

Development of Android-Based Learning Media in Mathematics and Natural Sciences Philosophy Courses for Physics Education Students

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Abstract

MIPA Philosophy is a course that discusses the fundamentals of the philosophy of science, particularly in the context of Mathematics and Natural Sciences (MIPA). In the Physics Education Study Program at UNINDRA, learning media for this course traditionally rely on PowerPoint presentations, papers, and oral presentations. Such conventional methods are often less effective in fostering student engagement and deep understanding. To address this, the present study aims to develop an Android-based interactive learning medium tailored for the MIPA Philosophy course. The research employed the ADDIE development model, consisting of Analysis, Design, Development, Implementation, and Evaluation phases. The product was implemented in a limited trial involving 25 undergraduate students from the Physics Education Study Program. The evaluation results showed an average score of 89.95%, which falls under the "very feasible" category. This indicates that the developed Android-based media is highly suitable for enhancing the learning experience. The integration of mobile technology in this context contributes to the broader field of educational technology by offering an engaging and accessible platform for philosophical learning in science education, potentially inspiring wider pedagogical innovations in higher education settings.

Keywords: MIPA Philosophy, Android, Media

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1. INTRODUCTION

The philosophy of science cannot be separated from the history of the development of science because the foundation of science lies in philosophy, which consists of ontology, epistemology, and axiology (Endraswara, 2021). While general knowledge may accept truths without much scrutiny, science systematically questions and verifies knowledge claims to ensure they have truth value and utility. These three philosophical pillars greatly influence the attitudes, methods, and directions of scientists in advancing science, making the nature of science itself dynamic and ever-evolving.

In the learning context, media refers to tools, materials, or situations used to facilitate communication between educators and learners. The presence of media is essential as it has a strong influence on increasing students' motivation and conceptual understanding (Mayasari et al., 2021). Media also function as visual aids that can simplify abstract ideas, enhance retention, and provide more engaging learning experiences (Miftah, 2013).

In the Mathematics and Natural Sciences (MIPA) Philosophy course at the UNINDRA Physics Education Study Program, traditional teaching methods such as PowerPoint presentations, student papers, and oral presentations are still dominantly used. These conventional approaches tend to be less effective in promoting student engagement and deep understanding (Jafar, 2021). For example, feedback from students reveals that the material is often perceived as too abstract and the delivery lacks visual or contextual appeal, making it hard for them to connect philosophical theories with scientific practices. One student commented that "PowerPoint slides only present main points without helping to visualize the complex ideas in philosophy." In line with Supardi et al. (2015), effective and interesting

media can enhance students' conceptual understanding, particularly important for abstract disciplines such as philosophy.

In the era of digital transformation, the integration of mobile technology in education has gained momentum. Mobile devices such as smartphones have become an inseparable part of students' daily lives (Adiarsi et al., 2015). Educators are therefore expected to leverage mobile-based technologies to support teaching and learning (Nazar et al., 2020; Wibowo, 2023). Android-based learning media offers significant advantages: flexibility, ease of access, multimedia integration, and opportunities for students to learn independently, beyond the physical classroom (Ruswan et al., 2024).

The MIPA Philosophy course introduces students to the basic concepts of the philosophy of science, especially within the context of Mathematics and Natural Sciences. Students are expected to understand and critically reflect on concepts such as epistemology, ontology, and axiology as they relate to scientific inquiry and ethics (Widyawati, 2013). The course also covers contextual and culturally rooted content such as the philosophy of wayang and how philosophical reasoning relates to the roles and responsibilities of scientists in society (Santi et al., 2022; Azizi, 2022).

The achievements in the Mathematics and Natural Sciences Philosophy course in the UNINDRA Education Study Program are:

1. Students are able to understand Introduction to Mathematics and Natural Sciences Philosophy.
2. Students are able to explain the History of the Philosophy of Science.
3. Students are able to identify the Epistemology of Natural Sciences.
4. Students are able to interpret Natural Science Ontology and Science Ethics.
5. Students can describe MIPA Philosophy, Logic and Scientific Reasoning.
6. Students are able to analyze the Wayang Philosophy, characters and the value of the Wayang Philosophy in science.
7. Students can identify Contemporary Philosophy of Science.

The course aims to develop students' critical and reflective thinking by grounding their scientific understanding in philosophical perspectives. However, the abstract nature of the subject matter and the limited interactivity of existing teaching methods highlight the need for alternative media that can present philosophical concepts in a more engaging and visual manner. This study addresses that need by developing Android-based learning media focused on one of the course's learning achievements.

Based on this background, the researchers conducted a study involving students of the Physics Education Study Program at UNINDRA. This research is entitled: "Development of Android-Based Learning Media in Mathematics and Natural Sciences Philosophy Courses in the UNINDRA Physics Education Study Program.

2. METHODS

This study employs a Research and Development (R&D) approach aimed at developing Android-based learning media for the Philosophy of Mathematics and Natural Sciences (MIPA) course in the Physics Education Study Program at UNINDRA. The development process followed the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation (Mayanty et al., 2023).

Data Development instruments are useful for obtaining the data needed according to research objectives. The research instrument is equipped with a questionnaire as well as a sheet of suggestions and comments. The contents of the questionnaire include an assessment form for experts/lecturers in the field of media and materials related to learning. Alternative answers were given a score, namely very good = 4, good = 3, poor = 2, very poor = 1.

The instrument grid that will be given to media experts consists of 12 questions divided into 3 aspects. The grid for material experts consists of 12 questions consisting of 2 aspects. Meanwhile, the grid for linguists consists of 13 questions divided into 2 aspects. The grids are in tables 1 and 2.

Table 1. Media expert validation test instrument grid

No	Aspect	Number of Questions
1	Design	6
2	Layout	4
3	Media Usage	2
Σ		12

Table 2. Material expert validation test instrument grid

No	Aspect	Number of Questions
1	Material/Content	6
2	Presentation	6
Σ		12

The student assessment instrument was created to determine students' responses or assessments of the developed learning media. The grid is in table 3.

Table 3. Grid of student validation test instruments

No	Aspect	Number of Questions
1	Media	7
2	Content	6
Σ		12

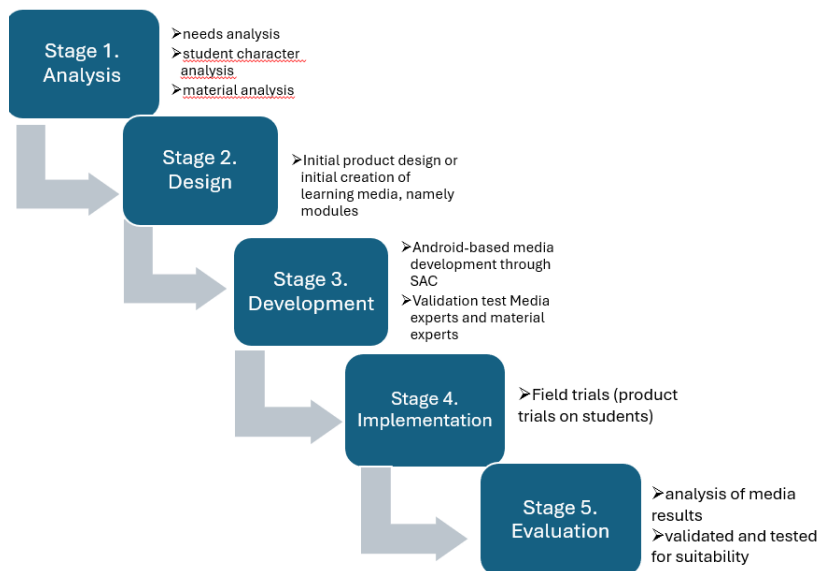


Figure 1. Research flow

Data in the form of a feasibility assessment of the product test from the questionnaire were analyzed using the provisions of the Likert scale with the scoring rules in table 4.

Table 4. Questionnaire Validation Score Level

Description	Score
Very good	4
Good	3
Enough	2
Not good	1

The field trial was conducted in two phases. Small-scale testing involved 5 third-semester students to assess usability and navigation. Large-scale testing was conducted with 25 third-semester students of the Physics Education Study Program at UNINDRA. Students used the media and completed an embedded response questionnaire at the end of the learning module. Data from expert validations and student responses were analyzed using the following formula to calculate the feasibility percentage:

$$\text{Percentage score} = \frac{(\sum \text{acquired score})}{(\sum \text{maximum score})} \times 100\%$$

After calculating the weight of the score obtained from the validator data, data will then be collected from students. During the field trial, students will be given a response questionnaire filled out by students which will be processed using the same technique. And the results will be used to see the extent of student responses to Android-based media and the readability of the learning media created so that this Android-based media deserves a decent predicate.

RESULT AND DISCUSSION

The results and discussion of this study will explain the things obtained from each stage of interactive learning media development, namely as follows;

1) Analysis

The research conducted produced a product in the form of android-based learning media development. This research is a research & development, namely Research and Development (R&D) which aims to produce android-based learning media in the MIPA philosophy course in the Physics Education Study Program, UNINDRA. The stages of this research are analysis, design, development, implementation, and evaluation.

In the analysis of student needs to develop innovative teaching media. Researchers as lecturers teaching the Philosophy of Mathematics and Natural Sciences course need learning media not just PPT (Power Point) and papers. Further analysis is to analyze the character of students, Physics Education students of UNINDRA semester 3 odd academic year 2024/2025 all have gadgets or cellphones. The characteristics of today's students have their own gadgets. In accordance with the last analysis, namely the selection of Philosophy of Mathematics and Natural Sciences material with joint considerations in accordance with the Semester Learning Plan (RPS). One of the interesting materials is the Introduction to the philosophy of wayang, the basic concepts of wayang philosophy, and its relevance in a modern context. This material is a characteristic material of UNINDRA and a novelty that has never existed before and researchers are interested in focusing on developing it.

2) Product Design (design)

At this product design stage, the results obtained in the process of developing and creating android-based media development through Smart Apps Creator (SAC) will be explained. The results of the problem analysis carried out, then the researcher designed an interactive multimedia product for students which contains various materials in the form of explanations, video materials, and quizzes that are designed attractively.

In presenting this media, software is needed that can provide space for researchers to be creative according to the needs of students, namely by using Canva and Smart Apps Creator (SAC). In addition, at the design stage, instruments were created that would be used for research. This media uses a composite navigation structure design (mixed) which is a combined structure of linear, non-linear and hierarchical navigation structures.

a. Linear Navigation Structure

A linear navigation structure is a structure that only has one sequential series of stories.



Figure 2. Linear Navigation Structure

b. Non-Linear Navigation Structure

Non-linear (unordered) navigation structure is a development of linear structure that uses branching. This branching is different from hierarchical branching structure, because each view has the same position.

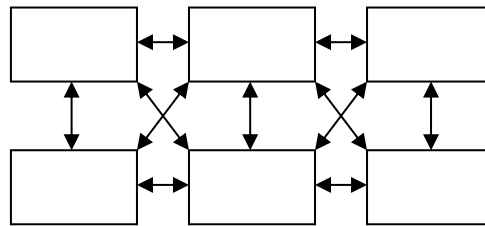


Figure 3. Non-Linear Navigation Structure
Source: Personal Document

c. Hierarchy Navigation Structure

The hierarchical navigation structure is a structure that relies on branching to display information contained in a multimedia application.

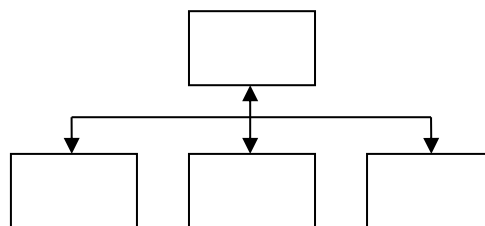


Figure 4. Hierarchy Navigation Structure
Source: Personal Document

3) Development





After conducting the development, the research team created a validity questionnaire and consulted with experts, namely media experts, material experts. After getting input from experts, it can be improved according to the direction and input of experts. Then the product was tested on a limited group. The results of the interactive media development prototype on the Wayang Philosophy material are as follows.







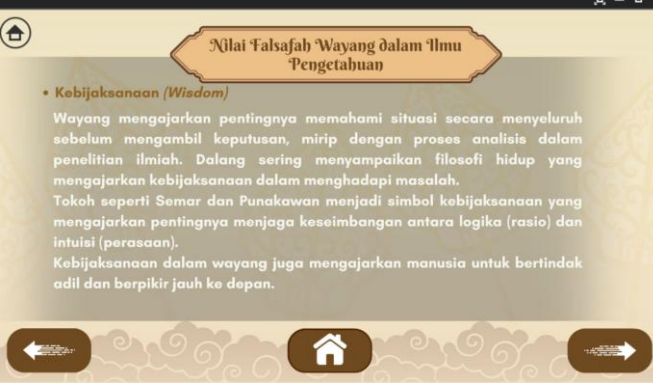



Figure 5. Interactive Learning Media Cover Display

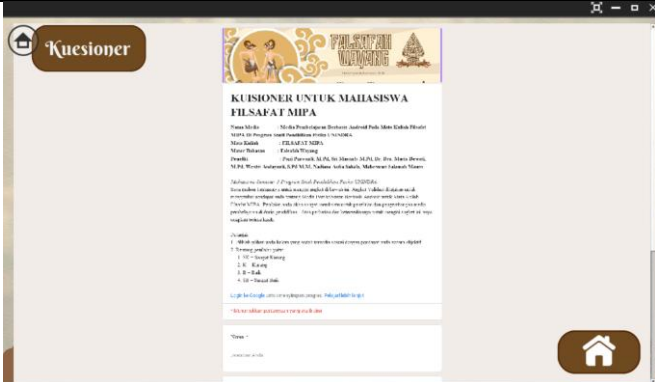
The following is a display of interactive learning media that is operated on Android, as follows;

Table 5. Android-Based Learning Media Display

Display	Description
	<p>The initial cover of the Android-based media for the MIPA Philosophy course with the material Wayang Philosophy.</p>
	<p>The initial menu display for the Android-based media for the MIPA Philosophy course with the material Wayang Philosophy</p>
	<p>The main menu display consists of:</p> <ol style="list-style-type: none"> 1. Competence 2. Concept map 3. Material 4. Video 5. Evaluation questions 6. About the Application
	<p>Student Competency Menu consists of:</p> <ol style="list-style-type: none"> 1. Course Achievements (CPMK) 2. Graduate Learning Achievements 3. Final abilities for each stage of learning

Display	Description
	<p>Menu Concept Map regarding wayang philosophy material</p>
	<p>The material menu consists of:</p> <ol style="list-style-type: none"> 1. Definition 2. Basic concepts 3. Figures 4. Philosophical values 5. Relevance
	<p>The display of the basic concept menu contains four discussion materials:</p> <ol style="list-style-type: none"> 1. Dharma 2. Karma 3. Buana alit, buana agung 4. Tri huta karena
	<p>Main character menu material display in wayang:</p> <ol style="list-style-type: none"> 1. Pandawa 2. Kurawa 3. Panukawan

Display	Description
	<p>Display of the material on the philosophical values of wayang in science</p>
	<p>The video learning menu display has four discussions:</p> <ol style="list-style-type: none">1. Wayang philosophy2. Wayang character philosophy3. Wayang existence4. Wayang creation
	<p>The evaluation question menu display contains ten multiple-choice questions. In the evaluation question, the correct score appears after clicking on one answer.</p>
	<p>The About application menu display has three discussions:</p> <ol style="list-style-type: none">1. Application instructions2. Application developers3. Questionnaires

Display	Description
	<p>View of the questionnaire menu integrated with Google Forms.</p>

4) Implement (Implementation)

Android-based interactive media on the material of Wayang Philosophy was validated to material and media experts. After the media was validated and got several points that needed to be fixed, the researcher immediately fixed the deficiencies. After being repaired, the learning media was ready to be tested on students.

Trial Design Products in the form of Android-based media need to be tested to determine their quality and suitability. Student readability tests were carried out on Physics Education students at Indraprasta PGRI University, the aim was to determine the suitability of the media developed based on student assessments after validation from experts was carried out. A trial was carried out to see how effective learning took place using Android-based media, using a one group pretest posttest research design. The research design is as follows:



Note:

X: The treatment is using Android-based media

O_i: Pre Test

O_f: Post Test

5) Evaluation

The overall results of the questionnaire starting from validation by media experts, material experts to field trials on students will be used as material for improving the interactive media that is being developed to be improved. The results of this improvement are evaluated, then this interactive media is refined and becomes an application that is ready to be used in the learning process.

Research Results and Discussion

1) Android-Based Media Products

The developed Android-based interactive media consists of several parts, namely the main menu, namely Competence, Concept Map, Material, Video, about the application and Evaluation questions. While the evaluation questions section consists of several questions related to the Wayang Philosophy material which will later be known how many scores are obtained. The scores obtained from the evaluation questions are used as value parameters in the material on the philosophy of wayang, a science philosophy course. Students usually only present and have never had experience in using applications with mobile phones. can be used anytime and studied repeatedly.

2) Description of Product Assessment Results

Android-based learning media in the MIPA philosophy course in Physics Education UNINDRA which was developed was validated by several experts with different fields of expertise, namely 3 material expert validators and 3 media expert validators. Interactive multimedia feasibility data was obtained from media experts, media experts and language experts. The following is a description of the validation test results.

a. Description of Material Test Results by Material Experts

The validation test by material experts aims to determine the feasibility of teaching materials in terms of material. The validation test by material experts involved 3 lecturers from the Faculty of Mathematics and Natural Sciences who teach Philosophy of Mathematics and Natural Sciences.

The assessment is given through a material validation test sheet (attachment 1). The validation test sheet by this material expert contains 12 statements covering 2 aspects, namely the material/content aspect and the presentation aspect. The data obtained from the physics material expert are as follows:

Table 6. Validation Test Results by Material Experts

No.	Aspect	Percentage of Achievement	Interpretation
1	Material/content	88.89%	Very worthy
2	Presentation	87.5%	Very worthy
Average of All Aspects		88.19%	Very worthy

The histogram of the results of the interactive multimedia validation test by material experts is as follows:

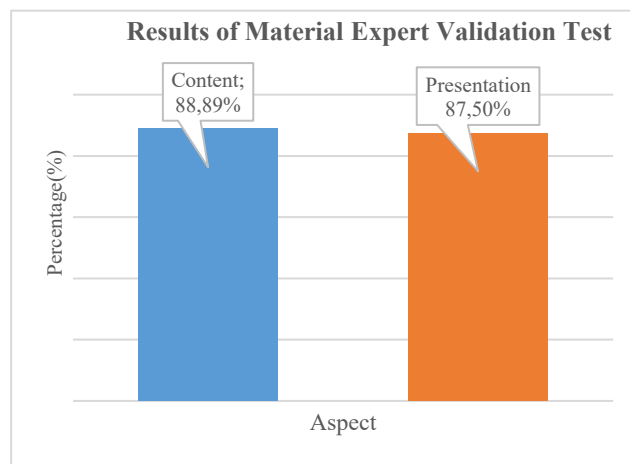


Figure 6. Graph of Material Validation Test Results

From the validation result graph conducted by the material expert lecturer of Philosophy of Science course at the Faculty of Mathematics and Natural Sciences, the average percentage of achievement of all aspects was 88.19%. Based on the interpretation of the Likert scale, this figure shows that the developed android-based media is considered very feasible to be used as a learning medium. However, according to the evaluation, suggestions and comments from the material expert, the material developed still has several shortcomings, including the need to add material related to puppet characters in more detail, the material explained should be equipped with picture illustrations, and the systematics of the material should be given more attention. The author has improved these suggestions and improvements and assisted by providing additional explanations. The main advantage of this application is its ability to combine local wisdom with modern digital technology, bridging cultural preservation through a contemporary approach.

b. Description of Validation Test Results by Media Experts

Android-based media feasibility test conducted by 4 media experts. Media experts are media expert lecturers in the Faculty of Mathematics and Natural Sciences. The validation test sheet by this media expert contains 12 statements from 3 aspects, namely design, layout and media use. The data obtained from media experts (attachment 1) are as follows:

Table 7. Test Results by Media Experts

No.	Aspect	Percentage of Achievement	Interpretation
1.	Design	89.58%	Very worthy
2.	Layout	83.33%	Very worthy
3.	Media usage	83.33%	Very worthy

No.	Aspect	Percentage of Achievement	Interpretation
	Rata-rata Seluruh Aspek	85.41%	Very worthy

The histogram of the results of the Android-based media validation test by media experts is as follows:

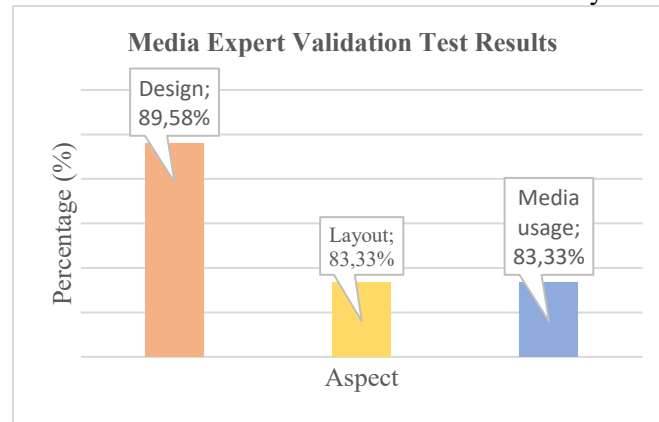


Figure 7. Media Validation Test Result Graph

From the validation result graph conducted by physics learning media experts, the average percentage of overall achievement of aspects was 85.41%. Based on the interpretation of the Likert scale, this figure shows that the interactive media developed is reviewed from the design, layout and media usage aspects. However, according to the evaluation, suggestions and comments from media experts, interactive multimedia needs to be improved, including the addition of musical instruments in the evaluation, the visualization of images is completed again, more images are added, these suggestions have been improved and clarified by the researcher. Advantages according to material experts, the flow of the material is clear, there are videos, there is integrated evaluation questions, the visual display is attractive and easy to use on a mobile phone.

c. Description of Field Trial Results by Students

Field trials by students aim to determine the feasibility of learning media directly used by students. Small group trials were conducted on 5 students, then large group trials were conducted including giving questionnaires to 25 Physics Education students of Indraprasta PGRI University Jakarta semester 3. The results obtained based on field trials produced an average score of 89.95% which is interpreted as very feasible. This result means that the media used can be well received by students. Based on the results of interviews with several students, the results showed that students felt enthusiastic about learning, interested in using the application and students' understanding of a concept became easy to understand. The appearance of the material is attractive; there are videos explaining the material and the interactive evaluation section is part of the media that is liked by students. However, behind these advantages, there are suggestions from students, namely regarding questionnaires that appear too small, as well as explanations of material for which there are no pictures.

The following is a picture at the time of the study as follows;



Figure 8. Research Documentation

The assessment is given through a trial sheet for students in the form of a questionnaire. The field trial sheet contains 13 statements from 2 indicators. The data obtained from students for the trial are as follows:

Table 8. Results of Trial on Students

No.	Aspect	Percentage of Achievement	Interpretation
1.	Media View	88.4%	Very worthy
2.	Material/content	91.5%	Very worthy
Average of All Aspects		89.95 %	Very worthy

The histogram of the results of the field trial on students is as follows:

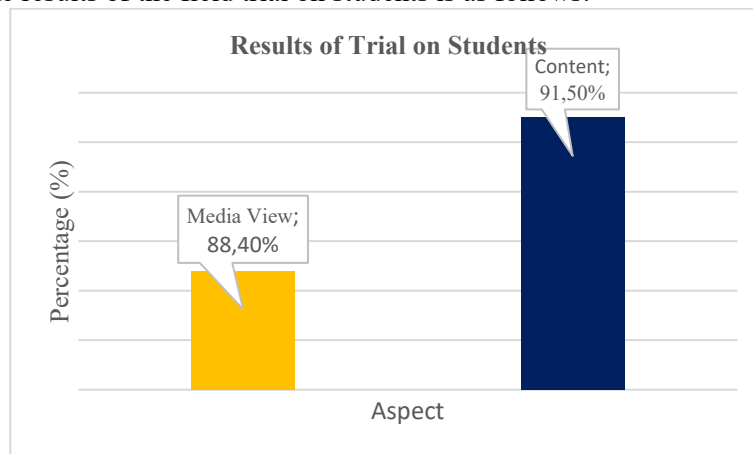


Figure 8. Field Trial Result Graph

The development of this interactive media primarily focused on its feasibility assessment, which explains why a control or comparison group wasn't utilized. Despite this, comprehensive qualitative and quantitative feedback loops were instrumental during revisions. For instance, expert suggestions led to significant enhancements, including the addition of character illustrations in wayang material, clarification of the layout structure, and the inclusion of interactive elements like quizzes. These iterative changes, incorporated and revalidated before final implementation, ensured the media was not only technically functional but also pedagogically aligned with course objectives and student learning needs.

As a result of this meticulous development process, the field trial conducted on students showed an impressive average overall stage achievement of 89.95%. Based on the Likert scale interpretation, this figure indicates that the developed interactive media is considered very good for use as an Android-based learning tool for UNINDRA Physics Education students in their 3rd semester for the MIPA

Philosophy course. During the learning process, students consistently demonstrated enthusiasm and active participation.

CONCLUSION

The development of interactive media based on android is a research with the Research and Development (R&D) method using the ADDIE model development concept (Analyze, Design, Develop, Implement, and Evaluate). This research produces a product in the form of interactive media on the material of Wayang Philosophy in the MIPA Philosophy course conducted for Physics Education students at UNINDRA Based on the validation results from various experts including media experts, and material experts and trials on students, the results were "very feasible". Based on the results of the validation of material experts, an average score of 88.19% was obtained with the interpretation of "very feasible", the results of the validation of media experts obtained an average score of 85.41% with the interpretation of "very feasible". And the results of the trials conducted on students obtained an average score of 89.95% with the interpretation of "very feasible". These results can be concluded that android-based learning media in the MIPA philosophy course. Very feasible to be used as a medium in the learning process. The suggestions in this study are 1) The development of this android-based media can be developed again for subsequent materials, 2) The development of android-based media is also more in the discussion of material questions or quizzes. 3) Android-based media development can be installed via the Play Store application.

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