DESIGNING AND BUILDING A LEARNING MEDIA FOR EN-ROUTE FLIGHT INFORMATION

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Abstract
En-route Flight Information (EFI) is a science that studies the procedures for guiding aircraft in uncontrolled airspace. With the development of teaching aid technology, digitizing the EFI learning system in the form of a website-based TopSky Simulator is expected to make it easier for cadets to understand the concept of EFI learning about providing advisory and surveillance services in Uncontrolled Airspace. The deepening of EFI learning material is very necessary as a preparation for cadets before carrying out On the Job Training which must be undertaken by cadets of the Surabaya Aviation Polytechnic to carry out field work practices as an application of knowledge, especially in fields that have been studied during class education both in theory and practice. Therefore, the author intends to develop learning support facilities, especially the En-route Flight Information course by making this TopSky Simulator website. It is hoped that the information system and the features available in it can help teachers and cadets in learning flight traffic control via radar and practicing it well in the field.

Keywords: Radar Simulator, TopSky, En-route Flight Information, TopSky Simulator

INTRODUCTION

One form of digitization of the education system in the Aeronautical Communication study program at Surabaya Aviation Polytechnic is the design of a website-based En-route Flight Information learning system. En-route Flight Information (EFI) is one of the expertise courses in the Aeronautical Communication study program which studies the procedures for guiding aircraft in uncontrolled airspace. Basically, service communication has a basic principle, namely the creation of excellent service. In achieving this excellent service, it requires the integrity of the message from the communicator to the communicant that is conveyed in its entirety. [1] [2] With the development of teaching aid technology, the website-based TopSky Simulator is expected to facilitate and train flight traffic control skills for cadets.

The National Science Teachers Association (NSTA) defines e-learning as the effective learning process created by combining digitally delivered content with learning support and services. [3] [4] Through the e-Learning system more effectively provide access to images of science teaching that embrace three-dimensional learning in a wide range of classrooms with diverse learners [5] it is expected to help Aeronautical Communication cadets in improving the effectiveness and efficiency of the learning process and assist in achieving learning objectives. E-learning experiences should provide opportunities for students to develop and use science and engineering practices, disciplinary core ideas, and crosscutting concepts in order to explain phenomena or design solutions to problems. [6] In addition, cadets are expected to more easily understand the concept of EFI learning about providing advisory and surveillance services in Uncontrolled Airspace with the ATS System media in the form of a website-based simulator so that they can be more active in participating in learning activities. On the other hand, the deepening of EFI

learning material is needed as a preparation for cadets before carrying out On the Job Training. On the Job Training is a field work practice activity as an application of knowledge, especially in the field that has been learned during class education, both theory and practice.

These statistics implies that the air traffic management (ATM) system is under significant stress, and will be challenged to handle the imbalance of demand-capacity and flight delays, which may cause safety and congestion issues in the future. As such, it is critical to improve the performance of ATM system from the aspects of increasing capacity and efficiency of the airspace, such as terminal maneuvering area (TMA) and area control center (ACC). Compared with TMA, the en route traffic congestion in ACC becomes more and more prominent in crowded airspace around the world [7] [8]. Nevertheless, most researchers address the structural optimization of airspace or novel operation strategies, and not the issues of en route capacity improvement from the perspective of establishment of precise evaluation approaches (they are rarely discussed in current studies). Another motivation for this paper is that scholars and experts at home and abroad usually use airspace capacity, flow, and other indicators to evaluate or measure the airspace status. [9] [10] [11]

The decision was based on the Air Navigation Service Providen (ANSP) comprising the countries of Ireland, Sweden, Denmark, Croatia and Austria who jointly agreed on Thales Eurocat's ATM system called "TopSky". Whereas originally ATC controllers used paper strips to provide all the necessary flight data, TopSky operates completely paperless. Also, the low failure rate of the TopSky system allowed ANSP to fully rely on this system and get rid of paper strips. [12] The ATC system used by both groups in this paper is the TopSky automated system from Thales which plays a major role in airspace operations. TopSky-ATC is an advanced ATC automation solution, designed to control en-route, approach and oceanic traffic in both civil and military environments. [13] [14]

Based on the observations that the author carried out as preparation for On the Job Training (OJT) related to En-route Flight Information, in terms of human resources, it is good and sufficient. On-the-Job Training surveys the recent literature from both a theoretical and empirical perspective. The analysis of how individuals obtain and are paid for their skills is fundamental to labor economics. The basic idea of human capital theory is that workers and firms invest in workers' skills in order to increase their productivity. [15] However, due to the lack of supporting facilities for learning media, especially En-route Flight Information, cadets have not been able to maximize their potential to support OJT activities. On-the-Job Training focuses on recent literature including empirical research using direct measures of training and theoretical papers inspired by findings from this empirical work. [16] Some of the current conditions of the EFI Laboratory are considered a problem, namely:

(1) There is only an En-route Chart in the form of a map with flight routes that have not been updated. So that cadets only imagine where the position of the aircraft is according to the flight routes available on the map.

(2) The En-route Flight Information learning method is carried out manually, such as writing aircraft call signs, flight levels, and aircraft movements that are only limited to images.

METHODS

A. Design of Research

This research uses a research and development method approach, which is a process used to develop and validate educational products. The result of development writing is not only the development of an existing product but also to find knowledge or answers to practical problems.

Research and Development or writing and development basically has two main objectives, namely producing or developing certain products and testing the effectiveness of these products. Writing and development is also defined as a process or steps to develop a new product or improve existing products that can be accounted for. In the recent past a growing number of software radar simulators has been developed, thanks also to

the rapidly increasing computing power that is available to scientists. [17] [18]

Based on some of the definitions above, it can be concluded that writing and development or Research and Development is a step to develop a new product or improve existing products and test the effectiveness of these products [19] [20] which will produce innovative works that are very useful for institutions, especially the Surabaya Aviation Polytechnic. Therefore, the development model used in this paper is the ADDIE development model, which can also be used for the development of a web-based learning media or software [21]. There are five stages in the ADDIE development model, including the following:

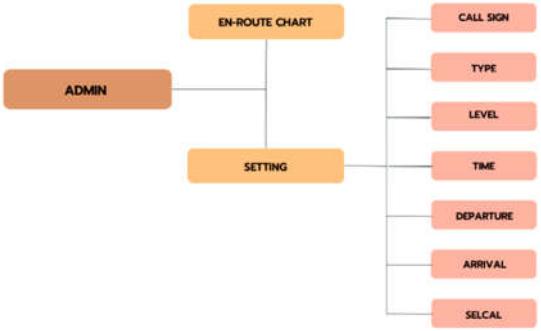
1. Analysis Phase
   The analysis stage is an activity to review problems, identify sources of problems, define problems and determine suitable and appropriate solutions. At this stage, the author will look for the root or source of the problem regarding learning using the media currently applied in educational institutions and conduct discussions to find solutions or innovations to the En-route Flight Information (EFI) learning system based on the website-based TopSky Simulator that will be carried out. So that the subject matter becomes directed, structured and does not deviate from the limits of the problem that has been determined.
2. Design Phase
   Product design design which aims to plan the concept of making products. Based on the needs analysis, the next step is for the author to design the product to be developed. The product produced in this writing is En-route Flight Information learning media using the website-based TopSky Simulator. This stage is a method or development technique used and has the aim of developing website-based En-route Flight Information learning media. At this stage, the author will make a writing workflow starting from design, design, testing, discussion and conclusion which will be described in a flowchart.
3. Development Phase
   This stage is a method or development technique used and has the aim of developing website-based En-route Flight Information learning media. At this stage the author will make the workflow of this writing starting from the design, design, trial, discussion and finally the conclusion which will be described in a flowchart. The output of this stage is an information system application that can be used and will be a reference for the implementation stage.
4. Implementation Phase
   The implementation stage is the stage for implementing the product of development or the subject of writing which is then applied to real conditions. Such as applying the results of the development stage, namely the website-based TopSky Simulator to the target of this product, namely the website-based En-route Flight Information learning media for Surabaya Aviation Polytechnic cadets.
5. Evaluation Phase
   The last stage in this ADDIE development model is evaluating the developed product to determine the feasibility of the product whether it is feasible to use or not in the learning process. This stage measures the effectiveness and efficiency of this product by testing by the author which will be tested and then evaluated to be developed to be more optimal. The testing technique will be explained further in Sub Chapter 3.4 regarding Testing Techniques.

B. Design of Research

1. Website Design
   In this section contains a model (concept) of the appearance of a website that contains a design of the work process of the website that shows the flow of data usage and the role of the human component in the information system. This system is made using a website as the basis for its creation, this system can be accessed anytime and anywhere with the support of an internet connection.

2. Testing Technique

The stages used in analyzing this testing technique were developed by James Wetherbe with a framework called PIECES, which is useful for classifying problems and fixing them. (James Wetherbe, 2012)



Gambar 1. Diagram of Website Display

The PIECES category consists of:

- P (Performance), the need to correct or improve performance.
- I (Information), the need to correct or improve information and data.
- E (Economics), the need to correct or improve economics, control costs, or increase profits.
- C (Control), the need to correct or improve control or security.
- E (Efficiency), the need to improve or increase the efficiency of processes and human resources.
- S (Service), the need to improve or enhance services to customers, suppliers, partners, employees, and so on.

The Likert scale is a psychometric scale commonly used in survey research. On this Likert scale respondents determine their level of agreement with a statement, or respond to a question, by choosing one of the available options. According to Rensis Likert, it explains that when all the data obtained from the questionnaire is obtained, the following formula is used:

T = Total number of respondents who chose
Pn = Likert score number options

$$T \times Pn$$

After all the results are summed up, then to further summarize the Interpretation Score Calculation as follows:

$$\text{Interval Formula} = \frac{100}{\text{Total Skor } (Likert)}$$

$$\text{Index Formula \%} = \frac{\text{Total Score}}{Y} \times 100$$

RESEARCH RESULT

A. Results of Analysis

The analysis that researchers get at this time is the lack of supporting facilities for learning media, especially En-route Flight Information. The condition of the EFI Laboratory which is currently used as a means of learning En-route Flight Information does not display a demonstration of aircraft movement via radar. So that cadets have not been able to maximize the practice of learning En-route Flight Information in preparation for the implementation of OJT activities.

In this study, researchers need to collect data so that the information obtained is accurate and can be accounted for. Therefore, researchers took from several sources, namely:

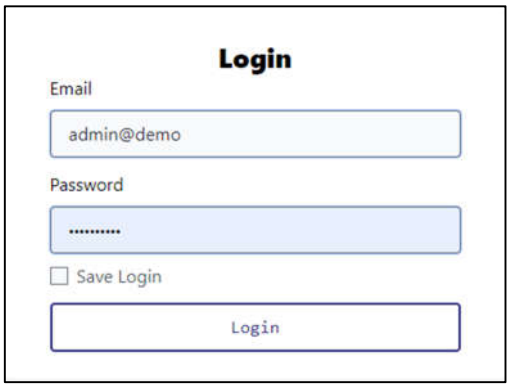
1. This observation was carried out by researchers when carrying out On the Job Training at the Makassar Air Traffic Service Center (MATSC)
2. Filling out a questionnaire with the aim of measuring the performance of the website-based TopSky Simulator that has been built, which is addressed to 50 respondents. Which consists of Aviation Communication Cadets, Air Traffic Cadets, Aeronautical Communication Officer Personnel of the MATSC branch and En-route Flight Information Course Lecturers and Information & Technology Experts.

B. Results of Design

In this website, researchers will display the appearance, data and features available on the TopSky Simulator website. The preparation of the design by researchers is adjusted to the

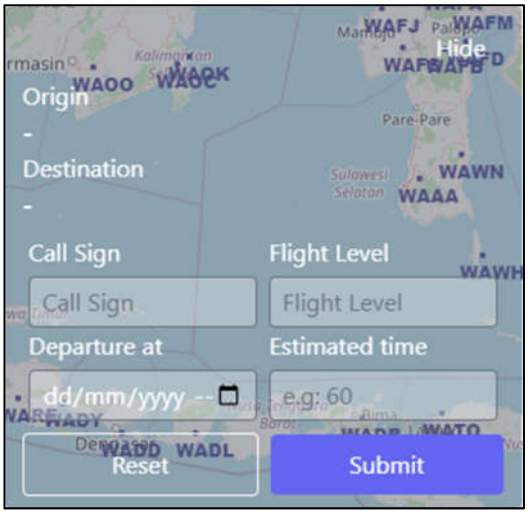
original radar operating at MATSC, namely TOPSKY with the aim that cadets get an idea of how to monitor and provide flight traffic services through radar and get used to it when going into the field later. The following is the TopSky Simulator website database design.

1. Login Page



Gambar 2. Login Page

In this feature window, 'Select Origin' is a feature that will instruct the system to select the departure airport. Meanwhile, 'Select Destination' is the command to select the arrival airport. After determining and selecting the location of the flight that will take place, the user must click the 'Confirm' button. Then, the system will display another feature window that must be filled in regarding the information and data required for the flight.



Gambar 3. Dashboard Radar

This is the display before entering the main page of TopSky Simulator. Participants must log in using the email and password that has been determined by the researcher. This needs to be done so that not just anyone can access this website because it is related to learning at the Surabaya Aviation Polytechnic.

2. Dashboard Radar

This shows the TopSky Simulator dashboard after passing the login page. Researchers took the eastern Indonesian airspace under the Makassar Air Traffic Center, so that the area covers parts of Kalimantan Island to Papua Island

Gambar 4. Feature Windows

This explains how the system displays a feature window after the user has selected the departure and destination aerodrome locations. This window contains relevant flight information and data that the user must fill in which can be customized by the instructor and cadets concerned, namely:

- Call Sign → The identity of the aircraft that will appear on the radar.
- Flight Level → Determines the altitude of the aircraft and is filled with 3 numbers that indicate the altitude indicator in accordance with existing regulations. (Ex: 150 means 150,000 ft and 090 means 9,000 ft)
- Departure at → Users can specify the EOBT or flight hours of the aircraft. This is very useful for instructors because it can provide variations in a flight related to abnormal situations.

- Elapsed Time → This feature can set how long the flight time the aircraft will take. The unit of time used in this feature is minutes.

This displays the system running when the user

Gambar 5. Display of Radar Simulator

has clicked the submit button on the previous feature window. The radar display will run the aircraft with the pre-filled data from the departure point to the destination point. In addition, it will also track a red route that shows the flight route of the aircraft.

C. Result of Development

This TopSky Simulator website is a development of the ATC System operating at the Makassar Air Traffic Service Center (MATSC) which is used to serve and monitor flight traffic via radar. And in its application, this simulator website uses a Content Management System (CMS) which is easy to operate and access because it is more flexible and can be done anywhere.

Gambar 6. Stages of Website Development

In the development stage, researchers realize that accessing the website that will be used as a medium to support En-route Flight Information learning is quite unfamiliar to users. Therefore, researchers made a Manual Procedure related to accessing the TopSky Simulator website as attached.

D. Result of Implementation

At this implementation stage, researchers apply the results of the development stage to the target of this website to teachers and cadets through the shared website address. So that from here it can be proven that this TopSky Simulator runs as it should and is used as a supporting medium for learning En-route Flight Information based on this website can be accessed by cadets online by accessing the website address https://topskysimulator.com/

E. Result of Evaluation

Data at the evaluation stage comes from two types of subjects, the first is expert evaluation conducted by En-route Flight Information course lecturers, AirNav employees and also cadet respondents. Opinions and suggestions from testing this website position the respondents as ACO personnel who will later implement it directly in the field.

The expert validators mentioned by the author as expert workers in their fields who provide an assessment and feasibility of this website, namely as a validator of the suitability of content and material by Mr. Ady Sumarno as a lecturer in the En-route Flight Information course, for validation of data and information suitability by Mr. Risky Artanto as Aeronautical Communication Officer personnel at the MATSC Main Branch, and as a validator of design and appearance by Mr. Dani Candra as an Information and Technology Expert who has tested this TopSky Simulator website and filled out the validation and verification sheet that the researcher attached.

CONCLUSIONS

To test the feasibility of the TopSky Simulator website that has been built, this research uses the PIECES framework and Likert Scale. This assessment was carried out

through filling out a questionnaire, where the users consisted of:

1. Lecturer of En-route Flight Information Course as many as 1 person
2. Information and Technology Expert Lecturer as many as 1 person
3. ACO MATSC personnel as many as 8 people
4. LLU 13 cadets as many as 17 people
5. KP 6 cadets as many as 23 people

Of the total respondents mentioned above, there were 50 people, each of whom could only fill out the questionnaire once. Respondents consisting of 10 expert respondents and 40 cadet respondents. The statements given to respondents were made based on this testing technique developed by James Wetherbe called PIECES, so that each statement contains certain aspects. Statement number 1 is an assessment in terms of Performance, statement number 2 is an assessment in terms of Information, statement number 3 is an assessment in terms of Economic, statement number 4 is an assessment in terms of Control, statement number 5 in terms of Efficiency and the last statement is an assessment in terms of Service. From the questions that have been given to respondents, here are the results of the User assessment that have been calculated by adjusting the Likert scale.

1. Calculation about Perfomance

Indikator	Pilihan Jawaban	Jumlah Responden	Total Skor
5	Sangat Baik	32	160
4	Baik	17	68
3	Cukup	1	3
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	231
Indeks %		Rumus indeks % = 231 / 250 x 100 Rumus indeks % = 92,4%	

2. Calculation about Information

3. Calculation about Economics

Indikator	Pilihan Jawaban	Jumlah Responden	Total Skor
5	Sangat Baik	36	180
4	Baik	14	56
3	Cukup	0	0
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	236
Indeks %		Rumus indeks % = 236 / 250 x 100 Rumus indeks % = 94,4%	

4	Baik	30	120
3	Cukup	1	3
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	218
Indeks %		Rumus indeks % = 218 / 250 x 100 Rumus indeks % = 87,2%	

4. Calculation about Control

Indikator	Pilihan Jawaban	Jumlah Responden	Total Skor
5	Sangat Baik	36	180
4	Baik	12	58
3	Cukup	2	6
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	244
Indeks %		Rumus indeks % = 244 / 250 x 100 Rumus indeks % = 97,6%	

5. Calculation about Efficiency

Indikator	Pilihan Jawaban	Jumlah Responden	Total Skor
5	Sangat Baik	28	140
4	Baik	17	68
3	Cukup	5	15
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	213
Indeks %		Rumus indeks % = 213 / 250 x 100 Rumus indeks % = 85,2%	

6. Calculation about Service

Indikator	Pilihan Jawaban	Jumlah Responden	Total Skor
5	Sangat Baik	32	160
4	Baik	12	58
3	Cukup	2	6
2	Kurang	0	0
1	Sangat Kurang	0	0
Total		50	244
Indeks %		Rumus indeks % = 244 / 250 x 100 Rumus indeks % = 92,4%	

From the calculation data above, it can be concluded as follows:

a. Respondents assessed that the Perfomance value, namely the display and the features in it are easily understood by users and are considered very good with an index of 92.4%
b. Respondents assessed that the value of Information, namely the information and data displayed related to flight navigation services, has been realized and is rated very well with an index of 87.2%
c. Respondents assessed that the value of Economics, namely the benefits of the system in terms of economics and improving the ability of aviation traffic services, was rated very well with an index of 94.4%.
d. Respondents assessed that the value of Control, namely the ease of management and operation of the system along with the available features, was rated very well with an index of 97.6%
e. Respondents assessed that the value of Efficiency, namely the benefits of the system are considered effective in increasing the interest in learning and the ability of cadets, which is rated very well with an index of 85.2%
f. Respondents assessed that the Service value, namely the accuracy of the system, is considered capable of providing an overview to flight cadets which is rated very well with an index of 92.4%.

Overall, the average system performance is rated very good with an index of 91.5%.

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