

Analysis of User Satisfaction in the Development of ICT Learning Media Using AR-Based Assemblr Edu with the PIECES Framework Method

Zulham Sitorus¹, Ami Abdul Jabar², Maida Indrayani³, Sipra Barutu⁴, Meiarni Situkkir⁵

^{1,2,3,4,5}Master of Information Technology, Universitas Pembangunan Panca Budi, Indonesia

ABSTRACT

This study analyzes user satisfaction in the development of Augmented Reality (AR) learning media using the Assemblr Edu application. The method employed is the PIECES Framework, which includes the variables of Performance, Information, Economics, Control and Security, Efficiency, and Service. The sample consists of 30 respondents, including 1 teacher and 29 students from class X TKJ 1 at SMKS Panca Budi Medan. Data were collected through a questionnaire utilizing a Likert scale to measure satisfaction levels. The analysis results indicate that the respondents' satisfaction level is VERY SATISFIED. This research is expected to contribute to the development of AR-based learning media in education, enhance understanding of user satisfaction with the Assemblr Edu application, and encourage the use of similar technologies in other educational institutions.

Keyword : Assemblr Edu; Augmented Reality; Pieces Framework



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Corresponding Author:

Zulham Sitorus
Master Of Information Technology
Universitas Pembangunan Panca Budi
Jl. Jend. Gatot Subroto Km. 4,5 Sei Sikambang 20122, Medan, Indonesia.
Email : zulhamsitorus@dosen.pancabudi.ac.id

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1. INTRODUCTION

Technology offers numerous benefits across various fields and aspects of life, including education (Syarif & Astuti, 2023). Education is a crucial factor in enhancing abilities and improving the quality of life and dignity of individuals in the context of national development (Sofyan & Dewantari, 2023). The rapid development of Information and Communication Technology (ICT) has impacted the use of learning media (Sukma et al., 2023). One of the key factors for the success of the learning process is the presence of learning media (Sukma et al., 2023). Learning in the era of Industry 4.0 requires digitalization in education, as evidenced by the use and utilization of technology in the learning process, particularly through media as a tool for interaction between teachers and students (Sulistiani et al., 2023). The importance of learning media cannot be underestimated in the context of education (Rahmatika et al., 2023).

In the field of education, AR technology can be utilized as a learning medium (Assegaf Baalwi, 2023). The utilization of Augmented Reality in the learning process is an effort to correlate learning with evolving technology (Karisman & Wulandari, 2019). Augmented Reality, as one of the growing fields in the Industry 4.0 era, is already widely used in various aspects of human life (Nurhasanah & Putri, 2020). Augmented Reality is an application that combines the real world with virtual worlds in two or three dimensions, simultaneously projected into the real environment (Wibowo et al., 2022). Assemblr Edu is a straightforward platform that provides an interactive learning environment where users can create creative projects using Augmented and Virtual Reality technologies. (Ridho & Ekowati, 2024). The use of Augmented Reality (AR) in the Assemblr Edu application is not only enjoyable for users but also easy to understand. (Ridho & Ekowati, 2024)

Based on previous research titled "Analysis of the Utilization of Assemblr Edu Learning Media in Mathematics Education on Circle Material at SMA Negeri 14 Semarang" conducted by Ali Ridho, Supandi, and Noer Hudha Ekowati, it was concluded that both teachers and students are highly interested in using Assemblr Edu, particularly for circle material in class 11-3. This tool is well-liked because it helps students better understand lessons and fosters good interaction between teachers and students. The use of Assemblr Edu also boosts students' enthusiasm and engagement in mathematics. Learning

mathematics is often perceived as difficult, but with Assemblr Edu, students can learn while playing. Technology-based learning allows teachers to use Assemblr Edu as a teaching tool, enhancing learning outcomes and quality while providing motivation to students. Especially in mathematics, Assemblr Edu aids teachers in delivering concepts more clearly through three-dimensional visualizations, thus facilitating students' understanding of the taught material (Ridho & Ekowati, 2024).

Augmented Reality (AR) technology in Assemblr Edu has garnered significant attention from researchers and practitioners, especially in the field of education. Despite its proven ability to increase student engagement, research on user satisfaction remains limited. Therefore, there is a need for analysis using the PIECES Framework to gain a deeper understanding of user satisfaction in educational contexts, particularly in the development of AR-based learning media using Assemblr Edu. The PIECES Framework is a method or framework used to classify problems or issues within the scope of definition, system analysis, and design. In PIECES, there are 6 variables: Performance, Information and Data, Economics, Control and Security, Efficiency, and Service. Each of these variables is calculated using formulas to obtain average scores. (Adiansyah et al., 2023). Therefore, this research focuses on user satisfaction with the development of ICT-based Augmented Reality (AR) learning media using the Assemblr Edu application, particularly in the ICT subject for class X TKJ 1 at SMKS Panca Budi Medan. The method used in this research is the PIECES Framework, which includes Performance, Information, Economics, Control, Efficiency, and Service. This research aims to bridge the knowledge gap regarding user satisfaction with the Assemblr Edu application in an educational context using the PIECES Framework, thereby making a significant contribution to the development and implementation of Augmented Reality (AR) technology in education.

2. RESEARCH METHOD

- a. Sample selection, using the census method, involves sampling the entire population because the population is relatively small. (Yuniari et al., 2024). The population in class X TKJ 1 at SMKS Panca Budi Medan consists of 30 individuals (1 teacher and 29 students). Therefore, this study utilizes a sample size of 30 users of the Assemblr Edu application in developing AR-based ICT learning media related to computer hardware knowledge, which will be evaluated for user satisfaction.
- b. Data Collection Method using questionnaires. A questionnaire is a tool used to gather data through a series of questions designed to measure research variables (Adiansyah et al., 2023). The questionnaire contains questions related to the Assemblr Edu application used by the users, and the results will be measured accordingly.
- c. Measurement Method, in measuring the questionnaire results, a Likert scale is used to gauge user opinions on using the Assemblr Edu application. The Likert scale is a quantitative method of measuring someone's opinion using a questionnaire to assess attitudes towards a specific object (Sumartini et al., 2020). Here are the Likert scale values from respondents that will be used in this study:

Table 1. Likert Scale

Answer Choices	Abbreviation	Score
Strongly Agree	SA	5
Agree	A	4
Doubtful	D	3
Don't Agree	DA	2
Strongly Disagree	SD	1

- d. Data analysis to measure the level of user satisfaction with the Assemblr Edu application is conducted using the PIECES Framework method as part of the evaluation process. Menurut (Indrayani et al., 2023) The PIECES Framework method is a method used to evaluate systems, comprising Performance, Information and Data, Economics, Control and Security, Efficiency, and Service. The following are several variables contained in the PIECES Framework method:
 - 1) Performance
Analysis Evaluation of the performance of the Assemblr Edu application using AR technology will help measure how well the application operates in providing a smooth and responsive user experience.
 - 2) Information
Analysis Evaluation of Assemblr Edu application information using AR technology will help measure how well this application provides relevant information to users in the learning media development process.
 - 3) Economics

Analyzing the economic evaluation of the Assemblr Edu application using AR technology will help measure how well the application manages expenditure costs or investments in using Assemblr Edu.

4) Control and Security

Analyzing the control and security evaluation of the Assemblr Edu application using AR technology will help measure how well the application implements user data security.

5) Efficiency

Analyzing the efficiency evaluation of the Assemblr Edu application using AR technology will help measure how well the application manages resources to provide an efficient learning experience.

6) Service

Analyzing the service evaluation of the Assemblr Edu application using AR technology will help measure how well the application provides services in AR development.

After collecting data from the questionnaires distributed to Assemblr Edu application users, the next step will be data analysis process. According to (Indrayani et al., 2023), here are the formulas used in the PIECES method.

$$RK = JSK / JK$$

Explanation

RK = Average Satisfaction

JSK = Total Questionnaire Score

JK = Number of questionnaires

Based on the formula above, the average satisfaction score is obtained by dividing the total score of the questionnaires by the number of questionnaires for each variable. The determination of satisfaction levels can use the model stated by Kaplan and Norton, with satisfaction levels as follows (Kinanti et al., 2021):

Scale	Assessment Category
1 - 1.79	Very Dissatisfied
1.8 - 2.59	Not satisfied
2.6 - 3.39	Doubtful
3.4 - 4.19	Satisfied
4.2 - 5	Very satisfied

3. RESULTS AND DISCUSSION

A. Sample Selection

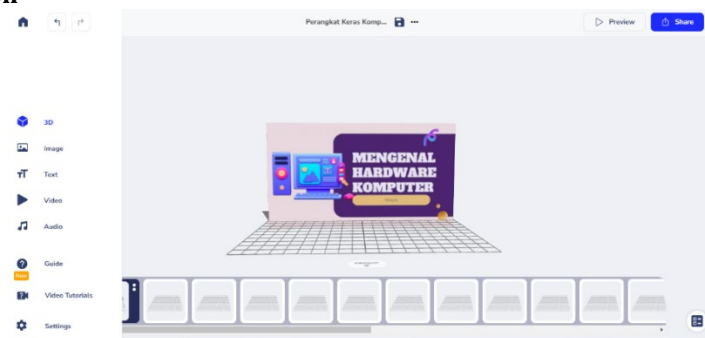


Fig 1. Development of AR-Based ICT Learning Media

In Figure 1, a sample of users (teachers and students) is engaged in developing AR-based ICT learning media using Assemblr Edu, focusing on the topic of Computer Hardware Awareness. It is evident from the 30 samples of Assemblr Edu application users that they have successfully developed AR-based learning media, specifically related to the topic of "computer hardware awareness," as demonstrated by the thumbnail in Figure 1.

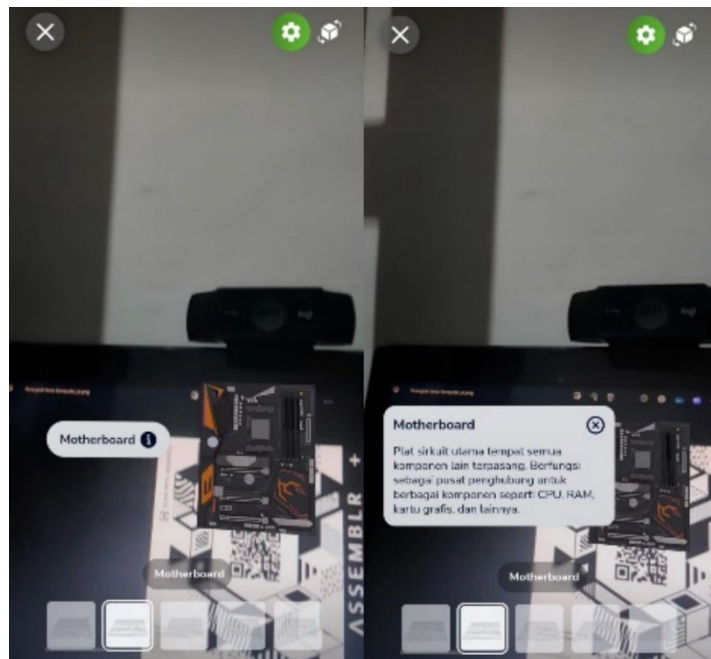


Fig. 2 Displays the results of AR-based learning media development

In Figure 2, the results of AR-based ICT learning media development on the topic of Computer Hardware Awareness can be seen successfully created using Assemblr Edu. According to the statement made by (Wibowo et al., 2022) Augmented Reality is an application that combines the real world with virtual elements in two or three dimensions simultaneously projected into the real environment.

B. Data Analysis

Data analysis includes questionnaires, Likert scales, and the PIECES method to measure user satisfaction levels with the Assemblr Edu application. The PIECES Framework method is used as an evaluation stage to determine user satisfaction levels based on six variables within the PIECES Framework, namely:

1) Performance

The Performance aspect in the PIECES method focuses on how the Assemblr Edu application performs in terms of speed, reliability, and quality of interaction with users. This includes response time, user interface, feedback, and visualization quality. The aspect is expressed in questionnaire statements as shown in Table 3.

Table 3. Performance Variables Questionnaire

Code	Statement
P1	The Assemblr Edu application provides a quick response time when loading Augmented Reality (AR) content.
P2	The Assemblr Edu application features an attractive and user-friendly interface (UI).
P3	The Assemblr Edu application provides clear feedback when interacting with AR objects.
P4	The application responds well to user interactions when using AR features.
P5	The navigation features in the Assemblr Edu application are easy to understand and use.
P6	The quality of AR object visualization in the Assemblr Edu application meets my expectations
P7	I am satisfied with the AR content loading speed in the Assemblr Edu application.

Tabel 4 Questionnaire Results for Performance Variables

RESPONDENT	PERFORMANCE						
	P1	P2	P3	P4	P5	P6	P7
R1	5	5	4	4	4	4	5
R2	5	5	5	4	4	5	4
R3	5	5	5	5	5	5	5
R4	5	5	5	4	4	4	4
R5	4	4	5	5	4	5	4
R6	4	4	5	5	4	4	4
R7	5	5	4	5	4	4	5
R8	5	5	5	4	4	5	4

R9	4	4	5	4	4	5	4
R10	4	5	4	5	4	5	4
R11	5	4	5	5	5	5	4
R12	4	4	4	5	5	5	5
R13	5	4	5	4	5	5	5
R14	5	5	4	4	5	5	4
R15	4	5	4	5	4	4	4
R16	5	4	5	5	4	4	5
R17	4	4	4	5	4	5	4
R18	4	5	5	4	5	5	5
R19	4	4	5	4	5	5	5
R20	4	5	5	4	4	5	5
R21	5	5	4	5	4	5	5
R22	4	4	5	5	5	5	4
R23	5	4	5	5	4	4	5
R24	4	5	5	4	5	4	4
R25	5	5	5	5	4	5	5
R26	4	4	5	5	5	5	4
R27	4	4	4	5	4	4	4
R28	5	5	5	4	4	4	4
R29	5	4	4	5	5	5	4
R30	5	5	5	4	4	5	5
Total	136	136	140	137	131	140	133
Average	4,53	4,53	4,67	4,57	4,37	4,67	4,43

$$RK = \frac{4,53 + 4,53 + 4,67 + 4,57 + 4,37 + 4,67 + 4,43}{7}$$

$$RK = \frac{31,77}{7}$$

$$RK = 4,54$$

Based on the calculation in table 4, the questionnaire results for the performance variable obtained an average satisfaction score of 4.54. According to the PIECES method, this categorizes the performance as **VERY SATISFIED**.

2) Information

The Information aspect in the PIECES method focuses on how the Assemblr Edu application efficiently and effectively provides, manages, distributes, and integrates information, and how the system aids users in accessing and comprehending the necessary information. The corresponding questionnaire statements can be found in Table 5

Table 5. Kuesioner Variabel Information

Code	Statement
I1	The Assemblr Edu application provides user guides in the form of clear and easy-to-understand articles.
I2	The Assemblr Edu application provides user guides in the form of clear and easy-to-understand video tutorials.
I3	The Assemblr Edu application facilitates access to user communities or forums for sharing information and experiences.
I4	I am satisfied with the ease of access to the necessary information in the Assemblr Edu application.
I5	I feel that the Assemblr Edu application facilitates self-learning for new users.
I6	The Assemblr Edu application facilitates efficient management and distribution of information.
I7	The Assemblr Edu application facilitates effective integration with other systems.

Table 6. Questionnaire Results for Information Variables

RESPONDENT	INFORMATION						
	I1	I2	I3	I4	I5	I6	I7
R1	4	5	5	4	5	5	5
R2	5	4	5	5	4	4	4
R3	4	4	4	4	4	5	5
R4	5	5	4	4	5	4	5
R5	5	5	4	4	4	4	5
R6	5	5	5	4	4	4	4
R7	4	5	4	5	5	4	4
R8	4	5	5	4	4	5	5
R9	4	4	4	5	5	5	5
R10	4	4	4	4	4	5	5
R11	5	5	4	4	5	5	5

R12	5	4	4	4	4	5	4
R13	5	5	4	5	4	5	4
R14	5	4	5	5	4	5	5
R15	5	4	4	5	5	5	5
R16	5	4	4	5	5	5	5
R17	5	4	4	4	5	5	4
R18	4	5	5	4	4	4	4
R19	4	4	4	4	4	4	5
R20	4	4	4	4	5	4	5
R21	5	4	5	4	4	4	5
R22	5	4	4	4	4	4	5
R23	4	5	4	4	5	4	4
R24	4	5	4	4	4	5	5
R25	5	4	4	4	5	4	4
R26	5	5	5	4	5	4	4
R27	5	5	5	4	5	5	4
R28	5	5	4	4	4	4	5
R29	5	4	5	5	4	4	4
R30	5	4	4	4	5	4	4
Total	139	134	130	128	134	134	137
Average	4,63	4,47	4,33	4,27	4,47	4,47	4,57

$$RK = \frac{4,63 + 4,47 + 4,33 + 4,27 + 4,47 + 4,47 + 4,57}{7}$$

$$RK = \frac{31,20}{7}$$

$$RK = 4,46$$

Based on the calculation in Table 6, the questionnaire results for the information variable obtained an average satisfaction score of 4.46. According to the PIECES method, this categorizes the information as **VERY SATISFIED**.

3) Economics

The Economics aspect in the PIECES method focuses on how the Assemblr Edu application can reduce costs, optimize resources, increase productivity, reduce waste, save time, and provide value commensurate with the expenses incurred. The corresponding questionnaire statements can be found in Table 7.

Table 7. Economic Variables Questionnaire

Code	Statement
E1	This application helps reduce operational costs in developing AR content compared to conventional methods.
E2	This application helps optimize resource utilization in the development and implementation of AR content.
E3	This application helps improve productivity in learning through the use of AR technology.
E4	I feel that this application helps reduce the cost of acquiring traditional learning materials.
E5	This application helps reduce wastage of resources in the learning process.
E6	This application facilitates time savings in creating and using AR learning materials.
E7	I feel that this application provides results that are worth the cost incurred.

Table 8. Questionnaire Results for Economics Variables

RESPONDENT	ECONOMICS						
	E1	E2	E3	E4	E5	E6	E7
R1	5	5	4	5	4	5	5
R2	4	4	4	5	5	4	4
R3	4	5	5	5	4	5	5
R4	4	5	5	5	4	4	4
R5	4	4	4	5	4	4	4
R6	4	5	4	4	5	4	4
R7	4	5	4	4	5	4	4
R8	5	4	5	5	4	4	5
R9	4	5	4	5	4	5	5
R10	5	5	4	4	5	4	4
R11	5	5	4	4	5	5	4
R12	4	4	5	5	5	5	4
R13	5	5	5	4	4	4	4
R14	4	5	4	4	4	4	4
R15	4	5	5	4	4	5	5

R16	4	4	4	5	4	5	4
R17	4	5	5	4	5	5	5
R18	5	4	5	5	5	5	4
R19	4	5	5	5	5	5	4
R20	5	4	4	4	5	5	5
R21	5	5	4	4	5	5	5
R22	4	5	4	4	5	5	4
R23	4	4	4	5	4	5	4
R24	4	4	4	5	5	5	5
R25	4	5	4	5	5	5	5
R26	5	4	5	5	4	4	4
R27	5	5	5	5	5	4	5
R28	4	4	4	5	5	5	5
R29	5	4	5	5	4	6	5
R30	4	4	5	5	5	5	5
Total	131	137	133	139	137	140	134
Average	4,37	4,57	4,43	4,63	4,57	4,67	4,47

$$RK = \frac{4,37 + 4,57 + 4,43 + 4,63 + 4,57 + 4,67 + 4,47}{7}$$

$$RK = \frac{31,70}{7}$$

$$RK = 4,53$$

Based on the calculation in Table 8, the questionnaire results for the economics variable obtained an average satisfaction score of 4.53. According to the PIECES method, this categorizes the economics aspect as **VERY SATISFIED**.

4) Control and Security

The Control and Security aspect in the PIECES method focuses on how the Assemblr Edu application manages access control, encryption, data security, data deletion procedures, transaction security, and security monitoring to ensure data and transaction integrity and protection. Statements related to this aspect can be found in Table 9 of the questionnaire.

Table 9. Kuesioner Variabel Control and Security

Code	Statement
C1	The AR projects I have created are automatically saved, allowing me to edit or even delete projects at different times.
C2	This application has access restrictions, ensuring that AR projects I create cannot be accessed or modified by users without specific permissions.
C3	This application provides an account deletion feature, allowing users to remove their account from the system.
C4	This application provides a refund option.
C5	This application uses SSL encryption to securely transmit data.
C6	This application provides ease of payment using Midtrans while ensuring optimal transaction security.
C7	This application conducts regular security audits and monitoring to ensure the security and integrity of the system.

Table 10. Questionnaire Results for Control and Security Variables

RESPONDENT	CONTROL AND SCURITY						
	CS1	CS2	CS3	CS4	CS5	CS6	CS7
R1	5	5	5	5	4	4	4
R2	5	5	4	5	5	5	5
R3	4	4	5	5	5	5	5
R4	5	5	4	5	5	4	5
R5	4	5	5	5	4	4	5
R6	4	4	5	4	4	4	4
R7	5	4	4	4	4	4	5
R8	4	5	4	4	4	4	5
R9	4	5	4	4	4	4	4
R10	4	4	5	5	5	5	4
R11	4	5	5	5	5	5	5
R12	4	4	5	4	4	5	5
R13	4	4	5	5	4	5	5
R14	4	5	4	5	4	5	4
R15	5	4	5	4	5	4	5
R16	5	4	5	4	5	5	5
R17	5	5	4	4	5	5	4
R18	5	5	4	5	4	4	4

R19	4	5	4	5	5	5	5
R20	5	5	4	4	4	5	5
R21	4	4	4	5	5	4	5
R22	5	4	4	4	4	5	4
R23	5	4	5	5	4	5	4
R24	5	4	4	5	5	5	4
R25	4	5	5	5	4	5	5
R26	4	4	4	4	5	5	5
R27	5	5	5	5	4	5	5
R28	4	5	4	4	4	4	4
R29	4	4	5	4	5	5	5
R30	5	5	4	4	4	5	5
Total	134	136	134	136	133	139	139
Average	4,47	4,53	4,47	4,53	4,43	4,63	4,63

$$RK = \frac{4,47 + 4,53 + 4,47 + 4,53 + 4,43 + 4,63 + 4,63}{7}$$

$$RK = \frac{31,70}{7}$$

$$RK = 4,53$$

Based on the calculation in Table 10, the questionnaire results for the Control and Security variable obtained an average satisfaction score of 4.53. According to the PIECES method, this categorizes the Control and Security aspect as **VERY SATISFIED**.

5) Efficiency

The Efficiency aspect in the PIECES method focuses on how the Assemblr Edu application minimizes the use of time, effort, and resources to achieve desired outcomes, enhances productivity, and optimizes processes and workflows. Statements related to this aspect are located in Table 11 of the questionnaire.

Table 11. Questionnaire for Efficiency Variables

Code	Statement
E1	The account registration process in the Assemblr Edu application is quick and efficient.
E2	Creating an account in this application does not require much effort or unnecessary steps.
E3	This application provides options to efficiently log in through existing social media accounts or email.
E4	The AR creation system in this application does not require a long time to complete.
E5	This application allows me to start using AR content immediately after creation is finished.
E6	This application provides options to efficiently use templates or automation tools in AR creation.
E7	The user experience with pre-provided AR content such as 3D Bundles, 3D Objects, and the option to import content (3D, Audio, Images) in this application adds value without requiring excessive effort.

Table 12. Questionnaire Results for Efficiency Variables

RESPONDENT	EFFICIENCY						
	E1	E2	E3	E4	E5	E6	E7
R1	5	4	4	5	5	4	5
R2	4	4	4	5	5	4	4
R3	5	5	5	5	5	5	4
R4	5	4	4	4	5	5	4
R5	5	5	5	4	5	4	5
R6	4	5	4	5	4	5	4
R7	5	4	5	5	4	5	5
R8	5	4	4	4	4	5	4
R9	4	5	5	5	4	5	4
R10	5	4	5	5	5	4	4
R11	5	5	4	5	4	5	5
R12	4	5	5	4	4	5	4
R13	5	5	4	4	4	5	4
R14	5	4	5	4	4	4	4
R15	5	4	4	5	4	4	5
R16	4	5	4	4	4	4	5
R17	5	5	5	5	4	4	4
R18	5	4	4	5	5	4	5
R19	4	5	4	5	5	4	5
R20	5	4	5	4	5	4	4
R21	5	5	4	5	5	4	5
R22	5	5	5	5	5	5	4

R23	5	4	4	5	4	4	4
R24	5	4	4	5	4	4	5
R25	4	4	4	4	4	4	5
R26	4	4	5	5	4	4	5
R27	5	4	4	4	5	4	5
R28	4	4	4	4	4	5	5
R29	4	5	5	5	5	5	5
R30	5	5	5	5	4	4	5
Total	140	134	133	139	133	133	136
Average	4,67	4,47	4,43	4,63	4,43	4,43	4,53

$$RK = \frac{4,67 + 4,47 + 4,43 + 4,63 + 4,43 + 4,43 + 4,53}{7}$$

$$RK = \frac{31,60}{7}$$

$$RK = 4,51$$

Based on the calculation in Table 12, the questionnaire results for the efficiency variable obtained an average satisfaction score of 4.51. According to the PIECES method, this categorizes the efficiency aspect as **VERY SATISFIED**.

6) Service

The Service aspect in the PIECES methodology emphasizes how the Assemblr Edu application supports users through the provision of resources, training modules, instructional guides, technical assistance, and effective solutions to facilitate system utilization. These aspects are reflected in the questionnaire statements found in Table 13.

Table 13. Service Variables Questionnaire

Code	Statement
S1	This application provides comprehensive tutorials and guides to assist me in creating AR content.
S2	The guides provided by this application make it easier for me to understand how the AR creation tools work.
S3	This application provides examples of AR content that can be used as references in creation.
S4	This application provides training or workshops that are beneficial for improving my skills in creating AR content.
S5	This application provides online resources, such as video tutorials and documentation, which are very helpful.
S6	This application provides adequate support through various channels such as email, chat, or phone.
S7	This application provides quick and effective solutions to the technical issues I encounter.

Table 14. Questionnaire Results for Service Variables

RESPONDENT	SERVICE						
	S1	S2	S3	S4	S5	S6	S7
R1	5	4	5	4	5	5	4
R2	5	5	5	4	5	4	5
R3	4	5	5	5	5	5	5
R4	4	5	4	4	4	4	5
R5	4	5	4	4	4	5	4
R6	4	5	4	5	5	5	4
R7	4	5	4	4	5	5	5
R8	4	5	5	5	4	5	5
R9	4	5	4	5	5	4	5
R10	5	5	4	4	4	4	4
R11	4	5	4	5	5	4	4
R12	5	4	4	4	5	5	4
R13	5	4	5	5	5	4	5
R14	4	5	4	4	4	5	5
R15	5	5	5	4	4	5	4
R16	5	5	5	4	4	5	4
R17	5	4	4	5	5	4	4
R18	5	4	4	4	5	4	5
R19	5	4	4	5	4	4	4
R20	5	4	5	4	5	5	4
R21	4	5	4	4	5	5	5
R22	4	4	5	5	4	5	4
R23	5	4	4	4	4	4	4
R24	5	5	5	5	4	4	5
R25	5	4	5	5	5	5	4
R26	4	5	4	5	4	4	5

R27	4	5	5	4	4	4	5
R28	5	5	4	5	4	5	5
R29	4	4	5	5	5	4	4
S30	5	5	4	4	5	5	4
Total	136	139	133	134	136	136	134
Average	4,53	4,63	4,43	4,47	4,53	4,53	4,47

$$RK = \frac{4,53 + 4,63 + 4,40 + 4,47 + 4,53 + 4,53 + 4,47}{7}$$

$$RK = \frac{31,60}{7}$$

$$RK = 4,51$$

Based on the calculation in table 14, the questionnaire results for the service variable obtained an average satisfaction score of 4.51. According to the PIECES method, this categorizes the service as **VERY SATISFACTORY**.

4. CONCLUSION

Based on the research conducted on user satisfaction with the Assemblr Edu application in developing Augmented Reality (AR)-based learning media, it can be concluded that all variables in the PIECES Framework indicate a high level of satisfaction.

1. Performance: The analysis results indicate that the application has fast response times, an attractive interface, and adequate visualization quality, with an average satisfaction rating of 4.54, categorized as **VERY SATISFIED**.
2. Information: The application also provides relevant and easily accessible information to users, including clear guides and tutorials. The average satisfaction score for this aspect reaches 4.46, also falling under the **VERY SATISFIED** category.
3. Economics: Economically, users feel that the application helps reduce costs and optimize resources, with an average satisfaction rating of 4.50, indicating significant satisfaction and **VERY SATISFIED**.
4. Control and Security: The aspect of control and security related to user data management shows that the application implements adequate measures to maintain privacy and security, with an average satisfaction rating above 4.40, thus falling into the **VERY SATISFIED** category.
5. Efficiency: The use of this application proves efficient in time and resource management, with users feeling supported in the learning process. The average satisfaction rating in this area reaches 4.45, also categorized as **VERY SATISFIED**.
6. Service: In terms of service, the Assemblr Edu application provides excellent support in the development of learning media, with an average satisfaction rating also showing positive results above 4.40 and falling into the **VERY SATISFIED** category.

Overall, this research confirms that the use of AR technology through the Assemblr Edu application is highly sought after and effective in enhancing learning experiences in the field of education, especially in ICT subjects. These findings are expected to contribute to further development of AR-based learning media and encourage the adoption of similar technologies in other educational institutions.

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