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Innovation in Aviation Education: Development of a Web-Based Flight Simulator Management System (FSMS) at Pilot Academy

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ABSTRACT

The main objective of this study is to optimise the documentation process for simulator administration in compliance with regulatory norms. This will allow both the simulator administrator and operations administrator to efficiently strategize the utilisation of the simulator, while also providing management with easy access to documented results. The research methodology utilized in this investigation is the ADDIE research model, which encompasses Analysis, Design, Development, Implementation, and Evaluation. The results of this research illustrate that the Flight Simulator Management System (FSMS) information system operates effectively, incorporating various menu pages. These menu pages include a dashboard, simulator schedule, simulator checklist, simulator log book, simulator maintenance, simulator malfunction, reports, database summary, cadet data, flight instructor data, and user data. The results of the validation of the three experts have an average value of 3.41 or are classified as good criteria. These results are obtained by looking at the usability aspect, which has an average value of 3.27, while the design aspect has an average value of 3.53, and the operational aspect has an average value of 3.44. the validation results of ten users have an average value of 3.37 or are classified as good criteria. These results were obtained by looking at the truth aspect, which had an average value of 3.30, while the effectiveness aspect obtained an average value of 3.34, and the operational aspect received an average value of 3.47.

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1. INTRODUCTION

The aviation industry has experienced significant advancements in technology and the integration of digital solutions in recent years. An essential advancement in this area is the Flight Simulator Management System (FSMS), which has a crucial function in overseeing and controlling the laboratory unit at the Indonesian Pilot Academy of Banyuwangi. The Indonesian Aviation Academy of Banyuwangi, as an educational institution specialising in aviation, recognises the significance of adopting contemporary technology and acknowledges the necessity of enhancing management

governance. Flight simulators are software programmes that replicate the movements of aircraft, enabling aspiring pilots to become acquainted with different flight instruments using the simulation equipment prior to engaging in real flights. The use of flight simulators aims to make it easier for cadets to adjust to the aviation environment before practising airplane flying (Arif, Ikhwanul Qiram, & Rubiono, 2022). Becoming a pilot entails more than just acquiring knowledge through diverse educational programs. Regular participation in simulator training is also mandatory to navigate different flight scenarios, including emergencies. Failure to complete or insufficient frequency of these training sessions will inevitably lead to a decline in a pilot's competence to effectively operate an aircraft, particularly during critical moments (Suprianto, 2020).

In accordance with Regulation KM 56 of 2010, which pertains to Article 60 of the Civil Aviation Safety Regulations, there are specific provisions outlined for synthetic training aids. These provisions state that individuals or entities in possession of flight simulator certificates or flight training aids that meet the stipulated requirements must maintain detailed records regarding the tool. Furthermore, once the simulator or tool is no longer in use, it must be stored for a minimum duration of two years. Records include master qualification testing guidelines and qualification assessment results (initial and any escalation) since the original qualification statement was issued, amendment records, quality system records, and records of all complaints noted on the master qualification statement. Complaint diary for the last 2 years, listing components or equipment that were not installed, not working, or not operating, actions taken to correct the complaint, the date the corrective action was taken, and the identity of the person who made the complaint or that the damage has been repaired.

Designed and implemented a web-based Flight Simulator Management System (FSMS) specifically developed for the Indonesia Pilot Academy of Banyuwangi to meet these needs. The system will leverage the power of web technologies to provide an intuitive and comprehensive platform for managing records required for regulatory compliance and collecting or capturing, processing, storing and distributing information as a set of interconnected components to support decision-making. An information system is a combination of various resources, including hardware, software, network devices, brain devices, and data. Inputs, models, processes, outputs, storage and controls also exist in information systems so that information systems can be used to plan, process, control and integrate data within an organization in terms of key success to determine organizational success (Frisdayanti, 2019). In general, a system consists of interconnected elements to form a single unit to achieve the system's main goal.

The main purpose of the system is to process data and generate information, so it requires support from elements such as hardware, software and brainware. Hardware is the computer equipment itself, software are programs that contain instructions for carrying out certain processes, and brainware are the people involved in operating and managing the system. There are several methods available for information systems development, including structured and object-based approaches. The choice of development method will ultimately determine the specific devices in which the information system will be implemented (Triandini, Jayanatha, Indrawan, Werla Putra, & Iswara, 2019).

Prior investigations on Flight Simulator Management Systems have been undertaken by other scholars. Luu et al. (2021) created an air traffic control simulator system that is utilised for educational and training purposes. The conclusive outcome of this research endeavour is the effective construction of a simulation system that caters to the needs of teaching air traffic management. This system has two primary simulation modules: ATC and flight. Casanova et al. (2020) create precise and scalable simulators for production workflow management systems using WRENCH. This project is centred around the creation of a web-based system for managing a flight simulator. A crucial element in a computerised system is a web-based information system. This system has been meticulously crafted with a multitude of features and tailored to meet the specific requirements of users. The primary objective of this system is to streamline and expedite the data input process with enhanced precision (Wahyudin & Rahayu, 2020). This online flight simulator management solution will significantly transform operational procedures and enhance information management by providing numerous benefits compared to conventional approaches. By using this system, staff will be able to schedule

simulator usage sessions efficiently, record uptime, document scheduled maintenance, and monitor complaint logs that arise during simulator use. This will effectively reduce administrative workload and enhance workflow efficiency.

2. METHODS

The integration of the ADDIE framework (Analysis, Design, Development, Implementation, and Evaluation) within the realm of research and development (R&D) can be observed in Figure 1. R&D plays a pivotal role in both the creation and enhancement of new and existing products (Sa'adah, 2021). During the analysis phase, a comprehensive evaluation of the information system's requirements is conducted, while the design phase entails the creation of a system blueprint. Additionally, the development phase focuses on the implementation of the design process to establish a fully operational information system. The deployment of the designed information system takes place during the implementation phase, and the evaluation phase is regularly executed to assess its practical feasibility.

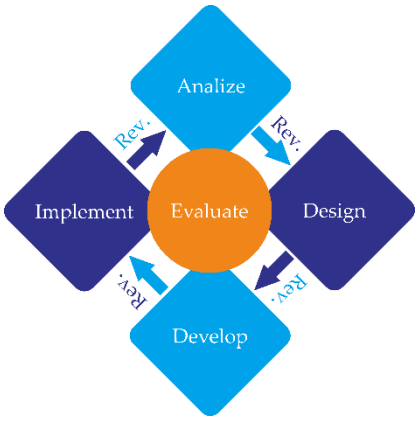

Figure 1. Showcases the seamless incorporation of the ADDIE framework

The study involved thirteen individuals: three information system expert functioning as a developer, and ten staff members serving as test subjects. A combination of interviews and questionnaires was utilized to collect data. The primary goal of the interviews was to gather information pertaining to different facets of the web-based information system, including input, process, and output data requirements. The interviews were conducted in an open and unrestricted manner. Conversely, the purpose of the questionnaires was to evaluate the validity of the product. This encompassed two questionnaires: one for information systems experts and another for user feedback.

The data for this research was gathered using a closed questionnaire, which required participants to input predetermined responses in specific columns and assign a value to each answer. The assessment of user feedback for information systems focuses on three primary indicators: usability, functionality, and visual communication. The analysis of the data utilized a descriptive technique, which involved calculating the percentage value for each indicator of the instrument.

To analyze needs, the first steps taken were observation and interviews with simulator and operation staff. The data obtained from this step is then used to design and develop an information system. The results of this design are then validated by experts. Validation is carried out by experts and the results are used to determine whether the information system is feasible or not. The indicators used as an assessment by experts can be found in table 1, while indicators from users can be found in table 2.

Table 1. The validation of expert instruments

No.	Aspects	Indicators
1	Aspects of expediency	a. The utilization of information systems offers a multitude of advantages in the realm of management and governance.
		b. The information system offers a convenient solution for organizing and managing the scheduling of simulator usage.
		c. The utilization of an information system grants ease and convenience when it comes to the logging and recording of simulator data.
		d. The information system offers a convenient solution for documenting and managing complaints regarding simulators.
		e. The information system offers a convenient solution for documenting simulator maintenance.
2	Design Aspect	a. User friendly information system.
		b. The information system is easy to understand.
		c. Clear design and font format.
		d. The menu structure is easy to understand.
		e. The sub menu structure is easy to understand.
3	Operational aspect	a. Ease of use of information systems.
		b. Availability of user manual.
		c. Ease of understanding the resulting information output format.

The evaluation of the information system, once it has been constructed, relies on user validation. This validation process is crucial in determining the usability and effectiveness of the product. The specific steps involved in user validation are as follows:

Table 2. An instrument for validating users' credentials and qualifications

No.	Aspects	Indicators
1	The aspect of correctness	a. To achieve effectiveness in decision-making, it is imperative to utilize information systems
		b. The utilization of information systems has the potential to expedite the completion of tasks
		c. Understanding and navigating the menu structure is straightforward and devoid of complexity
		d. The utilization of the information system facilitates the completion of tasks with efficiency and convenience
		e. Operating the information system does not necessitate extensive knowledge
2	The aspect of effectiveness	a. The utilization of information systems can be instrumental in successfully accomplishing tasks
		b. Reports can be generated in a prompt fashion by information systems.
		c. The creation of this specific information system does not necessitate any understanding or expertise in the field of information technology.
		d. Information systems play a crucial role in facilitating effective communication and interaction.
		e. The impact of information systems on work can be significantly positive.
3	Operational aspect	a. Ease of use of information systems.
		b. Availability of user manual.

c. The accessibility and comprehensibility of the information system are apparent and straightforward.

The Likert rating system, which comprised a series of items, was employed to develop the survey. Participants were solely tasked with indicating their level of agreement or disagreement with these items. (Yusuf, 2016) The objective of this scale is to evaluate personal attitudes on a standardized continuum, allowing individuals to position themselves within the scope of the items.

Table 3. Responses from experts and users of the Likert Scale were collected through a questionnaire

No.	Description	Score
1	Strongly Agree	4
2	Agree	3
3	Disagree	2
4	Strongly Disagree	1

Source: adoption and modification (Amrullah, Andarwati, Swalaganata, & Rosyadi, 2021)

Table 4 provides an explanation of the criteria used for data analysis in relation to the validation results from both experts and users. The criteria are based on qualitative data.

Table 4. Validation results from both experts and users

Score Interval	Grade Value	Remarks
$x > 3,45$	A	Very Good
$2,80 < x \leq 3,40$	B	Good
$2,20 < x \leq 2,80$	C	Pretty Good
$1,60 < x \leq 2,20$	D	Not Good
$x \leq 1,60$	E	Very Not Good

Source: adoption and modification (Sabirin, Sulistiyarini, & Zulkarnain, 2020)

3. FINDINGS AND DISCUSSION

To access the Flight Simulator Management System (FSMS) information system, users can visit the website https://fsms.icpa-banyuwangi.ac.id/. The user can be either the laboratory unit responsible for flight simulator maintenance or the operations unit in charge of scheduling simulator usage. The structure and design of the website are described in a straightforward manner as follows:

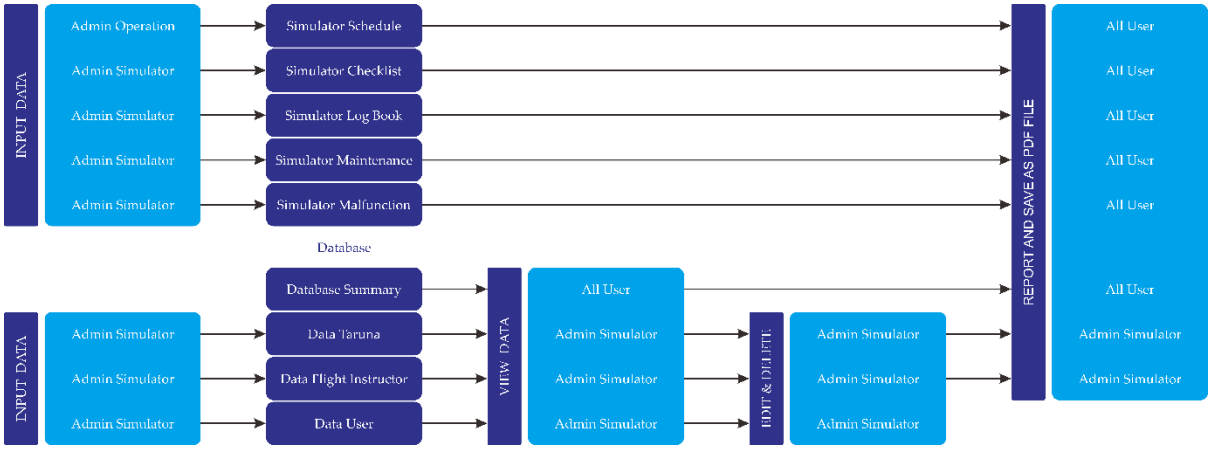

Figure 2. FSMS information system menu structure and design

The menu structure of the FSMS has been designed with simplicity in mind, allowing users to easily input, view, edit, delete, and print reports in PDF format. The simulator schedule menu is utilized by the operations administrator to input the schedule of simulator usage and has the capability to generate reports. The simulator checklist menu, simulator log book, simulator maintenance, simulator malfunction, database summary, cadet data, flight instructor data, and user data are all accessible to the simulator administrator, who has full permissions to this information system. On the other hand, user access rights are assigned to management, granting them the ability to view reports, while their permissions are limited to inputting, editing, and deleting data. The display of FSMS system information is presented in the following manner:

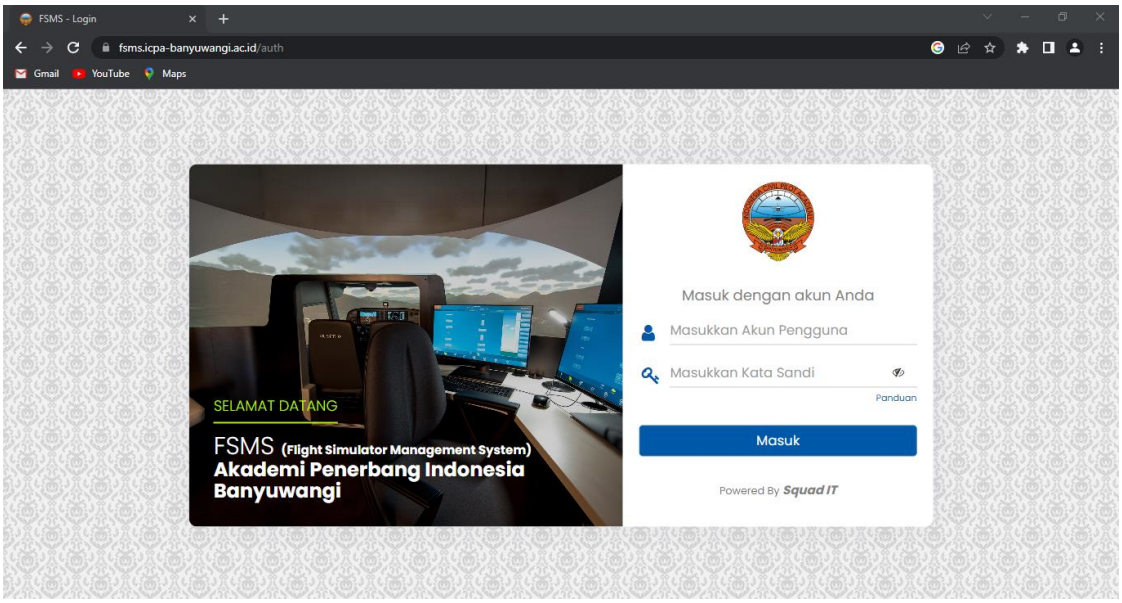

Figure 3. The display of the FSMS login page

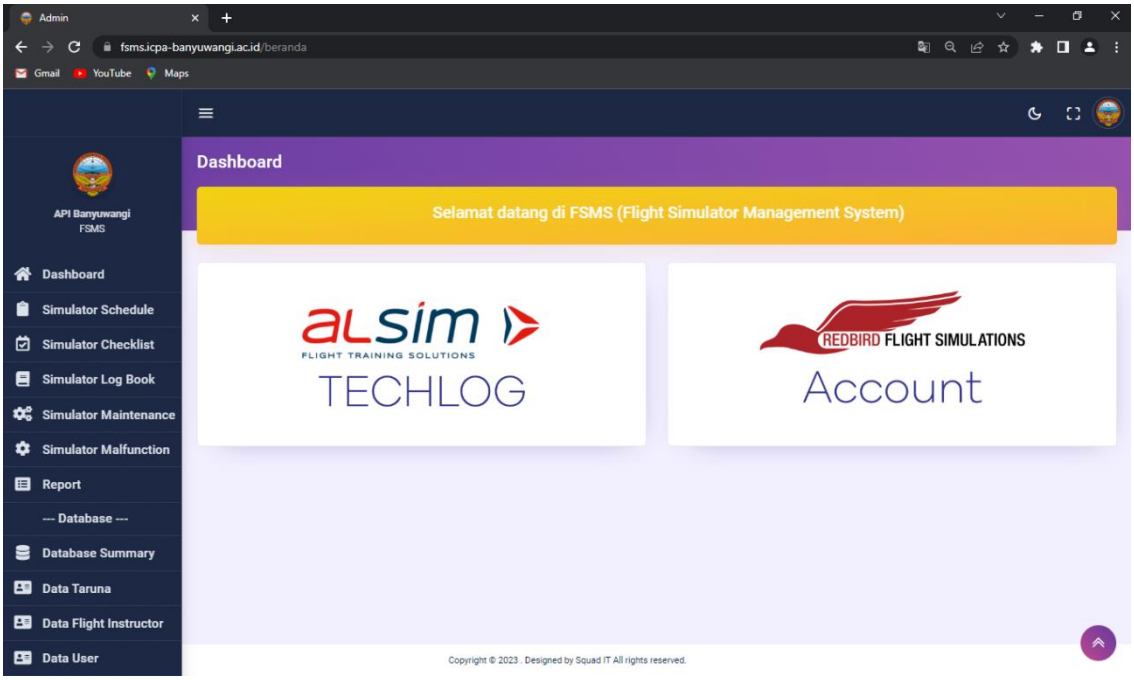

Figure 4. View of the FSMS home page

On the homepage, you will find links to technical support for two renowned flight simulator companies: ALSIM and Redbird Simulator. The ALSIM Techlog link will direct you to the login page for ALSIM maintenance support. Similarly, the Redbird Account link will take you to the login page for Redbird Simulator maintenance support. These links have been designed to facilitate easy access for simulator administrators.

The study does not provide a comprehensive display of other menus in order to protect the author's innovative work. However, access rights are showcased on the user data menu, which can be accessed by the simulator administrator on a limited basis for the purpose of inputting, editing, and deleting user data. The display of the user data menu is as follows:

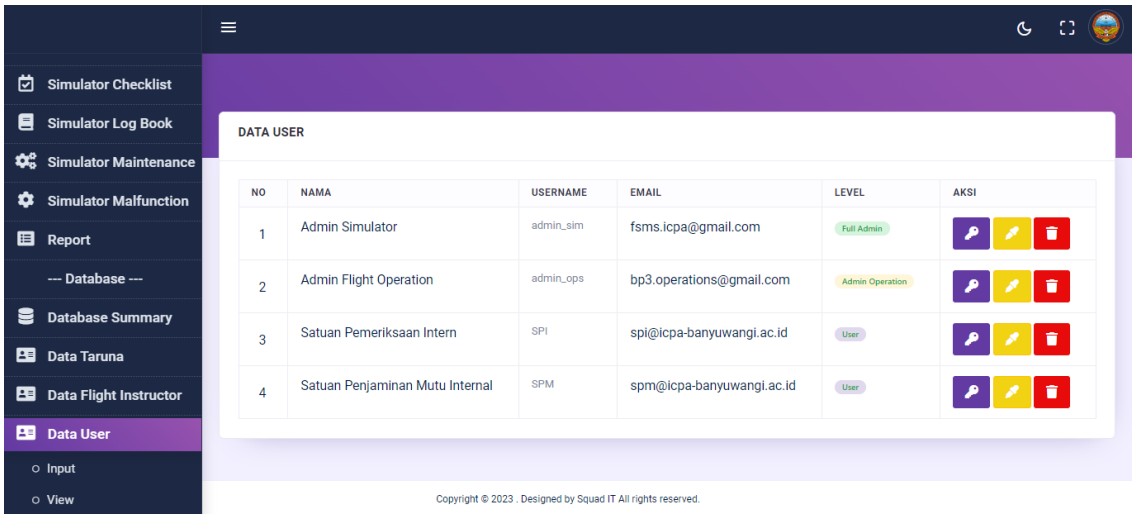

Figure 5. The display of the user data view menu in the FSMS

A set of criteria is proposed for judging a system's efficacy (Arifin et al., 2022). Here are the criteria must be met: 1) The system should produce up-to-date and pertinent data to aid in making decisions. 2) The system's usefulness to society should outweigh its monetary price tag. Thirdly, the system's output must be consistent, accurate, and functionally adequate. 4) The system's design and functionality should be intuitive and understandable, with a focus on clarity and efficiency. 5) The system should be malleable enough to accommodate unforeseen modifications.

Once the developed information system is completed, it undergoes rigorous testing to assess its overall quality. The quality assessment involves the utilization of a questionnaire-based data collection technique, which is administered to three experts. The results of this technique are presented in table 5. Additionally, the collective feedback gathered from ten staff members is summarized in table 6. The subsequent data analysis yielded the following findings:

Table 5. The validation process of the instrument by experts yielded valid results

Aspect Category	Value Result	Average Value
Aspects of expediency	49	3.27
Design Aspect	53	3.53
Operational aspect	31	3.44
Average Value		**3.41**
Criteria		**Very Good**

According to the data provided in Table 5, it is evident that the validation findings for the FSMS (Flight Simulator Management System) information system by three experts exhibit an average rating of 3.41, indicating a classification of very good. This outcome is derived from an assessment of the system's usability, which garnered an average score of 3.27. Additionally, the design aspect received

an average score of 3.53, while the operational aspect attained an average score of 3.44. The following table displays the outcomes derived from user validation data.

Table 6. The user's assessment of the information system's outcomes

Aspect Category	Value Result	Average Value
The aspect of correctness	165	3.30
The aspect of effectiveness	167	3.34
Operational aspect	104	3.47
Average Value		**3.37**
Criteria		**Good**

Based on the data presented in Table 6, it is clear that the evaluation results for the FSMS (Flight Simulator Management System) information system, as evaluated by ten users, have an average score of 3.37. This score falls within the "good" range, indicating a positive assessment. The evaluation specifically looked at the authenticity aspect, which received an average score of 3.30. Similarly, the efficacy aspect received an average score of 3.34, and the operational aspect received an average score of 3.47.

In order to ensure sufficient assurance, the FSMS information system conducts comprehensive testing on various menus. These menus include the simulator schedule, simulator checklist, simulator log book, simulator maintenance, simulator malfunction report, database summary, cadet data, flight instructor data, and user data. Table 7 provides a detailed overview of these menus.

Table 7. To acquire sufficient information, it is necessary to obtain test results

No.	Tested Menu	The results achieved	Remarks
1	Dashboard	Displays a home page, a welcome note with running text, a link to the ALSIM Techlog and the Redbird Account	Succeed
2	Simulator Schedule	Displays the schedule simulator data input page and print page and functions properly	Succeed
3	Simulator Checklist	Displays the checklist simulator data input page and print page and works fine	Succeed
4	Simulator Log Book	Displays log book simulator data input pages and print pages and works fine	Succeed
5	Simulator Maintenance	Displays maintenance simulator data input pages and print pages and works properly	Succeed
6	Simulator Malfunction	Displays the malfunction simulator data input page and prints the page and it works properly	Succeed
7	Report	Displays report pages and print pages and functions properly	Succeed
8	Database Summary	Displays the data view page on the database summary and print page and works fine	Succeed
9	Cadet Data	Displays data input pages, data views (to edit and delete data) on cadet data and print pages and functions properly	Succeed
10	Flight Instructor Data	Displays the data input page, data view (to edit and delete data) on the flight instructor data and print page and works properly	Succeed
11	User Data	Displays input and data view pages (for editing and deleting data) on user data and works properly	Succeed

4. CONCLUSION

The Flight Simulator Management System (FSMS) functions efficiently by employing a comprehensive page menu. This menu includes a range of important elements, including the

dashboard, simulator schedule, simulator checklist, simulator log book, simulator maintenance, simulator malfunction report, database summary, cadet data, flight instructor data, and user data. The main objective of this information system is to aid simulator administrators in effectively documenting simulator administration in accordance with regulatory criteria. Furthermore, it empowers administrators to easily schedule the utilisation of simulators and provides easy access to management results.

The average rating of the validation results from three experts evaluating the FSMS (Flight Simulator Management System) information system is 3.41, indicating that it meets the criteria for a good system. This assessment was based on the usability aspect, which received an average rating of 3.27, as well as the design aspect, which received an average rating of 3.53, and the operational aspect, which received an average rating of 3.44. Similarly, the average rating of the validation results from ten users is 3.37, also indicating a good system. These results were based on the truth aspect, which received an average rating of 3.30, the effectiveness aspect, which received an average rating of 3.34, and the operational aspect, which received an average rating of 3.47. In the future, within the context of the present scientific and technical era, it is anticipated that the project will continue to enhance and become more adaptable and beneficial for aviation instruction. Integrating new modules (such as approach control and area control) for training purposes is a straightforward process in later investigations.

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