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THE EFFECT OF AUGMENTED REALITY-BASED AUTOMATIC TRANSMISSION MEDIA ON BASIC KNOWLEDGE

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ABSTRACT
Innovative and interactive learning media was needed to graduate a workforce that was in accordance with the world of work. Automatic Transmission based on Augmented Reality operated using a smartphone can help students know the components, functions and workings of AT. Augmented Reality is an application that combines the real world with the virtual world in the form of two dimensions or three dimensions projected in a real environment at the same time. Smartphones can be a digital media in delivering material. This research uses the ADDIE development model. This research aims to develop Automatic Transmission media based on Augmented Reality. AT media was evaluated by media experts, automotive experts and students. The validity test results show that AT media was valid according to media experts and automotive experts. This study aims to develop this media to help students master the prior knowledge of AT material. ANOVA test results show that AT AR media has an effect on prior knowledge. AT AR media was attractive, easy to operate using a smartphone and improves the ability to mention the names of AT components, explain the functions and workings of AT.

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I. INTRODUCTION

IN August 2024, national car sales saw a slight increase of 2.79% compared to July 2024, with total sales reaching 76,304 units[1]. This increase was partly due to the launch of new models, which may include automatic transmission variants. The Indonesian automotive market shows that cars with automatic transmissions were increasingly by consumers. This was driven by the comfort and ease of driving offered by automatic cars, especially in urban areas with heavy traffic [2]. Automotive Engineering Education Department is an institution that prepares prospective teachers and prospective experts in the automotive field must respond to these conditions. Every graduate of the Automotive Engineering Education Department must master the competencies of automatic transmission (AT) maintenance and repair. However, there remains a gap in ensuring the mastery of automatic transmission competencies among students, as the existing media and teaching tools are not adequately addressing their needs. Innovative and interactive learning media were needed to graduate a workforce that is in accordance with the world of work [3]. Previous research shows that the use of learning media in the classroom can help mastery of the material. Learning media mediates between prior knowledge and new material presented in lecture activities. Prior knowledge in technical learning to underpin subsequent learning [4].

Nonetheless, previous research has not provided effective solutions for bridging students' conceptual understanding with practical experiences in automatic transmission learning. The existing media in the automotive education study programme is not able to bridge the information conveyed to students. The results of observations in the Automotive Engineering Education Department showed that the AT media was in the form of an AT unit so that it could not show the inside. This condition causes students to be inactive. This condition causes students to be unable to mention the names of automatic transmission components. This highlights a specific gap: the lack of teaching tools that enable students to interactively explore the internal workings of automatic transmissions. One of the media that is currently widely used is Augmented reality.

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Augmented Reality is a major step in technological innovation that provides fun services and aesthetic experiences [5]. Augmented Reality is an application of combining the real world with the virtual world in the form of two dimensions or three dimensions projected in a real environment at the same time [6]. AR technology can help the teaching and learning process [7]. Augmented reality is a technology that integrates computer-generated virtual reality with the real world and allows users to experience the natural environment with virtual experiences. The technology has received tremendous application in education [8]. Augmented reality has the potential to motivate and enhance learning [9]. The acceptance of augmented reality experiences and the interest shown in the application of technology in education seems promising in improving student learning. According to [10] student achievement increased after instruction with augmented reality. This technology provides a wide range of benefits for learning. These include accommodation of students from different campus levels, and engagement of student participation as they interact with real and virtual world observations [8]. Despite its growing application, research has yet to explore the specific advantages of AR in improving students' ability to understand automatic transmission systems. As time goes by, technological advancements are increasingly evident, Augmented Reality (AR) is an emerging innovative technological tool that is highly attractive to users, allowing dynamic and realistic information sharing [11]. AR is a type of technology that superimposes information on the real world, which can be visualised from a technological tool, to interact and enrich various types of information, according to[12]; [13], there are various types of AR, including visual augmentation, haptic feedback and multimodal feedback [14]; [15]. AR, like most digital technologies, includes algorithms, which in this case allow the distortion of reality, counting with additional information of interest to the user [16], therefore, it is possible to use AR to augment the experience [17], AR technology currently covers a wide range of fields, as well as AR applied in education, video games, medicine, architecture, etc., [11]. Automatic Transmission based on Augmented Reality operated using a smartphone can help students know the components of AT.

The development of smartphone technology has progressed and become one of the most widely used technologies [18]. The rapid development of science and technology currently has an impact on all aspects of life. Smartphones can be a digital media in delivering material [19]. Android has become one of the mobile phone operating systems in Indonesia in recent decades[20]. The price of android smartphones is affordable so that it can be purchased and is a communication tool [21], [22]. Android-based smartphones are usually installed with learning platforms. Learning using mobile phones makes it easier for students to learn without being limited by time and place [23]. Smartphone learning can improve thinking skills and learning motivation. Many studies have developed android-based learning for example learning mathematics [24]. This study fills a unique gap by developing Augmented Reality-based Automatic Transmission learning media (AT AR), which can be operated using smartphones. Unlike previous learning tools, AT AR enables students to explore the internal components of automatic transmissions interactively and remotely. This research will develop Automatic Transmission media based on Augmented Reality (AT AR) which is operated using a Smartphone so that it can be operated at home and provides opportunities for learning. This condition is in line with the ‘Merdeka belajar’ programme. The uniqueness of this study lies in its ability to integrate mobile technology with interactive AR tools, addressing specific challenges in automotive education while aligning with contemporary educational policies.

II. METHODS

This research uses the ADDIE development model. The ADDIE model was chosen because this model has several advantages including: 1) interdependent; 2) synergistic, 3) dynamic, 4) cybernetic, 5) systematic[25]. This model is suitable for developing learning media.

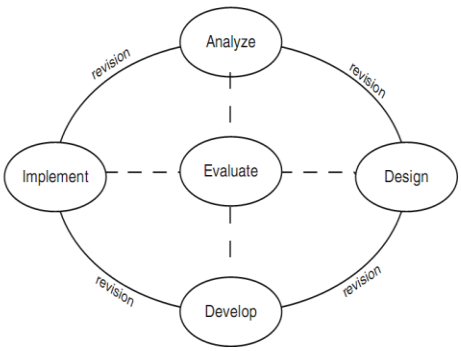

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Figure 1. Augmented Reality-based Automatic Transmission development flow

Analysis is the first step in developing media. There are several aspects that are analysed: 1) analysis of media on campus; 2) student analysis of learning conditions; 3) achievement of goals, the achievement aspect can be seen from 2 points of view, namely the teacher's point of view and the learner's point of view. The next step is design. AR media design is based on the results of needs analysis and conditions on campus. In the design process, researchers asked for input from automotive experts and subject matter experts. The third phase is Development. This phase depends on the previous two phases, namely the analysis and design phases. The development of AR-based automatic transmission media is made by paying attention to the ease of operation and the ability to convey information. The developed media is then implemented**.** The implementation phase is turning our plans into action. AR-based AT applications are implemented in the power transfer system course with a sample size of 90 students. The implementation results are then evaluated**.** The evaluation phase is the collection of research data that aims to test the application that has been developed.

A. Research instruments

The instruments used to collect research data were questionnaires filled out by experts, practitioners, students and tests. The questionnaire for experts consisted of two parts, namely a questionnaire to measure content validity and construct validity. Meanwhile, questionnaires for practitioners and students were used to measure the practicality of the application with indicators of effectiveness, interactivity, efficiency, and creativity. Validity was collected using questionnaires filled out by automotive experts and educational practitioners. The validity test aims to measure the content and construct of the application made. The results of the validity test are used to determine whether the application is valid or not. If it is not valid then it must be corrected. In addition to the application evaluation expert questionnaire filled by students who have used it. AR-based AT media was tested on 3rd semester students. The test aims to test the effectiveness of the media on improving the ability to mention the name and function of Automatic Transmission components.

B. Analysing research data

The research data was analysed descriptively (mean) to determine the validity criteria. The research data was also used to measure the reliability of the application by testing the Cronbach Alpha (α) value. Products and devices are said to be reliable if the α value > 0.6. Practicality questionnaires by teachers and students were analysed descriptively (mean). The criteria for determining validity and practicality can be seen in Table 1.

TABLE I
VALIDITY CRITERIA

Value Range	Descripsion
±0,7 s/d 1,00	Strong
±0,3 s/d 0,69	Moderate
±0,00 s/d 0,29	None/to weak

III. RESULTS AND DISCUSION

Figure 2. Application View

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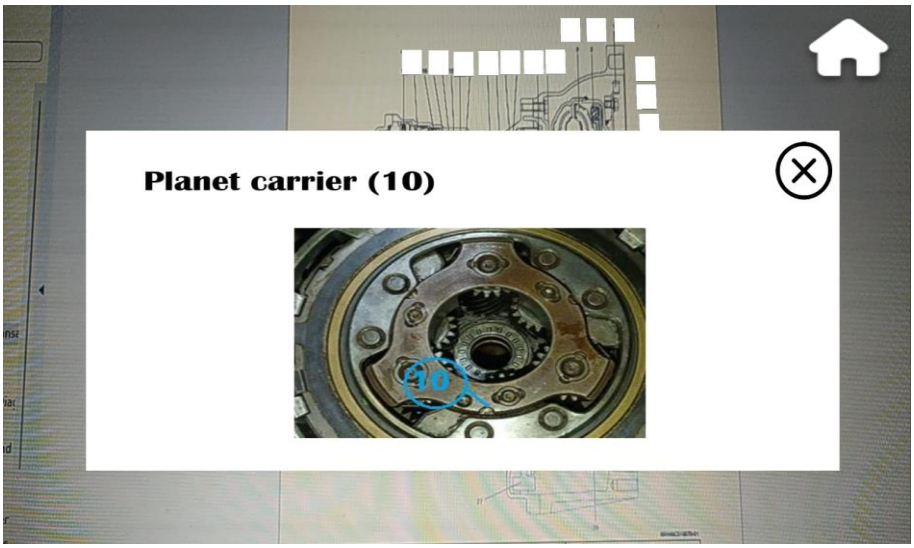
The application has several specifications: application size 88MB, does not require internet, android version at least 7.0, so it is easily accessible and easy to use. figure 2 shows the front home page of the application. The AR simulation menu displays (1) automatic transmission components; (2) materials that can be used to enrich knowledge. This ATAR is easy to use and comes with a guide. The components of the AT on the media can be flicked then it will display a picture of the real object. The user only scans the poster in Figure 3, then a picture of the real object in the transmission will appear. Compared to existing tools in automotive education, such as physical AT models or non-interactive learning modules, AR-based applications like ATAR provide a distinct advantage by enabling real-time interaction and visualization without requiring physical access to hardware. This feature offers an immersive learning experience that is not achievable with conventional tools. ATAR technology can help the teaching and learning process [17]; [18]. Augmented Reality (AR) is an innovative technological tool very attractive to users, allowing dynamic and realistic information sharing [9].



Fiture. 3 2D shape of AT component

The guide menu contains procedures for using the AT AR application. The application usage guide has an important role so that users can utilise this application to support learning activities on campus. Unlike traditional manuals or static media, this guide integrates with the AR application to provide contextual help during practical exercises, enhancing usability. Research [25][26] suggests that such integration improves both engagement and knowledge retention compared to static methods.

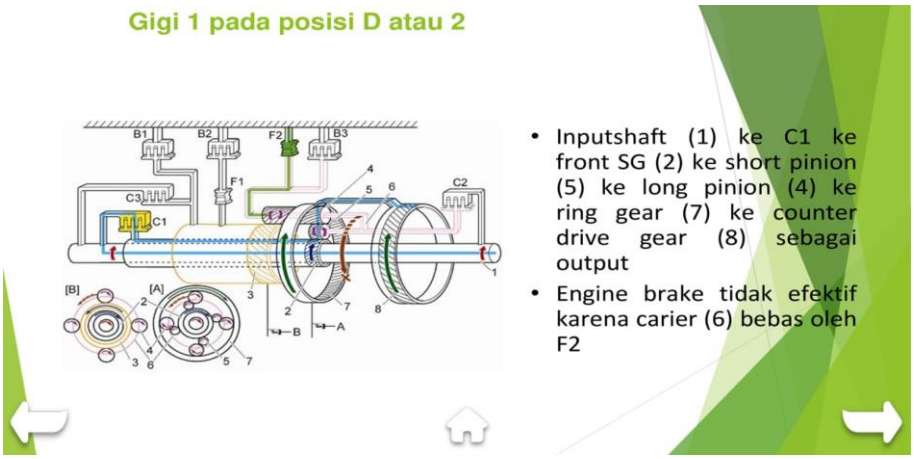


Figure 4. Material View

The material menu contains information about the component name, location and function. The ease of using the augmented reality application is one of the factors expected in the development of this application. Ease of using applications that can be used without being limited in time and place. Augmented reality has the potential to

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motivate and enhance learning [19]. Based on analysis of pretest and posttest results, the AT AR application shows significant improvement in students' ability to recall and apply knowledge about AT components. The highest improvements were observed in students' ability to name AT components and describe their functions, which are critical for practical maintenance tasks. Additionally, students exhibited increased problem-solving skills when diagnosing AT issues during simulated tasks. According to [20] student achievement increased after being given instruction with augmented reality. This technology provides a wide range of benefits for learning [18]; [21]; [22]; [23]; [24].

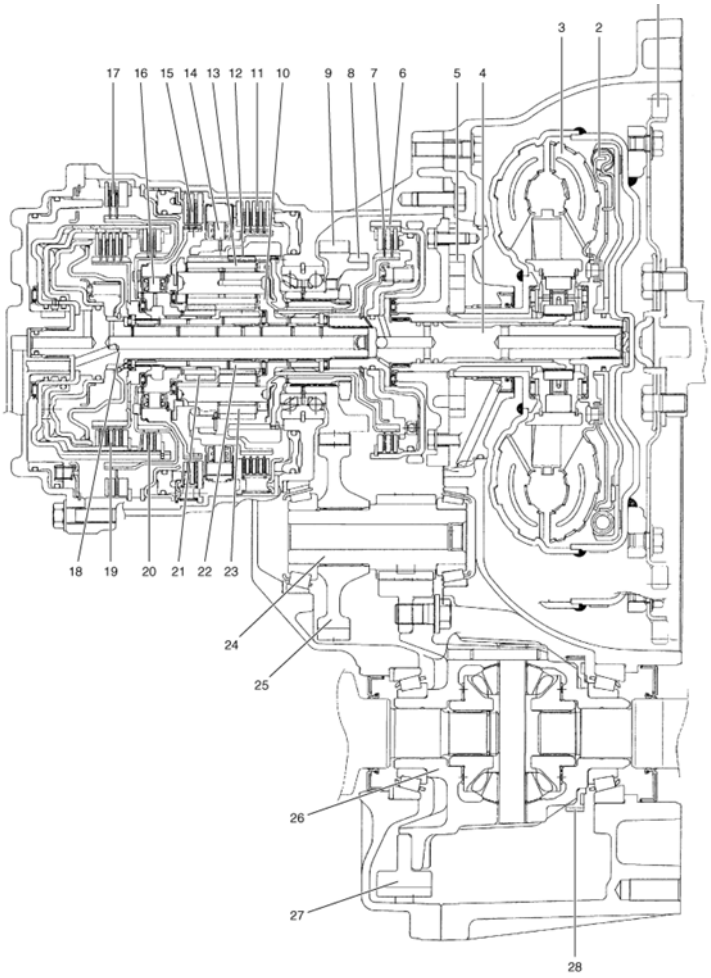

Figure 5. Image of AT in the Manual Book

Figure 5 is the image displayed in the manual book. Based on experience during teaching, many undergraduate automotive Education students had difficulty memorising the names of automatic transmission components. Augmented reality-based AT media helps translate Figure 5.

A. Validity of AT AR application

The AT AR application was evaluated by media experts and automotive experts. Both validators provided assessments on: (1) media display aspect; (2) knowledge aspect; (3) convenience aspect; and (4) completeness aspect. The more complete the media developed, the more attractive it will be. The validity of the EMS application according to the experts is shown in Table 2.

TABEL 2. MEDIA EXPERT AND AUTOMOTIVE EXPERT RESPONSES

Component	Media Expert Validity Score	Automotive Expert Validity Score
Display	0,950	0,950
Knowledge	0.937	1
Ease of use	1	1
Completeness	1	1

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The data from the validity assessment results show that the ATAR application is declared very valid as in Table 2. Display is rated very valid with a value of 0.95, knowledge is rated very valid by 1, ease is rated very valid with a value of 1 and clarity is rated very valid with a value of 1. The validity obtained by the media provided by the validator is compared with the criteria in Table.1. The ATAR application has advantages in: (1) the same appearance as the media used on campus so that it can become basic knowledge during practice, (2) the knowledge gained is approximately the same as the media used on campus, (3) ease of use at home, (4) the same completeness as the media on campus. According to the expert validators, this application was declared suitable for use after a few revisions. However, this application still has limitations to display three-dimensional shapes.

Other limitations include the absence of collaborative learning features, which could be beneficial for group-based automotive training, and the lack of adaptability for various types of vehicles or components beyond the scope of the current AT module. Future development should focus on integrating these features to make the application more versatile and suitable for broader use cases. For example, adding a feature for multi-user interaction could enable students to collaboratively work on virtual projects, enhancing teamwork and communication skills. The researcher attached a photo of a real object to the number bardcode in the picture.

B. The effect of AT AR application on student knowledge

ATAR media is implemented in power transfer system lectures. This application is used during theory classes and practical classes. The two processes cannot be separated, understanding AT material has an important role when doing practicum. Data collection is done by giving pretest and posttest. Test results. The test result data was tested using the Anova test.

TABEL 3. ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2170.278	1	2170.278	7.150	.009
Within Groups	23675.984	78	303.538		
Total	25846.262	79			

The research data in Table 3 obtained a probability value smaller than 0.05, so it is concluded that there is a difference in the ability to mention the names and explain the functions of AT components before and after using the AT AR application. The ability to mention the names and functions of basic knowledge components to perform maintenance and repair of AT. The results of this study are in line with research [25] which states that augmanted reality interactive media has an impact on basic skills and learning interests. The results of this study are in line with research [26] stating that the media has a direct impact on basic knowledge. *Prior knowledge* is explicit knowledge, conceptual knowledge, and metacognitive knowledge that learners master when entering learning situations that are relevant to obtaining new information[27]. At media based on *augmented reality* can be operated using a smartphone. Mobile is not only a communication tool but can be a learning media such as by utilising augmented reality [28]. Media can improve basic skills [29]; [30].

Research [29] and [31] stated that the ability of *prior knowledge* is an important component in learning that must be improved through the use of media. Media is used in building *prior knowledge* in course places [32]. According to [33] using interactive visualisation can reduce the lack of prior knowledge ability. Visualisation is the main key in providing deep understanding to participants [34]. The use of media in this study is an effort to help students to visualise. AT AR media is a learning media in the Bachelor of Automotive Education and vocational education programmes, expected to help students to think coherently. Learning media helps students to visualise information. AR to increase student interest and learning outcomes in the learning process [35]. Interesting media helps students to memorise the components of automatic transmission. One of the competencies that must be mastered is the ability to convey AT components orally. That ability is communication skills. Augmanted reality media helps communication skills [31]. The right media is the main key in automotive activities.

IV. CONCLUSION

Automatic Transmission application based on augmented reality is an application to help students master the ability to mention the names of components, functions of components and how automatic transmission works. This media is to help students translate images into real form. The validation results show that the appearance of AT AR media is very attractive. This media can convey knowledge well. AT AR media is easy to use with completeness in accordance with the purpose of media development. The results of ANOVA analysis show that AT AR media can improve the ability to mention the names of AT components, the function of AT components and how AT

works.

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