanations. This was due to the use of traditional print media, which lacked interactivity, resulting in suboptimal mathematics learning outcomes and low student interest. This issue was evident from students' daily test scores on ranked number material, which were still below the Minimum Mastery Criteria (KKM), as conventional teaching methods failed to inspire enthusiasm. Students also expressed dissatisfaction with online learning links shared by teachers, as these were deemed ineffective and did not cater to diverse learning styles, focusing only on assignments or questions without proper explanations. This approach led to a decline in students' motivation, as they felt overwhelmed by accumulated tasks. Consequently, teachers must foster students' enthusiasm and interest by adopting engaging teaching methods, such as a differentiated approach.

Differentiated learning is an approach aimed at adapting the classroom learning process to address the individual learning needs of each student (Carol Ann Tomlinson n.d, 2001:2). The goal is to identify students who require further support, understand their learning styles whether visual, auditory, or kinesthetic and determine which students have achieved the set learning objectives. (Joseph et al. 2013:28). Through differentiated learning, student performance can significantly improve as each child is able to maximize their potential, with teachers providing diverse content tailored to the individual learning needs of the students (Wijiastuti and Fitrotun Nisa, 2022:1).

On the other hand, advancements in technology have encouraged developers to create various Android-based learning media, which are then distributed through the Google Play Store. However, trials of mathematics learning applications available on the Play Store revealed several issues: (1) Developers often fail to present or clearly highlight learning materials, making it difficult for students to select appropriate applications, (2) excessive advertisements frequently disrupt user experience, (3) Developers tend to prioritize AdMob revenue over the educational value of the applications, and (4) the content of these applications is generally monotonous, consisting mainly of text and questions, which quickly leads to student boredom. Additionally, none of the existing applications focus on creating Android-based media tailored to differentiated learning needs

(Purwanto and Dwi Gita, 2023:34) to see the cognitive abilities of students according to their learning styles. Thus, this research is focused on developing an application according to the learning needs of students with an android-based differentiated approach.

Based on the phenomena and issues outlined above, the use of learning media and consideration of learning styles play a significant role in enhancing students' mathematics learning outcomes. The Android-based *Expomath* learning media, incorporating a differentiated approach, is expected to help students better understand the subject matter taught by teachers and contribute to improving their academic achievement. This media stands out by presenting material tailored to students' learning styles, mapped through an initial assessment, representing a novel aspect compared to previous studies. Research on the integration of Android-based tools and differentiated approaches has been conducted by several scholars, consistently showing positive effects on mathematics learning. Building on these findings and the issues described, the implementation of *Expomath* media is anticipated to positively impact learning activities.

This application was designed to provide a more engaging, flexible, and user-friendly learning experience, enhancing both the effectiveness and efficiency of student learning. It enables students to study anytime and anywhere, overcoming the constraints of space and time. By aligning with students' learning needs, it aims to improve learning outcomes and cultivate greater interest in mathematics.

RESEARCH METHODS

Types and Models of Development

The types of research used are *Research and Development* (R&D) developed by Reis and Mollenda in 1990 (Ahmad Nizar Rangkuti, 2016:258) namely the ADDIE model. The development model consists of 5 stages, namely *Analysis, Design, Development, Implementation*and *Evaluation*. Researchers chose the ADDIE model because it aligns with the research objectives and can be applied across various teaching contexts. This development model is straightforward and practical for field implementation due to its simple work stages. Continuous evaluation and revision are conducted at each phase to ensure the final product meets the necessary requirements, resulting in a highly valid outcome (Sugiyono, 2013 : 297).

Time and Place of Research

The research was conducted at the Private Vocational School of the Padangsidimpuan Campus during the even semester of the 2023/2024 academic year, from February 17, 2024, to May 18, 2024. The location was selected using purposive sampling, a method chosen intentionally

and based on specific objectives, as the developed learning media is aimed at grade X vocational school students who struggle with understanding and solving mathematical problems, particularly those related to ranked number material.

Research Subject and Object

The research subjects consisted of two groups: media validation subjects and field trial subjects. The media validation group included 2 material experts, 2 media experts, 2 linguists, 2 assessment experts, and 2 mathematics teachers who conducted the practical test. The field trial group consisted of all 28 grade X students, with the sample selection using the saturated sampling method, meaning the entire population was included as research subjects. The validators were selected due to their expertise in their respective fields, holding S-2 and S-3 degrees. The object of this research is the Android-based *Expomath* media, which uses a differentiated approach to enhance student learning outcomes and interests at the Private Vocational School of the Padangsidimpuan Campus.

Research Procedure

The procedure for developing *android-based Expomath* media is explained as follows:

1. *Analysis,* The researcher conducts the analysis as a reference or benchmark. The analysis stage carried out by the researcher includes four aspects, namely (1) analysis of student characteristics, (2) analysis of learning interests, (3) analysis of learning media characteristics, and (4) analysis of content (content).
2. *Design*, the stage of making learning media design or product design to be developed includes (1) assessment of learning materials (2) making media design (*flowchart*) (3) making media design (*storyboard*)
3. *Development,* refers to the process of creating the learning media itself. The step of transforming the media design into a format that can be used by students is as an Android application. In this study, the Android-based Expomath media with a differentiated approach was developed using *Google Sites software.* Additionally, the researcher utilized various supporting applications such as *Microsoft Word* for text creation. *Canva* for content design, *Pinterest* for collecting icons. *Acegif.com* for animated images, *Google Forms* for creating questions, attendance sheets, worksheets, and assessment rubrics. *Podcasters* for voice recordings. *Live Worksheet* for post-test worksheets. *Mentimeter* for real-time student polling, and the *Appsgeyser* app to convert media links into an Android app without coding. *Google Drive* was used to store the developed media files. Furthermore, a media assessment was carried out that had been developed as a

form of initial product by material experts, media experts, linguists and assessment experts. The product validation stage aims to obtain statements or suggestions from a team of experts based on the set eligibility criteria, to find out the feasibility of the product being developed. The product will be implemented in learning if it has been declared feasible (valid) by material experts, media experts, linguists and assessors.

4. *Implementation*, refers to the process of using the learning media in the classroom according to the teaching module. Before students engage with it, the learning media undergoes feasibility testing and has been validated by expert reviewers in their respective fields to ensure its quality. After validation, the media is applied or implemented with the subject teachers and grade X students of the Private Vocational School Padangsidimpuan Campus.

   Teachers and students involved in the implementation of the learning media completed a practicality questionnaire to evaluate their responses to its usage. The purpose of this questionnaire was to assess the practicality of the developed product and determine how useful and practical the Android-based media was, in alignment with the concepts of usability and practicality (Kartini and Putra 2020). The effectiveness of the Android-based *Expomath* media was evaluated through a learning outcomes test, with results measured using the N-Gain from pretest and posttest scores. Additionally, differences in the average learning outcomes of students before and after using the Android-based *Expomath* media with a differentiated approach were analyzed using the *One Group Pretest-Posttest Design*.
5. *Evaluation,* is the next stage following the implementation process, involving an assessment to revise the results of the student trials. This step identifies the strengths and weaknesses of the developed product and contributes to refining the final product. The evaluation aims to assess the validity, practicality, and effectiveness of the media at each stage of the activity.

Data Collection Instruments and Techniques

Data Collection Instruments

Research instruments serve as tools for collecting data and are designed to measure responses and feedback on the developed learning media. The design of instruments varies across studies, as the objectives and methodological approaches differ depending on the specific research techniques employed (Sukendra and Atmaja 2020:2). The research instruments include validation sheets for material experts, media experts, linguists, and assessment experts, as well as questionnaire and test sheets. The material expert validation sheet is used to evaluate the depth of the material presented and its alignment with learning objectives. The media expert validation sheet

is designed based on criteria for effective learning media, referencing the modified theories of Ashhar and Arsyad (Fuada, 2016:854).

Linguist validation aims to gather data in the form of evaluations, opinions, or suggestions regarding the accuracy and appropriateness of the language used in the Android-based *Expomath* media with a differentiated approach. Meanwhile, the purpose of validation by assessment experts is to evaluate the quality of the assessment rubric and provide suggestions for improvement, ensuring the media can be effectively utilized by both students and teachers.

Data Collection Techniques

The data collection techniques used in this study include observation, interviews, questionnaires, tests, and documentation. The purpose of observation is to examine, observe, and understand the learning process as it unfolds. This study employs the participant observation method, where the researcher is directly involved and actively experiences the situation.

Interviews were conducted in an unstructured format, allowing researchers to gather clear, accurate, and reliable information without adhering to specific interview guidelines. Questionnaires were used to collect information from respondents, utilizing the Likert scale, which was first developed by Rensis Likert in 1932 to measure attitudes. Each item on the questionnaire is rated using a Likert scale with the following variations: 5 = Very Good, 4 = Good, 3 = Fair, 2 = Poor, and 1 = Very Poor (Maryuliana, Subroto, and Haviana 2016:12).

The test administered was an objective multiple-choice test consisting of 15 questions. Correct answers were awarded a score of 1, while incorrect answers received a score of 0. Each question offered four answer options, and the test had been previously validated by expert lecturers in their respective fields *(expert judgment)*. Multiple-choice tests were chosen because they ensure only one correct answer among the options, making students' responses more objective. Additionally, this format allows for quick grading and reliable results. Documentation included photos of activities during the learning process with the media, serving as evidence of research implementation, along with supporting data such as a list of student names and photos with experts.

Data Analysis Techniques

The data analysis techniques used in this study include qualitative descriptive analysis and quantitative descriptive analysis. Qualitative descriptive analysis is employed to process data obtained from the evaluations of material experts, media experts, linguists, assessment experts, teacher response questionnaires, and student response questionnaires, including criticisms and

suggestions for improvement noted in the questionnaires. The results of this analysis serve as a guide for revising the developed product. Quantitative descriptive analysis, on the other hand, is utilized to assess the effectiveness of the learning media in supporting the learning process.

1. Validity Analysis

The validity analysis is carried out with the following steps:

(1) Each criterion is scored as follows: Very Good (SB) receives a score of 5, Good (B) receives a score of 4, Fair (C) receives a score of 3, Poor (K) receives a score of 2, and Very Poor (SK) receives a score of 1 (Maryuliana, Subroto, and Haviana 2016:73)

(2) The collected data is analyzed by determining the average score for each criterion, using the following average calculation formula: $(\bar{x}) = \frac{\Sigma x}{n}$
Description: = average ; = amount of data; n = a lot of data$\bar{x}\sum x$

(3) To analyze the validity level of the data, the following formulas are utilized:

$$V_{ax} = \frac{T_{se}}{T_{sm}} \; x\; 100\%$$

Information:

Tse = Total empirical score (validation result from validators)

Tsm = Maximum expected total score

Vax = Expert validators

(4) After obtaining the scores or values from each validator, the researcher can calculate the overall validity of the analysis using the following formula:

$$V = \frac{V_{a_1} + V_{a_2}}{2} = \ldots \%$$

Information:

V = Final validation

Va_1 = Expert validation 1

Va_2 = Expert validation 2

(5) Qualitative research data, including comments and suggestions, is used as a foundation for revising the learning media.

(6) To conclude the results of the average percentage of the total validation score using the following product quality criteria:

Table 1. Range and Validity Assessment Criteria

Information	Criterion	Validity Level
4,01 – 5,00	81% - 100%	Highly valid, suitable for use without modifications.
3,01 – 4,00	61% - 80%	Valid, usable with minor adjustments needed.
2,01 – 3,00	41% - 60%	Moderately valid, requires significant improvements, and is not recommended for use.
1,01 – 2,00	21% - 40%	Less Valid, not suitable for use.
0,00 – 1,00	≤ 20%	Invalid, completely unsuitable for use.

2. Practicality Analysis

The practicality of the Android-based *Expomath* media with a differentiated approach is determined from the teacher and student response questionnaires regarding the use of the learning media. To analyze the level of practicality, the following formula can be applied descriptively:

(1) Teacher Response Questionnaire

The practicality formula for the questionnaire of teachers' responses to *android-based Expomath* media with a differentiated approach using the formula is

$$The\ Value\ of\ Practicality\ (NP) = \frac{Number\ of\ scores\ obtained}{Number\ of\ highest\ scores}\ x\ 100\%$$

(2) Student Response Questionnaire

The practicality formula for the student response questionnaire to *the android-based Expomath* media with a differentiated approach is as follows:

$$The\ Value\ of\ Practicality\ (NP) = \frac{Number\ of\ scores\ obtained}{Number\ of\ highest\ scores}\ x\ 100\%$$

The final result of the combined student responses was calculated using the mean formula.

$$Rpd = \frac{Rpd_1 + Rpd_2 + Rpd_3 + \ldots + Rpd_n}{N}$$

Information:

IDR : Student response with n = 1, 2, 3, . . ., 28

IDR : Combined average of all students' responses

N : Many Students

The practical results of the practicality analysis, once the presentation level is determined, can be aligned with the modified practicality assessment criteria from Riduwan as follows:

Table 2. Practicability Assessment Range and Criteria

Information	Criterion	Practicality Level
4,01 – 5,00	81% - 100%	Very Practical
3,01 – 4,00	61% - 80%	Practical
2,01 – 3,00	41% - 60%	Quite Practical
1,01 – 2,00	21% - 40%	Less Practical
0,00 – 1,00	≤ 20%	Impractical

Source: Riduwan modified, 2015 (Hamdunah 2015)

3. Effectiveness Analysis

The analysis of test result data was conducted to examine the difference in student learning outcomes before and after using the media. The media is considered effective if it

successfully achieves its objective, which is to show significant differences and positive improvements in student learning outcomes before and after using the Android-based media (Iman Taka 2018).

Effectiveness tests are tests carried out on products that have been developed by involving potential product users (Yulia Sari 2016). The researcher applied the N-Gain Test to assess the effectiveness of student learning outcomes and interests after using the Android-based differentiated mathematics learning media, using the following formula:

$$N - Gain = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Ideal - Skor\ Pretest}$$

The category for determining N-Gain scores can be based on the percentage (%) or the interpretation category of N-Gain effectiveness. The classification of N-Gain value categories can be seen in the following table:

Table 3. Gain Score Distribution

N-Gain Value	Category
g > 0.7	Tall
0.3 ≤ g ≤ 0.7	Keep
g < 0.3	Low

Source: (HakeR.R, 1998, 64)

Table 4. Categories Interpretation of *N-Gain Efficacy*

Percentage (%)	Interpretation
< 40	Ineffective
40 – 50	Less Effective
56 - 75	Quite Effective
>76	Effective

Source: (Meltzer, David.E, 2002, 1259)

RESULTS AND DISCUSSION

This study resulted in the creation of an Android-based mathematics learning media called Expomath, derived from the words "Exponent" (for ranked numbers) and "Math" (for mathematics). It is designed to assist teachers in delivering ranked number material to class X students at the Private Vocational School Padangsidimpuan Campus in a more engaging way, while also serving as a learning resource for students. The research focuses on developing learning media using *Google Sites software*, with the aim of evaluating the media's feasibility, practicality, effectiveness, and assessing the differences in average learning outcomes before and after the use of the media. The development process follows the ADDIE model, which includes five stages: (1) *Analysis*, (2) *Design*, (3) *Development*, (4) *Implementation*, and (5) *Evaluation*. In this stage, an analysis of the learning media's needs will be conducted, with the activities planned for this phase.

1. Analysis Results

This stage of analysis aims to find problems that may occur in learning. The following is an explanation of the stages of analysis carried out by the researcher:

a. Student Characteristics Analysis

The first step in developing learning media is understanding the characteristics of students. Given their diverse abilities and learning styles, teachers need to adopt a differentiated approach in line with the principles of the independent curriculum. This approach does not mean treating each student differently, but rather using initial assessment data to design lessons that cater to students' needs and learning preferences. In today's technological age, most grade X students at the Private Vocational Schools on the Padangsidimpuan Campus own Android devices, highlighting the potential for developing technology-based learning media.

b. Learning Interest Analysis

Some students do not focus on the teacher's explanations, leading to low interest in mathematics. This is attributed to teaching methods that do not align with individual learning styles. Additionally, the use of learning media by teachers has not been maximized, making it less effective in boosting students' interest and understanding. This observation is supported by the results of a pretest questionnaire on students' learning interests. Below are the findings from the learning interest questionnaire for class X students at the Private Vocational School of the Padang Sidimpuan Campus:

Table 5. Results of Students' Early Learning Interest *(Pretest)*

Aspects	Percentage	Criterion
Interest in Learning	59,71%	Enough
Attention in Learning	61,57%	Good
Feeling of Pleasure	60,29%	Good
Learning Engagement	57,57%	Enough
Total	**59,79%**	**Enough**
Number of Students	**28 people**	

According to the table above, students' interest in learning and their involvement in lessons are categorized as adequate. Regarding attention during lessons and feelings of enjoyment, the category is good. The overall average of these aspects indicates that the learning interest of class X students at the Private Vocational School Campus falls into the fair category, with a percentage of 59.79%, based on a total of 28 students.

c. Analysis of Learning Media Characteristics

Through interviews with math teachers, it was found that the current learning media is limited to printed books, whiteboards, and PowerPoint slides. Students struggle to understand ranked number material, and teachers face challenges in selecting media that align with students' needs and learning styles, as well as in presenting the material in an engaging way.

To address this, there is a need for learning media that can effectively visualize the material in an engaging manner to facilitate the teaching and learning process. The researcher plans to develop Android-based learning media that captures students' interest through visual, auditory, and kinesthetic presentations of the material. This media is designed to align with students' learning styles, support technological advancements, and be accessible anytime and anywhere.

d. Content or Content Analysis

The Android-based learning media presents ranked number material interactively through various formats, such as comics, podcasts, and exercises. Comics assist students in understanding concepts with enjoyable visualizations in the form of stories. Podcasts offer detailed verbal explanations for students who prefer auditory learning. Interactive exercises enable students to practice the concepts directly, reinforcing their understanding in an engaging manner. This approach makes learning more accessible, engaging, and enjoyable for students.

At this stage, the material analysis is based on the Learning Outcomes (CP) and Learning Objectives (TP) that will be incorporated into the Expo Math media to achieve the learning goals. The Learning Outcomes and Learning Objectives that students must achieve in the ranked number material are derived from the Ministry of Education and Culture No.008/H/KR/2022 in Phase-E.

2. Design Results

This stage involves designing the learning media using *Google Sites software* to make it engaging, easily accessible, and enhanced with appealing images and stories to enrich students' understanding. The steps are carried out as follows:

a) Assessment of Learning Materials

The content covers the fundamental concept of ranked numbers, their operational properties, methods for calculating ranks, and their practical applications in everyday life.

b) Media Design *Creation (Flowchart)*

Flowchart is an overview of the learning media that will be contained in the application The media to be developed is described in the *flowchart* as follows:

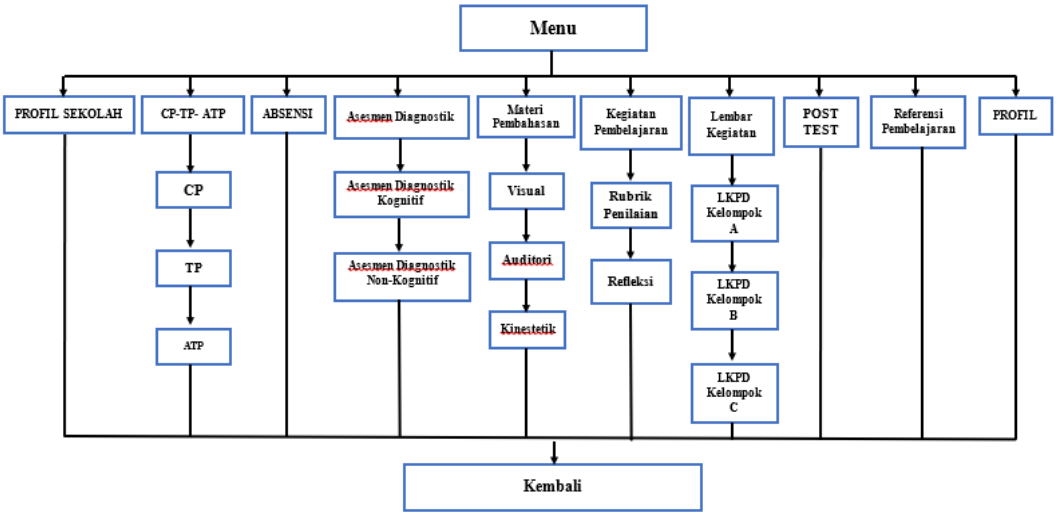


Fig. 1 Flowchart Design

These pages consist of: (1) the school profile page, (2) CP, TP, and ATP pages, (3) attendance tracking pages, (4) diagnostic assessment pages, (5) discussion material pages designed for three learning styles visual, auditory, and kinesthetic, (6) learning activity pages, (7) activity sheet pages, (8) post-test pages, (9) learning reference pages, and (10) a developer profile page.

c) Creating Media Design *(Storyboard)*

The storyboard design includes the initial layout, display, and content arrangement for the learning media, such as navigation buttons, page structure, text placement, and other elements within the media. Storyboards are created to offer a visual plan or blueprint for the learning media being developed. This storyboard acts as a guide throughout the media creation process, ensuring it is organized and systematic. Here's what the storyboard design looks like:

1. Initial Display Design

The initial appearance is made as a form of application of the product being developed.

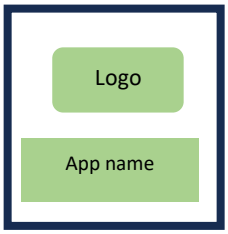


Figure 2. Main View *Storyboard* Design

2. Main Menu Plan

The main menu will appear after the initial view. On the main menu, there are several buttons that can move to the next page, namely school profile, CP, TP, ATP, attendance, diagnostic assessment, discussion materials, learning activities, worksheets, *posttests*, learning references, developer profiles.

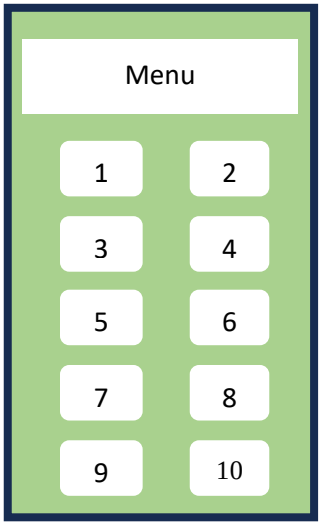


Figure 3. Homepage *Storyboard* Design

3. Development Results

In the development stage, the researcher creates learning media using *Google Sites*. The development process involves incorporating all components and designing the media according to the storyboard.

a. Initial View

The initial display is an image of the logo of an *Expomath* application which is first seen when clicked will open the learning media to enter the menu page. Here's a look at the start.

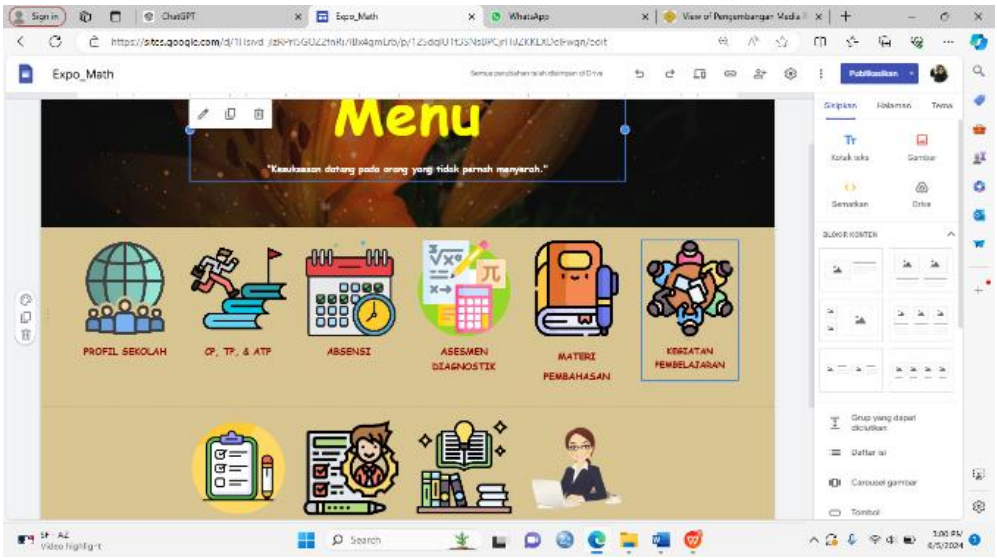
Figure 4. Initial view

b. Main Menu Display

The menu section contains various components that can be accessed, including the application menu options such as school profiles, CP, TP, ATP, attendance, diagnostic assessments, learning materials, learning activities, worksheets, posttests, learning

references, and developer profiles. The access link for the ExpoMath media is *https://bit.ly/Expo_Math.*

Figure 5. Main Menu Display



4. Implementation Results

During the implementation phase, the developed and validated *Expomath* media is tested on grade X students of Private Vocational Schools at the Padangsidimpuan Campus, as well as mathematics teachers. This trial also evaluates the alignment of the material with the learning outcomes and indicators used in the school's mathematics curriculum.

Additionally, both teachers and students are asked to complete a questionnaire to provide feedback and suggestions for improving the android-based *Expomath* materials and media, which were developed using a differentiated approach. The purpose of the questionnaire is to assess the quality of the materials and media, as well as to evaluate their effectiveness in enhancing students' interest in learning mathematics.

5. Evaluation Results

The evaluation at this stage, based on the data analysis from previous stages, indicates that the Android-based *Expomath* media, which incorporates a differentiated approach to learning numbers, has been proven to be valid, practical, and effective.

Data Analysis Results

1. Results of Media, Material, Language and Assessment Validation

Analysis of the results of the assessment of 8 validators, namely 2 material experts, 2 media experts, 2 linguists, and 2 assessment experts, found that the development of android-based *Expomath* media with a differentiated approach was in the very valid

category. All items of the learning media criteria have been revised according to the suggestions from the validators, so it can be concluded that the android-based *Expomath* media is ready to be tested in learning. The overall validation results are as follows:

Table 6. Overall Validation Result Data

It	Validation	Percentage		Average Percentage	Category
		Member 1	Member 2		
1	Material Validator	78.30%	98.30%	88.30%	Highly Valid
2	Validator Media	100%	94.70%	97.35%	Highly Valid
3	Language Validator	92.00%	80.00%	86.00%	Highly Valid
4	Assessment Validator	98.60%	94.30%	96.45%	Highly Valid
Overall Average				**92.025%**	**Highly Valid**

Based on the overall average of all validators, the validation instrument falls into the "Highly Valid" category, with an average score of 92.025%. Consequently, the development of *Expomath* media is deemed highly valid and appropriate for use, as indicated by the assessment results.

2. Product Development Practicality Analysis

To evaluate the practicality of the product developed in this study, the researcher utilized user questionnaires, which included feedback from both teachers and students, as detailed in the following explanation:

a. Teacher's Response

The practicality test is conducted following the validation process to determine the ease of use of the learning media. This test involves teachers with at least a bachelor's degree (S1) and over 15 years of teaching experience.

Table 7. Practicality Results by the Practitioner Test (Teacher)

It	Statement	Teacher 1	Teacher 2
1	This educational tool supports the instruction of mathematics courses.	5	5
2	This educational tool encourages students to take an active role in the learning process.	5	5
3	The learning objectives in *Expomath* media align with the CP and ATP standards.	5	5

4	The clarity and simplicity of material delivery.	4	5
5	The comprehensiveness of questions in the *Expomath* media.	4	4
6	The font type and size in this learning medium are readable and easy to comprehend.	5	5
7	The assessment rubric in the media is complete and comprehensive.	5	5
8	This medium is user-friendly and highly practical.	5	5
9	The design of this learning media is visually appealing and well-organized.	5	5
10	The assessment tool in this learning medium is capable of evaluating students' skills.	5	5
Sum		**48**	**49**
Maximum Score		**50**	**50**
Percentage (%)		**96%**	**98%**
Average Combined Percentage (%)		**97 %**	
Criterion		**Very Practical**	

The combined average percentage of responses from the two teachers is 97%, falling within the "Very Practical" category as it lies in the 81%-100% range. *Expomath* media is considered practical due to its simplicity in application creation without requiring coding and its ease of operation by simply clicking on the media images to access connected content.

b. Student Response

After conducting a practicality test by the teacher, the next stage is the student response test stage, this stage is carried out by class X students.

Table 8. Student Respondent Test Results

It	Assessment Items	Percentage of Practicality	Criterion
1	This learning media can make it easier to teach mathematics subjects.	85 %	Very Practical
2	This learning media makes students active in learning.	84 %	Very Practical
3	The learning objectives in the *Expomath* media are in accordance with CP and ATP.	89 %	Very Practical
4	The clarity and simplicity of material delivery in *Expomath* media.	88 %	Very Practical

5	The thoroughness of the questions in *Expomath* media.	88 %	Very Practical
6	The font size and style used in this learning medium are clear and easy to comprehend.	85 %	Very Practical
7	The assessment rubric in the media is comprehensive and complete.	90 %	Very Practical
8	This medium is convenient and simple to use.	86 %	Very Practical
9	The design of this learning media is organized and visually appealing.	91 %	Very Practical
10	The assessment tool in this learning medium is capable of evaluating students' competencies.	86 %	Very Practical
Average		**87,07%**	**Very Practical**

Based on the average results from the student response questionnaire, an average percentage of 87.07% was obtained, which falls under the very practical category according to the practical criteria table. The combined feedback from both teachers and students regarding the use of *Expomath* media shows the overall practicality of the media, as illustrated in the following table and graph:

Table 9. Average Results of *Expomath Media Practicality*

Response	Percentage of Practicality	Information
Teacher's Response	97,00 %	Very Practical
Student Response	87,07 %	Very Practical
Average	**92,03 %**	**Very Practical**

Based on the average percentage of the practicality level of the learning media, as assessed by teachers and students in class X, *Expomath* media is considered "Very Practical" with a percentage of 92.03%. This indicates that *Expomath* media is practical to use and offers benefits to its users.

3. Product Effectiveness

a. Analysis of *N-Gain Scores* of Learning Outcome Tests

Data on student learning outcomes before and after using the media were collected from grade X students at the Private Vocational School Padangsidimpuan Campus. The pretest and posttest scores were compared, and the N-Gain results were calculated and classified according to the N-Gain effectiveness interpretation category table. Below are the results of the N-Gain analysis of the learning outcomes:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score	28	.26	1.00	.5252	.16336
NGain_Persen	28	25.93	100.00	52.5222	16.33552
Valid N (listwise)	28				

Based on the calculation results presented in the table from Excel and SPSS data, the average N-Gain score is 0.525 or 52.52%. This indicates that the N-Gain level falls within the medium category according to the criteria table.

b. N-Gain Value Analysis of Learning Interest Questionnaire

The N-Gain value analysis of learning interest was used to assess the effectiveness of students' engagement before and after using *Expomath* media. The N-Gain results indicate that the researchers aimed to enhance students' interest in mathematics lessons. Below are the results of the N-Gain analysis of learning interests:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score_Minat_Belajar	28	.25	.78	.6422	.12166
NGain_Persentase_Minat_Belajar	28	25	78	64.22	12.166
Valid N (listwise)	28				

Based on the calculation results displayed in the table from *Excel* and SPSS data, the average value of the *N-Gain Score* is 0.6422 or 64.22%. This shows that the *N-Gain level* is in the medium category according to the criteria table.

CONCLUSION

The conclusions of this study are as follows: (1) The Android-based ExpoMath learning media software for ranked number material has been successfully developed; (2) The developed learning media has proven to meet the criteria of validity, practicality, and effectiveness in mathematics education, leading to improved learning outcomes and student engagement. It also satisfies the criteria for learning media, including alignment with teaching objectives, ease of use, and adaptation to students' learning needs. (3) The use of Android-based ExpoMath media positively impacts academic performance, enhancing both student interest in learning and cognitive learning outcomes in vocational school students.

ACKNOWLEDGMENTS

All praise and gratitude are for Allah SWT, for His mercy and blessings. Special thanks go to the Private Vocational School of the Padangsidimpuan Campus for giving the opportunity to carry out this research, as well as to everyone who has offered their support and collaboration during this process.

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