

Development of an Android-Based Informatics Learning Media Application Using the ADDIE Model

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ABSTRACT

Purpose of the study: This study aims to develop an Android-based learning medium for the Informatics subject in grade X, to measure the feasibility level of the developed media and content, and to determine student responses as users toward the developed learning media product.

Methodology: This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), limited to the Implementation stage. The media was developed using Adobe Animate and Adobe Photoshop CS6, validated by two media experts and two content experts, and tested on 20 grade X students at SMA Negeri 1 Sikur using Likert-scale and Guttman-scale questionnaires, with quantitative descriptive data analysis techniques.

Main Findings: The results show a media feasibility level of 92% (very feasible category), a content feasibility level of 94% (very feasible category), and a user response of 93% (very good category). The learning aspect obtained the highest score in both the content expert assessment and the student response, indicating that the developed media effectively delivers Informatics content clearly and in a way that is easy for students to understand.

Novelty/Originality of this study: The novelty of this study lies in the development of Android-based learning media specifically designed for the Informatics subject using a combination of Adobe Animate and Adobe Photoshop, differing from previous studies that generally used Adobe Flash CS6 for other subjects. This study also provides a feasibility measurement broken down by aspect, offering a more detailed picture for the development of ICT-based learning media at the senior high school level.

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1. INTRODUCTION

Information and Communication Technology (ICT) is one of the main pillars supporting the development of a nation and continues to grow rapidly as society enters the era of the Industrial Revolution 4.0. The involvement of technology has now expanded into almost every aspect of life, including education, making the utilization of ICT an integral part of the modern teaching and learning process [1]. In the educational context, the presence of technology provides teachers with opportunities to transfer knowledge to students more

effectively and efficiently [2], [3]. The prototype curriculum policy introduced by the Ministry of Education, Culture, Research, and Technology also provides teachers with greater flexibility to design learning processes according to students' abilities [4]. This flexibility requires teachers to be creative in utilizing ICT, one of which is through the development of digital technology-based learning media. Digital learning media is considered a solution to the limitations of conventional methods that have long been widely used in schools.

Although conventional learning media such as textbooks and PowerPoint presentations are still widely used, their implementation in the field reveals several weaknesses that hinder learning effectiveness. Observations of Informatics learning in Grade X at SMA Negeri 1 Sikur found that the use of PowerPoint was less practical because it depended on the availability of computers and limited access time to the computer laboratory [5], [6]. Interviews with subject teachers also revealed that lecture-based methods and textbooks tended to make students passive, as they merely received the material without adequate interaction or feedback. This condition was further exacerbated by teachers' limited mastery of ICT, resulting in the use of learning methods similar to those applied in other subjects, despite their different characteristics. On the other hand, all Grade X students were reported to have Android-based smartphones, but this potential had not been optimally utilized as a learning tool [7]. The gap between the availability of devices and their actual utilization constitutes the underlying problem that motivated this study.

Several previous studies have examined the development of Android-based learning media across various subjects and have reported positive results. Cholifah et al. (2021) [8] developed an Android application using Adobe Animate CC with a Contextual Teaching and Learning approach for teaching Algebraic Forms to junior high school students, and the feasibility test results were categorized as very good [9]. Hakky et al. (2018) [10] developed Android-based learning media for the Operating Systems subject using the ADDIE model and obtained very high feasibility ratings for both the learning materials and media, along with positive student responses. Adesti (2020) [11] also developed Android-based learning media using Adobe Flash CS6 for Sociology, with similarly favorable feasibility results. These three studies consistently demonstrate that Android-based learning media can improve media feasibility and generate positive student responses to the learning process. However, these studies were conducted in different subject areas and used development tools that differ from those employed in the context of the present study.

Based on the review of previous studies, the development of Android-based learning media has largely focused on subjects such as Mathematics, Operating Systems, and Sociology, while its specific application to Grade X Informatics remains limited [12]. In fact, the characteristics of Informatics as an applied subject involving computer-based practice create an urgent need for media that supports flexible learning beyond the computer laboratory. In addition, previous studies have generally used development tools such as Adobe Flash CS6, while the use of a combination of Adobe Animate and Adobe Photoshop in the context of Informatics learning materials has received limited attention [13]. Differences in subject characteristics, research participants, and development tools indicate a research gap that needs to be addressed through further research. This gap provides the basis for developing Android-based learning media specifically adapted to the characteristics of Informatics as a subject [14]. Therefore, this study seeks to address this gap through a development approach that is more relevant to the context of Informatics learning in senior high schools.

The urgency of this study is further supported by the fact that all Grade X students at SMA Negeri 1 Sikur have Android smartphones, representing a significant potential that has not yet been optimally integrated into the learning process. Data also indicate that Indonesia is among the countries with the largest number of smartphone users worldwide, making the utilization of mobile devices for educational purposes highly relevant and increasingly important to develop. Dependence on computer laboratories with limited access time makes Android-based learning media a more flexible alternative, as it can be accessed by students anytime and anywhere, both offline and online [15]. Without learning media that are aligned with students' digital habits, Informatics learning risks remaining monotonous and may be less effective in fostering students' learning motivation. Therefore, the development of Android-based learning media represents a strategic step toward addressing the need for learning that is more interactive, practical, and aligned with the characteristics of today's digital generation. If this issue is not addressed, the gap between the availability of technology and its utilization in learning may continue to hinder the effectiveness of the teaching and learning process.

Based on the problems and research gaps described above, this study aims to develop Android-based learning media for Grade X Informatics at SMA Negeri 1 Sikur. The development of the media employs the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation, to ensure that the resulting product meets users' needs. In addition to the development process, this study aims to assess the feasibility of the developed learning media through evaluations conducted by media experts and material experts. Another objective is to determine students' responses as users to the developed Android-based learning media. These three objectives are collectively directed toward producing learning media that are feasible for use and capable of supporting the effectiveness of learning and students' motivation [16]. By achieving these objectives, Informatics learning is expected to become more interactive and no longer be constrained by limitations of space and time.

The novelty of this study lies in the development of Android-based learning media specifically designed for Grade X Informatics, a context that has received limited attention in previous studies [17]. Unlike previous studies that have generally used Adobe Flash CS6, this study employs a combination of Adobe Animate and Adobe Photoshop as development tools, resulting in a lightweight application in apk format that comprehensively incorporates learning materials, exercises, user profiles, and usage instructions [18]. The resulting product is also specifically adapted to the needs of Informatics learning, which is characterized by an applied and technology-oriented nature, rather than simply adapting media developed for other subjects [19]. This study further provides an empirical contribution by measuring feasibility across three media aspects operation, appearance, and font and two material aspects learning and content separately, thereby providing a more detailed assessment than similar development studies [20], [21]. Through this approach, the study is expected to provide a new reference for the development of Android-based learning media adapted to the characteristics of ICT-oriented subjects at the senior high school level. This contribution constitutes the main distinction between the present study and previous studies on Android-based learning media development [22].

2. RESEARCH METHOD

2.1 Research Design

This study employed a Research and Development (R&D) approach, which is a research method used to produce a particular product and examine its effectiveness [23]. The product developed in this study was Android-based learning media for Grade X Informatics. The development model employed was the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) developed by Robert Maribe Branch, as this model is simple, procedural, and structured in systematic stages, making it suitable for developing learning media. However, this study was limited to the Implementation stage and did not proceed to a large-scale summative evaluation [24]. The approach used for data collection and analysis was descriptive quantitative, as the data obtained consisted of assessment scores from media experts, material experts, and user responses, which were analyzed using descriptive statistical techniques.

The research subjects were divided into two groups, namely validation subjects and field trial subjects [25]. The validation subjects consisted of four experts and practitioners who assessed the feasibility of the developed learning media and materials, while the field trial subjects consisted of Grade X students who participated in the user response assessment. The distribution of research subjects is presented in Table 1.

Table 1. Research Subjects

No.	Subject Group	Position/Role	Number
1	Validation	Learning Media Expert (Lecturer)	1
2	Validation	Learning Media Practitioner/Expert	1
3	Validation	Informatics Material Expert (Lecturer)	1
4	Validation	Grade X Informatics Teacher	1
5	Field Trial	Grade X Students	20
Total			24

As presented in Table 1, the study involved 24 participants, consisting of four validation subjects and 20 students in the field trial. The experts and teacher were involved in assessing the feasibility of the media and learning materials, while the students were involved in assessing their responses to the developed Android-based learning media. The field trial participants were selected using *purposive sampling* based on their direct involvement in Informatics learning and their use of Android-based smartphones.

2.3 Data Sources and Data Collection Techniques

The data collection process was designed to obtain comprehensive information regarding the needs, feasibility, and user responses related to the development of Android-based learning media. The sources, techniques, and purposes of data collection are summarized in Table 2.

Table 2. Data Sources and Data Collection Techniques

No.	Data Collection Technique	Data Source	Purpose	Instrument
1	Observation	Grade X Informatics learning process	To identify learning conditions, problems, and the need for Android-based learning media	Observation sheet

2	Interview	Grade X Informatics teacher	To obtain preliminary information regarding learning methods, media used, and problems encountered in the learning process	Interview guide
3	Questionnaire	Media experts	To assess the feasibility of the developed learning media	5-point Likert questionnaire
4	Questionnaire	Material expert and Informatics teacher	To assess the feasibility and suitability of the learning materials	5-point Likert questionnaire
5	Questionnaire	Grade X students	To determine students' responses to the developed Android-based learning media	Guttman questionnaire (Yes/No)

As shown in Table 2, observation and interviews were conducted during the preliminary stage to identify learning needs and problems in the existing learning process. Questionnaires were subsequently administered to experts, teachers, and students to obtain quantitative data on media feasibility, material suitability, and user responses [26]. The combination of these techniques provided complementary data for evaluating the developed Android-based learning media.

2.4 Research Instruments

The instrument used in this study was a structured questionnaire developed based on instrument specifications for each group of respondents, namely media experts, material experts, and users (students). Each instrument was designed to assess different aspects of the developed Android-based learning media [27]. The specifications of the media expert instrument are presented in Table 3.

Table 3. Specifications of the Media Expert Instrument

Aspect	Indicator	Item Number
Media Operation	Ease of operating the media	1, 2, 3, 4
Media Operation	Accuracy of navigation button functions	5, 6, 7
Media Appearance	Quality of the media display	8, 9, 10
Media Appearance	Readability of text in the media	11, 12
Media Font	Appropriateness of font color and type	13, 14

Table 3 shows that the media expert instrument consisted of three main aspects: media operation, media appearance, and media font. These aspects were measured through 14 items to assess the technical and visual feasibility of the developed learning media.

The material expert instrument was developed to assess the suitability, accuracy, and quality of the learning content presented in the Android-based media. The specifications of the material expert instrument are presented in Table 4.

Table 4. Specifications of the Material Expert Instrument

Aspect	Indicator	Item Number
Learning	Learning outcomes	1
Learning	Clarity of the material	2
Learning	Use of language	3
Content	Accuracy of content/concepts	4
Content	Depth of the material	5
Content	Suitability of questions to the material	6
Content	Sequence of the material	7

As presented in Table 4, the material expert instrument consisted of two main aspects, namely learning and content, with a total of seven assessment items. These indicators were used to determine whether the learning materials were appropriate, accurate, clear, and consistent with the intended learning objectives.

In addition to expert assessments, a user response instrument was administered to Grade X students to determine their responses to the developed Android-based learning media. The specifications of the user response instrument are presented in Table 5.

Table 5. Specifications of the User Response Instrument

Aspect	Indicator	Item Number
Appearance	Clarity of usage instructions	1
Appearance	Ease of menu selection	2
Appearance	Ease of using buttons	3
Appearance	Clarity of colors	4
Appearance	Attractiveness of animation	5
Appearance	Attractiveness of the overall display	6
Content	Clarity of the material	7
Content	Suitability of questions to the material	8
Content	Clarity of language	9
Learning	Materials are easy to learn	10
Learning	Attractive presentation of the material	11
Learning	Clear text	12

Table 5 indicates that the user response instrument consisted of three aspects: appearance, content, and learning, with a total of 12 items. The instrument was used to obtain students' responses regarding the attractiveness, ease of use, clarity, and usefulness of the developed learning media.

The validity of the instruments was tested using the Gregory formula based on assessments from two experts. The results showed a content validity coefficient of 1.00 for the media expert, material expert, and user response instruments, all of which were categorized as *very high* [28], [29]. The reliability of the instrument was tested using Cronbach's Alpha formula. The user response instrument obtained a reliability coefficient of 0.643, which was categorized as *high* [30].

These results indicate that the instruments used in this study demonstrated adequate content validity and reliability for collecting data on the feasibility and user responses to the developed Android-based learning media.

2.5 Data Analysis Techniques

The data collected in this study were analyzed using quantitative descriptive analysis. The scores obtained from the Likert-scale instruments were converted using the following weighting: Very Good (5), Good (4), Fairly Good (3), Poor (2), and Very Poor (1). The percentage of feasibility was calculated using the following formula:

$$\text{Persentase Kelayakan (\%)} = \frac{\text{Skor yang diperoleh}}{\text{Skor maksimum}} \times 100\%$$

The maximum score was obtained by multiplying the maximum score for each item by the number of items and the number of respondents. The resulting percentage was then converted into a feasibility category based on the criteria presented in Table 6.

Table 6. Categories of Media/Material Feasibility

No.	Score (%)	Feasibility Classification
1	0–20%	Very Not Feasible
2	21–40%	Not Feasible
3	41–60%	Fairly Feasible
4	61–80%	Feasible
5	81–100%	Very Feasible

Table 6 presents the criteria used to interpret the percentage scores obtained from the media and material expert assessments. A higher percentage indicates a higher level of feasibility of the developed learning media and materials. Products obtaining a percentage of 81–100% are categorized as *very feasible*.

For the user response data, the percentage scores were also analyzed descriptively and then interpreted using the response categories presented in Table 7.

Table 7. Categories of User Response

No.	Score (%)	Response Classification
1	0–20%	Very Poor
2	21–40%	Poor
3	41–60%	Fairly Good
4	61–80%	Good
5	81–100%	Very Good

Table 7 was used to interpret students' responses to the developed Android-based learning media. The higher the percentage obtained, the more positive the students' responses to the media. A percentage of 81–100% indicates a *very good* user response.

The research procedure employed the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. In this study, the product development process was carried out through the Implementation stage, while the Evaluation stage was conducted on a limited basis as a formative evaluation of the implementation results. The stages of the research procedure are presented in Figure 1.

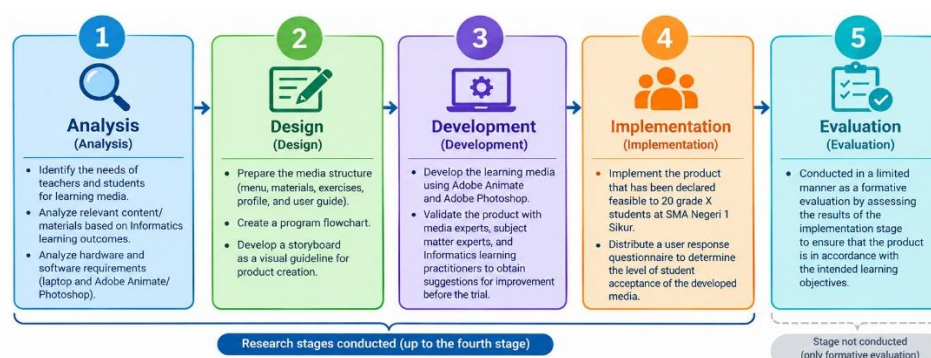


Figure 2. Stages of the ADDIE Development Model

3. RESULTS AND DISCUSSION

This section presents the results of the development of an Android-based learning media for Grade X Informatics, along with a comprehensive discussion of the findings. The results are presented in the form of tables and graphs to facilitate readers' understanding. The discussion is divided into several subsections as follows.

3.1. Product Development Results

The analysis stage revealed that among the 20 Grade X students, most tended to be passive during the learning process. In addition, the learning media used, namely PowerPoint presentations and textbooks, were relatively monotonous and therefore less effective in fostering students' learning interest. This finding is consistent with previous studies indicating that conventional learning tends to make students passive and less motivated [31], [32]. Based on these findings, the PowerPoint-based learning media was subsequently transformed into an Android-based learning media as a more interactive and flexible solution.

The design stage resulted in a flowchart and storyboard that served as the framework for the development process. These designs were then implemented into an initial learning media product using Adobe Animate and Adobe Photoshop. The initial product consisted of eight main pages, namely the Home Page, Discussion, Learning Objectives, Materials, Quiz, Profile, Contact, and Sources [33]. Overall, the media covered topics on computational thinking, information and communication technology, computer systems, as well as computer networks and the internet.

3.2. Results of the Media Expert Feasibility Test

Media expert validation was conducted by two validators using a 5-point Likert-scale questionnaire consisting of 14 items across three aspects. The percentage of feasibility scores for each aspect is presented in Table 6.

Table 6. Media Expert Assessment Results

No.	Aspect	Percentage	Category
1	Media Operation	93%	Very Feasible
2	Media Display	90%	Very Feasible
3	Media Font	95%	Very Feasible

Average 92% Very Feasible

The feasibility percentage was calculated using the following equation:

$$P = \frac{\sum x}{S_{max}} \times 100\% \quad \dots (1)$$

Where P is the feasibility percentage, $\sum x$ is the total score obtained from all respondents, and S_{max} is the ideal maximum score (maximum score per item $\times$ number of items $\times$ number of respondents). Based on Table 6, the average media feasibility score was 92%, which falls into the *very feasible* category. The media font aspect obtained the highest score (95%), while the media display aspect obtained the lowest score (90%) [34]. Nevertheless, the media experts provided recommendations for improvement regarding the contrast between the background and text colors, as well as the need to add user instructions to the product.

3.2. Results of the Material Expert Feasibility Test

Material expert validation was conducted by two validators using a 7-item questionnaire covering two aspects, namely the learning aspect and the content aspect. The assessment results are presented in Table 7.

Table 7. Material Expert Assessment Results

No.	Aspect	Percentage	Category
1	Learning	97%	Very Feasible
2	Content	93%	Very Feasible
Average		94%	Very Feasible

The average material feasibility score of 94% indicates that the material falls into the *very feasible* category, with the learning aspect (alignment with learning outcomes and language clarity) obtaining the highest score. The material experts recommended adding animations to make the material less monotonous, as well as including the learning outcomes and additional exercises in the product.

3.4 Results of the User Trial (Student Responses)

The user trial was conducted with 20 Grade X students using a 12 item Guttman-scale questionnaire (Yes/No) covering three aspects. The recapitulated percentages of student responses are presented in Table 8.

Table 8. User Response Results

No.	Aspect	Percentage	Category
1	Display	91%	Very Good
2	Content	92%	Very Good
3	Learning	97%	Very Good
Average		93%	Very Good

Based on Table 8, all aspects of user responses were categorized as *very good*, with an overall average score of 93%. The learning aspect obtained the highest score (97%), indicating that students considered the presented material easy to learn and capable of increasing their learning motivation [35], [36]. The display aspect obtained the lowest score (91%), particularly on the item concerning the suitability of text colors against the background, which is consistent with the improvement recommendations previously provided by the media experts.

3.5 Product Revision

Based on the validation results, two major revisions were implemented: (1) adjusting the contrast between the background and text colors to ensure that they do not interfere with each other, and (2) adding a user instruction page [37]. These revisions were completed before the product was tested with students; therefore, the user trial results represent the students' assessment of the revised version of the product.

The findings indicate that the Android-based learning media for Grade X Informatics at SMA Negeri 1 Sikur is feasible for use in the learning process, with an average media feasibility score of 92% (very feasible), material feasibility of 94% (very feasible), and user response of 93% (very good). All three assessment aspects consistently fell within the highest category, indicating that the developed product met feasibility standards in terms of technical media quality, material suitability, and user acceptance [38]. These results suggest that the development approach based on the ADDIE model can produce a product that not only meets academic criteria but is also positively received by students as the end users. The high percentage obtained for the learning aspect (97%), particularly in the student responses, indicates that the media successfully presents Informatics materials

clearly and understandably, thereby supporting the primary objective of the development as a self-directed learning medium.

There was an alignment between the improvement recommendations provided by the media experts and the students' responses regarding the display aspect. The media experts noted the need to improve the contrast between the background and text colors. This recommendation was consistent with the display aspect of the student responses, which obtained the lowest percentage (91%) compared with the content (92%) and learning (97%) aspects, although adjustments had already been made before the field trial. This small difference indicates that visual aspects, despite having been revised, remained the area most sensitive to users' perceptions compared with content-related aspects. Conversely, a factor supporting the overall high feasibility results was the suitability of the material to actual conditions in the field [39]. All students already owned and were accustomed to using Android smartphones, so there were no technological adoption barriers that could hinder the trial process. Another supporting factor was the multi-stage validation process involving media experts, material experts, and learning practitioners, which enabled improvements to be made before the product was directly tested with students, thereby minimizing the risk of product infeasibility during the implementation stage.

For media feasibility, the media font aspect obtained the highest score (95%), indicating that the selection of font types and colors in the product was appropriate and easy for users to read. Meanwhile, the media display aspect obtained the lowest score (90%), indicating the need for further refinement of visual elements such as color composition and animation. For material feasibility, the learning aspect obtained the highest score (97%) compared with the content aspect (93%), indicating that the alignment of the material with the learning outcomes and objectives was assessed very positively by the experts, although the depth of the content could still be further developed. Regarding user responses, the learning aspect also obtained the highest score (97%), reinforcing the finding that content quality and ease of understanding were key factors in students' acceptance of the media. Although the display aspect (91%) remained in the very good category, it was relatively lower than the other two aspects. The consistency of this pattern across the variables, in which the learning/content aspects consistently obtained the highest scores, indicates that the primary strength of the product lies in the quality and relevance of the instructional materials rather than solely in the sophistication of its visual design.

These findings reinforce the results of, Cholifah et al. (2021) [8], who developed an Android-based learning media using Adobe Animate CC for algebraic forms and reported a very good feasibility category. The findings are also consistent with Hakky et al. (2018) [10], who employed the ADDIE model to develop Android-based learning media for Operating Systems and obtained very feasible results for the material, media, and student response assessments. The consistency of these findings suggests that the ADDIE model can be applied across different subject areas to develop feasible Android-based learning media. This study also aligns with Adesti (2020) [11], who used Adobe Flash CS6 to develop learning media for Sociology and obtained a high feasibility level, although a different development tool was employed. The main differences between this study and the three previous studies lie in the target subject, namely Informatics, and the combination of development tools, namely Adobe Animate and Adobe Photoshop. In this study, these tools contributed to a high feasibility level while producing a relatively lightweight application.

The novelty of this study lies in the development of Android-based learning media specifically designed for Grade X Informatics, a context that has received less attention in previous Android-based learning media development studies, which have more commonly focused on Mathematics, Operating Systems, and Sociology. The use of Adobe Animate and Adobe Photoshop as development tools also distinguishes this study from previous research that generally employed Adobe Flash CS6 [40]. The resulting .apk product remains comprehensive, incorporating eight page components, including materials, quizzes, learning objectives, profile, contact, and sources. In addition, this study provides an empirical contribution by assessing feasibility across three separate media aspects—operation, display, and font and three material/user-response aspects—learning, content, and display. This approach provides a more detailed description of the product's strengths and areas for improvement than studies that generally report feasibility scores in aggregate.

The findings imply that Android-based learning media can serve as a strategic alternative for Informatics teachers in addressing limitations in access to computer laboratories while utilizing students' widespread smartphone ownership as a means of self-directed learning both at school and at home. Practically, the finding that content and learning aspects were more prominent in students' acceptance than visual aspects can serve as a reference for other learning media developers to prioritize the quality and clarity of instructional materials without neglecting the feasibility of the visual presentation.

This study has several limitations that should be considered in future research. First, the development process was conducted only through the Implementation stage of the ADDIE model; therefore, a large-scale summative Evaluation stage to quantitatively measure the effectiveness of the media on students' learning outcomes was not conducted [41]. Second, the trial was limited to 20 Grade X students at a single school, so the generalizability of the findings to broader populations or other school contexts requires further investigation. Third, this study did not measure the impact of the media on improvements in learning outcomes, such as

through a pretest-posttest design. Instead, it focused on product feasibility and user responses. Therefore, future studies are recommended to examine the effectiveness of the developed media in improving students' learning outcomes more comprehensively.

4. CONCLUSION

This study aimed to develop an Android-based learning medium for the Informatics subject in grade X at SMA Negeri 1 Sikur using the ADDIE model, motivated by the problem of monotonous learning that had not yet utilized the potential of the Android smartphones already owned by all students. The results and discussion demonstrate that this objective was fully achieved: the learning media product was successfully developed through the Analysis, Design, Development, and Implementation stages, with a media feasibility level of 92% (very feasible), a content feasibility level of 94% (very feasible), and a user response of 93% (very good). Thus, there is a clear alignment between the problems and objectives formulated in the Introduction and the outcomes achieved in the Results and Discussion, namely that the Android-based learning media has proven feasible and was well received by students as a solution to the limitations of conventional media in Informatics learning.

Going forward, this learning media product has the potential for further development through a comprehensive Evaluation stage, including testing its effectiveness on improving student learning outcomes through a pretest-posttest experimental design. In addition, the content coverage could be expanded to other Informatics topics in line with curriculum developments, and tested on a broader student population or at different school levels to examine the generalizability of the research findings. Further development could also incorporate additional interactive features, such as an online discussion forum or a learning-progress tracking system, to enrich the media's function as an independent Android-based learning tool.

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