JOVES (Journal of Vocational Education Studies)
VOL 9, No. 1, 2026, pp. 234- 248
pISSN: 2614-7483 pISSN: 2614-7475 https://doi.org/10.12928/joves.v9i1.12672

Development of Vision-Based Mobile Learning Media for Robotic System Competency Improvement in Vocational High School

Yana Yohana*, **Herlambang Sigit Pramono, Choirozyad Muhammad Hafidz**

Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

*Coresponding Email: yana.yohana16@gmail.com

ARTICLE INFO

Article history
Received: Jan 24, 2025
Revised: Sep 30, 2025
Accepted: Oct 13, 2025

Keywords
Mobile Robots
Vision-Based
Huskylens Vision Sensors
Robotic Systems
Learning Media
Vocational High School

ABSTRACT

This developmental research evaluates the development, performance, feasibility, and effectiveness of mobile robot learning media for goods transfer based on the HUSKYLENS vision sensor as an effort to improve robotic system competencies in vocational high schools. This research employs the ADDIE development model, which includes five stages: analysis, design, development, implementation, and evaluation. The research site is located at SMK KB Pusdikpal Cimahi. The subjects of this research are 11th-grade students specializing in mechatronics engineering, and the object of this research is the learning media for a vision-based mobile robot used to move goods. In this study, the data analysis employed is quantitative descriptive analysis, which is used to describe the feasibility, functionality, and effectiveness of the study. Based on assessments from subject matter experts, media experts, and users, the findings of this study reveal that the mobile robot learning media for item transfer, utilizing the HUSKYLENS vision sensor, are considered valid and practical for use in the classroom. Hypothesis testing results indicate that the developed learning media are effective in enhancing students' competencies in robotic systems.

Introduction

The advancement of automation and data exchange marks a significant development in industrial technology. The development of this technology significantly alters the way humans live in various aspects of life, as the boundaries between humans, machines, and resources increasingly blur Spada Indonesia, (2019). The 4.0 industrial revolution is marked by advancements in digital systems, artificial intelligence, and virtual technology, as well as improved communication and interaction Lase, (2019). Undoubtedly, many aspects of daily life will be influenced by the ability of humans, machines, and other resources to transcend boundaries thanks to advancements in information and communication technology. Especially with the development of technology in the 4.0 revolution era, the world of industry and human jobs has undergone quite significant changes. Many fields of work have been replaced by robotic technology and artificial intelligence Schwab, (2016)

Robots have become an indispensable part of modern society, assisting in various daily activities Sørensen et al., (2024). Robots are multifunctional manipulators that can be programmed to move objects, components, tools, or specific equipment, thereby enhancing the efficiency of certain tasks Knasel, (1985). The development of robot technology has been widely applied in various fields of human life, including healthcare, transportation, defense, manufacturing, and education Lee, H. Y., and Murray, (2018).

The development of robotic technology has a significant impact on the world of education. According to the Google report, "The Future of Education," the development of robotic technology will bring considerable changes to the education sector, especially in the aspect of educational digitalization. Regulation of the Ministry of Education and Culture Number 20 Concerning Graduate Competency Standards for Primary and Secondary Education (2016) explains that the emotional, cognitive, and psychomotor domains are included in the graduate competency standards. In carrying out the learning process, educators must obtain information about students' performance in all three areas. Additionally, life in the 21st century requires humans to master various skills A. Munir, (2008). Thus, the goal of education is to provide the information and skills they need to meet the demands of the industrial world and fully participate in contemporary society Kolb, (1984).

The reality found in the field is that the workforce produced by vocational high school graduates still does not meet the competencies required by the industrial world. The gap between the competencies of vocational high school graduates and the needs of the industry results in many vocational high school graduates not being effectively absorbed into the industrial world. Referring to data from Statistics Indonesia in February (2024), the Open Unemployment Rate for vocational high school graduates is 8.62%. The cause is that vocational high schools have not yet been able to produce graduates with the competencies needed by the industrial or job market Waraditya, (2024).

One of the elements that can enhance graduates' competencies and students' learning efficiency is the availability of learning materials and media that impact learning outcomes Asyhar, (2012). The unavailability of learning materials and media will affect the learning process and students' learning outcomes Reiser, R. A., and Dempsey, (2012). To improve learning standards, learning media can also be used to transmit the content of lessons physically. One way to encourage students to pay more attention and think critically is by utilizing learning media Hamalik, (1994).

The benefits of using learning media in the teaching and learning process: (1) Learning media facilitates and enhances learning outcomes by conveying messages and information clearly; (2) learning media directs students' attention, thereby increasing focus, interest, and motivation to learn, and (3) learning media help overcome constraints such as time, space, and sensory limitations Arsyad, (2007). The following factors need to be considered when selecting educational media: (1) Alignment with learning media objectives, (2) Practicality, flexibility, and durability, (3) Capacity and proficiency with learning media, (4) The condition of the learners, and (5) Availability Miftah and Nur Rokhman, 2022).

Based on these facts, it is necessary to develop a product in the form of learning media that meets the learning outcomes of the needs of the industrial world. This research involves the development of a vision-based mobile robot for goods transfer learning media, aiming to facilitate practical learning in vocational high schools. This product development aims to enhance the competencies of robotic systems among vocational high school graduates specializing in Mechatronics Engineering.

Method

The mobile vision-based goods transfer robot learning media was developed as a practical learning tool in the robotics system subject at the Vocational High School. This study utilized a research and development (R&D) methodology. The ADDIE development model, as described by Branch Branch, (2009), was used to create this learning media. The ADDIE development model consists of five interrelated stages: Analysis, Design, Development, Implementation, and Evaluation. According to Robert Maribe Branch, the ADDIE development procedure has the advantage of systematic work stages and includes evaluation stages in each procedure, resulting in a maximum and valid product. The purpose of the product trial is to assess user reactions to the finished product and evaluate the feasibility of the created product. The trial was conducted at SMK KB Pusdikpal. Students in the Mechatronics Engineering concentration at SMK KB Pusdikpal were the subjects of the trial for the educational media being developed.

The data collection technique used in the research included interviews and completion of questionnaires Vernon and Gage, (1965). Interviews were conducted to obtain more detailed information by directly interacting with the relevant parties at the vocational high school, including the teacher of robotic systems subject and students. The questionnaire research instrument is used to determine performance testing, media feasibility testing by media experts and subject matter experts, and user feasibility testing. The items on the questionnaire instrument use a 4-point Likert scale. The use of a 4-point Likert scale is intended to encourage respondents to provide neutral ratings Budiaji, (2013).

The data collection instruments used are interview sheets, questionnaire sheets, and test sheets. The data analysis technique employed is quantitative descriptive analysis, which aims to explain the feasibility, functionality, and effectiveness of vision-based mobile robots for material handling as a learning medium in robotics systems for the Mechatronics Engineering concentration.

In this study, the validity of the instrument is evaluated through content validity using expert judgment from two experts (lecturers), and construct validity is determined by conducting item analysis Meyer, M., and Booker, (1991). The questionnaire instrument was developed based on the underlying theory and subsequently validated by experts. The experts conduct validation to assess whether the instrument used is suitable for use without modifications, with modifications, or requires comprehensive revisions.

The reliability of an instrument is a measure of its dependability when used in research. If a study is conducted repeatedly at various times and yields consistent results, then the research instrument is considered trustworthy or reliable Cronbach, (1951). The reliability test data were obtained from the results of user feasibility testing, which utilized a questionnaire instrument with 30 respondents from the experimental class in the Mechatronics Engineering concentration. The questionnaire instrument is declared reliable if the reliability coefficient value obtained is > 0.6 to 0.8, whereas if the coefficient value is 0.8 to 1, the questionnaire instrument is very dependable. The reliability test was then conducted using Cronbach's alpha technique Cronbach, (1951).

Result and Discussion

Analyze

The analysis stage of the researcher involved conducting observations and interviews in the robotics system laboratory at SMK KB Pusdikpal Cimahi. To maintain the credibility of the analysis stage results, the researcher employed the triangulation method by collecting data from various sources, including observation, documentation, and interviews. The identification of facilities and infrastructure is an observational process conducted during the teaching of the robotics system subject. This observation aims to determine the availability and condition of facilities and infrastructure that affect the quality of student learning and the delivery of material by the teacher. The results of the observation in Table 1 show several findings, including the following:

Table 1. Analysis of learning process facilities and infrastructure

Learning process facilities and infrastructure
The unavailability of a learning medium in the form of a mobile robot that can be used to achieve learning objectives in the sub-element of the mobile robot system
The learning media currently used still rely on conventional robot arms that cannot move mobile
The students' competencies are still limited to operating, distributing, and handling robot systems

Evaluation of the curriculum used is necessary to verify that this learning media aligns with the learning objectives in the subject of robotic systems. The learning objectives to be achieved in robotic systems learning are shown in Table 2.

Table 2. Curriculum analysis

Learning objectives	**Material**
Students are able to install and operate pneumatic and hydraulic equipment	Basics of pneumatic materials and compressed air production
	Pneumatic components
	Direct and indirect cylinder control
Operating robotic systems (sorting/distributing/handling/processing/ mobile)	Cylinder speed control
	Logic circuit
	Memory circuit
	Electropneumatic control system

The initial stage, carried out before developing a vision-based mobile robot for goods transfer, is conducting an analysis of the components needed, including hardware and software. Table 3 shows the results of the hardware and software needs analysis.

The evaluation at the analysis stage is conducted together with the supervising lecturer, covering the hardware and software requirements for developing a vision-based mobile goods transfer robot. This evaluation, conducted at the analysis stage, aims to optimize the results of the analysis that has already been completed in the initial stages.

Table 3. Hardware and software need analysis

Component	Quantity
Arduino Mega 2560 Microcontroller	1
Arduino Mega 2560 Extension Board	1
Photodiode Sensor (TCSRT5000)	4
DFRobot Huskylens Vision Sensor	1
Lipo Battery 2200 mAh	1
L298 Motor Driver	1
Mobile Robot Chasis	2
DC Motor with Gears	4
Mechanum Wheels	4
Jumper Wires	As Needed
SG90 Servo Motor	1
Wokwi	-
Arduino IDE	-
Mobile Robot Practicum Kit	255mm x 180mm x 68mm
DFRobot Huskylens Vision Sensor	52mm x 44.5mm

Design

The learning media to be developed from the analysis results before entering the development stage undergoes a 3D design process so that the researcher has an accurate picture before the design is implemented in the development process with dimensions (L x W x H) 255mm x 180mm x 68mm. In addition to designing the 3D model of the mobile robot, this stage also involves designing the process of the mobile robot's track. The 3D design of the mobile robot was created using SolidWorks Premium 2022 software. Meanwhile, the mobile robot's track was designed using CorelDRAW X7 software. Figure 1 shows the result of the 3D design of the mobile robot.

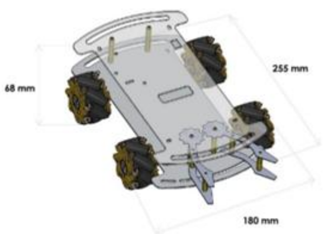

Fig 1: 3D Design Mobile Robot

Email : joves@mpv.uad.ac.id
Website : http://journal2.uad.ac.id/index.php/joves

The guidebook and practical lab sheets are part of the practical learning media, which include a guide for using the practical kit, software installation instructions, basic theory, and an operation guide for the Huskylens vision sensor. The developed practical lab sheets will contain material on robot components, including sensors, controllers, actuators, line follower robot programming, Huskylens vision sensor operation, and mobile robot programming. This material will be divided into 5 lab sheets, as shown in Table 4.

Table 4. Title of the practical labsheet

Labsheet	Title
1	Basic Microcontroller Programming Practice Using the Wokwi Simulator
2	Practice Line Tracking Sensor (Infrared Sensor) with Arduino Microcontroller
3	Practice of DC Motor Control Using L298N Motor Driver and Arduino Microcontroller
4	Practice with Vision Sensor Using Huskylens and Arduino Microcontroller
5	Practice of Mobile Robot for Item Transfer Based on Vision Sensor Using Arduino Microcontroller

The evaluation at this design stage aims to refine the existing design before proceeding to the next stage. Another evaluation result is the need for improvements in the design and construction of the learning media, specifically by using acrylic material for the upper robot base.

Develop

The main components used in the learning media for the vision-based mobile goods transfer robot include: (1) Arduino Mega 2560 Microcontroller, (2) Arduino Mega 2560 Extension Board, (3) Photodiode Sensor (TCSRT5000), (4) DFRobot Huskylens Vision Sensor, (5) DC Motor with Gear, (6) Mechanum Wheels, and (7) SG90 Servo Motor. The development of the vision-based mobile goods transfer robot measures (L x W x H) 255mm x 180mm x 68mm. The robot's base chassis is made of iron to ensure sturdy construction, while the upper part of the robot's base is made of acrylic. Figure 2 illustrates the development of a vision-based mobile robot for moving objects as a learning medium.

The developed guidebook contains basic material, including an introduction to robots and their components, basic programming, and setting up and programming the Huskylens vision sensor using the Arduino IDE software. The developed lab sheet is tailored to the practical material in the robotics system subject.

JOVES Vol 9. No.1 May 2026 p. 234- 248
Email : joves@mpv.uad.ac.id
Website : http://journal2.uad.ac.id/index.php/joves

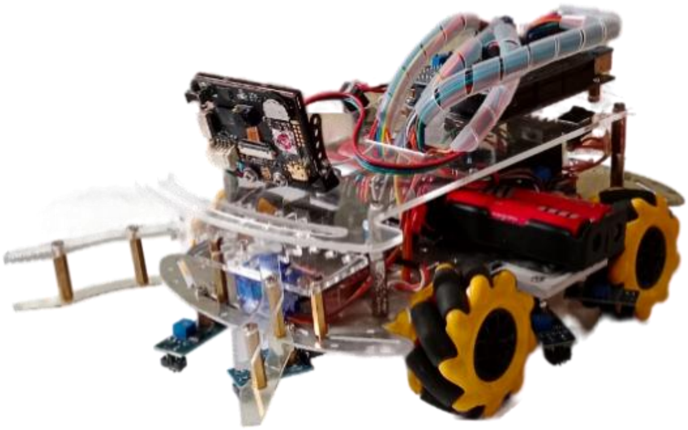

Fig 2: Vision-Based Mobile Goods Transfer Robot

The developed practical lab sheet will include material on robot components such as sensors, controllers, actuators, line follower robot programming, operation of the Huskylens vision sensor, and mobile robot programming. Figure 3 illustrates the development of the guidebook and labsheet.

Fig 3: Guidebook and Labsheet

Performance Test

Test the vision sensor at a specific light intensity with the vision sensor's distance from the object at 10cm and 50cm. Table 5 shows that the light intensity during the vision sensor testing process for colour significantly affects the detection results. The vision sensor can detect colour if the light intensity during testing is greater than or equal to 50 lux. In addition to light intensity, the 2.0-megapixel camera image sensor on the Huskylens vision sensor has a significant influence on the detection results.

Table 5. Results of vision sensor testing on light intensity

Light intensity	Distance to object	
	10cm	**50cm**
20	Not detected	Not detected
25	Detected	Not detected
50	Detected	Detected
100	Detected	Detected
150	Detected	Detected
200	Detected	Detected

The speed test of the mobile robot's movement was conducted five times to determine how long it takes for the mobile robot to cover a distance of 0.8 meters. Table 6 shows that the average movement speed of the mobile robot with a path of 0.124 meters/second and without a path of 0.216 meters/second.

Table 6. Results of mobile robot movement speed test

No.	Test No.	Distance (meters)	Time (seconds)		Speed (meters/second)	
			With track	**Without track**	**With track**	**Without track**
1	1	0.8	6.4	5	0.12	0.16
2	2	0.8	6.2	4	0.12	0.20
3	3	0.8	5.9	3	0.13	0.26
4	4	0.8	6.0	3	0.13	0.26
5	5	0.8	6.4	4	0.12	0.20
		Average			**0.124**	**0.216**

Material Feasibility Test

The assessment of material feasibility is conducted by experts in the field of robotic systems from the Department of Electrical Engineering Education and subject teachers at SMK KB Pusdikpal

Cimahi. The experts evaluate the material by filling out a questionnaire that covers three aspects: content quality, language, and presentation. Figure 4 illustrates the graph of feasibility data processing as determined by subject matter experts.

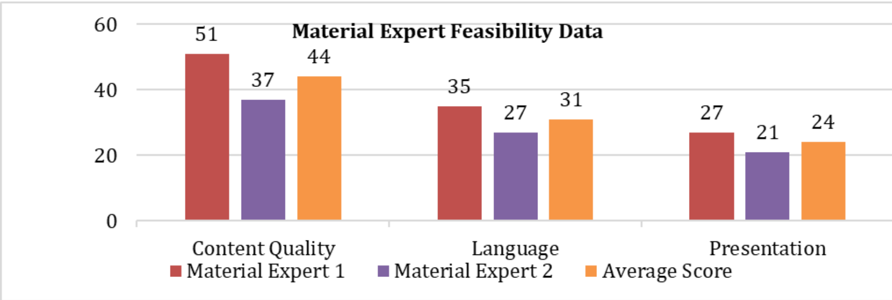

Fig 4: Feasibility Data Graph by Material Experts

The results of the material feasibility assessment received an average score for each aspect, namely content quality (44), language (31), and presentation (24), with the category "Very Feasible". Determination of material eligibility categories is presented in Table 7.

Table 7. Material eligibility categorys

Intervals in numbers			Category
Content quality	**Language**	**Presentation**	
42,25 < x ≤ 52	29,25 < x ≤ 36	22,75 < x ≤ 28	Very feasible
32,5 < x ≤ 42,25	22,5 < x ≤ 29,25	17,5 < x ≤ 22,75	Feasible
22,75 < x ≤ 32,5	15,75 < x ≤ 22,5	12,25 < x ≤ 17,5	Quite feasible
13 < x ≤ 22,75	9 < x ≤ 15,75	7 < x ≤ 12,25	Less feasible

Media Feasibility Test

The media feasibility assessment is conducted by experts in learning media development from the Department of Electrical Engineering Education. The experts evaluate the media by filling out a questionnaire that covers three aspects: content quality, technical quality, and instructional quality. Figure 5 shows the graph of feasibility data processing by media experts.

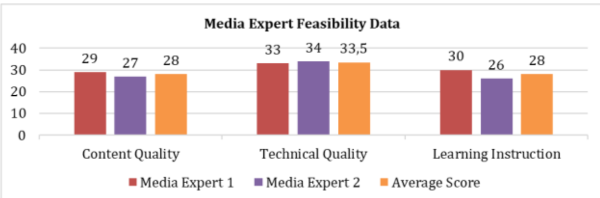

Fig 5: Feasibility Data Graph by Media Experts

The results of the feasibility assessment by media experts received an average score for each aspect, namely content quality (28), technical quality (33.5), and learning instruction (28), all categorized as "Very Feasible". Determination of media eligibility categories is presented in Table 8.

Table 8. Media eligibility categories

Intervals in numbers			Category
Content quality	**Technical quality**	**Learning instruction**	
26 < x ≤ 32	32,5 < x ≤ 40	26 < x ≤ 32	Very feasible
20 < x ≤ 26	25 < x ≤ 32,5	20 < x ≤ 26	Feasible
14 < x ≤ 20	17,5 < x ≤ 25	14 < x ≤ 20	Quite feasible
8 < x ≤ 14	10 < x ≤ 17,5	8 < x ≤ 14	Less feasible

User Feasibility Test

The user feasibility assessment was conducted by students in the experimental class with a concentration in Mechatronics Engineering skills in the 11th grade at SMK KB Pusdikpal Cimahi. They evaluated the media by filling out a questionnaire that covered three aspects: content quality, technical quality, and instructional quality. Thirty students conducted the user feasibility test. Figure 6 shows the graph of user feasibility data processing.

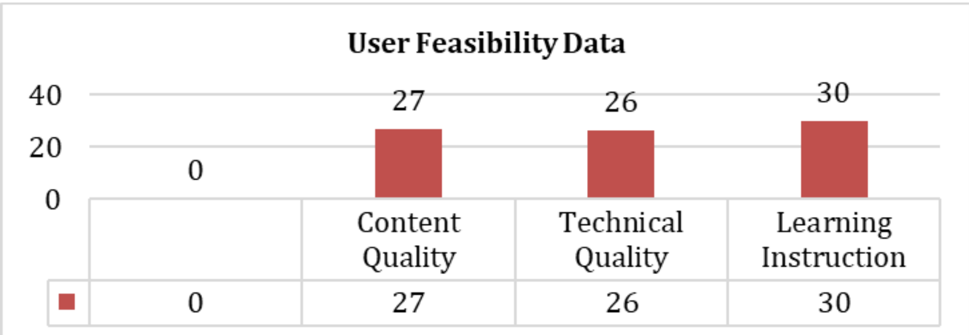

Fig 6: User Feasibility Data Graph

The results of the user feasibility test in Figure 6, received scores for each aspect: content quality (27), technical quality (26), and instructional learning (30). The category "Feasible" was assigned to the technical quality aspect, and "Very Feasible" was assigned to the content quality and instructional learning aspects.

Validity Test

Data to conduct the validity test on the user response assessment instrument was obtained from 30 student respondents in the experimental class with a concentration in Mechatronics Engineering in the 11th grade of SMK KB Pusdikpal Cimahi. The data obtained were then processed using the Pearson product-moment correlation test in IBM SPSS Statistics 26 software, with N = 30, at a significance level of 5% and an r-table statistic value of 0.361.

The data from the user response validity test obtained from 30 student respondents in the experimental class revealed that there were three invalid statements. The invalid statements were not tested using the IBM SPSS Statistics 26 software.

Reliability Test

The reliability test, using the Cronbach's Alpha formula with IBM SPSS Statistics software, yielded a final reliability coefficient of 0.852, which falls into the "Very High" category. Table 9 shows the results of the reliability test.

Table 9. Reliability Test

Reliability Value	Category
0.852	Very High

T-test

The T-test in this study is used to determine whether there is a positive and significant effect from using vision-based mobile robots for moving goods as a learning medium compared to the use of existing conventional learning media. This information is obtained from the average difference between the pretest and posttest scores in the experimental group. Table 10 shows the results of data calculations.

Table 10. Results of data calculations

Experimental group	Pretest	Posttest
Maximum value	75.00	90.00
Minimum value	35.00	65.00
Mean	58.17	78.50
Median	60.00	80.00
Modus	50.00	75.00
Standard deviation	9.33	6.04

The T-test was conducted using IBM SPSS Statistics software, with a significance value (2-tailed) of 0.000 < 0.5. These results indicate a significant difference between the initial variable and the final variable. This means there is a positive and significant effect from the use of vision-based mobile robots for goods transfer as a learning medium (H_0 is rejected, and H_a is accepted). Table 11 shows the results of the T-test.

Table 11. T-test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
PreEks-PostEks	-20.333	8.703	1.589	-23.583	-17.083	-12.796	29	0,000

Implementation

At this stage, it is conducted at SMK KB Pusdikpal in the Robotic System Laboratory, with a focus on Mechatronics Engineering expertise. This implementation stage was conducted by 30 users, comprising 11th-grade students, using a questionnaire. The results obtained from this implementation stage include assessments, comments, and suggestions from users regarding the developed learning media, which is a vision-based mobile goods transfer robot.

Evaluation

In research using the ADDIE model, the evaluation stage is the final stage conducted to assess the developed product. The evaluation is performed based on the results of testing by subject matter experts, media experts, and users. These evaluation results are used to assess the feasibility of using vision-based mobile robots for material handling as a learning medium.

Conclusion

The learning media consists of a mobile goods transfer robot equipped with a Huskylens vision sensor. The developed learning media guidebook covers five topics. The developed learning media lab sheet is divided into 5 lab sheets. Test the vision sensor at a specific light intensity with the sensor positioned at a distance of 10 cm and 50 cm from the object. The vision sensor can detect colour if the light intensity value during the test is equal to or greater than 50 lux. The average movement speed test of the mobile robot was 0.124 meters/second with a track and 0.216 meters/second without a track.

The developed learning media demonstrated its potential to support practical learning activities in vocational education, especially in robotics and automation subjects. The integration of the Huskylens vision sensor enables students to understand object detection and color recognition concepts through direct experimentation. The guidebook and lab sheets provide structured instructions that help students operate the robot systematically and independently. The learning media can improve students' hands-on skills, problem-solving abilities, and understanding of sensor-based robotic systems in real-world industrial applications.

The feasibility of the material is demonstrated by values for each aspect, specifically content quality at 44, linguistic quality at 31, and presentation at 24, resulting in an assessment category of "Very Feasible." The feasibility of mobile robot learning media for goods transfer based on vision, as determined by the media feasibility test, yields values for each aspect, with content quality reaching 28, technical quality at 33.5, and instructional quality at 28, resulting in an assessment category of "Very Feasible." The feasibility of mobile robot learning media for goods transfer, from the user's perspective, shows values for each aspect, with content quality reaching 27, technical quality at 26, and instructional quality at 30. This media is rated "Feasible" for the technical quality aspect and "Very Feasible" for the content quality and instructional quality aspects. The results of the hypothesis testing (t-test) showed a significance value (2-tailed) of 0.000. Thus, it was initially rejected but was subsequently accepted (Sig. < 0.05). Therefore, the proposed hypothesis decision is that there is a significant difference in student test scores on the robotics system material.

References

Akmal, F. (2024). *Data BPS Februari 2024: Tingkat pengangguran lulusan SMK tertinggi, ini catatannya*. Radar Solo.

Arsyad, A. (2007). *Media pembelajaran*. PT Raja Grafindo Persada.

Asyhar, R. (2012). *Kreatif mengembangkan media pembelajaran*. Referensi Jakarta.

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer.

Budiaji, W. (2013). Skala pengukuran dan jumlah respon skala Likert (The measurement scale and the number of responses in Likert scale). *Jurnal Ilmu Pertanian Dan Perikanan, 2*(2), 127–133.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334. https://doi.org/10.1007/BF02310555

Hamalik. (1994). *Encyclopedia of education research*. PT Citra Aditya Bakti.

Knasel, T. M. (1985). Robotics. *U.S. Robotics Industries Association Annual Meeting*. https://doi.org/10.1016/S0167-8493(85)90097-X

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*.

Prentice Hall.

Lase, D. (2019). *Education and industrial revolution 4.0*. Jurnal Sundermann.

Lee, H. Y., & Murray, C. C. (2018). Robotics in order picking: Evaluating warehouse layouts for pick, place, and transport vehicle routing systems. *International Journal of Production Research, 57*(18), 5821–5841. https://doi.org/10.1080/00207543.2018.1552031

Meyer, M., & Booker, J. (1991). *Eliciting and analyzing expert judgement: A practical guide*. Academic Press.

Miftah, M., & Nur Rokhman. (2022). Kriteria pemilihan dan prinsip pemanfaatan media pembelajaran berbasis TIK sesuai kebutuhan peserta didik. *Educenter: Jurnal Ilmiah Pendidikan, 1*(9), 641–649. https://doi.org/10.55904/educenter.v1i9.92

Munir, Y. A. (2008). *Kurikulum berbasis teknologi informasi dan komunikasi*. CV Alfabeta.

Peraturan Pemerintah Republik Indonesia. (2016). *Peraturan Menteri Pendidikan dan Kebudayaan Nomor 20 Tahun 2016 tentang standar kompetensi lulusan pendidikan dasar dan menengah*.

Reiser, R. A., & Dempsey, J. V. (2012). *Trends and issues in instructional design and technology* (3rd ed.). Pearson.

Schwab, K. (2016). *The fourth industrial revolution*. World Economic Forum.

Sørensen, L., Johannesen, D. T., & Johnsen, H. M. (2024). Humanoid robots for assisting people with physical disabilities in activities of daily living: A scoping review. *Assistive Technology, 37*(3), 203–219. https://doi.org/10.1080/10400435.2024.2337194

Spada Indonesia. (2019). *Era revolusi industri 4.0: Perlu persiapkan literasi data, teknologi dan sumber daya manusia*.

Vernon, P. E., & Gage, N. L. (1965). Handbook of research on teaching. *British Journal of Educational Studies, 14*(1). https://doi.org/10.2307/3119055

Waraditya, D. (2024). *SMK dan industri tak kunjung selaras*. Kompas.