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The Practicality and Effectiveness of Integrated Augmented Reality Car Audio System Learning Modules in Vocational Education

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Abstract

Technological developments are undergoing an increasingly rapid transformation. Revolution 4.0 which is oriented towards digitalization and IoT technology is increasingly entering the order of human life, even in all aspects of national life. Of course, the educational field needs to be able to strike a balance between the advancement of technology and the process of learning. One way is to take advantage of the existence of technology as a means of improving the quality of learning. Up until now, a lot of instructional resources and learning media have been created through cooperation with cutting-edge technology. One technology that can be implemented is augmented reality. In response to this, this research focuses on developing a car audio system learning module integrated with augmented reality in vocational education. Teachers and XII students at SMK YKP Magetan served as the study's subjects. Data were gathered using test, questionnaire, and observation techniques. 95.33% was the module validity level, according to the results. According to the study's findings, 87.67% of teachers' and students' replies to the module demonstrated practicality, which is why it was included in the very practical qualification. The effectiveness aspect showed a significant difference between the pretest and posttest results of 35 students. The results of the research show that the effectiveness of the module is 64.58%. Particularly when it comes to car audio system content, the integrated augmented reality learning module for car audio systems has a high degree of viability that makes it suitable for use in vocational education.

Keywords— *Augmented Reality, Moduls, Validity, Practicality, Effectiveness.*

1. INTRODUCTION

In 21st century education requires development in creating maximum learning outcomes and competencies so that they can provide benefits for real life. Preparing skilled human resources who can become experts in the technology itself requires education. By enforcing stringent oversight over the integration of technology in the educational sector to ensure the emergence of skilled labor and subject matter experts. It is intended that the technological revolution can provide benefits for the advancement of education and other aspects of life (KLEIN, 2020; Kosasi, 2020).

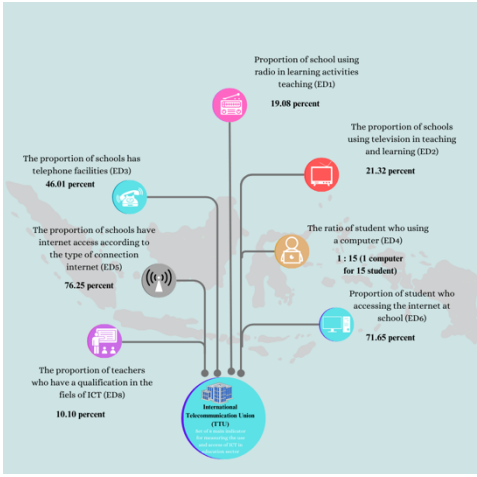


Figure 1. Statistical Data On Technology Implementation In Indonesian Education

The implementation of technology may be achieved in the sphere of education through interactive learning processes, learning media, and teaching materials. Learning media and teaching materials are a means of channeling information to students from valid sources in the learning process (Bamiah et al., 2018). The use of interactive media and teaching materials is important so that the process of providing abstract information to students is not only done verbally (Criollo-C et al., 2021; Dewi M et al., 2022). Knowledge becomes more complex and concrete by providing direct experience due to the fact that learning encompasses all of the senses (Arsyad, 2019).

Reviewing the urgency in this field, it is appropriate to implement the use of technology in education. The latest technology that can be implemented is metaverse, particularly in the augmented reality (AR) space. Using augmented reality in the classroom environment provides the latest breakthrough to improve the heterogeneous relationship between learners and educators (Weng et al., 2021). Through AR applications students get interactive learning visually and in real-time. In some studies conducted such as (Bower et al., 2014) AR provides a more directed learning experience and increases interactivity patterns through content and object visualization thereby reducing students' cognitive load. In some studies, the implementation of AR is proven to improve student achievement and learning outcomes, thereby improving cognitive and psychomotor abilities (Sirakaya & Cakmak, 2018). In addition, AR technology also has an influence on the level of student motivation (Weng et al., 2021). Meanwhile, research (Tuwoso et al., 2021) states that the use of AR has a moderate level of effectiveness in learning. The purpose of this study is to ascertain how augmented reality usage can enhance learning efficiency and motivation on vocational material in training and education for vocational. The use of AR not only focuses on learning media but also on interactive teaching materials as a student learning resource.

Starting from the results of preliminary observations made by researchers using the method of interviews with productive teachers and curriculum areas, several factors underlie the importance of this research. First, in terms of curriculum, SMK education is student-centred so that learning focuses on fostering student learning independence. However, this has not been fully realised due to the limited learning media such as trainers, especially in practical learning activities. Secondly, in terms of student quality, it is known that students cannot fully learn independently without being accompanied by relevant and interactive learning media so that teaching seems monotonous and student learning motivation decreases. Student motivation is also an important factor in this study.

Third so far, learning about car audio system material has only used power point media and explanations using the lecture method. This of course greatly impacts student learning motivation and student competence in the psychomotor domain. Knowing student learning outcomes both before and after learning is one of the objectives of this study. Fourth, there has

never been an implementation of AR technology used in SMK YKP Magetan so that the emergence of this innovation can encourage the creativity of educators in creating fun and interactive learning.

This paper discusses the use of AR technology combined in a learning module for car audio system material. This material is one of the basic skills that need to be possessed by students who take vocational education, especially for the automotive light vehicle engineering study programme. Module development aims to facilitate learning in order to achieve instructional goals, mastery of cognitive aspects, skills and competencies (Supriadi et al., 2022). In learning car audio systems, augmented reality technology is used as a form of visualisation of car audio system components so that students can learn independently and effectively.

Based on what has been described above, it is important to create learning media in the form of trainers equipped with interactive modules by adopting augmented reality technology. The purpose of this study is to evaluate the usability and effectiveness of a car audio system module integrated with augmented reality technology. The findings of this study are expected to help in the creation of interactive learning materials and modules that effectively improve student competence, especially at the SMK level.

2. METHOD

Research conducted using research and development methods. Development research (RnD) a study done with the goal of creating a learning tool, media, and instructional materials (Mogana, 2017). This research produced a product in the form of a valid, practical, and effective integrated car audio system learning module. The subjects of this study were lecturers at Surabaya State University as module validators, as well as teachers and students majoring in YKP Magetan Vocational High School Automotive Light Vehicle Engineering (refer to TKRO SMK YKP Magetan) as practical and effective respondents. This study implements the research model shown in Figure 1.

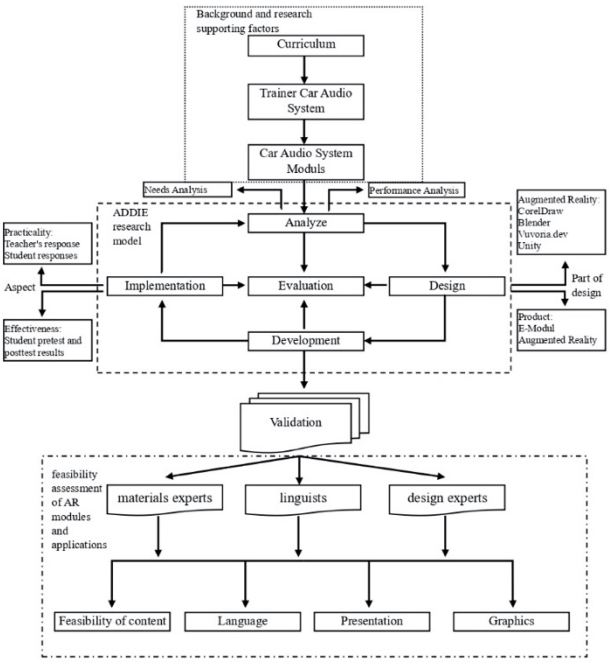


Figure 2. Research Design Using The Addie Model

The data gathering and analysis method for this study is carried out using the ADDIE (Analyze, Design, Development, Implementation, Evaluation) paradigm. ADDIE is a systematic and continuous model that is suitable for application in development and research. A set of

straightforward techniques for creating a learning process and the process itself is the ADDIE research model can be applied in various situations because of its simple structure. The ADDIE research model will be more clearly presented in Table 1.

No	Stages	Process
1	Analyze	The researcher conducted an analysis phase to identify performance gaps by interviewing teachers at SMK YKP Magetan, majoring in TKRO.
2	Design	The researcher designs learning modules for a car audio system installation, including e-modules, augmented reality objects, and applications, based on existing designs.
3	Development	The development stage assesses the module's validity using questionnaires from experts, integrating augmented reality technology, to determine its effectiveness.
4	Implementation	The implementation phase prepares the learning environment and encourages student participation, assessing the module's practicality through teacher and student questionnaires and its effectiveness through pre-test and post-test results.
5	Evaluation	The Evaluation Phase assesses product teaching quality before and after implementation using teacher and student questionnaire results and student learning outcomes.

Table I. The Process Of The Addie Model Stages

The stage of analysis is to find a problem that occurs in a learning process. The analysis was carried out at SMK YKP Magetan, especially in the TKRO department to find out the situation and learning conditions that had been carried out. The analysis carried out includes performance analysis and needs analysis.

1. Performance analysis

From the performance analysis carried out, it resulted in a conclusion that the learning process carried out was still one-way. That is, the teacher provides stimulation through the lecture method so that students cannot improve their learning abilities independently. Besides that, the thing that hinders the learning process is that students do not know the learning objectives to be achieved.

2. Needs analysis

Needs analysis includes the availability and condition of learning materials for TKRO majors, especially in car audio system material. The results of the observations concluded that in learning the car audio system, teaching materials in the form of modules used by students as learning guides were not yet available. In addition, the availability of learning trainers but the absence of learning resources makes the learning process run less than optimally.

Design of Augmented Reality

The design stage aims to design the developed teaching materials. This refers to the research objectives of producing interactive modules by utilizing augmented reality technology. The design stage consists of learning module design and object design as well as augmented reality applications. This stage utilizes several applications such as CorelDraw, blender, unity, and vuvoria web. These applications work integrated with each other so that they become one unit to create and develop augmented reality technology. The AR application design scheme is shown in Figure 2.

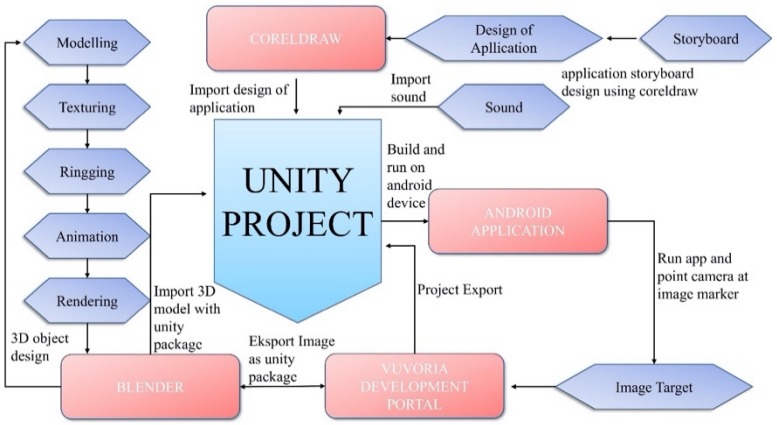


Figure 3. AR Manufacturing Scheme

The validity test which is carried out by three validators, yields the learning module's level of validity. Both qualitative and quantitative analysis were used to examine the feasibility of the module data. While information about the success of the module is gathered from the learning results of the students through several assessments.

A one-shot pretest-posttest design is used in this investigation. Using the generated module, this design is utilized to assess the degree of relevance of the impact of learning outcomes. The Shapiro-Wilk normality test and the non-parametric statistical test were used to analyze the effectiveness test results and the significance test using the non-parametric statistical test Rank test signed by Wilcoxon. The data is used as a reference to see differences in the learning objectives of students both before and after utilizing the module. Based on the findings of the students' pretest and posttest, an N-gain test was conducted to determine the module's effectiveness.

Pre- and post-testing were used as data gathering techniques in this study. By using this test, researchers can measure student learning outcomes. The test is a process measurement instrument that assesses an individual's degree of learning process success. This method of obtaining data values or data collection methods is carried out using expert validation responses, as well as questionnaires to students and also administering tests. Media experts, material specialists, and linguists' validated questionnaires are the tools utilized to look for these data. Response questionnaire sheets to students, and pretest and posttest competency questions.

In this data analysis technique, validity is applied to the validators. The degree of precision between the data that actually occurs on the item and the data that the researcher obtained is known as validity (Sugiyono, 2018). In practicality interpreting the convenience that exists in evaluation instruments both in preparing, using, interpreting or obtaining results (Lestari & Irawati, 2020). Then the data that has been obtained is multiplied according to the weight of each value and the total results are added up. Thus, it may be said that the student's respondent score and the validation score results. In the practicality analysis obtained in the student questionnaire and the data is processed using practicality criteria after that conclusions can be drawn. Analysis of effectiveness can be obtained from the results of the answers to students' questions by comparing the pretest and posttest scores.

On effectiveness electivity is that which produces useful and purposeful learning for students, through appropriate learning procedures. (Sadiman & Miarso, 1977) This study used a multiple-choice or multiple-choice with 20 question objective test research instrument approach. The material used is adjusted first to the material that is already known by students in the light vehicle electrical system maintenance subject.

Validity assessment is carried out by providing a response questionnaire to the validator to provide an assessment of the learning modules developed. The validation process involves verifying the work of linguists, media specialists, and material experts. The results of the

validator's response will be analyzed using a Likert scale and Guttman scale to assess the learning module's degree of validity. Table 2 shows the analysis criteria for validity assessment.

Criteria of Assesment	Value
Strongly agree	4
Agree	3
Disagree	2
Strongly Disagree	1

Table 2. Validation Sheet Assessment Weight

In addition to using the formula above, a formula using a Likert scale can be used as follows:

$$N = \sum T \times Pn \quad (1)$$

Information:
N = Total Score
T = Number of respondents
Pn = Likert score
To determine the validation rating score, the Guttman scale is used as follows:

$$HR = \frac{\sum SV}{\sum SM} \times 100\% \quad (2)$$

Information:
SV = Validator/Respondent Score
SM = Maximum Score

Following receipt of the validator's results for the values or scores, then the results of these scores are calculated by the average value of all validators and then the scores are adjusted to the rating levels in table 3.

Rating Classification	Rating Results
Very Valid	82% - 100%
Valid	63% - 81 %
Invalid	44 % - 62 %
Very Invalid	25% - 43 %

Table 3. Rating Level Of Validity

Practically

In the practicality analysis obtained in the student questionnaire and the data is processed using practicality criteria after that conclusions can be drawn. Students were given a questionnaire to complete in order to gauge their practicality with the automobile audio system learning material. Respondents were TKRO class XII students at SMK YKP Magetan with a total of 35 respondents. A Guttman Likert scale will be used to assess the survey responses in order to assess how useful the module is for learning.

Table 2 lists the criteria for the practicality assessment based on the answers from the students. After obtaining the results of the values or scores obtained from the validator, then the results of these scores are calculated by the average value of all validators and then the scores are adjusted to the rating levels in Table 3.

Effectiveness

Effectiveness is used to measure changes in learning outcomes through useful and directed learning for students and appropriate learning procedures. This study uses a multiple-choice objective test research instrument approach with 20 questions. A single hypothesis is used as a reference for decision making which is defined as follows.

H0: The pre-test and post-test findings do not significantly differ from one another.

H1: The pre-test and post-test findings differ significantly from one another.

Based on the significant value (Sig.) in SPSS, the following guidelines should be followed when making decisions in the paired sample t-test:

1) H1 is accepted and H0 is rejected if the Sig. (2-tailed) < 0.05.

2) H0 is approved and H1 is denied if the Sig. (2-tailed) > 0.05.

The conclusion reached is that there is no discernible difference between the pretest and posttest findings if the statistical test results support H0. On the other hand, if you agree with H1, the test concludes that the pretest and posttest findings differ significantly from one another.

Furthermore, in determining the level of effectiveness The N-gain test is used to determine the effectiveness of learning modules. Normalized gain, also known as N-gain, is used in one group pre-test-post-test design studies to evaluate the efficacy of a given approach. Table 4 displays the outcome categories for N-gain.

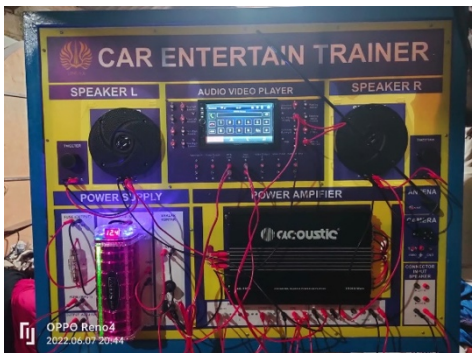
Percentage (%)	Category
<40	Ineffective
41 - 55	Less effective
56 - 75	Effective enough
>76	Effective

Table 4. Rating Category N-Gain

3. RESULT AND DISCUSSION

Result

In this study, the car audio system module was arranged based on the workings and installation of the car audio system trainer. The car audio system trainer can work with two systems, namely a circuit without a power amplifier and a full accessories circuit with a power amplifier. The components that make up the trainer include batteries, capacitor banks, head units, power amplifiers, and a number of speakers including tweeters, midrange and subwoofers. The type of components used are in accordance with the latest standards of car audio systems. The head unit used is a double DIN type so that it can be used to display audio video. While the power amplifier used is a 4-channel type with a power of 900W watts and an operating voltage of 12 volts. The design of the car audio system trainer and circuit schematic is shown in Figure 3.



(a)

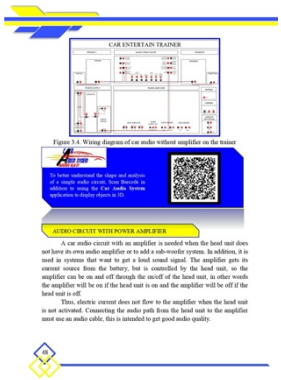
(b)

Figure 4. (A) Trainer Car Audio Sytem, (B) Wiring Diagram Car Audio System

The preparation of the integrated augmented reality car audio system learning module takes into account several criteria and systematics in the preparation of the module based on the Ministry of National Education. The material in the module is arranged systematically so that it can contain indicators of competency achievement, learning objectives, materials, practice questions, and evaluations.

The developed module is equipped with a barcode which functions as additional information for student learning. In addition, the augmented reality technology developed is integrated into the learning module through barcodes so that students can scan through the barcodes that have been provided. This of course can increase students' interest in learning and achieve the research objectives previously described. The design of the learning module is presented in Figure 4.

(a)



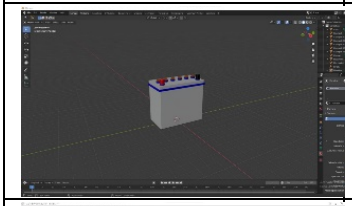
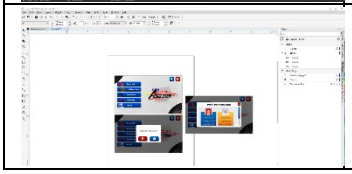
(b)

Figure 5. Learning Module, (A) Module Cover (B) Module Content

The developed learning module is then collaborated with augmented reality technology which is presented in the form of a barcode on the module. Component visualization can be seen in 3D and can be rotated so that students can observe and analyze components and circuits. In addition, augmented reality technology that is packaged through this application provides additional information to students to support student knowledge on cognitive aspects. The results of making AR technology according to the stages are presented in table 5.

Figure 5 shows the AR technology that has been created and integrated into the module. This augmented reality technology utilizes unity-based applications to be able to give an interactive impression to students so that students do not only study independently through printed modules but can also do learning through the applications that have been presented. This integrated augmented reality module is also equipped with an e-module so that it can be accessed by students even though the student is not carrying out learning at school. This of course can support student learning independently.

The car audio system application developed as a companion module is an application used to carry out the AR technology scanning process on the module. This application is made with a minimum standard of Android 4.4 KitKat with API level 19. This application developed based on Android pays attention to the use of students' smartphones where the majority of students are Android users. Several menus are presented in the application for the purpose of facilitating students during learning. The features in the application developed include AR scanning, practice questions, application guides, about the application, and application developer profiles. The practice questions presented are in the form of multiple choices with five answer options and a final score or value after working on the questions. The exercises were randomly generated in order to find out the ability of individual students to understand the car audio system material. The AR application display is shown in Figure 6.

Stage	Information
	Make 3D sketches of objects using blender software
	Create an application storyboard display using CorelDraw software

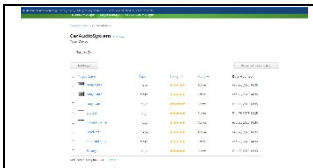
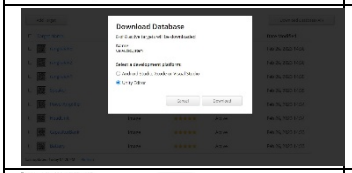
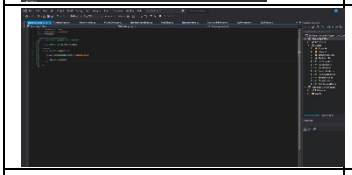
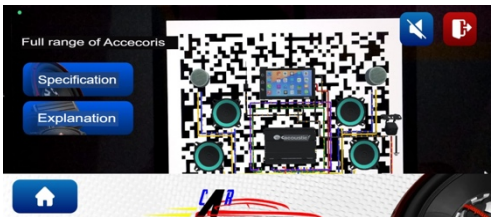
	Create an AR object barcode then upload it at developer.vuforia.com to create a marker
	After the marker is finished, then download the marker and enter it into the Unity software so that the marker is in sync with scanning in the application
	Arrange all components such as display designs, markers, and 3d objects in Unity Software
	Make the function code in visual studio so that the application is made according to the design
	After that, export it as a file that has the.apk extension so that an Android phone may use it.

Table 5. Stage Of Making AR

(a)



(b)

Figure 6. Application Of Augmented Reality On Modules, (A) Car Audio System Components (B) Moving Car Audio System Circuits

Figure 7. Car Audio System Application

The average validation result was 95.33%, falling into the very valid category, based on the validation of content, language, and design specialists using closed questionnaires. The results of the material content validation were 95%, the validation on the linguistic aspect showed a value of 96.7 and the validation on the design and graphic aspects obtained a value of 94.95%. These results indicate that the resulting learning module is very valid so that it can be applied as teaching material to car audio system learners. This % demonstrates that the assessment's degree of validation is at a very valid qualification. Table 6 displays the findings from the validation of the integrated learning module for the augmented reality car audio system.

No	Aspect	Score			Max Score
		1st validator response	2nd validator response	3rd validator response	
1	feasibility of content (5 items)	19	18	20	20
2	Language (5 items)	18	20	20	20
3	Presentation (7 items)	27	26	26	28
4	Graphics (8 items)	29	32	31	32
Total Score		93	96	97	100
Mean		95,33			

Table 6. Learning Modul Validation Results

The practicality of a learning module is obtained from observations and responses from teachers and students through closed questionnaires. The score obtained is then converted into an assessment reference according to pre-established standards. If the average percentage achieved in this study achieves the minimal value of the practicality category or if the average percentage value obtained is included in the criterion score with intervals of 82% - 100%, then the generated module is considered to have practical value (Widoyoko et al., 2023). These educational resources can improve students' motivation to learn and facilitate teachers' material delivery. In addition, the car audio system module has been modified to serve as a learning tool, enabling educators and learners to engage in a variety of activities that align with the lesson plans.

Teachers can also build good interaction with students through their role as learning facilitators so that students can learn more independently and support students to explore material more broadly. This is of course in line with the concept of 21st century learning and has relevance to the concept of an independent curriculum where the learning process is student-centered (Indarta et al., 2022). On March 16, 2023, comments from two professors and thirty-five pupils in class XII TKRO B were used to determine the usefulness of the integrated augmented reality automobile audio system learning module. Table 7 presents the degree of practicality of the learning module based on the responses received.

No	Aspect	Score			Max Score
		1st teacher response	2nd teacher response	3rd Students response	
1	content feasibility (8 items)	30	31	992	1184
2	linguistic feasibility (6 items)	23	21	733	888
3	Benefits (8 items)	30	32	950	1184
4	Graphics (8 items)	32	29	980	1184
Mean score		87, 67			

Table 7. The Results Of The Practicality Of Learning Module

The integrated augmented reality automobile audio system learning module has very good reaction and is classified as extremely practical based on the results that have been presented. Teachers' and students' good feedback led to the usage of the four factors: usability, visuals, language appropriateness, and content feasibility. The content feasibility aspect shows that the modules developed with the integration of augmented reality can increase students' knowledge of car audio system material. The ease of teachers and students in using the module is manifested through linguistic aspects so that teachers and students can easily understand the intent or instructions given in the module when presenting the material. The developed module also provides useful value for teachers and students in car audio system material. The appearance of the presentation of the module gives the impression that it is not monotonous so that it can attract student learning motivation and make it easier for teachers to create an interactive classroom atmosphere.

Measurement of the level of practicality is based on the appropriateness or inappropriateness of these learning tools and can be implemented in the classroom by prioritizing aspects of usefulness and convenience (Utami et al., 2022). The outcomes of the observations and the user answers from the created learning module demonstrate this. If the observations and answers from users of the designed learning module demonstrate that it is user-friendly, then the practicality requirement can be satisfied. Learning process and material distribution are also factors that affect how easy it is to learn. The preparation of learning modules that are systematic, clear, good readability can be an indicator of the ease of a learning module. Thus teachers and students can easily use learning modules during the learning process.

Apart from the convenience aspect, the modules developed must have a significant impact on students' knowledge. The usability aspect is an indicator that the developed module is in accordance with content standards and student learning outcomes. In addition, modules equipped with augmented reality technology and additional information from other sources presented in the form of barcodes are increasingly providing benefits for students to be able to explore material more broadly. Evaluation of questions that are arranged systematically in each learning process also gives a positive impression in its application.

Assessments that are arranged Make it consistently simpler for educators to do assessments in every area, be it affective, cognitive, or psychomotor. Learning evaluation is also presented clearly and provides clear answer limits so that it facilitates the teacher's ability to conduct an impartial assessment. Preparation of worksheets that make it easier for students to completing projects has a beneficial effect on learning as well.

The learning process of the students demonstrates the usefulness of the car audio system learning module. The learning module on integrated augmented reality automobile audio systems has the potential to improve students' comprehension in both cognitive and psychomotor domains. Competency assessments in the cognitive domain are used to determine how well the automobile audio system learning module contributes to the learning process. Testing the level of effectiveness through tests of students' abilities and understanding of the car audio system

material was carried out in one class, namely students of class XII TKRO B with two tests, namely pretest and posttest. The pretest is carried out during pre-learning and before students use the car audio system learning module. Conversely, the posttest is carried out in post-learning and after students carry out learning using the car audio system module.

The pretest and posttest data results on the research subjects showed that the learning outcomes before using the module had an average of 37.42 and after using the module had an average of 77.57. Pretest and posttest comparison data are presented in statistical form in table 8.

Statistic	PreTest	PostTest
Mean	37.4286	77.5714
Median	35	75
Mode	35	75
Std. Deviation	13.13792	7.41337
Variance	172.605	54.958

Table 8. Statistical Comparison Of Pretest And Posttest Results

To ascertain the distribution of the data, the pretest and posttest results were tested before doing an efficacy analysis. The amount of data utilized determines how the normalcy test is conducted. The purpose of the normality test is to ascertain whether the investigated data has a regularly distributed distribution or not. Non-parametric statistical tests were used because the data that had been collected and processed showed an abnormal distribution of data using the Shapiro-Wilk test following the data normalcy test. The Shapiro-Wilk test is used on data having a quantity <100.

Based on the SPSS output data It is evident from the study data normalcy test results that the data's normalcy using Shapiro-Wilk yields a significance level of 0.002 for pretest data and a value of 0.037 for posttest data. Based on the basic assumption, namely the .Sig value obtained for both types of data is <0.05, a decision can be made using the Shapiro Wilk data normality test so that the conclusion that can be given is that The data from the pretest and posttest are not regularly dispersed. The normality test results are shown in table 9.

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre Test	.888	35	.002
Post Test	.934	35	.037

Table 9. Normality Test Results

The hypothesis is tested using a provisional conjecture test or with a significance level of α = 5% or 0.05. To perform data testing, the analysis of the data obtained was processed using IBM SPSS v.26 software. indicates that the Wilcoxon Signed-Rang Test, a non-parametric statistical test, is used to draw conclusions and make judgments. This test is predicated on the fundamental premise that the data collected is not normally distributed. Asymp.Sig(p) was compared and interpreted at a significance threshold of α of 5% or 0.05 to conduct the test. If the p value > 5% then the conclusion is acceptance of the H0 area whereas if p <5% then the conclusion is the rejection of the H0 area.

based on how the Wilcoxon test data is presented and how judgments and theories are formed, As can be observed, the value of the Asymp.Sig (2-tailed) has a score of 0.000. Given that the value is 0.000 <0.05, it is possible to conclude that H0 is rejected and H1 is accepted. This demonstrates that there is a considerable variation in the data gathered between the pretest

and posttest findings, suggesting that the use of the automobile audio system learning module is impacted. Tables 10 and 11 display data from the Wilcoxon signed rank test.

		N	Mean Rank	Sum of Ranks
Post Test - Pre Test	Negative Ranks	0[a]	.00	.00
	Positive Ranks	35[b]	18.00	630.00
	Ties	0[c]		
	Total	35		

Table 10. Statistical Results Of The Wilcoxon Signed Rank Test

	Post Test - Pre Test
Z	-5.187[b]
Asymp. Sig. (2-tailed)	.000

Table 11. Significance results of The Wilcoxon Signed Rank Test

			Statistic	Std. Error
NGain_score	Mean		.6458	.01564
	95% Confidence Interval for Mean	Lower Bound	.6140	
		Upper Bound	.6775	
	Median		.6250	
	Variance		.009	
	Std. Deviation		.09250	

Table I2. Test Result For N-Gain Scores

The N-gain test is used to assess the degree of efficacy of learning module utilization. In a research design that uses a single group pretest-posttest, normalized gain, also known as N-gain, serves to determine the degree of efficacy of applying a method that is being evaluated or treated based on specific standards. N-gain (normalized gain) aims as a reference for measuring the development of the level of social science process skills and student learning outcomes in the cognitive domain between before being given treatment and after being given treatment.

The normalcy value of the gain from the students' pretest and posttest results obtained a score of 0.645, or 64.5%, according to the findings of the N-Gain test conducted using SPSS. To classify the learning module as very successful in enhancing student learning results. Table 12 displays the data from the Ngain test findings.

Discussion

The application of interactive and systematic learning tools is an integral part of the concept of behavioristic learning theory. One application of behavioristic theory in education is the use of structured learning resources. The conditioning of the learning environment is emphasized by behaviorist theory as a component influencing the learning process and learning outcomes. The learning environment and learning tools that function as student stimuli are closely related to the laws of readiness, practice, and consequences. Interactive and systematic learning tools make teachers better prepared to carry out learning because interactions between teachers

and students have the same direction and goals. This certainly affects student learning outcomes where the learning environment and learning device conditions are the main factors in achieving learning objectives (Alloqmani et al., 2021).

Based on the explanation above, this study reveals that the use of learning devices in the form of modules is effective and provides benefits to both students and teachers in increasing understanding and facilitating the implementation of the learning process on car audio system material in vocational schools. This research supports several previous studies which suggest that the use of augmented reality integrated learning modules is an innovation in the world of education. The use of interactive and systematic learning modules has been proven to improve students' abilities and skills in the material being taught (Sudarman & Ardian, 2021). Some relevant previous research related to the development of augmented reality integrated learning modules is presented in Table 13.

No	Research	Research Result		
		Validity	Practicality	Effectiveness
1.	(Mashami et al., 2021)	80%	82.2%	59.44%
2.	(Apriani et al., 2021)	87%	87%	-
3.	(Murfi & Rukun, 2020)	89%	85,88%	-
4.	(Afifah et al., 2019)	88.3%	85.45%	56.3%
5.	(Nuraini & Ratnawati, 2021)	80.23%	85.26%	54.41%
6.	(Salamiati et al., 2020)	87.5%	82.62%	53.23%
7.	(Hurrahman et al., 2022)	85.33%	77%	-
8.	(Purwandari et al., 2021)	75.1%	75.14%	31%
9.	Our Work	95.33%	87.67%	64.58%

Table I3. Comparison With Previous Relevant Studies

When integrated augmented reality learning modules are used in the classroom, students get the feeling that learning is dynamic can independently learn more broadly by collaborating material on modules with supporting information on modules through augmented reality applications. To encourage interaction between teachers and students throughout the learning process, use interactive modules that place a greater emphasis on student involvement (Morel, 2021).

The findings of this study, which show that using learning modules on car audio system material can create good learning situations and conditions for students. The preparation of modules that are systematic, structured, clear and easy to understand in each learning activity and equipped with other learning resources then integrated with augmented reality technology can facilitate teachers and students in learning. Competency achievement indicators are adjusted to the RPP so that the material presented can be a means of achieving predetermined competency standards. It can be simpler for teachers to teach if the learning process is well-planned and uses learning resources (Akkaya, 2021). Students do tasks that are supported by learning activities that are visible as moving in the direction of learning through the use of an organized learning plan. To facilitate learning for teachers and students, teaching materials are structured clearly, methodically, and in accordance with learning instructions (Nababan & Tanjung, 2020). This offers a fantastic chance for the produced technology to reach levels of usefulness.

Students can benefit from the use of technology in the classroom and in helping them meet their learning objectives. In order to effectively educate in the twenty-first century, educators must be able to integrate technology into the classroom and involve students in the process using software, video, etc. This study supports earlier studies that found that the purpose of technology in the classroom is to facilitate students' comprehension of concepts delivered in an abstract way. (Febriyanti & Mustadi, 2020).

This study also demonstrates how using learning modules in the classroom can improve students' comprehension of the material, particularly when it comes to the automobile audio

system. Learning modules enable pupils to be taught so they can comprehend the content with clarity. The primary ideas of the content are also interactively designed into the learning modules that are offered. Students can therefore comprehend it more readily. Additional findings indicate that grades or learning outcomes are influenced by students' comprehension of the instructional materials. This can help them become more adept at managing their education and recognizing their requirements, which will help them become independent learners and get higher marks.

According to the justification given, it is critical to give educators the tools they need to design a classroom that encourages students to become independent learners through learning modules. Thus students can experience initiative taking, class involvement, conceptual learning, and psychomotor skills. The effectiveness of the learning modules generated was demonstrated by the students' comprehension of the modules in this study. The learning outcomes demonstrate that the class that received the automobile audio system learning module had a greater understanding of the content than the class that did not receive the module.

Through this AR integrated module, it can be seen that the technology approach in vocational programmes has a significant impact in improving student motivation and learning outcomes. From the results of this study, it was found that the application of technology is not only used for theoretical material but can also be used to improve students' psychomotor skills through practicum activities. Data on changes in learning motivation and student learning outcomes show the implications of AR integrated modules provide changes for the better.

4. CONCLUSSION

The created learning module for an integrated automotive audio system with augmented reality meets the aspects of validity, practicality, and effectiveness. Therefore, it can be concluded that students studying automotive audio system material can make advantage of the integrated augmented reality learning module. Aspects of validity were obtained from validation by UNESA lecturers including material, language and design. The practical aspects of this learning module were obtained from the responses of teachers and students at SMK YKP Magetan including content feasibility, language, usability and presentation or graphics. In the meantime, information on the pretest and posttest results of class XII TKRO SMK YKP Magetan, comprising 35 students in total, was used to determine the element of efficacy. The validity results were given a grade of 95.33%, practicality of 87.67%, and effectiveness of 64.58%. In this case the advice that can be given for further development is to pay attention to the benefits and convenience of learning modules. It is expected of teachers to be more organized, consistent, and capable of conditioning and reconstructing lesson plans that have been modified for different learning environments.

REFERENCESS

Abdullah, N., Baskaran, V. L., Mustafa, Z., Ali, S. R., & Zaini, S. H. (2022). Augmented Reality: The Effect in Students' Achievement, Satisfaction and Interest in Science Education. International Journal of Learning, Teaching and Educational Research, 21(5). https://doi.org/10.26803/ijlter.21.5.17

Afdal, Wulandari, E., Nirwana, H., Alizamar, A., & Sukmawati, I. (2019). Premarital Counseling: Opportunities and Challenges in Industrial Revolution 4.0 Era. Advances in Social Science, Education and Humanities Research, 372(ICoET).

Afifah, B., Widiyaningtyas, T., & Pujianto, U. (2019). Pengembangan bahan ajar perakitan komputer bermuatan augmented reality untuk menumbuhkan keaktifan belajar siswa. TEKNO, 29(2). https://doi.org/10.17977/um034v29i2p97-115

Akkaya, A. (2021). Theories of educational management and leadership. Educational Review, 73(6). https://doi.org/10.1080/00131911.2021.1890944

Alloqmani, A., Alsaedi, O., Bahatheg, N., Alnanih, R., & Elrefaei, L. (2021). Design Principles-Based Interactive Learning Tool for Solving Nonlinear Equations. Computer Systems Science and Engineering, 40(3). https://doi.org/10.32604/CSSE.2022.019704

Apriani, R., Harun*, A. I., Erlina, E., Sahputra, R., & Ulfah, M. (2021). Pengembangan Modul Berbasis Multipel Representasi dengan Bantuan Teknologi Augmented Reality untuk Membantu Siswa Memahami Konsep Ikatan Kimia. Jurnal IPA & Pembelajaran IPA, 5(4). https://doi.org/10.24815/jipi.v5i4.23260

Arici, F., Yildirim, P., Caliklar, Ş., & Yilmaz, R. M. (2019). Tren penelitian dalam penggunaan augmented reality dalam pendidikan sains: Analisis pemetaan konten dan bibliometrik. Computers & Education, 142.

Arsyad, A. (2019). Media pembelajaran; Edisi revisi. Repositori Riset Kesehatan Nasional.

Bamiah, M. A., Brohi, S. N., & Rad, B. B. (2018). Big data technology in education: Advantages, implementations, and challenges. Journal of Engineering Science and Technology, 13(Special Issue on ICCSIT 2018).

Bangun, A. V., & Pragholapati, A. (2021). Enhancing Critical Thinking Skills in Nursing Higher Education in Preparation for the Industrial Revolution 4.0. KnE Life Sciences. https://doi.org/10.18502/kls.v6i1.8756

Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented Reality in education - cases, places and potentials. In Educational Media International (Vol. 51, Issue 1). https://doi.org/10.1080/09523987.2014.889400

Criollo-C, S., Guerrero-Arias, A., Jaramillo-Alcázar, Á., & Luján-Mora, S. (2021). Mobile learning technologies for education: Benefits and pending issues. Applied Sciences (Switzerland), 11(9). https://doi.org/10.3390/app11094111

Dewi M, C. S., Khoiruddin, U., & Uswah, M. (2022). Improving Students Learning Outcomes of Grade X Students of SMK Al-Mahrusiyah on Narrative Text Through the Use of Interactive PowerPoint. PTK: Jurnal Tindakan Kelas, 2(2). https://doi.org/10.53624/ptk.v2i2.94

du Toit, J., & Verhoef, A. H. (2018). Embodied digital technology and transformation in higher education. Transformation in Higher Education, 3. https://doi.org/10.4102/the.v3i0.52

E-Diwan App: The 21st Century Solution for Teaching and Learning Arabic Poetry. (2022). International Journal of Advanced Research in Technology and Innovation. https://doi.org/10.55057/ijarti.2022.4.1.3

Febriyanti, R., & Mustadi, A. (2020). Developing Edutainment-Based Comic Media in Integrative-Thematic Learning in the Elementary School. Al Ibtida: Jurnal Pendidikan Guru MI, 7(2). https://doi.org/10.24235/al.ibtida.snj.v7i2.6676

Godin, V. V., & Terekhova, A. E. (2021). Digitalization of Education: Models and Methods. International Journal of Technology, 12(7). https://doi.org/10.14716/IJTECH.V12I7.5343

Gudoniene, D., & Rutkauskiene, D. (2019). Virtual and augmented reality in education. Baltic Journal of Modern Computing, 7(2). https://doi.org/10.22364/bjmc.2019.7.2.07

Herawati, A., Suhermin, S., Anisah, H. U., & Sambung, R. (2021). Industrial revolution 4.0: What should be prep

Hurrahman, M., Erlina*, E., Melati, H. A., Enawaty, E., & Sartika, R. P. (2022). Pengembangan E-Modul Berbasis Multipel Representasi Dengan Bantuan Teknologi Augmented Reality untuk Pembelajaran Materi Bentuk Molekul. Jurnal Pendidikan Sains Indonesia, 10(1). https://doi.org/10.24815/jpsi.v10i1.22579

Indarta, Y., Jalinus, N., Waskito, W., Samala, A. D., Riyanda, A. R., & Adi, N. H. (2022). Relevansi Kurikulum Merdeka Belajar dengan Model Pembelajaran Abad 21 dalam Perkembangan Era Society 5.0. Edukatif : Jurnal Ilmu Pendidikan, 4(2). https://doi.org/10.31004/edukatif.v4i2.2589

Ivanov, D., Dolgui, A., & Sokolov, B. (2019). The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. International Journal of Production Research, 57(3). https://doi.org/10.1080/00207543.2018.1488086

KLEIN, M. (2020). Leadership Characteristics In The Era Of Digital Transformation. Business & Management Studies: An International Journal, 8(1). https://doi.org/10.15295/bmij.v8i1.1441

Kosasi, S. (2020). Education Transformation in the Era of Digital Disruption 4.0. JUDIMAS, 1(1). https://doi.org/10.30700/jm.v1i1.989

Lestari, D. G., & Irawati, H. (2020). Literature Review : Peningkatan Hasil Belajar Kognitif Dan Motivasi Siswa Pada Materi Biologi Melalui Model Pembelajaran Guided Inquiry. Bioma, 2(2).

Lukita, C., Suwandi, S., Harahap, E. P., Rahardja, U., & Nas, C. (2020). Curriculum 4.0: Adoption of Industry Era 4.0 as Assessment of Higher Education Quality. IJCCS (Indonesian Journal of Computing and Cybernetics Systems), 14(3). https://doi.org/10.22146/ijccs.57321

Mantasia, M., & Jaya, H. (2016). Pengembangan Teknologi Augmented Reality Sebagai Penguatan Dan Penunjang Metode Pembelajaran Di Smk Untuk Implementasi Kurikulum 2013. Jurnal Pendidikan Vokasi, 6(3). https://doi.org/10.21831/jpv.v5i3.10522

Mashami, R. A., Khaeruman, K., & Ahmadi, A. (2021). Pengembangan Modul Pembelajaran Kontekstual Terintegrasi Augmented Reality untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. Hydrogen: Jurnal Kependidikan Kimia, 9(2). https://doi.org/10.33394/hjkk.v9i2.4500

Mogana, A. M. (2017). Metode Penelitian Dan Pengembangan. Kerangka Konsep Penelitian, 53(9).

Morel, G. M. (2021). Student-centered learning: context needed. In Educational Technology Research and Development (Vol. 69, Issue 1). https://doi.org/10.1007/s11423-021-09951-0

Murfi, M. S., & Rukun, K. (2020). Pengembangan Rancangan Media Pembelajaran Augmented Reality Perangkat Jaringan Komputer. INVOTEK: Jurnal Inovasi Vokasional Dan Teknologi, 20(1). https://doi.org/10.24036/invotek.v20i1.702

Nababan, S. A., & Tanjung, H. S. (2020). Pengembangan Perangkat Pembelajaran Berbasis Pendekatan Matematika Realistik untuk Meningkatkan Kemampuan Disposisi Matematis Siswa SMA Negeri 4 Wira Bangsa Kabupaten Aceh Barat. Genta Mulia, XI(2).

Nuraini, L., & Ratnawati, D. (2021). Pemanfaatan Teknologi Augmented Reality Untuk Pengembangan Bahan Ajar Materi Komputer Jaringan. Jurnal Edukasi Elektro, 5(2). https://doi.org/10.21831/jee.v5i2.43517

Purwandari, P., Yusro, A. C., & Purwito, A. (2021). Modul Fisika Berbasis Augmented Reality Sebagai Alternatif Sumber Belajar Siswa. Jurnal Ilmiah Pendidikan Fisika, 5(1). https://doi.org/10.20527/jipf.v5i1.2874

Rokhim, D. A., Kurniawan, C. S. A., Ula, Q., & Al Siddiq, I. H. (2022). Needs Analysis Of The Development Of Schoology And Powtoon-Based Learning Media To Increase Learning Motivation And Student Learning Outcomes. EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru, 14(1). https://doi.org/10.17509/eh.v14i1.30499

Sadiman, A. s., & Miarso, Y. (1977). Definisi teknologi pendidikan : satuan tugas definisi terminologi AECT / tim

penerjemah, Arief S. Sadiman ... [et al.] ; penyunting, Yusufhadi Miarso | OPAC Perpustakaan Nasional RI. In Raja Grafindo Persada.

Salamiati, U., Ramdhani, E. P., & ... (2020). Validitas Modul Pembelajaran Elektronik Terintegrasi Augmented Reality Pada Materi Termokimia. Student Online Journal ….

Santos, H., Batista, J., & Marques, R. P. (2019). Digital transformation in higher education: The use of communication technologies by students. Procedia Computer Science, 164. https://doi.org/10.1016/j.procs.2019.12.163

Sirakaya, M., & Cakmak, E. K. (2018). Effects of augmented reality on student achievement and self-efficacy in vocational education and training. International Journal for Research in Vocational Education and Training, 5(1). https://doi.org/10.13152/IJRVET.5.1.1

Suciani, N. K., Sudarma, I. K., & Bayu, G. W. (2022). The Impact of Learning Style and Learning Motivation on Students' Science Learning Outcomes. MIMBAR PGSD Undiksha, 10(2). https://doi.org/10.23887/jjpgsd.v10i2.49811

Sudarman, S., & Ardian, A. (2021). The Development Of Interactive Module To Support Student Centered Learning. Akademika, 10(01). https://doi.org/10.34005/akademika.v10i01.1344
Sugiyono. (2018). Metode Penelitian Kualitatif dan R&D.Bandung:Alfabeta. In Metode Penelitian Kualitatif dan R & D.Bandung:Alfabeta.
Supriadi, A., Iqbal, M. F., & Pratista, A. N. (2022). Blockchain and IoT Technology Transformation in Indonesian Education. Blockchain Frontier Technology, 2(2). https://doi.org/10.34306/bfront.v2i2.208
Tuwoso, Putra, A. B. N. R., & Muhammad, A. K. Bin. (2021). The Innovation of Augmented Reality Learning Media with Interactive Component Model to Improve Special Ability of Vocational Education Knowledge in the Digital Era. International Journal of Interactive Mobile Technologies, 15(21). https://doi.org/10.3991/ijim.v15i21.24833
Utami, W. A., Harlita, H., & Karyanto, P. (2022). Validity and Practicality of Discovery Learning E-Modules on environmental change material to Empower Critical Thinking Skills. Jurnal Penelitian Pendidikan IPA, 8(3). https://doi.org/10.29303/jppipa.v8i3.1726
Weng, C., Puspitasari, D., Tran, K. N. P., Feng, P. J., Awuor, N. O., & Matere, I. M. (2021). The effect of using theodolite 3D AR in teaching measurement error on learning outcomes and satisfaction of civil engineering students with different spatial ability. Interactive Learning Environments. https://doi.org/10.1080/10494820.2021.1898989
Wessemann, A. (2022). Metaverse. Tanz, Jahrbuch. https://doi.org/10.3390/encyclopedia2010031
Wicaksana, S. B., & Anistyasari, Y. (2020). Tinjauan Pustaka Sistematis Tentang Penggunaan Flashcard pada Media Pembelajaran Berbasis Augmented Reality. Jurnal IT- EDU, 5(1).
Widoyoko, S. E. P., Nursidiq, C., Suyitno, & Setiawan, B. (2023). Evaluation of Entrepreneurship Learning Programs in Vocational Schools. In Proceedings of the 3rd Borobudur International Symposium on Humanities and Social Science 2021 (BIS-HSS 2021). https://doi.org/10.2991/978-2-494069-49-7_64
Yang, Y., Siau, K., Xie, W., & Sun, Y. (2022). Smart Health: Intelligent Healthcare Systems in the Metaverse, Artificial Intelligence, and Data Science Era. Https://Services.Igi-Global.Com/Resolvedoi/Resolve.Aspx?Doi=10.4018/JOEUC.308814, 34(1).

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