INTERACTIVE MEDIA AUGMENTED REALITY PHARMACY FOR DRUG LEARNING IN HEALTH VOCATIONAL SCHOOL STUDENTS IN INDONESIA

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ABSTRACT: Pharmacy is a science that studies all the intricacies of medicine. A drug is any substance that causes changes in the physiology or psychology of the organism when it is consumed. Medicines are usually distinguished from foods and substances that provide nutrients. Therefore, the manufacture of a drug must be correct, starting from basic things such as the structure and benefits contained in the drug. So that vocational high school students, especially pharmacy, are not bored with monotonous and boring learning methods and to increase enthusiasm for learning, an application was created that utilizes augmented reality technology using unity and vuforia, considering that in this era everything is all digital. Based on the results of user testing, show a satisfaction value with criteria three satisfied or good. Based on function testing, the results were obtained that the marker could be detected properly.

Keywords:*Interactive Media, Augmented Reality, Pharmaceuticals*

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INTRODUCTION

Pharmacy in Greek is called "Farmakon" (medicinal/ medicine). Pharmacy itself is an art and science in the provision of natural source materials and synthetic materials that are suitable for distribution and are also used in the treatment and prevention of a disease[1]. In general, pharmacy includes knowledge about identification, combination, analysis and also standardization of drugs and treatment[2]. It also includes the properties of the drug and its distribution as well as in terms of its use. Medicine is an ingredient or ingredient intended to be used in establishing the diagnosis, preventing, reducing, eliminating, curing diseases or symptoms of diseases, wounds or physical and spiritual abnormalities in humans or animals, including the extortion of the human body or body parts[3].

A drug is any substance that causes changes in the physiology or psychology of the organism when consumed[4]. Medicines are usually distinguished from foods and substances that provide nutrients[5]. Drug consumption can be done through inhalation, injection, smoking, ingestion, absorption through the skin, or dissolution under the tongue[6]. In pharmacology, a drug is a chemical substance. Usually, its chemical structure is known, which, when administered to a living organism, will produce a biological effect[7].Pharmaceutical drugs, also called medications or drugs in the general public's understanding, are chemical substances used to treat, cure, prevent, or diagnose a disease or to improve well-being[8]. Traditionally, medicine is obtained through the extraction of medicinal herbs, but more recently, it is also through organic synthesis[9]. Pharmaceutical drugs can be used for a limited period of time or regularly for chronic disorders[10].

Unity is a game engine that allows individuals, as well as teams, to create a 3D game easily and quickly[11]. By default, Unity is set to make first-person shooting (FPS) games, but Unity can also be used to create Role Playing Games (RPG) and Real Time Strategy (RTS) games. In addition, Unity is a multiplatform engine that allows the games you build to be published for various platforms such as windows, Mac, Android, IOS, PS3, and also Wii. One year later, in 2006, the game developer app was nominated for the Apple design awards in the "Best OS X Graphics" category. Unity is also referred to as a multiplatform developer application, which means that Unity supports developing game applications and other applications for several platforms, such as game consoles, Mobile Phone platforms, Windows, and OS X.

The Android SDK is an API (Application Programming Interface) tool needed to start developing applications on the Android platform using the Java programming language. Vuforia is a Software Development Kit (SDK) to help make it easier for application developers to create Augmented Reality Applications[12].Because vuforia is an SDK, of course, you will need tools to be used to create augmented reality applications. There are two tools supported by Vuforia, namely Android Studio and Unity3D. However, what we use in the project is to use Unity3D. Meanwhile, the platforms supported by vuforia are only for iOS and Android Mobile. Here are some of the features that the vuforia SDK has: Quickly detect local targets with the capacity to track

five targets simultaneously, Detect in low light conditions and even when the target is partially covered. High tracking capacity, which makes the application continuously track targets and helps in maintaining consistency and added reference of an object even when the target is no longer visible on the camera.

AR (augmented reality) is a technology that combines two-dimensional and or three-dimensional virtual objects into a real environment and then projects these virtual objects in reality in real time[13]. Augmented reality can be applied to all senses, including hearing, touch, and smell, in addition to being used in fields such as health, the military, the manufacturing industry, and education. This AR technology can insert certain information into the virtual world and display it in the real world with the help of equipment such as webcams, computers, Android phones, and special glasses[14].

Augmented Reality (AR) is a technology that is able to integrate the real world with the virtual world interactively so that users can experience a more interesting and immersive visual experience[15]. The use of AR in various fields has increased considerably in recent years, including in education[16].

Pharmacy is a science that studies drugs and how they are used to treat diseases[17]. Pharmacy learning in health vocational school students in Indonesia is very important because it can help them understand the use of medicines appropriately and correctly. However, pharmacy learning is often considered difficult and tedious because of its abstract and heavy material[18].

Learning in pharmaceutical schools is the analysis of the structure of drugs. However, students' ability to recognize and solve problems related to making and analyzing the chemical molecular structure of drugs is still low. For example, sometimes students are unable to identify the analysis of the molecular structure of drugs in books because the presentation of the image is two-dimensional[19].

Therefore, using AR technology in pharmacy learning at vocational health schools in Indonesia can be the right solution to increase students' interest and understanding of learning materials. With AR, students can learn about medicine more interactive and immersively, so they can better understand and remember learning materials.

Augmented Reality (AR) is a very important technology in learning because it can help increase the effectiveness and efficiency of the learning process. Here are some reasons why AR is important in learning[20]: Increase student engagement: By using AR technology, students can learn about a concept or object directly and interactively. This can help increase student engagement in the learning process.

Augmented reality (AR) technology has the potential to transform many industries, including agriculture. AR can provide farmers with valuable information about their crops, livestock, and farm operations in real-time, enabling them to make better decisions and improve their overall efficiency.One of the primary applications of AR in agriculture is crop management. AR can help farmers identify pests and diseases early, allowing them to take action before the problem becomes severe. AR can also provide information about soil conditions, moisture levels, and other environmental factors that can affect crop growth. This information can help farmers make more informed decisions about when to plant, irrigate, and harvest their crops.AR can also be used to train farmers and farm workers. AR can provide interactive training modules that teach workers how to perform specific tasks, such as pruning, harvesting, and operating machinery. This type of training can be more engaging and effective than traditional classroom-based training.

Improve student understanding: AR can display a three-dimensional visualization of a concept or object, so students can understand more clearly and deeply about the concept. Increase student motivation: The use of AR technology can help increase student motivationAR technology can help increase student motivation in the learning process because it can provide a more exciting and fun learning experience. Improve students' cognitive skills: Using AR technology, students can interact directly with the concepts or objects learned, which can help improve students' cognitive skills, such as problem-solving and critical thinking. Improve the efficiency of the learning process: In conventional learning, students need a lot of time and resources to understand a concept or object.However, by using AR technology, students can gain a faster and more practical understanding. Expanding the accessibility of learning: AR can be used in the form of mobile applications or websites that can be accessed by students anywhere and anytime. This can help expand the accessibility of learning and help students who are in remote or hard-to-reach areas to gain access to quality learning.Another application of AR in agriculture is livestock management. AR can provide farmers with real-time information about the health and well-being of their animals. This information can include data on weight, feed consumption, and other vital signs. AR can also be used to track animal movements and behavior patterns, which can help farmers detect signs of illness or injury.

AR can also provide a more enjoyable and entertaining learning experience[21].In pharmacy learning, AR can be used to display three-dimensional visualizations of medicines, so that students can clearly see how they work inside the human body and how they are used in medicine.

By utilizing AR technology, students can learn about medicines independently through mobile applications or websites. That way, students can learn anytime and anywhere without having to be tied to a rigid time and place of learning. In the Indonesian context, using AR technology in pharmacy learning can also help improve the quality of education in the health sector. Indonesia has a fairly high mortality rate due to disease, so knowledge about the proper and correct use of medicines is very important for public health.

By introducing the use of AR technology in pharmacy learning at vocational health schools, it is hoped that students can understand and remember learning materials better so that it can help improve the quality of education and overall health of the Indonesian people. To overcome these problems, in this project, an android-based application will be developed. Utilization of android-based applications by using augmented reality technology. By utilizing this technology so that it can be combined directly into the image of the molecular structure of the drug. Drug molecular structure objects can be visualized concretely through three-dimensional virtual modeling. Virtual modeling is similar to the original 3D object. Varied media, namely the merger of three-dimensional virtual modeling in android applications with drug structure images .

RESEARCHMETHODS

The development method used is MDLC, or Model Development Life Cycle, a software development methodology used to guide the development team in developing software systems and structures. The MDLC development method can be seen in Figure 1.

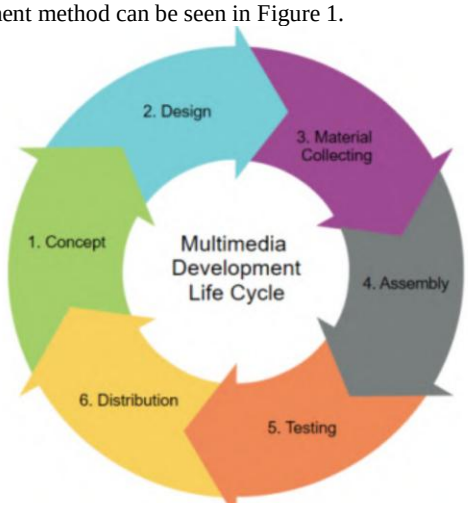


Figure 1. MDLC Method

The method used in this study is the Multimedia Development Life Cycle (MDLC) method. The MDLC method is used to create AR-based learning materials that use multimedia content in the form of videos. This method consists of several stages, namely: Concept, Design, Material Collecting, Assembly, Testing, and Distribution. The initial concept of this study was to create a marker-based augmented reality application to support learning about pharmacy, especially in restorative materials. At the design stage, several designs will be carried out regarding the material of medicines, such as the name, structure, and benefits of a drug. After that, a marker is designed that refers to a specific material. Each drug material has one marker that will help students to use AR technology when scanning markers that have been created.

Multimedia Development Life Cycle (MDLC) is a framework used for designing and developing multimedia projects, such as websites, interactive media, video games, and educational software. MDLC is similar to the software development life cycle, but it has some additional stages specific to multimedia development.The MDLC typically consists of six stages:Planning: This stage involves identifying the project's goals, target audience, and resources required for the project.Analysis: In this stage, the multimedia development team analyzes the project's requirements, such as content, design, and technology needs.Design: In this stage, the team creates a detailed plan for the project, including storyboards, mockups, and prototypes.Development: The development stage involves creating the actual multimedia content using various authoring tools and technologies.Testing: In this stage, the team tests the multimedia project to ensure that it meets the project's goals and requirements.Deployment: The final stage involves delivering the project to the end-users and making it available to them through various channels.The MDLC framework helps ensure that multimedia projects are developed in a structured and organized manner, which can result in more efficient development, better quality products, and higher customer satisfaction.

At the material collection stage, several materials will be collected that are needed in designing teaching materials and making applications such as markers, drawings, and materials. Furthermore, it will be processed and developed using AR maker applications, namely Unity and Vuforia. The application will be used on mobile devices based on the Android operating system. Next, in the testing stage, using the camera of a mobile device with the android operating system. The test carried out is to try to scan markers that have been made with white paper with a certain scan distance so that the use of AR is feasible to use in learning methods or not. In the last stage, namely distribution, instructions for the use of the application that has been made will be made. Thus, this application can be used and beneficial for the party using it.

In MDLC, each of the above stages has specific responsibilities and activities and is carried out sequentially. This methodology helps the development team to reduce the risk of errors and ensure efficient and effective software development.

RESULTSAND DISCUSSION

The result of the research that has been carried out is that the author has completed making a pharmacy learning application about the structure of chemical molecules in Augmented Reality-based drugs that can be used by pharmacy vocational school students to support learning about the material.

CONCEPT

The concept of this study is to create an augmented reality application that is used as a learning medium for vocational schools, especially pharmacy majors. The selected learning material is about medicine. The material used in this study was the composition of a drug. The concept of the composition of medicines is explained using drug structures that display 3D objects as a whole and realistically and can display the molecular formulas described in the material contained in the teaching materials..

DESIGN

An augmented reality application created using Unity integrated with Vuforia as a marker storage database. The application that is designed then goes through a compiler process (compile) with output in the form of a .apk extension so that the application can be run on an android device. In addition to being open source and easy to use, unity and vuforia are also very supportive of user interaction with the AR environment. For the manufacture of augmented reality markers using the Adobe XD application. Markers created using specific letter combinations with contrasting colors that aim to make them easier to recognize during application testing.

MATERIAL COLLECTION

The Material Collection stage is the initial stage in MDLC, where the software development team gathers the information necessary to understand the user's needs, system requirements, and the business environment in which the software will be used. The source of material collected in this step is based on journals and several websites that discuss Augmented Reality.

ASSEMBLY

This application requires a camera on a smartphone as an input medium to read markers (special markers). Making this AR begins with collecting materials such as markers and materials to be displayed. Then proceed with making five markers. The last is to create an augmented reality application.At this stage,

the author made five markers using the Adobe XD application. The marker manufacturing technique adopted at this stage is by creating markers based on the name of each drug name. An example would be to display the structure, empirical formula, and description of Paracetamol. Hence the word 'Paracetamol' was used for the manufacture of its marker. If it is going to display the structure, empirical formula, and description of Cefixime, then the word 'Cefixime' is used as a marker on its marker. In order for the marker to be easily recognized during application experiments, the color combination used must produce a high level of contrast. Simple colors that have a high degree of contrast are black and white. So that the color is chosen as the main color on the marker to be made, Black will be the edges that surround the marker, as well as the color on the created word. White color is used as the background on the marker.

The stages of making augmented reality applications use two main tools, namely the Vuforia engine, and Unity. The Vuforia engine serves as a database of storage markers that have been created. Unity functions as processing software that can process graphics, images, sounds, animations, and so on. Unity is a cross-platform software that can produce application output with various formats such as .exe, .apk, and so on. The first stage is to register the five markers that have been created on Vuforia. After all the markers are successfully uploaded, the second stage is to create an augmented reality project using Unity. The project on this as well as the name of the resulting application is Prototype. The project consists of 1 main scene called a prototype that contains five marker objects.

Naming objects based on marker names with the word 'Image Target' preceded in front of them. Each object loading each marker will then be displayed when the camera on the android device detects the marker. After completing all the objects in the main scene, the next step is to do the build process. The build process is a process that will make the scene that has been created into output in the form of an application with a certain format. In this project, the build process chosen is the Android platform.

SYSTEM DEVELOPMENT

The development of the system consists of several stages, as follows. The concept at this stage, the author designed in such a way that in AR, the introduction of drugs is more interactive and entertaining; besides that, the researcher also included an educational message in it. The following are the results of the concept details presented in Table 1.

Tabel 1. Concept

Category Concept	Description Concept
Title	Interactive Media Augmented Reality Pharmacy For Learning Medicine At Health Vocational School Students In Indonesia
Types of Multimedia	Learning Media to get to know the Drug Education System in the form of an Android Smartphone application that utilizes Augmented Reality technology with the Marker Based Tracking Method which is implemented with unity.
Purpose	Introducing medicines to pharmacy schools that are interactive, interesting, innovative is expected to provide an easy experience in recognizing molecule drugs that are real time more real.
Goal	User or user of vocational pharmacy student students.
Audio	Backsound audio sound in .mp3 format
Image	3-Dimensional image with gbl and fbx formats
Animation	Animation according to the selected drugs
Scripting	Using C# programming language, UnityScript (in the form of JavaScript)
Interaction Behavior	Using the scripts behavior helper

Design, along with the flow results in an application or system procedure logically. The drug AR system flow describes the flow of system procedures from beginning to end. To draw this system flow using the drawio application. The results of the designed system flow are presented in Figure 2.

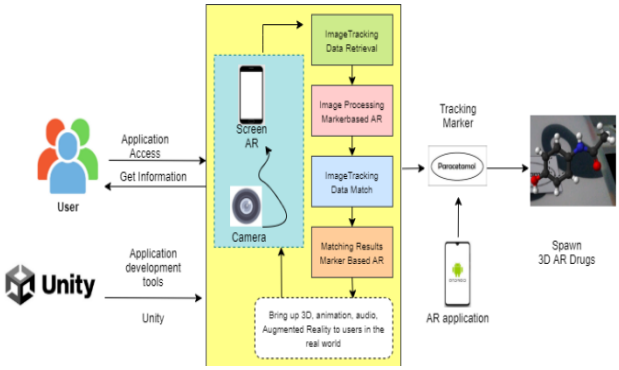
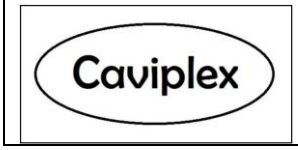


Figure 2. Flow Diagram

Material collection (material collecting), at this stage, the collection of materials / assets that are in accordance with the needs needed is carried out including the names of medicines, audio, scripting and markers. Markers are tested in https://developer.vuforia.com/ and the results are 5 stars all meaning the marker is great for tracking. The following are the results of the collection of materials or assets used presented in Table 2.

Table 2. Material Collecting

Marker	Rating
	★★★★★
	★★★★★
	★★★★★

In the assembly stage, this creation is carried out using unity software using the C# programming language for creating behavior, as well as in making AR features in this application integrated with Android. The results of the development of Augmented Reality (AR) applications an educational introduction to drugs that have been developed according to needs as learning that is integrated into Android and tried on several smartphones the results are as follows;

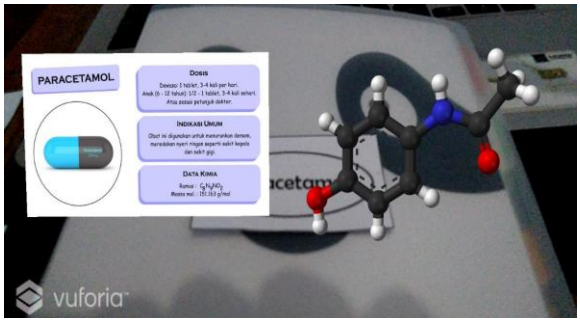


Figure 3. Parcetamol drug

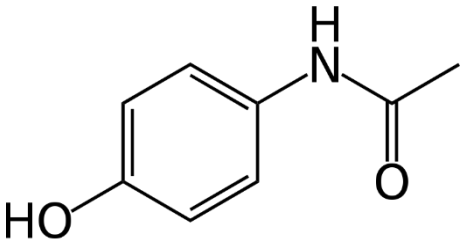
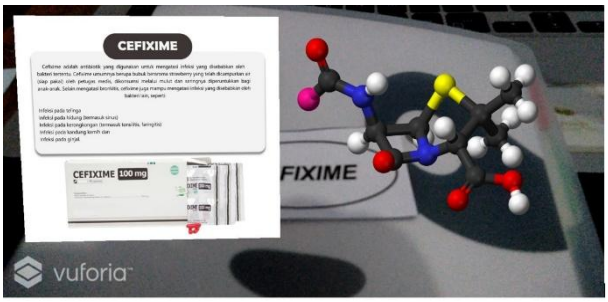


Figure 4. Paracetamol Molecules

Paracetamol medications are one type of analgesic (pain reliever) and antipyretic (febrifuge) medication that are often used to relieve headaches, toothaches, muscle aches, menstrual pains, and fevers. Paracetamol works by inhibiting the production of prostaglandins in the body that are responsible for pain and heat. Paracetamol is available in various forms, such as tablets, capsules, syrups, and suppositories (drugs that are inserted into the anus). This drug is an over-the-counter drug that can be purchased at a pharmacy without a prescription but should be used according to the recommended dosage and rules of use.

The dosage of paracetamol may vary depending on the patient's state of health and age. We recommend that the dosage of paracetamol should be adjusted to the doctor's recommendations or the instructions on the packaging of the drug. Here are the common paracetamol doses for adults: The maximum dose of paracetamol for adults is 4 grams per day, with the dose per time interval not more than 1 gram, and the minimum time interval between administrations is 4 hours. To reduce mild to moderate pain or reduce fever, the generally recommended dose of paracetamol is 500-1000 mg per dose, with an interval of administration of 4-6 hours.To reduce severe pain, the generally recommended dose of paracetamol is 1000 mg per dose, with an interval of administration of 4-6 hours.Paracetamol Drug Chemical formula: C8H9NO2, Molar mass: 151.16 g/mol, Display: white crystalline or white crystalline powder, Melting point: 168-172°C, Solubility: soluble in water, alcohol, and acetone; poorly soluble in ether and benzene, pH of solution: about 6.3 at a concentration of 1%, Function group: acetamide, phenolic alcohol, Drug class: analgesic (pain reliever) and antipyretic (dehumidifier). Next up is the drug Cefixime can be seen in Figure 5.

Figure5. Cefixime Drug



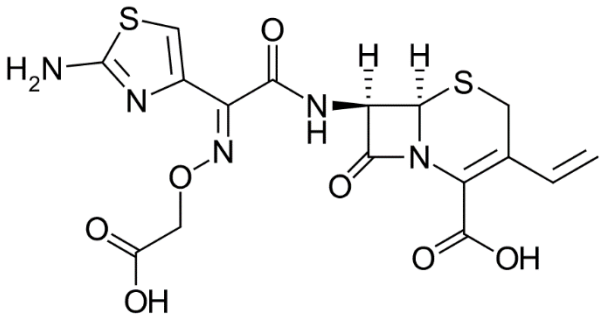


Figure 6. Cefixime Molecules

Cefixime is an antibiotic used to treat various bacterial infections, such as urinary tract infections, pneumonia, bronchitis, and pharyngitis. Cefixime works by inhibiting the growth and reproduction of bacteria that cause disease. The drug is usually given in the form of tablets or capsules taken orally. Cefixime belongs to the class of third-generation cephalosporin antibiotics, which are quite effective in treating various types of bacterial infections. However, as is the case with other antibiotics, the use of cefixime should be carried out with the appropriate prescription and veterinary supervision. What's more, it is not advisable to take this drug without a doctor's prescription or use this drug to treat viral infections or other infections that are not caused by bacteria.

The recommended dosage of the drug Cefixime depends on the type of infection, the severity of the infection, the age of the patient, the patient's medical condition, and the response to treatment. The dose given is usually adjusted by the doctor

who prescribed the drug. In the treatment of urinary tract infections, is usually recommended dose of Cefixime 400 mg once a day for 3-7 days. As for other infections, such as pharyngitis, the recommended dose is 400 mg once a day for 5-10 days.

Here is some information about Cefixime's chemical data: Chemical Name: Chemical Name: (6R,7R)-7-[2-(2-Amino-4-thiazolyl)glyoxylamido]-3-[(1-methyltetrazol-5yl)thiomethyl]-8-oxo-5-thia-1-azabicyclo[4.2.0]oct-2-ene-2-carboxylic acid, Chemical Formula: C16H15N5O7S2, Molecular Weight: 453.45 g/mol, Drug Grade: Third generation cephalosporin antibiotic, Physicochemical properties: Cefixime is usually available in the form of water- and alcohol-soluble white or near-white crystals. Next up is the drug caviplex.

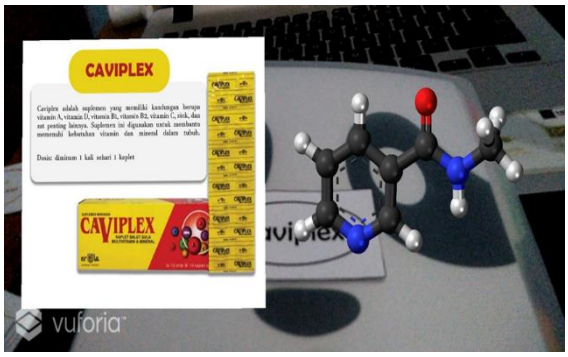


Figure 7. Caviplex Drug

Caviplex Caplet is a supplement that contains multivitamins and minerals. This supplement is used to help meet the needs of vitamins and minerals. General Indications Help meet the needs of vitamins and minerals. Composition Vitamin A 4000 iu, vitamin D 400 iu, vitamin B1 3 mg, vitamin B2 4 mg, vitamin B6 4 mg, vitamin B12 12 mcg, vitamin C 75 mg, nicotinamide 20 mg, Ca pantothenate 5 mg, Vitamin E 10 mg, Biotin 0.1 mg, Folic Acid 1 mg, Fe Fumarate 135 mg, Glutamic Acid 50 mg, Ca 100 mg, Mg carbonate 87.5 mg, Zn 15 mg, Cu 0.5 mg, Mn 0.5 mg, Fluorine 0.5 mg, Iodine 0.15 mg.

Dosage Adults and children >12 years: 1 x a day 1 caplet, Rules of Use After meals, Caution Store at temperatures below 30 C, protected from light, Contra Indications Hypersensitivity, Side Effects The use of the drug generally has certain side effects and corresponds to each individual. In case of excessive and dangerous side effects, please consult a medical professional. Vitamin & Supplement

Figure 8. Ultraflu Drug

Ultraflu tablets are a drug used to treat flu symptoms such as fever, headache, nasal congestion and sneezing. General Indications Flu, fever, headache, nasal congestion &sneezing. The composition of Paracetamol 600 mg, phenylpropanolamine HCl 15 mg, chlorpheniramine maleate 2 mg, Dosage Adult dose 3 - 4 times per day 1 caplet. Children (children age 6-12 years): 2 x per day 1/2 caplet, Rules of Use After meals, Cautions Liver and kidney dysfunction, Contra Indications of Hypersensitivity to paracetamol. Patients with liver and kidney dysfunction, Side Effects Large doses or long-term therapy can cause liver damage, Limited Over-the-Counter Drug Product Class (Blue), Box Packaging, 25 Catch Cover @ 1 Strip @ 4 caplets, Henson Farma Manufacturing, BPOM Registration No.:DTL7808102404A1. Next YOU C 1000.

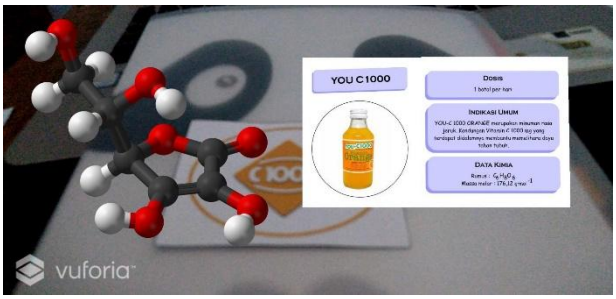


Figure 9. You C 1000

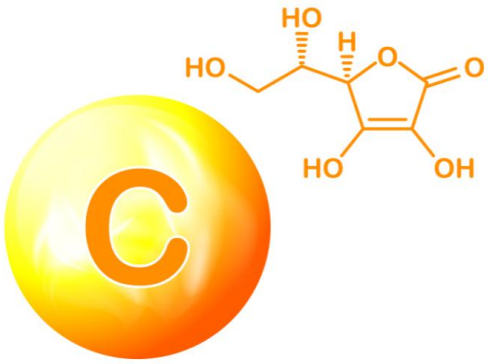


Figure 10. Molekul Kimia You C 1000

Description YOU-C 1000 ORANGE is an orange-flavored drink. The content of Vitamin C 1000 mg contained in it helps maintain endurance. General Indications of Maintaining endurance, Sugar Composition, Fructose, Fruit Juice Less Than 10% Derived from Fresh Orange Fruit Juice, Vitamins (C, B1, and E [From Soybeans], Niacin), Lemon Flavor, Acidity Regulator, Benibana Yellow Dye (Safflower) and Water up to 140 ml, Dosage 1 bottle per day, Rules of Use Consumed before or after meals. To avoid pain in the stomach, it is best to drink after meals. Caution Store at temperatures below 30 C and dry, as well as protected from direct sunlight, lamp light, and high temperatures. Cons of Indications of Hypersensitivity.Side Effects The use of drugs generally has certain side effects and corresponds to each individual. In case of excessive and dangerous side effects, please consult a medical professional. Vitamin & Supplement Product Group. Bottle Packaging @ 140 ml, Djojonegoro Manufacturing, BPOM Registration No.: SL061600251.

After the application creation process is completed, then the application is installed on the android device for testing. The android devices used in this trial are the Xiaomi Redmi note 9 pro and several other smartphones with the following specifications:

Table 3. Testing Smartphone

Name	OS	Memory	Camera	Information
Vivo Y81	Android8.1, Funtouch 4	RAM:3GB Internal :32GB	13MP(f/2.2,PDAF)	Successful
AsusZenfoneMax Pro (M1)	Android 9	RAM3GB Internal :32GB	13MP	Successful
InfinixHot11snfc	Android 11	RAM6GB Internal :128 GB	50MP,f/1.6,	Successful
Xiaomi MI10T 5G	Android 11	RAM8GB Internal :128 GB	64MP,	Successful
SamsungS10	Android 11	RAM:8GB Internal:128GB	12 MP	Successful
Xiaomi RedmiNote10 Pro	Android 11	RAM:8GB Internal :128GB	8MP	Successful

Next Stage of evaluation This stage includes follow-up to the results of the evaluation carried out. This follow-up can be in the form of improvements and development of the application to improve its quality and performance. The evaluation stage of the application program is very important to ensure that the application is effective, efficient, and can meet the needs of users. By conducting regular evaluation of the application program, developers can ensure that the application continues to grow and can provide optimal benefits to users. The evaluation can be shown in Figure 10.

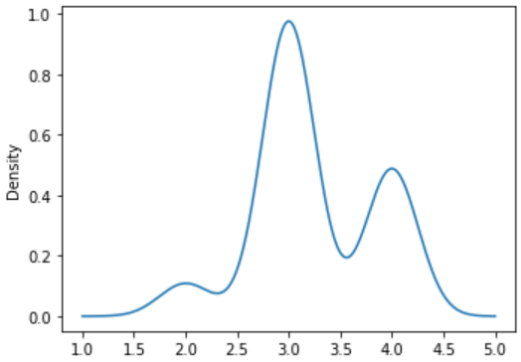


Figure 11. User Satisfaction Evaluation

The figure 11 in the image above is generated from the question using the average user likert scale answering 3 Satisfied. The Likert scale is a type of measurement scale often used in research and surveys to measure respondents' attitudes, opinions, and perceptions. The Likert scale is named after the American psychologist Rensis Likert, who developed this scale in 1932.

The Likert scale consists of a series of statements or affirmations that describe a particular concept or topic. Respondents were asked to assess the extent to which they agreed or disagreed with the statement by using a scale that had multiple levels or levels of assessment, usually ranging from 1 to 5 or 1 to 7.For example, a statement on the Likert scale can be something like "I'm satisfied with this AR App." Respondents were then asked to choose a rating level from 1 to 5, with one meaning "Very Dissatisfied" and five meaning "Very Satisfied." Respondents can choose either a level between the two or a level in the middle, such as "Neutral," if they do not have a strong opinion of the statement.

The Likert scale is a popular measurement tool because it can provide pretty detailed information about respondents' attitudes, opinions, and perceptions. The Likert scale is also relatively easy to implement and can be adapted for use on a variety of topics and research.Based on research on the use of augmented reality for pharmaceutical learning of medicines, it can be concluded that augmented reality technology can be an effective tool to improve the skills and understanding of pharmacy students in studying medicines..

The use of augmented reality in pharmaceutical learning of drugs allows students to experience firsthand how drugs work in the body and visually see the interaction of drugs with biological systems, which makes it easier for students to understand difficult concepts.Several studies have shown that the use of augmented reality in pharmaceutical learning of drugs can improve students' skills in identifying the right drugs and dosages, as well as improve students' ability to make decisions regarding drug use.

Nevertheless, although the use of augmented reality shows excellent potential for pharmaceutical learning of medicines, more research is still needed to evaluate the effectiveness of this technology and determine the most effective method of integrating augmented reality into the pharmaceutical curriculum.

CONCLUSION

The augmented reality application that has been made successfully displays the drug structure in 3D form and its empirical formula along with information about the drug, which can be used to complete the teaching and learning

process, especially in Pharmacy Vocational Schools. By utilizing markers in the form of drug images that have been provided, and do not have to be printed on white paper but can also be used digitally with so expected to facilitate the teaching and learning process. Both from the teacher's point of view because it becomes easier to convey the material because there is no need to draw the structure of the drug or experience problems because the pictures in the book are not clear or the book is incomplete. Besides that, it is also easier for students to accept the material given because they can see a visualization of the drug structure in the form of 3D, which, of course, will be more interesting considering that in the current era, learning using media is more in demand by students, especially for Vocational Schools because there is more practice than theory so this application can help facilitate students' understanding of drugs both from their structure and empirical formula. That way the teaching and learning process will be carried out more optimally and schools can produce graduates who are competent and ready to work. Therefore, this augmented reality application is expected to help schools create a generation that is more qualified and can utilize technology properly.

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