Development of Mobile Learning Based on Android Using Smart Apps Creator in Informatics Lessons of Grade XI in MA Negeri 2 Samarinda

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Abstract—In the rapidly developing digital era, Indonesia has shown significant progress in the use of technology, including in the world of education. Technology is used to facilitate various learning activities, such as accessing information, supporting learning activities, and facilitating tasks by teachers. However, the application of technology in education still faces several challenges, such as the implementation of the Independent Curriculum and limited facilities and infrastructure. Therefore, this study aims to develop mobile learning media and then assess the feasibility of the product through assessments from material experts, media experts and responses from teachers and students. The method used in this study is R&D (Research and Development) with the 4D model (Define, Design, Development, and Disseminate). With the results of the mobile learning feasibility test by one material expert with an average score of 94% with the criteria "very feasible". The results of the mobile learning feasibility test by three media experts with an average score of 93%, 92%, 99% with the criteria "very feasible". If the average score of the three validators is averaged, it gets a score of 95% with the criteria "very feasible". The level of feasibility of mobile learning based on the results of the validation of materials and media obtained an average of 94% with the criteria of "Very Feasible" which states that mobile learning is very feasible and valid for use. can be seen and the media display is 94%. After being processed, the overall average is 95% with the criteria of "Very Good". While the average results of student responses, the value of two aspects, namely the material aspect is 91% and the media display is 93%. After being processed, the overall average is 92% with the criteria of "Very Good". Therefore, the android-based mobile learning product in informatics lessons for class XI MA Negeri 2 Samarinda is very feasible to use in the learning process to be more effective, interactive, and flexible, so that it can increase student motivation and learning outcomes.

Keywords—Mobile Learning, Android, Smart Apps Creator, Smartphone, Informatics, Technology

I. INTRODUCTION

In the ever-evolving digital era, Indonesia has shown significant progress in utilizing technology. This development is clearly visible from the 2023 Information and Communication Technology Development Index (IPTIK) Report, which recorded sub-index values for Indonesia in 2023, namely ICT access and infrastructure of 5.81%, ICT users of 5.91%, and ICT skills of 6.00% (Girsang et al., 2024). This achievement illustrates positive developments in expanding access to technology, increasing community participation, and strengthening human resource capabilities in the modern era so that technological development in Indonesia is increasingly advanced.

Technology has developed along with the times, in the digital era the use of technology to facilitate all work, including in the world of education (Nento & Manto, 2023). In the world of education, technology is used as a tool to support the learning process such as accessing information, helping learning activities and facilitating assignments by teachers (Nurillahwaty, 2022). With technology, the learning process becomes more effective, interactive, and flexible, so that it can increase student motivation and learning outcomes (Suyuti et al., 2023). However, there are several challenges in implementing technology in the world of education. Some of these challenges include the implementation of the independent curriculum and the availability of adequate facilities and infrastructure in schools (Muhazir & Retnawati, 2020).

Education in Indonesia currently implements an independent curriculum, which is expected to produce superior human resources in various fields in the future. One way is by giving students the freedom to choose the subject matter they want to study (Tunas & Pangkey, 2024). However, based on data from the 2024 Ipson Education Monitor, the biggest challenge in the education system is still related to the effectiveness of the curriculum, where 29% of respondents called it the main problem in the learning process in a less than optimal curriculum (Ipsos, 2024). Facilities and infrastructure are also one of the challenges in education because they

support the learning process in schools. Facilities include all tools and equipment used to achieve learning goals, such as teaching materials, learning tools, and other equipment. Meanwhile, infrastructure refers to the basic facilities needed to carry out the functions of an educational unit, including land, buildings, and classrooms. The more complete and better the facilities and infrastructure in schools, the more effective the teaching and learning process (Hakim & Nabila, 2024). In the 2023/2024 Education Data Overview report, the number of classrooms in high schools in East Kalimantan is 2,837 rooms with a record of 1,496 classrooms in good condition, 945 in minor damage, 347 in moderate damage, and 49 in severe damage (Hakim & Nabila, 2024). This data shows that serious attention is needed from various parties to improve facilities and infrastructure to support a safe, comfortable, and quality learning process.

Technological developments play a major role in increasing the effectiveness of the independent curriculum. In today's digital era, technology can be an effective means of improving the quality of learning, facilitating access to information, and expanding interesting learning methods for students (Thana & Hanipah, 2023). In 2024, the use of technology in education by students includes mobile phones, computers, and the internet with 27.53% of students utilizing electronic devices such as mobile phones, computers, or laptops for learning (Girsang et al., 2024). Technological developments open up opportunities to improve the education system through online learning and e-learning (World Bank Group, 2020). Advances in information and communication technology (ICT) allow students across the country to access learning materials that are equivalent to those in big cities. The government and private sector have expanded access to digital learning through platforms such as belajar.id, which provides digital teaching materials for students and teachers throughout Indonesia (World Bank Group, 2021). Therefore, technology is expected to support educators and students in the learning process, making it more effective, flexible, and interesting.

Technological innovations that are increasingly developing in supporting the learning process are using learning media. Learning media are used as teaching aids for teachers to deliver teaching materials more interestingly and interactively and increase student creativity to be more motivated to be more active in learning and encourage students to think critically, speak, and imagine, so that learning media makes the teaching and learning process more effective and efficient (Firmadani, 2020).

One form of learning media that is increasingly relevant is Android-based mobile learning. Mobile learning uses Android-based mobile devices such as smartphones and tablets, thus facilitating flexible, easily accessible learning that can be adjusted to the needs of students. This device allows students to learn anytime and anywhere, thus supporting independent learning (Ardiansyah & Nana, 2020). One of the uses of Android-based mobile learning is in the Smart App Creator application. Smart App Creator is an application that can be used on the Android system without programming code. Smart App Creator contains animated images, videos, music, and many other menus that can be used to create an interactive learning atmosphere. Smart App Creator can be used as a learning medium because this application is mobile based, making it easy to access and can also increase students' learning motivation. Teachers can be creative and innovative in creating interesting learning media, such as compiling materials with animations, adding learning videos, creating practice questions and creating games, so that the learning process is more enjoyable, increasing student involvement, understanding of the material and their interest in learning (Azizah, 2020).

Based on the results of observations conducted by researchers during the PLP (School Field Introduction) and Teaching Assistance programs in Informatics subjects at MA Negeri 2 Samarinda in the 2024/2025 academic year. MA Negeri 2 Samarinda in 2024/2025 implemented an independent curriculum for classes X, XI and XII. Regular class X students take all compulsory subjects. Meanwhile, regular class XI students can choose subjects according to their interests, and regular class XII students continue the elective subjects they have taken in class XI. As for Class X Religion students, they take all compulsory subjects, while for class XI and XII Religion students can also choose the available elective subjects, but the choices are different from regular classes. Religion students are not allowed to take general elective subjects because only subjects that are in the religious field. Facilities and infrastructure at MA Negeri 2 Samarinda have quite adequate facilities where each class from class X to XII has been equipped with a projector. The laboratory is also in good condition but there are obstacles in the learning process, especially in the availability of rooms and infrastructure, such as the number of rooms available is not sufficient to accommodate students who take elective subjects, including informatics. In grade XI, students taking informatics are divided into four classes, namely S1 with 39 students, S2 with 27 students, K1 with 40 students and S2 with 36 students. For the computer laboratory space available is not enough because not all computers are in good condition. Some computers are damaged so they cannot be used during the learning process. In addition, the Multimedia Laboratory and the Religion Laboratory have computer facilities, but not all computers are in good condition. Meanwhile, the number of tables and chairs in the room is also insufficient, so many students are forced to sit on the floor during the learning process. On the other hand, not all students taking informatics have laptops because most students rely more on smartphones as a learning support tool. As for textbooks, not all students have them, so they use smartphones more often to access textbooks online and other learning materials.

This condition is reinforced by the results of an interview with one of the informatics subject teachers for

class XI who explained that MA Negeri 2 Samarinda has implemented an independent curriculum. Informatics is one of the subjects that is quite popular with students. However, the availability of rooms and infrastructure is not yet adequate to accommodate the number of students taking elective informatics subjects. There are tables and chairs that are not yet available because of the large number of students so that the capacity in the room is not sufficient and several computers available in the room are broken. As an alternative, teachers distribute teaching materials via smartphones to students in class, so that the use of technology becomes very important in the learning process, where teachers can utilize learning media, both mobile learning media as teaching aids during the learning process.

There are several previous studies that have examined the development of mobile learning, where the main problem in the learning process is the lack of media that supports student understanding. Students need interactive, clear and interesting learning media to make it easier to understand the material presented by the teacher. However, several previous studies only focused on the technical aspects of development, such as features or design, without evaluating the feasibility of its implementation. Unlike previous studies, this study not only tests the technical aspects of development, but also focuses on the feasibility and implementation aspects, including user responses to the products developed.

Based on the description of the problem above, steps are needed to overcome the limitations of facilities and infrastructure in the learning process. Therefore, researchers are interested in conducting research on Android-based mobile learning media in informatics lessons, especially on mobile application development material with App Inventor with the aim of being a solution to these problems and making it easier for teachers and students to carry out learning activities.

II. LITERATURE REVIEW

A. Learning Media

Media is used as a tool or material in learning. The word "media" comes from Latin, which is the plural form of the word "medium". Medium can be interpreted as an intermediary or connector in the communication process (Furoidah, 2020). Then learning is the process of interaction between teachers and students as a source of learning in schools. Learning is a process of gaining knowledge, understanding and forming the character of students assisted by a teacher. In the learning process, learning media are needed (Kaniawati et al., 2023).

Learning media is a teaching aid for teachers to deliver material, increase student creativity and increase student attention in the learning process in the classroom. With the existence of learning media, students will be more motivated to learn, encourage students to write, speak, and imagine more stimulated, so that the learning process is more effective and efficient and creates a good relationship between teachers and students (Firmadani, 2020).

The right learning media really helps students in the learning process, so that the existence of learning media can help teachers in providing explanations of the learning material to be delivered. Learning media functions to help communication for both communicators and recipients. The criteria in selecting learning media that must be considered by teachers include, looking at the purpose of use, target users of the media, considering the advantages and disadvantages of the media to be used, considering the right time, considering the costs available and seeing the availability of learning media (Wulandari et al., 2023).

The advantage of learning media is that teachers can easily give assignments to students to study the material first through media that has been created by the teacher which is supported by students' skills in operating smartphone. Meanwhile, the shortcomings of learning media are that not all teachers are proficient in using technology, and many teachers are still unable to create interesting, effective and efficient learning media. Apart from that, teachers must direct students to use the learning media that has been created, thereby reducing learning hours(Nirmala et al., 2023).

B. Mobile Learning

Mobile learning is a learning model that utilizes information and communication technology including the use of mobile devices to access learning resources from any location (Maharani et al., 2024). Mobile learning utilizes mobile devices that have been specifically designed to assist the learning process. The development of Mobile learning is able to create an environment that is motivating, fun and increases creativity. The approach in the form of Mobile learning is able to stimulate children's intellectual, emotional, and psychomotor skills. Mobile learning can help solve various learning difficulties in students and make classroom learning more interactive (Rifai et al., 2020).

Mobile learning can help teachers and students in the learning process which creates an innovation that encourages teachers to apply it, thus making learning more effective and efficient. Thus, teachers can utilize mobile learning as a creative and innovative learning medium. Students can also increase unlimited learning access and develop learning independence and better communication between teachers and students (Samsinar, 2021). Mobile learning can help access education in remote areas or those with limited infrastructure by utilizing mobile devices for students in remote areas because they can access learning resources directly and efficiently and also open up educational opportunities that were previously difficult to reach (Najjar & Oktasari, 2023). Where the purpose of developing mobile learning is to support the learning process all the time, so that students can be more actively involved in learning. In addition, mobile learning also saves time because students do not need to be present in class just to collect assignments, they are simply sent via an application on a smartphone(Arsyad & Lestari, 2020).

The advantages of mobile learning are that it can be used anywhere and anytime. In addition, most mobile devices are relatively cheap, small and lightweight, and can be accessed by more students because mobile learning utilizes technology that can be used in everyday life. However, the disadvantages of mobile learning lie in the devices or media used which have limitations in processor capabilities, memory capacity, display screens, battery life, and input or output devices (Samsinar, 2021).

C. Smartphone

Smartphone are technological tools used in communication that have sophisticated features such as storing photos, sending images, downloading applications, and with other smartphone users. This tool has an affordable price for the community and is practical to carry because of its small size. The development of smartphones in the world of technology is growing very rapidly, so that smartphones have become telecommunications tools that have a major influence on people's daily lives. This smartphone has different specifications such as processor type, screen size, battery capacity, camera resolution, storage space, RAM and various operating systems, resulting in people having problems choosing a smartphone (Liusman & Arijanto, 2022). Smartphone can be used by all groups to access information quickly via an internet connection and can also be used to communicate long distance using smartphone that have various features other than telephone and SMS, which shows their usefulness in today's modern era. Smartphone also function as a means of sharing information and entertainment, as well as helping in learning and developing technological skills (Hutami et al., 2023).

In the world of education, smartphones have an important role in the learning process as an effective learning resource. Smartphone can be used as a tool to provide information to students or educational institutions, so that they can add scientific insight through internet access. Other uses of smartphone can also be as a learning medium to foster certain attitudes and skills in the field of technology, thereby creating effective technological learning (Hutami et al., 2023).

The advantages of smartphones include being able to be carried anywhere, being more energy efficient than computers, and being able to access information anytime and anywhere easily, making them practical to use. The disadvantages of smartphone are that this tool can cause continuous user dependency and can be misused in negative ways (Syafrina & Nurfajri, 2021).

D. Android

Android is a Linux-based operating system for mobile phones such as smartphones and tablets. Android as an open-source operating system designed for mobile devices. Android is designed to provide flexibility, security, and ease in application development and use of mobile devices (Maharani et al., 2024). The function of Android is to connect devices with users for various applications, so that users can interact with their devices and use applications that facilitate activities in the digital world (Rahma et al., 2021).

In the world of education, Android-based applications are used as innovative learning media in learning activities. Android-based applications are used to help teachers deliver material more effectively, making it easier for students to understand learning materials. Android-based applications can also increase interactivity, motivation and involvement of students in the learning process which makes learning more interesting and interactive(Riyan, 2021).

E. Smart Apps Creator (SAC)

Smart Apps Creator (SAC) is software that can be used to create multimedia features based on mobile, desktop, and website. Smart Apps Creator is a desktop application that can be used to create Android-based mobile applications without programming code and can produce HTML, exe, and apk formats, making it easier for students to open learning resources on smartphone (Nursalimah & Sutisna, 2024). Smart Apps Creator in development can add images, videos, sound files and others and developers can also connect web services such as Google Drive, YouTube, and Google Maps to the Smart Apps Creator application (Hussein et al., 2022).

Smart Apps Creator is one of the interesting innovations in the world of education as a learning medium that can motivate students to be active in learning activities (Herawati et al., 2023). Smart Apps Creator can be used as a learning medium to increase teacher creativity in managing materials and also creating attractive mobile applications and can also be used offline which does not require using quota or internet. This media can be easily used by teachers and can make it easier for students to understand the material to be studied. Smart Apps Creator is one of the interactive learning media that can attract students' attention in the ongoing learning process but can increase students' motivation and focus by displaying text, images, audio, and video, games and can provide practice questions in the same application. This media not only attracts students' attention but can provide students with experience in understanding the use of technology in teaching and learning activities (Nursalimah & Sutisna, 2024).

F. Subject

The topic of this study is taken from the Informatics book for Senior High School Grade XI (Asfarian et al., 2021) published by the Ministry of Education, Culture, Research, and Technology. A more complete explanation of the topic is as follows:
1. Mobile Application Development with App Inventor

Human daily life is now greatly assisted by applications installed on smartphones, computers, or accessed online via browsers. Examples include office applications, messaging, music players, design, and accounting processors. Applications can be categorized based on their platform and use, namely desktop, web, and mobile applications.

a. Desktop Apps

Desktop applications are applications developed for the purpose of implementation on a desktop computer or local computer device. These applications must be installed on the local computer device, and once installed these applications will reside in the memory of the local device.

b. Web Apps

Web-based applications are applications developed with the aim of being accessible using a computer network connection and using the internet as the Hypertext Transfer Protocol (HTTP) protocol. This application is not installed on a local device or desktop computer but is installed on a specific server. This application is mostly accessed using a browser, but there are also those in the form of a client side where there is a small program installed on a local device, but the main computing process is carried out on the server.

c. Mobile Apps

Mobile applications are also called mobile apps, which are applications designed to be executed on mobile devices such as mobile phones, tablets, or smart watches. Mobile means easy to move. This application is growing rapidly due to the ease of use of mobile devices and can be integrated with other systems on mobile devices such as the Global Positioning System (GPS), camera, fingerprint, and others. Currently, there are millions of mobile applications available on the digital application distribution platform, namely the Play Store or Apps Store. Application development is greatly assisted by development tools called the Integrated Development Environment (IDE). The Integrated Development Environment (IDE) helps the ease and effectiveness of software development. One of the IDEs used for mobile application development is App Inventor.

d. Apps Inventor

App Inventor is a web-based integrated IDE software. App Inventor was originally developed by Google, which is currently maintained by the Massachusetts Institute of Technology (MIT). App Inventor allows novice computer programmers to create mobile apps on Android or iOS OS. The App Inventor application is open source and free.

App Inventor has a graphical interface similar to the Scratch or Blockly programming language. With the drag and drop method, users can create programs easily. Then developed through research in the field of Educational Computing and supports the use of cloud data with Firebase and Firebase Realtime Database. App Inventor can be accessed via a browser at *https://ai2.appinventor. mit.edu.*

Apps Inventor has many components that can be used in creating applications. These components are grouped into User Interface Components, Layout Components, Media Components, Drawing and Animation Components, and others. User Interface Components have components related to the user interface, such as: Button, Checkbox, Date Picker, Image, and others. Each component has methods, events, and properties that are used to manipulate the component.

III. METHODS

This research was conducted in the even semester of the 2024/2025 academic year at MA Negeri 2 Samarinda located at Jl. Harmonika No.98, Samarinda, East Kalimantan. The subjects of this study were two informatics teachers of grade XI and students of grade XI of the Specialization program consisting of 27 students of grade S2 and 36 students of grade K2 at MA Negeri 2 Samarinda. The collection technique in this study used 5 types of techniques, namely literature study, interview, observation, questionnaire and documentation.

A. Data and Equipment

The method used in this study is R&D (Research and Development) with the 4D model (Define, Design, Development, and Disseminate) with the following steps:

1. Define

The define stage consists of several steps including initial analysis, student analysis and curriculum analysis which aim to understand learning needs, regarding student characteristics, and adjusting to curriculum objectives. By conducting this analysis, the learning media developed can be more appropriate, effective, and in accordance with learning objectives.

2. Design

The define stage consists of several steps including media selection, format selection, initial design which aims to create an initial design of learning media that is in accordance with the results of the previous analysis.

3. Development

The development stage consists of several steps including making learning media, validation by experts, developing final products and taking responses which aim to ensure the quality and suitability of the media before use

4. Disseminate

The disseminate stage aims to disseminate products that have passed validation without revision to users through promotion.

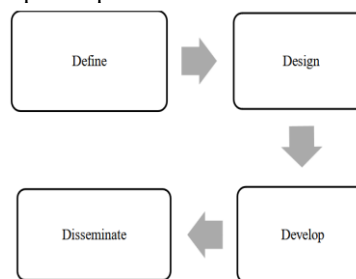From the explanation above, the stages of the 4D model development process can be seen in Figure 1.

Figure 1. 4D Model Development Stages
(Source: Waruwu, 2024)

B. Data Collection and Processing

Data collection in this study used five types of techniques including literature studies, interviews, observations, questionnaires and documentation. Literature studies were conducted by searching for and reading written sources to obtain data related to product

development. Interviews were conducted during pre-research with teachers and representatives of class XI Informatics students at MA Negeri 2 Samarinda to determine the use of teaching materials used, as well as problems that occurred during learning in class. Observations were conducted to find out how the learning process took place in class, then to find out the technological facilities provided by the school and to find out what materials and lessons they learned in class. Researchers conducted observations during the KKN-PLP & Teaching Assistance activities in the July-October 2024 period. The questionnaire was used to determine whether or not the product to be developed was feasible, which was shown to expert validators. Documentation was carried out to collect information from existing sources, such as documents, photos and videos as research materials and evidence of research implementation.

This study uses qualitative data analyzed using a Likert scale. Data was obtained from validation by material and media experts as well as teacher and student responses. Then the data obtained in the study were processed to answer the research problems. The process includes:

1. Validation Instrument Analysis

The validation instrument is used to assess the feasibility of the developed product. Data analysis is carried out using the Likert scale format as seen in Table 1.

Table 1. Likert Scale

Criteria	Score
Strongly Agree	5
Agree	4
Quite Agree	3
Disagree	2
Strongly Disagree	1

(Source: Khasanah & Rusman, 2021)

Once the data is obtained, the following formula is used to calculate product eligibility.

2. Eligibility Calculation Formula

The calculation results are converted into qualitative data to assess the feasibility and response to the developed product. Validation data obtained from media experts and material experts are calculated using the feasibility formula, then the results are compared with the validity criteria table to determine the level of product feasibility. In addition, teacher and student responses are also analyzed using the same formula to assess feasibility as product users using Equation (1).

$$\text{Validation result presentation} = \frac{\text{Score obtained (f)}}{\text{Maximum score (n)}} \quad (2)$$

(Source: Khasanah & Rusman, 2021)

3. Validity Criteria Table

To ensure the quality of the research instrument, a validation process was carried out by material experts and media experts. The assessment criteria used by the validators in evaluating the feasibility of the product can be seen in Table 2.

Table 2. Validity Criteria for Material and Media Experts

Percentage	Criteria
81% - 100%	Very Eligible
61% - 80%	Eligible
41% - 60%	Quite Eligible
21% - 40%	Less Eligible
0% - 20%	Not Eligible

(Source: Khasanah & Rusman, 2021)

In addition to expert validation, researchers also measured teacher and student responses to the developed products. The teacher and student response criteria can be seen in Table 3.

Table 3. Teacher and Student Response Criteria

Percentage	Criteria
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Quite Good
21% - 40%	Not Good
0% - 20%	Very Poor

(Source: Khasanah & Rusman, 2021)

IV. RESULTS AND DISCUSSION

A. Define

The define stage consists of three main analyses to develop Android-based mobile learning media for informatics lessons for class XI at MA Negeri 2 Samarinda. Initial analysis through teacher interviews found that the school uses the Independent Curriculum with inadequate infrastructure constraints, such as computer laboratories, tables and chairs that are not sufficient for the number of students and only a few students have laptops, so that during the learning process they are diverted to using smartphones. During the learning process, teachers use TPS, Jigsaw, PBL and PBL methods and media such as Quizizz and PowerPoint. but require more interactive teaching materials. Student analysis shows student enthusiasm for game-based learning and the need for media that facilitates understanding of the material. Meanwhile, the curriculum analysis on the mobile application development material uses App Inventor, which does not yet support adequate learning materials. Based on the initial analysis, the solution that can be concluded is the need for the development of Android based mobile learning media to increase student motivation and understanding.

B. Design

This Design Stage serves to form Android-based mobile learning media. This design stage is carried out with several steps as follows:

1. Media Selection

The media selection stage aims to determine the most effective platform in supporting the learning process. Based on the needs analysis, an Android-based mobile learning application was chosen using the Smart Apps Creator and Canva software. This selection was based on several considerations, including that many class XI

informatics students at MA Negeri 2 Samarinda are accustomed to using Android-based smartphone devices in their daily lives flexibly and independently. The use of Smart Apps Creator as a development tool was chosen because the learning media is interactive, interesting, and in accordance with the material. Canva was chosen as a design tool because of its ease of use and completeness of features. Canva can create attractive visual designs ranging from backgrounds, menus, icons and navigation buttons.

2. Format Selection

The selection of the format is done by considering the ease of use and flexibility of access for users. The selection of the format includes a screen resolution of 1024x768 pixels with horizontal orientation, a certain type and size of font for easy reading and the APK format in presenting material in the form of text, images and videos.

3. Initial Design

The initial design is in the form of a storyboard and flowchart. The storyboard contains details of the pages that will be displayed in mobile learning. The flowchart contains a diagram or flow chart that describes the steps, sequence and decisions of a mobile learning media development process. The entire design process aims to develop learning media that are not only easy to use but also able to improve students' understanding of the material. All details of the Flowchart flow can be seen in Figure 2.
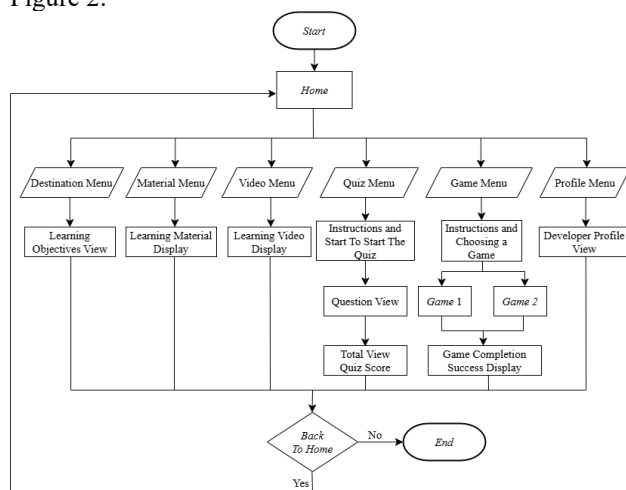

Figure 2. Flowchart

C. Development

After the product is designed, the next step is to develop learning media. After the product is produced, the development of learning media is carried out, validation by experts, development of the final product and taking responses. At this stage, the researcher takes several steps as follows:

1. Making learning media

At this stage, the researcher began to create learning media using the Smart Apps Creator and Canva applications. All components prepared at the design stage were then assembled into one unit using the Smart Apps Creator software. These components are assembled into one media unit according to the storyboard and flowchart. This product is designed for informatics subjects on

mobile application development materials using App Inventor. The result after the product is finished is a mobile learning application in the form of an APK (Android Package Kit) format that can be installed on Android-based smartphones. The design parts for making mobile learning media can be seen below.

The opening page functions as the opening display that will appear first when the user opens the mobile learning application. This page displays the background and the word "welcome" which will be displayed briefly before automatically switching to the start page on the mobile learning application. The complete display of the opening page can be seen in Figure 3.

Figure 3. Opening Page

This start page is the main page that introduces the informatics learning media application for MAN 2 Samarinda, then to start the user simply clicks the "start" button. The complete display of the start page can be seen in Figure 4.

Figure 4. Start Page

The home page has six menus, namely the menu for selecting goals, materials, videos, quizzes, games and profiles. Each menu that is clicked will direct the user to the page according to their choice. The home page also has navigation buttons to set the music on or off. The complete display of the home page can be seen in Figure 5.
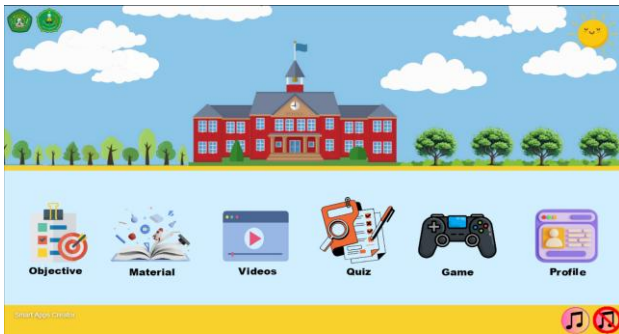
Figure 5. Home Page

The destination menu page displays the learning objectives in informatics subjects for mobile application development materials using App Inventor. The destination menu page provides navigation buttons to set the music on or off and return to the home page. The complete display of the learning objectives page can be seen in Figure 6.

Figure 6. Learning Objectives Menu Page

The material menu page is a page that contains the presentation of mobile application development materials using App Inventor for informatics subjects. The learning materials are arranged in 12 slides that can be accessed sequentially. The material menu page is equipped with navigation buttons to return to the home page, switch to the next slide and set the music on or off. The complete display of the learning material page can be seen in Figure 7.

Figure 7. Learning Materials Menu Page

The video menu page displays learning videos containing practical tutorials on implementing mobile application development materials using App Inventor. The videos can be accessed in an integrated manner through mobile learning by connecting to the YouTube platform. The video menu page is equipped with navigation buttons to return to the home page and turn the music on or off. A complete view of the learning video page can be seen in Figure 8.

Figure 8. Learning Video Menu Page

The quiz menu contains the initial display of the start page to start the quiz which contains the opening text "Welcome to the Quiz" and instructions for working on the questions correctly and precisely. Users can start the quiz by clicking the "Start" button. The video menu page is equipped with navigation buttons to return to the home page and set the music on or off. The complete display of the quiz page can be seen in Figure 9.
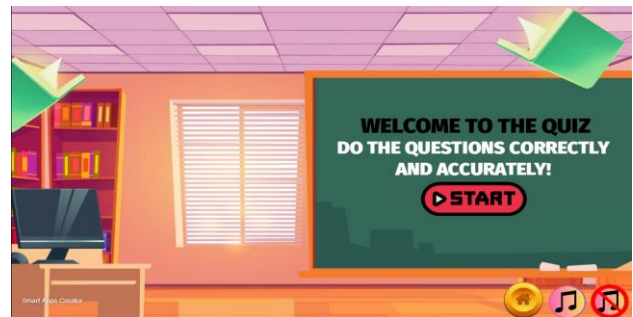

Figure 9. Start Page to Start Quiz

The Questions page presents 10 multiple-choice questions designed as an interactive evaluation on the mobile learning application. Each user response will receive a direct visual mark in the form of a green check mark (✓) for a correct response and a red cross (X) for an incorrect answer. The automatic evaluation system provides an accumulation of 10 points per correct answer with a perfect score of 100 points for all questions on the questions page. The complete display of the questions page can be seen in Figure 10.

Figure 10. Question Page

The total quiz score page displays the final accumulated score obtained by the user based on the number of correct answers from 10 questions available on mobile learning. The total quiz score page has a navigation button to return to the home page. The complete display of the question page can be seen in Figure 11.

Figure 11. Total Quiz Score Page

The game menu page contains an initial display that provides two game options, namely game 1 and game 2 along with instructions on how to play them. Users can read the game instructions first before choosing the game they want to play. The instructions page and selecting a game are equipped with navigation buttons to return to the home page and set the music on or off. A complete display of the instructions page and selecting a game can be seen in Figure 12.
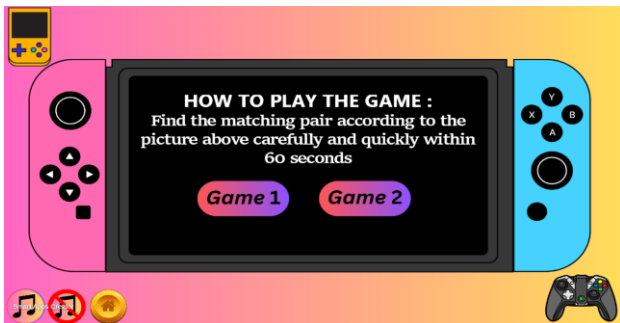

Figure 12. Game Selection and Instructions Page

The game page displays an interactive matching-based game designed to test the user's understanding of the learning material. In this game, the user is asked to match the image with the corresponding name by pulling and connecting it using a virtual rope. The system will provide an answer when the rope will be perfectly connected if the answer is correct, but will remain disconnected if the answer is wrong. This game has a 60-second completion time limit to add to the challenge of the game. The complete display of the game page can be seen in Figure 13.
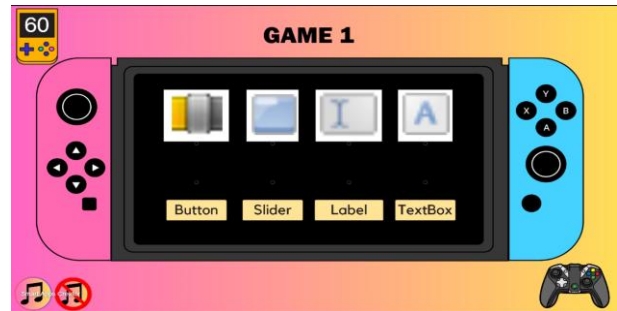

Figure 13. Games Page

This page is the final display that appears automatically when the user successfully completes the game challenge correctly, which congratulates the user on successfully completing the game. The game completion page is equipped with navigation buttons. The complete display of the instructions page and selecting the game can be seen in Figure 14.
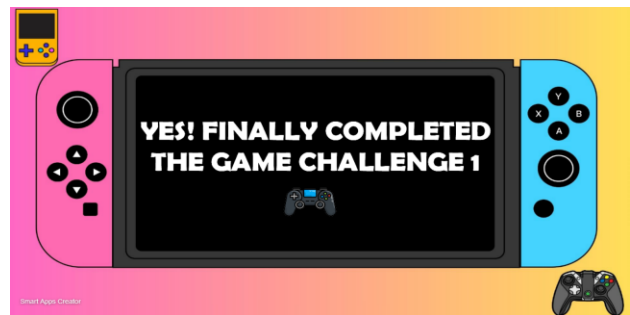

Figure 14. Completed Games Page

The profile menu page is a page that contains brief biographical information about the developer. The developer profile menu page is equipped with navigation buttons and setting the music on or off. A complete display of the instructions page and selecting the developer profile page can be seen in Figure 15.

Figure 15. Developer Profile Page

2. Validation by experts

The development stage is carried out with expert validation, final product development, and response collection. In this activity, media and material validation is carried out by validators. Material validation is carried out by one validator and media validation is carried out by three validators.

3. Final Product Development

After mobile learning has been declared valid (no revisions), mobile learning is published. The result of the development is a mobile learning application in the form of APK (Android Package Kit) format that can be installed on Android-based smartphones with a file size of 35 MB. The appearance of mobile learning on a laptop is presented in Figure 16.

Figure 16. Mobile Learning Appearance on a Laptop

The appearance of mobile learning on an Android-based smartphone with a file size of 35 MB is presented in Figure 17.

Figure 17. Mobile Learning Appearance on an Android based Smartphone

The average results of the assessment scores of the suitability of one material expert are explained in Table 4.

Table 4. Average Material Expert Feasibility Assessment Score

Aspect	Percentage	Criteria
Learning	100%	Very Eligible
Material Preparation	87%	Very Eligible
Content Quality (Evaluation)	96%	Very Eligible
Language	90%	Very Eligible
Total	93%	Very Eligible

The results of the feasibility test of one material expert validator, the average percentage of the four aspects, namely the learning aspect is 100%, material preparation is 87%, content quality (evaluation) is 96% and Language is 90% with the criteria "very eligible". After being processed, the overall percentage obtained is 93% with the criteria "very eligible". The average results of the three media experts' assessment scores for eligibility are explained in Table 5.

Table 5. Average Media Expert Validation Assessment Score

Aspect	Percentage	Criteria
Technical	97%	Very Eligible
View	83%	Very Eligible
Text	98%	Very Eligible
Images and Videos	90%	Very Eligible
Total	95%	Very Eligible

The results of the feasibility test of three material expert validators, the average percentage of the four aspects, namely the technical aspect is 97%, view is 83%, Text is 98% and Images and Videos is 90% with the criteria "very eligible". After being processed, the overall percentage obtained is 93% with the criteria "very eligible". The results of the processing of the feasibility data from the validator of the material and media on mobile learning obtained the average score assessment of each aspect of each validation of the material and media as described in Table 6.

Table 6. Average Score Assessment of Each Aspect of Feasibility

Aspect	Percentage	Criteria
Validity of Material		
Learning	100%	Very Eligible
Material Preparation	87%	Very Eligible
Content Quality (Evaluation)	96%	Very Eligible
Language	90%	Very Eligible
Media Validity		
Technical	97%	Very Eligible
View	83%	Very Eligible
Text	98%	Very Eligible
Images and Videos	90%	Very Eligible
Average		
Average	95%	Very Eligible

The results of the processing of the feasibility data from the material and media validator, it can be seen that the average percentage of the eight aspects, namely the learning aspect is 100%, material preparation is 87%, content quality (evaluation) is 96% and Language is 90%, technical is 97%, view is 83%, text is 98% and images and videos are 90% with the criteria "very eligible". After processing, the overall percentage is 95% with the criteria "very eligible".

4. Response retrieval

After mobile learning is declared valid and feasible by expert validators, the next step is to collect responses to determine the responses of teachers and students. to the mobile learning media that has been developed. The response collection process was carried out on 2 teachers and 52 informatics students of class XI at MA Negeri 2 Samarinda.

The average score of the assessment of two informatics teachers for class XI informatics subjects at MA Negeri 2 Samarinda can be seen in Table 7.

Table 7. Average Assessment Score of Informatics Teachers

Aspect	Percentage	Criteria
Material	95%	Very Good
Media Display	94%	Very Good
Total	95%	Very Good

The results of the responses of two informatics subject teachers, the average percentage of the two aspects, namely the material aspect is 95% and the media display is 94%. After being processed, the overall percentage is 95% with the criteria "Very Good". The average assessment score of 52 informatics students for class XI at MA Negeri 2 Samarinda can be seen in Table 8.

Table 8. Average Assessment Score of Students

Aspect	Percentage	Criteria
Material	91%	Very Good
Media Display	93%	Very Good
Total	92%	Very Good

The results of the responses of 52 class XI Informatics S2 and K2 students, the average percentage of the two aspects, namely the material aspect, is 91% and the media display is 93%. After being processed, the overall percentage is 92% with the criteria "Very Good".

D. Disseminate

The dissemination stage is the final stage in the development of mobile learning, where the finished product is distributed to students to be used as Android-based learning media during the learning process. This distribution was carried out for students in S2 and K2 Informatics classes. Documentation of the distribution of Android-based mobile learning media in class XI Informatics S2 can be seen in Figure 18.

Figure 18. Distribution of Mobile Learning to Class XI Informatics S2 Students

Documentation of the distribution of Android-based mobile learning media in class XI Informatics K2 can be seen in Figure 19.

Figure 19. Distribution of Mobile Learning to Class XI Informatics K2 Students

The distribution results show that the use of Android based mobile learning for Informatics subjects on mobile application development materials with App Inventor greatly helps the learning process. Students can access learning media via their smartphones by installing the application. During learning, this media has proven effective because students are very enthusiastic about using it. This makes the learning process more fun, interactive, and helps understanding the material in a more interesting way. In addition, the use of mobile learning is also considered very efficient in supporting learning.

V. CONCLUSION

The results of the study indicate that the development of mobile learning media uses the 4D model (Define, Design, Development, and Disseminate). The 4D model is a development model used in various fields, especially in the development of learning media. The 4D model consists of four main stages, namely define, design, development, and disseminate. At the define stage, the researcher conducts initial analysis, student analysis and curriculum analysis. At the design stage, the researcher selects media, formats and initial designs. At the development stage, the researcher creates learning media, expert validation, develops final products and collects responses. At the disseminate stage, the researcher carries out packaging and adoption and distribution. The results of the study indicate that the development of Android-based mobile learning media in informatics lessons for class XI MA Negeri 2 Samarinda is very feasible to use. With the results of the mobile learning feasibility test by one material expert obtaining an average score of 94% with the criteria of "very feasible". Furthermore, the results of the mobile learning feasibility test by media experts in succession, the first validator obtained an average score 93% with the criteria of "very feasible", then the second validator obtained an average score of 92% with the criteria of "very feasible" and the third validator obtained an average score of 99% with the criteria of "very feasible". If the average score of the three validators is averaged, it produces a score of 95%

with the criteria of "very feasible". The level of feasibility of mobile learning is based on the results of the validation of materials and media that have been carried out on one material validator and three media validators with the feasibility value of mobile learning obtaining an average percentage of 94% with the category level of "Very Feasible". Therefore, the mobile learning developed by the researcher is declared very feasible and valid for use. The responses of informatics subject teachers and students based on the response questionnaire that has been given the results of the recapitulation of the response questionnaires of two teachers, the average percentage of two aspects, namely the material aspect of 95% and the media display of 94%. After being processed, the overall percentage obtained was 95% with the criteria for "Very Good". While the results of the recapitulation of the student response questionnaire, the percentage of values from two aspects, namely the material aspect of 91% and the media display of 93%. After being processed, the overall percentage obtained was 92% with the criteria for "Very Good". Therefore, the product developed in the form of Android-based mobile learning media in Informatics lessons for class XI at MA Negeri 2 Samarinda is very suitable for use in the learning process to be more effective, interactive, and flexible, so that it can increase student motivation and learning outcomes.

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