



Development of Mobile Learning Android Application Learning on Patterns of Inheritance of Traits in Mendel's Laws

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Abstract: Genetics is a branch of biology that contains a lot of difficult material, for example inheritance patterns, gene interactions, hereditary inheritance and protein synthesis mechanisms, so it requires media as an aid in the learning process. Learning media created using the Kodular.io software is an educational product in the form of an Android application that includes material on inheritance patterns based on Mendel's laws. The aim of this research is to develop mobile learning media, Android application, and material on inheritance patterns based on Mendel's laws and to see the feasibility of learning media. This type of research is Research and Development (R&D) and the research model used includes the stages of Analysis, Design, Development and Evaluation. The research instruments used were observation sheets, questionnaires, research sheets and documentation. The research subjects in the study were students in class XII MA Jambi City Laboratory. The trial was carried out on 6 students and 15 students. The material validation results are in the very feasible category and the media validation results are in the very feasible category. The results of trials in small groups are in the very good category and the results of trials in large groups are in the very good category, and the results of teacher perceptions are in the very good category. Based on data analysis, it can be concluded that the media is suitable for use in learning.

Keywords: Android; Mendel's laws; Mobile learning

Introduction

Biology is a part of science that studies living things based on their level of organization and interaction with the environment. The product of biological science is a collection of facts and concepts. (Arifin et al., 2018). Biology studies everything related to the life of living creatures, therefore the scope of the material is very broad. One branch of science in biology learning is genetics. Genetics is studied at high school level in class XII. Genetics studies various things related to patterns of inheritance of traits.

Based on the distribution of questionnaires carried out, it is known that of all the material that has been studied, as many as 56.5% still have difficulty understanding the material on Mendelian patterns of inheritance. Difficulties experienced by students include not understanding the concept of inheritance of traits, too much coverage or elaboration of material, so that

students are confused by many types of pseudo-deviations and do not understand the meaning of the questions. This is reinforced from the results of interviews with biology teachers who stated that the results of the cognitive assessment carried out by the teacher on this material showed that only 56% of students achieved the minimum standard value (≥ 78). Based on the teacher's statement, it is known that the difficulty experienced is that students still do not understand the meaning or essence of the inheritance material.

According to Sulfiah et al. (2013), genetics is a branch of biology that contains a lot of difficult material, for example inheritance patterns, gene interactions, hereditary inheritance and protein synthesis mechanisms that cannot be observed using a light microscope, so media is needed that can provide illustrations related to this material. Learning with a high level of difficulty, such as material on inheritance,

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requires the involvement of many of the five senses so that it is more likely that the information will be understood and can be retained in memory.

Based on the results of observations carried out at the Madrasah Aliyah Laboratory in Jambi City, it is known that the MA Laboratory has inadequate facilities and infrastructure as a learning medium. One of the facilities the school has is a computer laboratory, science laboratory and projector. In the school environment there is Wi-Fi and an internet network, so school regulations allow students to bring cellphones to school with the aim of helping the learning process. The media used is still limited. So, to overcome students' difficulties in understanding the material, learning media is needed. Based on interviews with biology teachers, teachers hope that there will be learning media that can help students understand material they have not yet mastered, packaged in simple writing, can be used independently and are not monotonous. Based on this, the media that can be used is the Android Mobile Learning Application (Ibrahim & Ishartiwi, 2017; Ichsan et al., 2018; Anwari et al., 2020; Handoyono & Mahmud, 2020).

Mobile learning has various definitions that refer to educational technology and distance education that focuses on learning with mobile devices. Mobile learning is one of the new generations of electronic learning services that can increase student productivity because knowledge and learning can be obtained anytime and anywhere. There are many advantages that mobile learning has that other media do not have. Mobile learning gives students the freedom to learn and get information anytime and anywhere (Mehdipour & Zerehkafi, 2013).

Method

The type of research carried out is Research and Development. The research carried out was to develop learning media in the form of an Android application for Mendelian Law Patterns of Inheritance Material for Class XII SMA Students. This development uses a development model that goes through the stages of analysis, design, development and evaluation.

The development procedure goes through 4 stages, including: The analysis stage is carried out by validating performance gaps to find out problems through a needs analysis questionnaire, instructional objectives or determining priorities to be taken, identifying student characteristics for media development, identifying available resources consisting of content resources, technology and human resources, then determine the potential delivery system and prepare a work plan consisting of a development schedule, development

team, material structure and specifications to be developed; the design stage is carried out by a design process in the form of compiling things needed for development such as flowcharts and storyboards, preparing performance goals that must be achieved by students, preparing testing strategies to determine the effectiveness of the product that has been developed later; The development stage is carried out by a process, namely producing a product, followed by developing a guide for teachers and students, formative revision in the form of product validation and revision from a team of experts, conducting product trials consisting of teacher trials and student trials consisting of small group trials and large group trials; The evaluation stage carries out an evaluation consisting of formative evaluation.

Trials are carried out to determine students' responses to the learning media that will be developed. The test subjects taken were class XII MA Jambi City Laboratory students. According to Hasyim (2016) and Setyosari (2016) small group trials involve 5-8 people and large group trials involve 15-30 people. The subjects of the small group trials were carried out on 6 students and large groups were carried out on 15 students and 1 teacher. Data analysis is a process of processing and interpreting data with the aim of putting together various information so that it has clear meaning and significance based on the research objectives. The data analysis technique was carried out using descriptive analysis. The data analyzed includes qualitative and quantitative data. Qualitative data in the form of suggestions from material experts, media experts, biology subject teachers and students. Quantitative data in the form of assessment scores from material experts and media experts, student and teacher questionnaires using a Likert scale.

According to Sugiyono (2015), the Likert scale is a research scale used in developing instruments used to measure the attitudes, perceptions and opinions of a person or group of people regarding the potential and problems of an object, the design of a product, the process of making a product and products that have been developed. With this Likert scale, respondents are asked to complete a questionnaire that requires them to indicate their level of agreement with a series of questions. The level of agreement referred to in this Likert scale consists of 4 scale options which have gradations from Strongly Agree to Strongly Disagree.

Result and Discussion

The results obtained at the analysis stage are students still experience difficulties in understanding the material on Mendelian patterns of inheritance, indicated by only 56% of students who meet the

minimum completeness criteria, while 44% have not yet achieved completeness; Difficulties occur because students still do not understand the meaning or essence of the material on inheritance patterns, there is a lack of integration of the material with the reality of everyday life; students' attention in learning begins to decline because in class XII they tend to study complex material so that a medium is needed learning; students need learning media that is practical, effective and efficient to use in accordance with technological advances; learning media is needed that can facilitate students' difficulties in understanding the material independently. Due to the large amount of material coverage on Mendelian patterns of legal inheritance, based on teacher interviews, simple media is needed that students can understand independently. Based on this, the learning media that can be used independently by students, practically efficiently, in accordance with technological advances is the Android application.

The result of the design stage is that the product is designed using Canva software, then the output is input to the kodular.io website to turn it into an application. The results of this development will be presented in the form of an Android application. In this design stage there are several stages, including arranging all the things needed to make a product, such as initial designs in the form of flowcharts and storyboards, starting to be realized to produce a product that can be used in learning activities.

The development stage is the stage of realizing the product that has been designed which is then validated by the validator team until it is declared feasible, and then ready to be tested. Product validation is carried out using a questionnaire designed based on the assessment instrument grid. The product validation results are as follows:

Table 1. Material Validation Results

Assessment aspect	Result		
	1st Validation	2nd Validation	3th Validation
Format (%)	50	75	100
Content (%)	53	67	89
Language (%)	50	68	87
Percentage (%)	52	68.75	89.5
Category	Not Proper	Proper	Very Proper

Based on the results of validation of stage 1 material which was not suitable, a revision was carried out again and then stage 2 validation was carried out, obtaining a product quality percentage of 68.75% with the appropriate category but still needing to be revised, then stage 3 validation was carried out, obtaining a product quality percentage of 89.5% in the very feasible category and it can be concluded that the product is worth testing in terms of material aspects.

Table 2. Media validation results

Assessment aspect	Result		
	1st Validation	2nd Validation	3th Validation
Simplicity (%)	62	75	75
Integration (%)	50	50	100
Balance (%)	58	83	83
Colour (%)	50	75	75
Appearance (%)	62	75	87
Operation (%)	75	100	100
Percentage (%)	56.25	77	85.4
Category	Not Proper	Proper	Very Proper

Based on the results of the validation of stage 1 material which was not feasible, a revision was carried out again and then validation was carried out in stage 2. The results were obtained that the product was included in the feasible category but there were still several revisions from the media expert team, so it was necessary to make improvements again and carry out the next stage of validation 3 and obtained a product quality percentage of 85.4% with a very feasible category and it can be concluded that the product is worthy of being tested in terms of media appearance aspects.

Table 3. The results of teacher perceptions

Assessment aspect	Result
Accurate	87.5
Integration	100
Control in Learning	87.5
Appearance	100
Prerequisite Abilities	100
Easy to Use	95
Percentage	94.6
Category	Very Good

The evaluation stage used is formative evaluation, where formative evaluation activities are carried out starting from media validation, material validation, teacher assessment and testing of research products on small groups and large groups of students. After carrying out the material and media validation stage until the product can be declared suitable for field testing, then proceed with an assessment by the biology subject teacher so that they can find out that the product is good for testing on students. After that, it was continued with small and large group trials to see the feasibility of the Android application mobile learning media product material on patterns of inheritance based on Mendel's laws.

The learning media for mobile learning android applications, material on inheritance patterns based on Mendel's laws, was developed using the ADDIE model. This development model consists of several stages, namely analysis, design, development, implementation and evaluation. The first stage in the ADDIE model is the

analysis stage which consists of needs analysis, setting instructional objectives, analyzing student characteristics, identifying available resources, material analysis and preparing a work plan. This analysis aims to determine the conditions and needs of students who will be the target users of the product to be developed. This analysis stage is based on the results of interviews with biology subject teachers and the results of distributing questionnaires regarding the needs of students in class XII IPA MA Jambi City Laboratory.

Table 4. Student Perception Results

Assessment aspect	Product testing	
	Small groups	Large groups
Appearance	88.3%	87.6%
Material	88.5%	85%
Learning	90.6%	87.9%
Percentage	89.1%	87%
Category	Very Good	Very Good

Based on the results of the analysis, it is known that students in class. This is based on the results of the completeness score where only 60% of students achieved the completeness score while 40% have not yet achieved completeness. According to Kusnadi et al. (2022) the learning process is said to be successful if 70% of students or more achieve a completion score. The difficulties experienced by students are due to the lack of integration of material with daily life and complex material which causes a decrease in students' interest in learning. This can be overcome by using learning media. According to Prastya (2016), Misbahudin et al. (2018), Yudha (2019), Damitri & Adista (2020), Pramestika (2021), Abidin & Utami (2021), and Prasetyo (2022) the solution to overcoming students' learning difficulties during the learning process is to use learning media.

Based on the results of observations regarding the analysis of student needs carried out at the MA Laboratory of Jambi City, the results were obtained in the form of problems and obstacles, namely the lack of variety of learning media available and the lack of interest in learning by students in class. Based on the results of interviews conducted with class XII biology subject teachers, it is known that the media used in the learning process are worksheets, printed books and pictures. Most participants currently really like the existence of interesting learning media so that students are more motivated to easily understand the material. According to Sukiman (2012), Nugraheni (2017), and Nurrita (2018) interesting learning media can be a stimulus for students in the learning process.

Based on the material analysis carried out, it is known that it is quite difficult for students to understand the material on inheritance patterns in Mendel's laws because the material is complex and quite extensive and

the learning process only uses LKS media. Therefore, there is a need for supporting media to support the learning process so that students can more easily understand the material being studied. According to Kurniawan (2017), Daeng et al. (2017), Alhafidz & Haryono (2018), Aripin (2018), Amajida (2020), Supratman & Padli (2021), and Nurhidayati et al. (2021) learning media that are interactive, creative and innovative and can be used anywhere and anytime, one of which is Android application media. Therefore, researchers developed mobile learning android application learning media to help the teaching and learning process.

Next is the design stage which is the process of designing the product to be made. This stage begins with creating a flowchart and storyboard. Then it was designed using the kodular.io website. Next, it is developed in the development stage, where at this stage a feasibility test is carried out by material and media experts. There are several comments, suggestions and input from the expert team which will later be used as a reference for improving the product being developed until the product is declared suitable for testing in the field. Validation of learning media products is carried out three times each, namely material validation and media validation. The following are the results of material validation. Based on the results of material validation in the first stage, the percentage of product quality was obtained, namely 52%. Improvements were made based on suggestions and input from material experts regarding the appearance of material pages, inappropriate references and the addition of a glossary. Then revisions are made to improve the product.

Next, the second validation stage was carried out and the product quality percentage was obtained at 68.75%, based on suggestions and input from material experts, the product still needed improvements and the addition of more complete materials. After improvements were made, the product was validated for its suitability and received a product quality percentage of 89.5% and was categorized as suitable for testing without revision. Based on the analysis of the three stages of product feasibility validation, it was concluded that at each stage of material validation there was an increase in improvement and quality. So the product is worthy of being tested in the field.

Next, it continued with the media expert validation stage based on the results of the media expert validation. It was found that in the first stage of validation, the product feasibility percentage was 56.25%. Improvements were made based on suggestions and comments from media experts regarding improvements to the background and appearance of the application which was less attractive. Next, the second validation

stage was carried out, the percentage was 77%, and improvements were made to the learning videos and the layout of the material titles. After improvements were made, the product was validated in the third stage and obtained a product quality percentage of 85.4% and was suitable for testing in the field. Based on the analysis of the three stages of product feasibility validation, it was concluded that at each stage of media validation there was an increase in improvement and quality. So the product is worthy of being tested in the field.

After the media product developed is validated by material experts and media experts, the product is then tested in the field to see teacher assessments and student responses. This Android application media trial was carried out at the MA Laboratory of Jambi City with one biology subject teacher, a small group of 6 people and a large group of 15 people. This trial was carried out by distributing teacher questionnaires directly and student questionnaires via Google Form.

Based on the test results, it is known that the mobile learning Android application learning media material on inheritance patterns based on Mendel's laws is suitable for use as learning media and additional learning resources for teachers and students. The results of the teacher perception questionnaire regarding the product obtained a feasibility percentage of 94.6% and was included in the very good category. The results of the small group student perception questionnaire regarding the product obtained a percentage of 89.1% and was included in the very good category. The results of a large group student perception questionnaire regarding the product obtained a percentage of 87% and were included in the very good category. Based on the perception results, it can be concluded that the mobile learning Android application learning media material on patterns of inheritance of traits in Mendel's law is suitable for use as a learning medium, because it is very interesting and motivating for students and increases knowledge of the material on patterns of inheritance of traits in Mendel's law.

This is achieved due to the use of learning media which is integrated in the form of an Android application which can be accessed anytime and anywhere, whether connected to an internet network or without the internet. So that it can make it easier for students and teachers in the learning process. According to Sari et al. (2018), mobile learning is learning through mobile wireless technology which allows everyone to access information and learning materials from anywhere and at any time. Interesting things can also be seen from the advantages of using learning applications according to Azizah (2018) stated that because it is portable, Android mobile learning applications also have the advantage of being able to be used repeatedly.

The evaluation stage carried out is formative evaluation, namely formative evaluation activities carried out are material validation, media validation and media product testing. After being tested for feasibility, the result was that the media developed was suitable for testing. The results of trials carried out in small groups and large groups received suggestions and input from students and teachers and then revised according to the suggestions given so that learning media could be suitable for use in the learning process.

Conclusion

Learning media is developed through four stages, namely Analysis, Design, Development and Evaluation. The media developed did not go through the implementation stage because it is in accordance with the aim of this research, namely to develop and analyze the feasibility of the media created. The application was designed using Canva, then the design was produced in PDF form and continued with application creation via the Kodular.io website so that the output was produced in the form of an Android application. The product developed has been validated by a team of material expert validation and media expert validation before being tested on class XII Science students at the Jambi City Laboratory MA. Learning Media Mobile learning Android application is suitable for use based on the results of the assessment by the material validator, getting a final result of 89.5% in the Very Feasible category. Then the media validator assessment with a final result of 85.4% in the Very Eligible category. The assessment by the biology subject teacher received a final result of 94.6% in the Very Good category so that the media developed could be accepted by the teacher for use by students as a learning resource and medium. The assessment by students got a final result of 89.1% in the Very Good category for the small group, while for the large group the final result was 87% in the Very Good category, thus this learning media can be used as a learning media that can help increase knowledge in the learning process.

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Author Contributions

Taufik Pramudya contributes to conceptualizing the research idea, developing product, analyzing data, and writing articles. Afreni Hamidah and Harlis is a supervisor in research activities to article writing, reviewed and edited.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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