Development of an Android-Based Virtual Laboratory Using the Adobe Animate Application for Urine Tests At Sma Negeri 3 Mataram

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Abstract: This research aims to determine the validity of Android-based virtual laboratory products with the Adobe Animate application. Practicality of Android-based virtual laboratory products with the Adobe Animate application. Student responses to Android-based virtual laboratory products developed with the Adobe Animate application. The research methods used are R&D with the ADDIE Analyze model (identifying problems and finding solutions to the problems found), Design (designing the components needed to develop products and other instruments used at the implementation stage), Development (product development) , Implementation (implemented in the learning process involving students), and Evaluation (measuring the quality of products that have been developed and processed before and after learning using a virtual laboratory). The research results show that the Android-based virtual laboratory product developed has an average readability score of 89.98% with very good criteria. The Android-based virtual laboratory media developed has met the very valid criteria with an average score of 95%. The practicality of the laboratory being developed has met the very practical criteria with an average score of 82.5% and students' responses to Android-based virtual laboratory products include the criteria of agreeing with an average percentage score of 83.33%.

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Introduction

Biology learning is a scientific discipline that was developed as an integrative science subject which means combining various aspects in the domains of attitudes, knowledge and skills (Liana & Kurniawan, 2018). Biology learning is not only about mastering facts, concepts or principles but also a process of discovery. Students are expected to be able to understand concepts and carry out a discovery process in learning Biology. Learning Biology material, there are still many students who have difficulty understanding Biology concepts. Biology learning is considered a lesson that is difficult for students to understand because it contains many scientific concepts and words that are difficult to understand and are abstract (Lestari et al, 2017).

Biology is a field of science that provides various learning experiences such as understanding scientific concepts and processes. The scientific process in biology can include observation, experimentation and rational analysis activities to produce facts and concepts (Marlina et al, 2018). The independent curriculum requires several basic competencies (KD)

consisting of observation, experimentation and stimulation activities (Kemendikbud, 2022). These basic competencies (KD) must be fulfilled through practicum activities. Some obstacles that often arise in practicum activities are; inadequate facilities and infrastructure to support the implementation of practical activities, inadequate laboratory facilities, and inefficient use of laboratory facilities (Masruri, 2020).

Virtual Laboratory is one of the media that can be used in biology learning. Virtual Laboratory is an interactive media that can calculate activities in actual laboratories (Wahyuni, 2020). Virtual laboratories can also overcome existing problems in learning by stimulating material that is difficult to put into practice, such as abstract material and concepts. Through practical activities, students can gain experience identifying real problems, designing them operationally, stimulating the best way to solve and implement them in the laboratory, and being able to analyze and transmit the results.

One of the learning subjects that requires practicum is the excretory system material in the urine test sub-chapter. The excretory system is the process of removing metabolic waste substances that are no longer used by the body. The remains of this metabolism are in the form of compounds that are toxic (poison) so that if they are not removed they can disrupt the function of organs in the body (Legiawan & Agustina, 2021). Practical learning can provide concrete experience, can increase discussions with themes that lead to the discovery of ideas and new concepts. Practicum-based learning can be used as an alternative learning that can encourage students to learn actively (Anggriani et al, 2019).

Based on the results of interviews with the Biology subject teacher for class . Students at SMA Negeri 3 Mataram have the problem of a lack of tools and materials to support the implementation of practical activities (inadequate laboratories), as well as practical materials such as urine from diabetes mellitus sufferers which are difficult to obtain. This makes practicums rarely carried out. Basic Competency (KD) 3.9 requires observation, experimentation and simulation activities. Then the researchers were interested in conducting research on "Development of an Android-Based Virtual Laboratory Using the Adobe Animate Application for Urine Testing for Students at SMA Negeri 3 Mataram".

Based on the description of the problem above and an alternative solution to the obstacles in implementing Biology practicum that can be applied to this problem is by implementing a Virtual Laboratory. Virtual Laboratory is one of the media that can be used in biology learning. Virtual Laboratory is an interactive media that can simulate activities in a real laboratory (Wahyuni, 2020).

Method

This type of research is research and development. Media research and development procedures are carried out using the ADDIE development model. Analyze (identify problems and find solutions to the problems found), Design (design the components needed to develop products and other instruments used at the implementation stage), Develop (product development), Implement (implemented in a learning process involving students), and Evaluation (measuring the quality of products that have been developed and processed before and after learning using a virtual laboratory). Data was collected by distributing media and material validity test questionnaires filled in by teachers, product readability tests, practicality tests and student responses filled in by students.

Result and Discussion

Virtual Laboratory Development Process

The development of a virtual laboratory as an Android-based learning medium has been implemented using the ADDIE model. The virtual laboratory development process has fulfilled five stages, namely; Analyze, Design, Develop, Implement and Evaluation stages.

1. Description of the Analysis Stage

The analysis stage involves identifying the potential and problems found. Problem identification is carried out by means of observation and interviews. Observations were carried out to determine the condition of the biology laboratory at SMA Negeri 3 Mataram and interviews were carried out with the class XI biology subject teacher at SMA Negeri 3 Mataram. Observing laboratory conditions at SMA Negeri 3 Mataram, the following information was obtained. (1) Biology laboratory used as a classroom temporarily. (2) There are not enough equipment in the laboratory such as test tubes.

The results of the interview with the biology teacher are as follows. (1) The subject matter of the excretory system is still abstract, so it is difficult and rarely put into practice. (2) Lack of equipment such as test tubes to support the implementation of practical activities (inadequate laboratory). (3) Practical materials such as urine from Diabetes Mellitus (DM) sufferers are difficult to obtain, which is one of the reasons practical urine testing is rarely carried out.

2. Product Design Stage

This stage determines the format of the learning media and prepares a Story Board for the learning media that will be used. The purpose of this preparation is so that the media developed has a precise and targeted design. The learning media product in the form of a Virtual Laboratory was developed in the form of an application. This application was created in Android format which contains information in the form of text, sound, animation, images and audio that are interconnected. The virtual laboratory concept is in the form of a simulation of the implementation of urine testing practical activities. After determining the format and concept of the virtual laboratory product, the next stage is designing a Story Board. It can be seen in Figure 1.
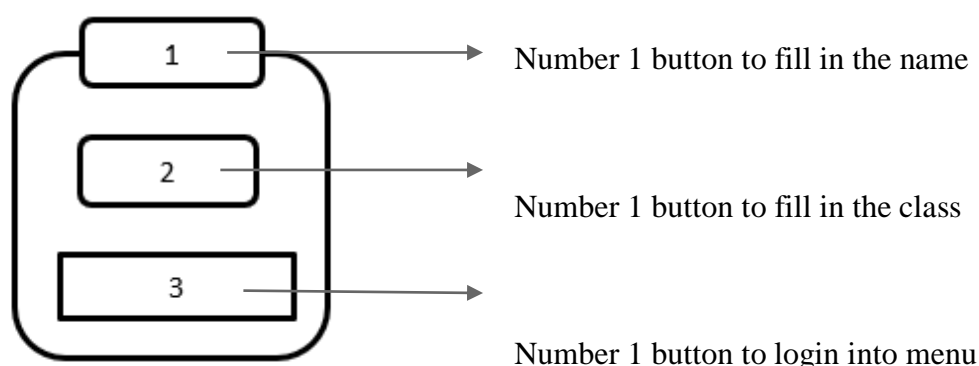

Figure 1. Story Board Laboratorium Virtual

3. Development Product Stage

The process of developing this virtual laboratory product was carried out with the help of the Adobe Animate application using the action script 3.0 format with the use of tools in it. The tools used in product development are: Texs Tool to create objects in the form of text, import to add audio, text and images as desired, layers to add objects such as

images and writing to the frame work page to determine the duration of animation on an object. keyframe functions to determine when the object will appear, blankframe functions to add a new frame, ink bottle functions to color strokes on the object, eyedropper tool functions to select color samples, zoom tool functions to enlarge and reduce the stage display.

The process of making this virtual laboratory product includes making buttons in the form of (login button, home button, enter button, back button, next button, repeat button, volume button, settings button, exit button). Addition of Basic Competencies (KD), excretory system material, urine test sub-chapter, practical instructions containing (practical objectives, practical time, practical equipment, practical materials, work steps and observation results table). Addition of practical activities consisting of three experiments, namely (urine protein test, urine glucose test and urine pH test), additional audio, sound and images in the form of (pipette drops, test tubes, biuret solution, Benedict's solution, healthy person urine, urine diabetes mellitus (DM) sufferers, spirit burners, matches, universal table pH paper, and test tube racks), these images are made in animated form, after the animation process is complete, it continues with the coding or programming process. Can be seen in Figures 2, 3 and 4.
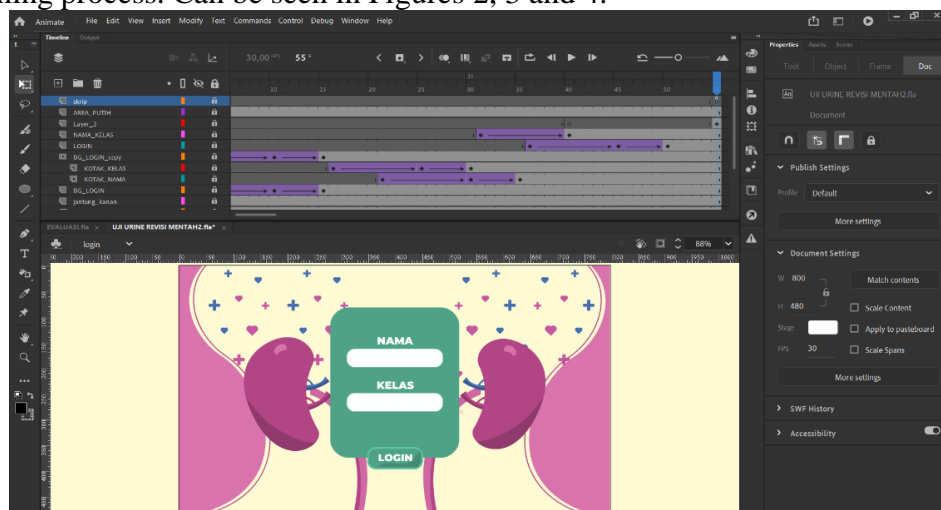

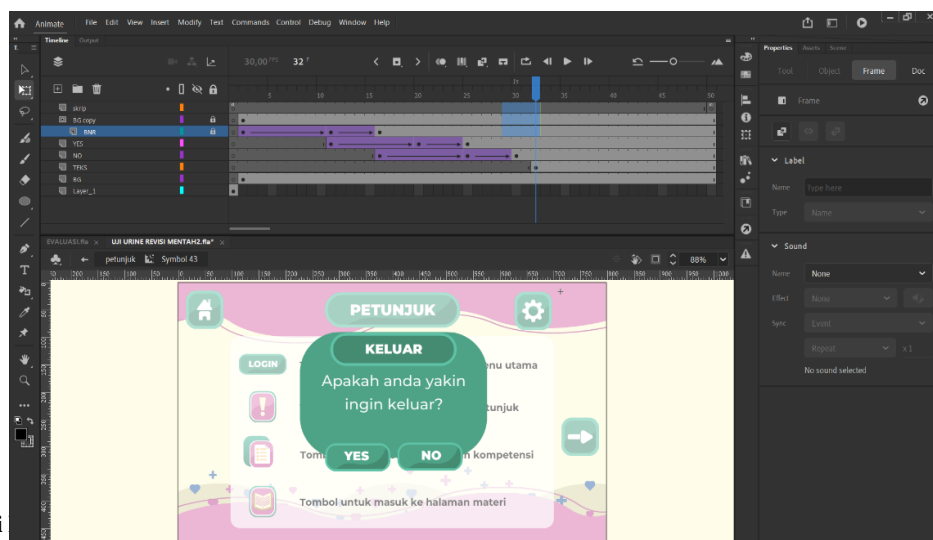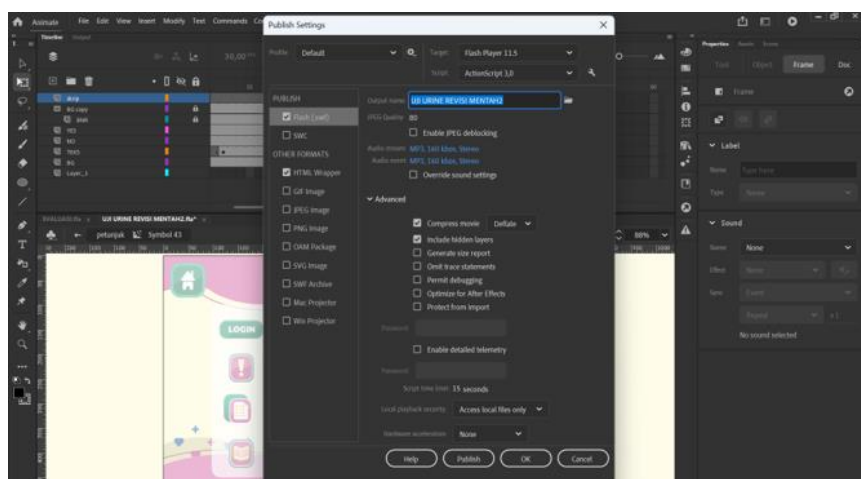Figure 2. Virtual Laboratory Creation Process

Figure 3. *movie clip* from button exit

Above there is a movie clip from the exit button, so if you want to publish on Android and the media you want to publish has been completed, the next step is to enter the movie clip exit and enter the coding. The native coding that has been added is useful if players who are playing media and want to exit can use exit and it will automatically close if the media has been published.

Gambar 4 Proses *Publish* Laboratorium Virtual

The completed laboratory product will then be published so that it can be accessed in the form of an application on Android. The way to do this is by installing the Adobe AIR SDK in the Adobe Animate application. If it is installed, then click the publish settings button to select the publish target, namely AIR for Android. Once installed, the virtual laboratory can be uploaded in the form of an application that can be accessed on Android. The results of the development of the virtual laboratory can be seen in Figure 5 Virtual Laboratory Development Results

Figure 5. Results of Virtual Laboratory Development

4. Description of Implementation Stage

Implementation stage, at this stage virtual laboratory product trials are carried out, virtual laboratory product trials use small scale trials. When a small-scale trial of virtual laboratory products was tested on five students in class XI MIPA, this trial activity included filling out a questionnaire. The assessment instrument used in small-scale trials is a product readability test questionnaire. The aim of carrying out product readability tests is to determine the readability level of virtual laboratory products.

5. Description of Evaluation Stage

In the evaluation stage, all data that has been obtained, starting from product validity data, material validity, product readability tests, product practicality data and student response data, is processed using predetermined formulas. The results of the data obtained will then be analyzed. The data analysis process is carried out to determine whether the resulting laboratory product meets the valid and practical categories.

Analisis Hasil Validasi Laboratorium Virtual

Validation of Android-based virtual laboratory learning media on urine test material was carried out by two validators. The results of this validation will determine the validity of the learning media that will be developed. The validators in this research are, as a media expert validator, one lecturer in biology education, Faculty of Teacher Training and Education (FKIP), Mataram University, as a material expert validator, namely one teacher at SMA Negeri 3 Mataram. The Android-based Virtual Laboratory Product Validity Test Results can be seen in Table 5.

Table 1. Validity Test Results for Android-Based Virtual Laboratory Products

No.	Validator	Score Validasi %	Criteria Validitas
1.	Media Expert (Lecture	95	Very Valid
2.	Expert	96,8	Very Valid
	Content Expert (Biologi Teacher)	95	Very Valid
	Mean		

The cause of the high validity value of the media and material is due to several factors, namely, the high score obtained for each aspect and the appearance of the media and material in the Android-based virtual laboratory application is more attractive. The advantage of a virtual laboratory is as a learning medium that can be used for practical activities to provide direct practical experience for its users.

The results of this research were compared with similar research conducted by Sukenti (2021), where the virtual laboratory media developed obtained a validity score of 88.5%, from the average validity score of media experts and material experts. This score is included in the very good category and is very suitable for use as learning media. These results compared with this study show lower validity. This is because the validity percentage score developed received a lower value from media experts, the score obtained from media experts was 82.4%. This is different from this research which obtained a validity score from media experts of 95% even though both were included in the very valid category.

Revision Result on Virtual Laboratory

The lecturer as a media expert gave advice that in the excretion section through the kidneys on the explanation board, click one of the buttons on the side to click on one of the organs on the side, while the teacher as a material expert stated that all the material used in the Android-based virtual laboratory application was good and complete. interesting animated pictures. The appearance of the application before and after repair can be seen in Figures 6 and 7.

Figure 6. Display before text changes changes

Figure 7. Display after text changes

Virtual Laboratory Product Readability Test Results

Product readability tests are carried out to find out information regarding whether or not the use of virtual laboratory products is acceptable in practical activities. This product readability test was carried out with five students in class XI MIPA SMA Negeri 3 Mataram outside the trial class. The purpose of carrying out this readability test is to determine the feasibility of a product in the form of an Android-based virtual laboratory.

Selected students are asked to install the virtual laboratory application on their respective smartphones. After students have finished installing the application, students are asked to fill out a product readability test questionnaire. The results of filling out the questionnaire are used as a reference for product revision before being tested on a larger group. The results of the readability test analysis of virtual laboratory products can be seen in Table 2.

Tabel 2. Virtual Laboratory Product Readability Test Results

No.	Responden	Presentase (%) Hasil Angket	Kriteria
1.	Respondence 1	95,4	Very Good
2.	Respondence 2	90,9	Very Good
3.	Respondence 3	90,9	Very Good
4.	Respondence 4	81,8	Very Good
5.	Respondence 5	90,9	Very Good
	Mean	89,98	Very Good

Based on the contents of table 2, it can be concluded that the average percentage value of the readability test results is 89.98%, where this value is included in the very good criteria. The high percentage of 89.98% of students who responded "strongly agree" shows that the Android-based virtual laboratory can be accepted as an Android-based learning medium, because the score obtained for each response has exceeded the specified indicators. The response "strongly agree" was seen in most of the mean scores of the student response items.

Results of Virtual Laboratory Product Practicality Analysis

The product practicality test questionnaire has been validated by an expert validator (Teacher), based on the results of the practicality questionnaire validation there are no suggestions from the validator and the questionnaire is considered good. The practicality test of this product was carried out by one of the biology subject supervisors for class XI MIPA 3 SMA Negeri 3 Mataram using a questionnaire which aimed to determine the practicality of the Android-based virtual laboratory product.

The validator who has been selected installs the virtual laboratory application on a smartphone, then fills out a questionnaire which is used as a reference to determine the practicality of the virtual laboratory product to be used. The results of the practicality questionnaire analysis can be seen in Table 3.

Table 3. Results of Virtual Laboratory Product Practicality Analysis

Validator	Presentase (%)	Kriteria
Teacher	82,5%	Very Practice

The product practicality analysis questionnaire was analyzed by looking for the average percentage of questionnaire results filled in by validators (Teachers). Based on the results from table 3, it is concluded that the average percentage of practicality test questionnaire results is 82.5% and is referred to as very practical criteria.

The level of practicality of the product in the form of an Android-based virtual laboratory in research conducted by Melennia (2021), to test the practicality of the Android-based virtual laboratory virtual media developed obtained a practicality score of 85.83%, where this score is included in the very practical category. The practicality results obtained by Milennia (2021) were higher than the practicality level of the virtual laboratory in this study. The high practicality score was due to the greater number of respondents filling out the product practicality questionnaire, while in this study the product practicality test was only carried out by one person, namely the class XI MIPA biology teacher at SMA Negeri 3 Mataram.

Another study conducted by Chairani (2019) obtained a practicality score of 73%, the practicality score obtained was lower than this research. The low practicality score obtained was due to differences in product practicality level criteria. In research conducted by Chairani (2019), the level of practicality of virtual laboratories was based on Djaali and Muljono (2004) with a small score range of 15 for the impractical category and the highest score of 75 for the largest score and very practical category. Meanwhile, in this research, to determine the practicality criteria for a virtual laboratory, the practicality category according to Riduwan (2009) was used.

Results of analysis of students' responses to the virtual laboratory

Analysis of the student response questionnaire was carried out descriptively. Apart from being carried out descriptively, analysis was also carried out to determine the Cronbach's Alpha value. This Cronbach's Alpha analysis aims to determine the consistency of the research sample in filling out the response questionnaire. Students' consistency in filling out response questionnaires is included in the special criteria, Cronbach's Alpha has a value of 0.828 (Sumintoni, 2015). From these results it can be concluded that students are consistent in filling out the response questionnaire sheet. Descriptive analysis of the response questionnaire was obtained by calculating the average percentage of questionnaire results.

The results of the response questionnaire analysis obtained an average score of 83.33%, where this value is included in the agree category. Based on the questionnaire score interpretation criteria for student responses to virtual laboratory products, it can be concluded that the virtual laboratory products are in the "Agree" category because they have a score of >83.33%. The results of the overall analysis of student response questionnaires can be seen in Figure 7.
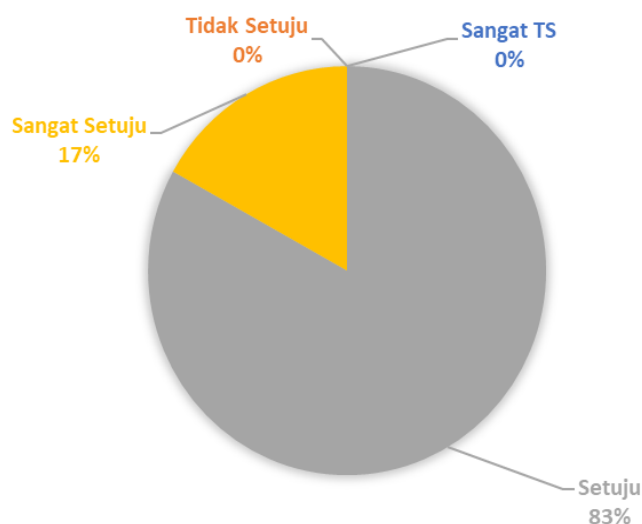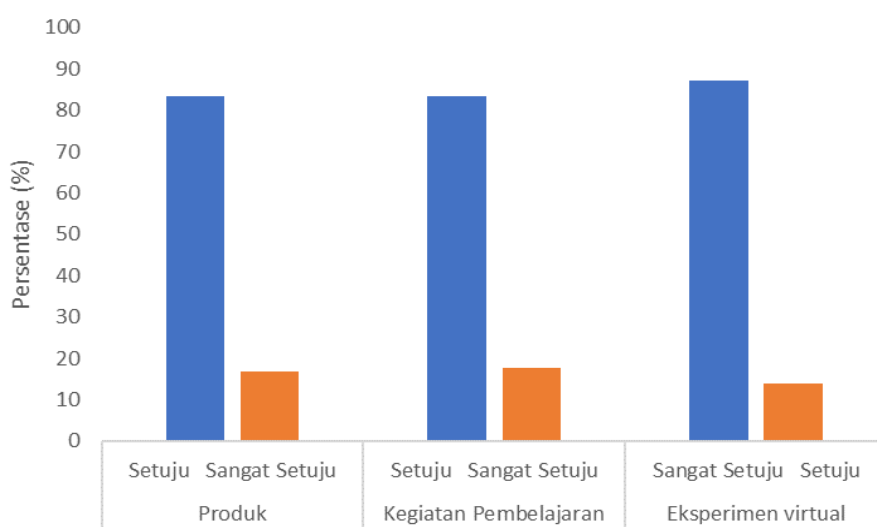

Figure 7. Overall Student Response Questionnaire Analysis Results

These results show that the Android-based virtual laboratory product developed can help students in biology learning activities regarding excretory system material, especially in the urine test sub-chapter. The results of the analysis of students' responses to each aspect can

be seen in Figure 8.

Figure 8. Results of questionnaire analysis of student responses in each aspect; Products, Learning Activities and Virtual Experiments

Student responses to Android-based virtual laboratory products in every aspect, namely in aspect 1; The student response in aspect 1 based on Figure 4.7 has a score of 83.27%

which falls within the agree criteria, this shows that the virtual laboratory product is suitable for use as a medium for carrying out virtual practicum activities in the urine test sub-chapter. Student responses to the excretory system learning material, urine test sub-chapter in Android-based virtual laboratory products, aspect 2; namely 82.40% included in the agree criteria. This shows that the excretory system test material in the urine test sub-chapter in the Android-based virtual laboratory product can help students understand the excretory system material, especially in the kidney section, before carrying out practical activities. Student responses to virtual practicum aspect 3; namely 87.11% included in the criteria of strongly agree. This shows that the Android-based virtual practicum carried out can help students understand the excretory system material in the urine test section.

Another research conducted by Puspayanti (2023) obtained a student response score to the virtual laboratory of 84.72% and was included in the strongly agree criteria. The response results obtained in research conducted by Puspayanti (2023) were higher than the response scores of students in this study even though both were included in the strongly agree criteria. The higher response rate in this study was caused by the number of respondents who filled out the product response questionnaire being 50 students, while in this study the number of respondents who filled out the response questionnaire was fewer, namely 32 students.

The results of the research above show that students' responses to Android-based virtual laboratory products strongly agree, this is caused by several things, one of which is the advantages of virtual laboratories. Virtual laboratories are a learning medium used for practicum activities that can provide direct practicum experience for users. The use of virtual laboratories in practical activities makes practical activities more interesting, students' interest in learning to use virtual laboratories can make students more active and independent.

Conclusion

Based on the research and discussion carried out, it can be concluded that: The Android-based virtual laboratory media developed has met the very valid criteria with an average score of 95%. The practicality of the Android-based virtual laboratory developed has met the very practical criteria with an average score of 82.5%. Student responses to Android-based virtual laboratory products have met the criteria for agreeing with an average percentage score of 83.33%.

Recomendation

Some suggestions that can be given for further research are as follows; It is hoped that other researchers and teachers will be able to re-develop virtual laboratory learning media for other topics besides urine testing. Students are expected to be able to improve their skills in using virtual laboratories in the form of applications. Schools are expected to be able to facilitate teachers and students to carry out practical activities, both offline and online using virtual laboratories.

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