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PIKSEL

Penelitian Ilmu Komputer
Sistem *Embedded & Logic*

*Artificial Intelligence and Decision Support Technology
to Improve Quality of Life*

Department of Computer Engineering

Universitas Islam "45" Bekasi

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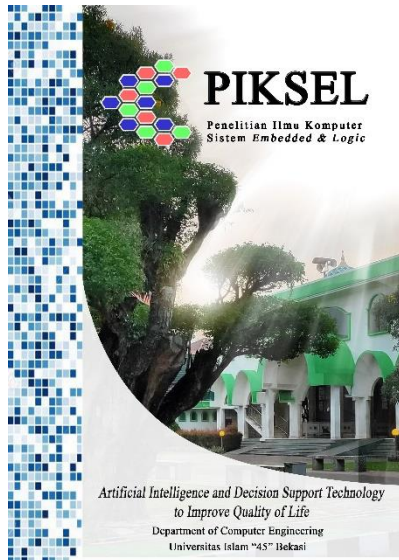
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From Editor-in-Chief

السَّلَامُ عَلَيْكُمْ وَرَحْمَةُ اللَّهِ وَبَرَكَاتُهُ

Best wishes to all the members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL for a very happy, and stay healthy in current global situation.



Rahmadya, Ph.D.
Editor-in-Chief

The computer science research is still needed in post-pandemic/endemic situation. Quality of life can be improved through the implementation of current computer science and information systems methods.

Although the face-to-face learning has just been started, the research to support teaching and learning, especially for scheduling is very useful as well as in business areas, e.g., helpdesk ticketing system or purchasing in a company. Also, a decision support technology to predict the major of high school students using forward chaining is presented. Other computer science methods, e.g., generative adversarial method (GAN), C4.5 algorithms, and genetic algorithm (GA) are discussed in this volume.

I hope this issue contribute to support nation after pandemic situation. And once again, thank you to members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL (Penelitian Ilmu Komputer, *Sistem Embedded & Logic*).

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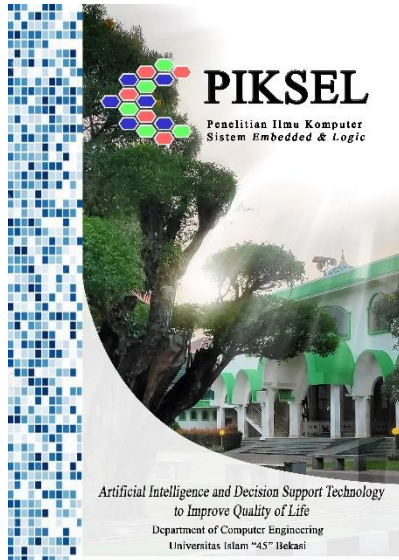
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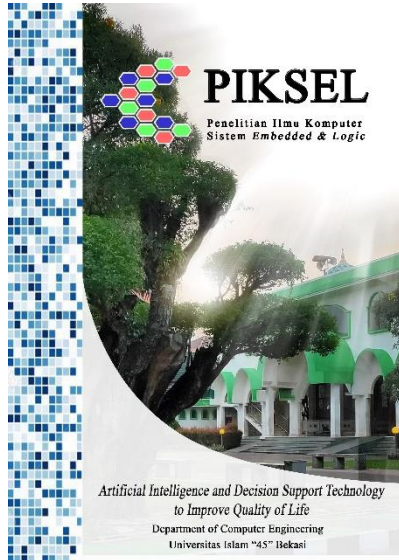
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Web-Based Recommender System for High School Major Decision Using Forward Chaining

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Abstract

Education is a learning process for students to develop their potential skills. One of the vocational schools is the State Vocational High School (SMK) 05 Bekasi, that educates students to have high expertise in industrial fields. However, not every student can choose the right major, there are students who choose majors based on the wishes of their parents, and do not know their real potential and abilities, so that the abilities of students are not in accordance with the majors they have chosen. One way that can be used to help choose the right major is to take a preference test that is assessed by a psychologist or the Counseling Guidance section. This method is quite effective, but it takes time especially for large numbers of student. Therefore, the researcher created a website-based recommendation system to identify majors using the Forward Chaining method. The purpose of the research is to make a recommendation system to determine the majors that students will choose. The application are developed using the System Development Life Cycle.

Keywords: black box testing, forward chaining, rule, SDLC, Web-based DSS.

1. Introduction

Education is the main tool for the government to create a learning process to develop people potential skill. Vocational high schools are an integral part of the national education system having a variety of majors available that students can choose from. Based on the questionnaire that the author conducted on 1.213 students at SMKN 05 Bekasi as the respondent; from a total of 1.213 students only 740 students took part in the questionnaire. From 740 students, the author found that 35.7% admitted that they had thought of moving. major. Based on these conditions, the author feels that students should consult with the teachers of “Bimbingan Karir (BK)” (Counseling Guidance), because this is very necessary for students to determine majors in taking education at Vocational High Schools.

The method commonly used in determining majors in schools is to take a

psychotest which is assessed by a psychologist or the school's counseling guidance section. Psychologists can map the abilities of students based on the results obtained from the tests taken. Identification of problems in this study, namely (1) the number of students who do not know what majors are in accordance with their interests and talents, (2) the number of students who are lazy to consult a psychologist or the school counseling guidance section to determine the major they will choose, (3) The absence of a website-based recommendation system to assist students in determining the majors they will choose. The research is aimed to create a recommender system to assist schools and students in choosing majors at State Vocational High School 05 Bekasi that are in accordance with the interests and talents of these students.

One way to solve this problem is to create a website-based recommender system to help schools and especially students in choosing majors at SMKN 05 Bekasi, there are several methods that can be used, namely Forward Chaining and Backward Chaining, to determine the effectiveness of the expert system. Forward Chaining system involves writing rules to set sub goals (Akil, 2017).

Research related to the Forward Chaining method, namely measuring the personality components of students to get personality test results can determine college majors and determine the type of work based on the type of personality they have (Wandira & Naam, 2020). Another research using the Forward Chaining method is a way of collecting data on the characteristics of learning styles, then it is made with existing rules, so that teachers can find out how to teach and how to learn according to the learning styles of each student (Ibrohim & Purwanty, 2017). Similar research to assist student evaluation activities, especially in the field of majors can make it easier for users to provide recommendations for majors for students at Madrasah Aliyah Negeri 2 Kediri City (Farida & Firliana, 2017), the use of the forward chaining method is also to help determine the choice of study programs when entering college (Delvira & Anwar, 2021), in providing recommendations based on the value possessed by users or new students in determining majors at school (Dedi Irawan & Herviana, 2018).

Based on several applications of the forward chaining method as a recommender system for selecting majors in the school, the current research will use the Forward Chaining method to draw conclusions about recommendations for students at SMKN 05 Bekasi to choose majors in a web-based application.

2. Research Method

2.1. Data Collection

The research was conducted through some steps, including: (1) Observing SMKN 05 Bekasi located at Villa Indah Permai Blok E27 RT 009/033, Teluk Pucung, North Bekasi District, Bekasi City, West Java, 17121, (2) Direct interviews and face-to-face interviews. face to face with respondents in the school environment to students and BK teachers, (3) literature study through reference books, journals, and literature related to research.

2.2. Software Development Concept

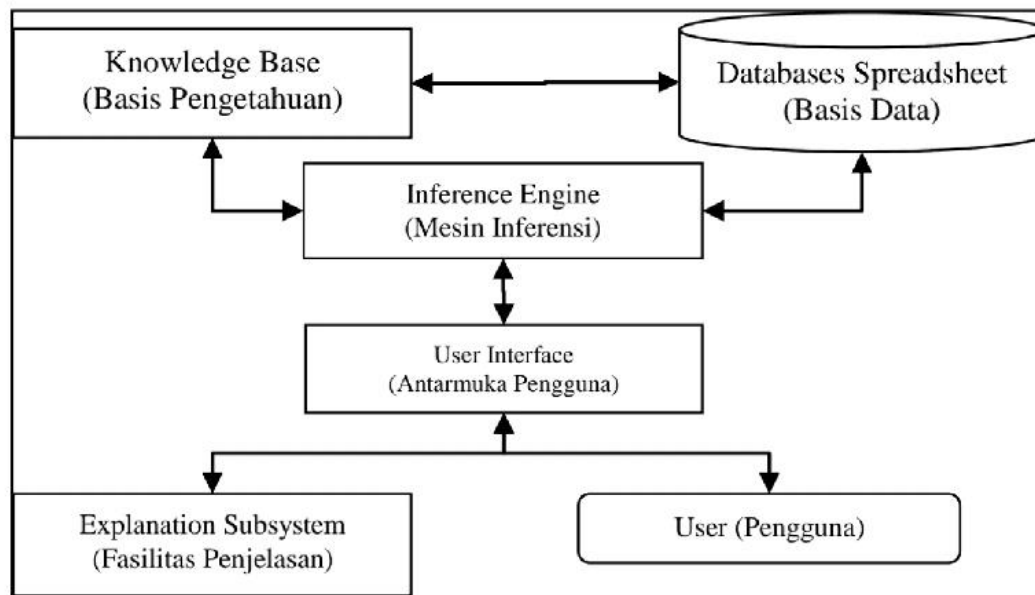
We use the waterfall method for software development from the system created, following the stages of analysis, design, coding, testing, and maintenance (Sukamto & Shalahuddin, 2016).

The analysis phase uses UML diagrams, i.e., use case diagrams, activity diagrams, and sequence diagrams. UML provides conceptual components such as actors, business processes, system components and activities (Sari & Utami, 2021).

Based on the results of system analysis, then designing the system includes database design which is done by designing data flow diagrams and relationships between tables and then by making designs regarding the user interface of the program created. The next stage is implementing in the form of programming code. The system testing phase with black box testing from implementation through data testing and functional analysis of the system so that it can detect deficiencies in the system built. The maintenance and re-checking stage of the application aims to minimize errors that may occur during use, as well as adapt the system to user needs.

2.3. Expert system

Expert System (ES) exists in artificial intelligence in diagnosing and providing solutions to problems (Ramadhan & Pane, 2018). The expert system is organized into six main parts, namely: (1) Knowledge base, (2) Inference engine, (3) User interface, (4) explanation subsystem, (6) User.



Source: Ramadhan & Fatimah (2018)

Figure 1. Expert System Architecture

The knowledge base contains the knowledge needed to understand, formulate, and solve problems. Databases Spreadsheets are used as media that serves to accommodate facts, conditions obtained from the knowledge base to be stored and processed by a computer.

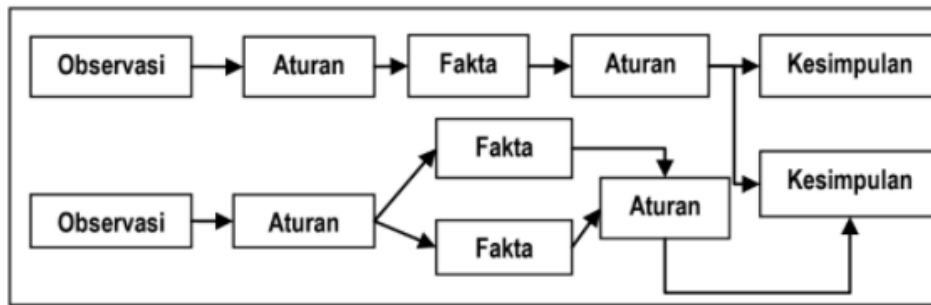
Inference engine (a process of reasoning conditions based on knowledge base) manipulates and stores the knowledge into knowledge base to reach conclusions. There are three control techniques in the inference engine, namely Forward Chaining, Backward Chaining, and a combination of both.

The User Interface is used as a medium of communication between the user and the Expert System, that should be represented in natural language and equipped with graphics, menus, and electronic forms.

The Explanation Subsystem describes how conclusions are drawn. Users who in general are not experts who need solutions or suggestions for various existing problems.

2.4. Forward Chaining

The forward chaining method is usually implemented in an inference engine starting with data and reasons to lead to an answer or conclusion (Wadi, 2020).



Source: Ramadhan & Fatimah (2018)

Figure 2. Forward Chaining Interference Process

The inference engine that uses the Forward Chaining method will look for rules until an antecedent (if clause) that is true (true) is found. When a rule is found, the inference engine can conclude the existing data.

3. Results and Analysis

3.1. Data Collection

Researchers conducted direct interviews with the school by giving five questions, related to recommendations for students in choosing majors, the questions in table 1.

Table 1. Interview Table

No	Questions	Answers
1	Does SMKN 05 Bekasi already have a computerized system to provide recommendations for choosing majors to students?	We do not have a computerized system yet, but we do a written test to determine the motor skills of the brain, interests and talents of the students.
2	Are the results of the test that many students follow the recommendations that have been given?	Quite a lot of people follow it but there are also some who feel that the results may not be in line with their expectations and finally they choose their own major without following the recommendations.
3	How does the school respond to the students who do not follow the recommendations?	We have tried to provide assistance, so that the students have no difficulty in choosing their majors, but we also support those who choose not to take the test according to the results of the test.

No	Questions	Answers
4	Have there ever been students who complained to the school and they felt they chose the wrong major?	Of course there are things like that, but we always try to convince them that their choice is not wrong.
5	How will the school respond if later the test is made computerized?	We gladly accept it, this will make the test results easier to obtain and can also make this school better in serving its students.

Source: Research Result

In addition to conducting interviews, distributing questionnaires via google form to 1.213 students at SMKN 05 Bekasi with the result that 740 students gave responses while the other 473 students did not respond. Figure 3 captures one of the questions given to students related to the selection of majors, namely "How is it when did you first choose a major?".



Source: Research Result

Figure 3. Student Questionnaire – Feelings When Choosing a Major

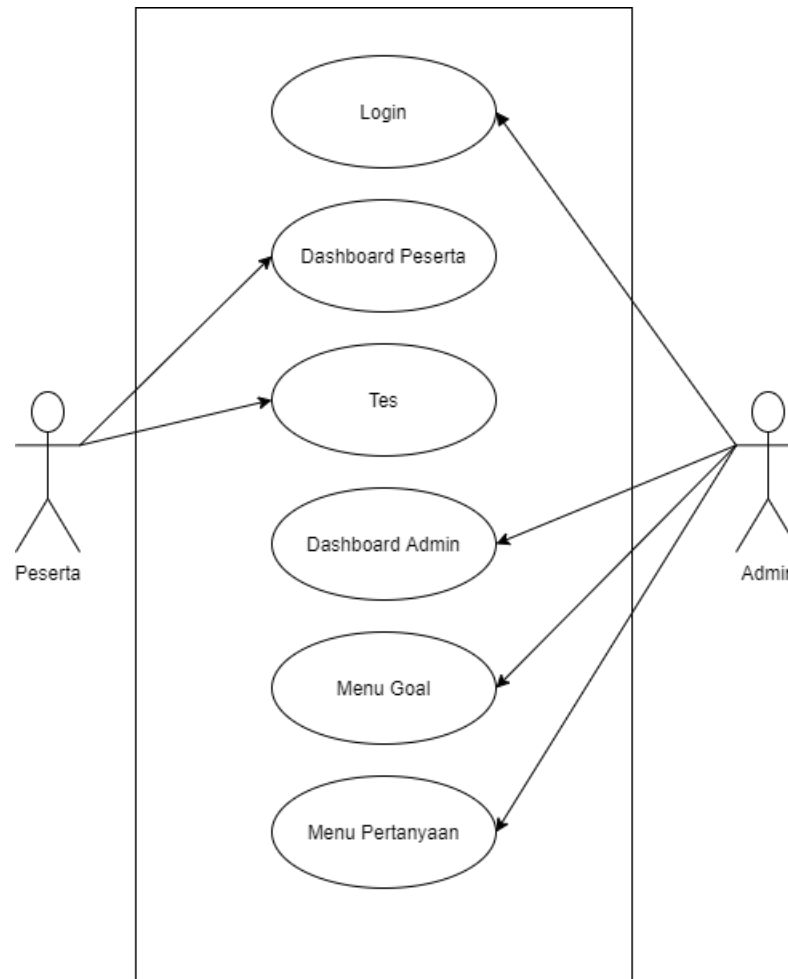
Based on Figure 1, the result is that 23.8% of students feel confused, then 43.2% of students are a little confused, 19.5% of students feel normal and 13.5% of students find it easy to choose. It can be concluded that there are still quite a lot of students who are confused when choosing which major they should choose when going to school at SMKN 05 Bekasi.

3.2. System Design

In designing a web-based recommender system for SMKN 05 Bekasi, UML (Unified Modeling Language) diagrams were used.

Use Case Diagram

The work flow in this system consists of two actors, namely participants and admins, as shown in Figure 4.

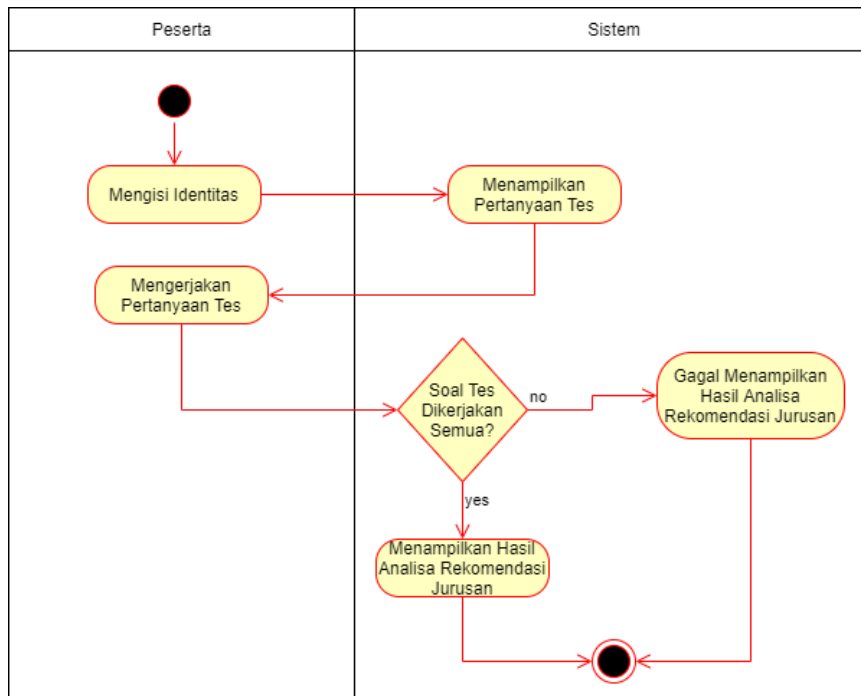


Source: Research Result

Figure 4. Use Case Diagram

Activity Diagram Test

Participants are required to fill in their identity, after that the system will display questions that must be done by the test taker, then the participant must answer all these questions to the end to find out which major is recommended for him, if the participant does not answer all the questions then the system will not display the major recommended to these participants, in Figure 5.

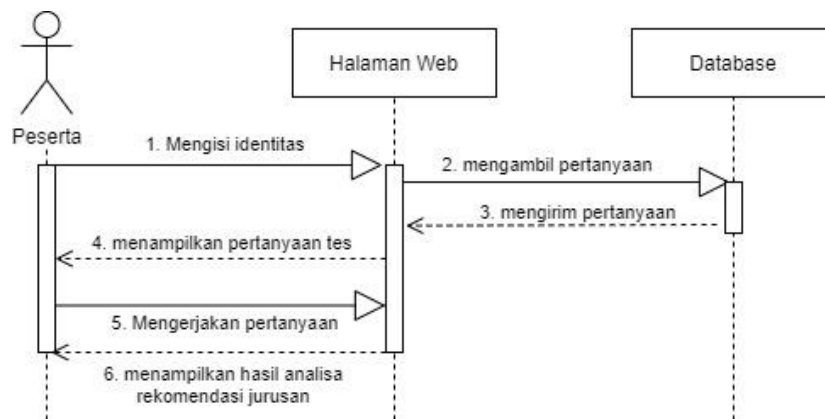


Source: Research Result

Figure 5. Activity Diagram Test

Sequence Diagram Test

Participants are asked to fill in their identities to save the data, after that the new participants can work on the majors recommendation test. The questions that will be tested by the participants come from a database that has been filled in by the admin, such as picture 6.



Source: Research Result

Figure 6. Sequence Diagram Test


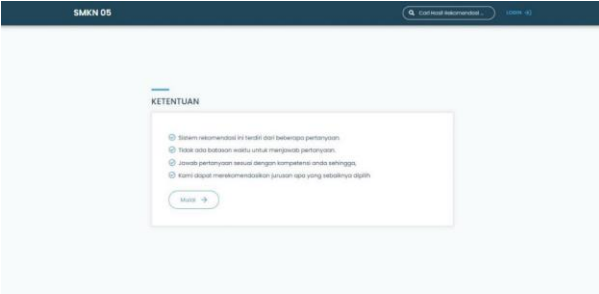
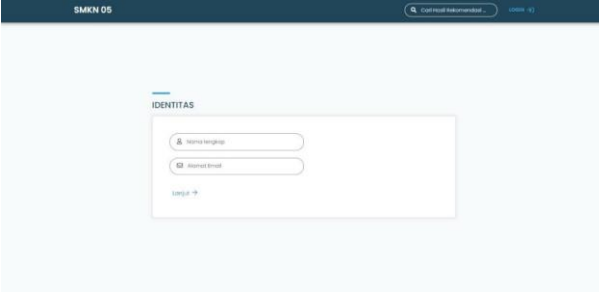
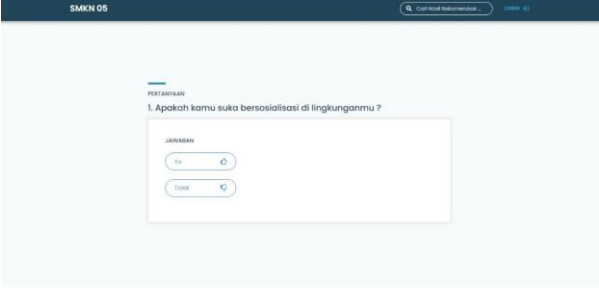
3.3. Application Implementation

After the analysis is made, then implement it to become a real application.

Participants User Interface Test

Table 2 is the results of the program made for test takers in choosing majors at SMKN 05 Bekasi.

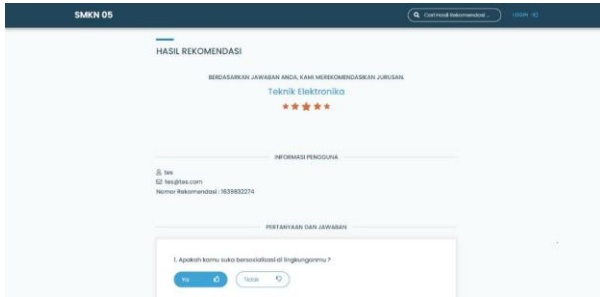
Table 2. Implementation of the Test Participants Program

User Interface	Function
<p>Test Participants Dashboard Display</p> 	<p>The display of the system dashboard has the name of the school, namely SMKN 05, in the upper right corner of the search column to search for recommendation results and also next to it there is a login button that functions to carry out the login process.</p>
<p>Display of Test Rules (Test Terms)</p> 	<p>The test rules display contains the rules or conditions for carrying out this test, there is a "start" button to start the test.</p>
<p>Self Identity Display</p> 	<p>Display to fill in the identity of the test taker, containing the name and e-mail address that must be filled in by the test taker before starting the test.</p>
<p>Test Question Display</p> 	<p>Test question display, contains questions and also answer options for test takers to fill out.</p>

User Interface

Function

Test Results Display



A display that will display the results of tests that have been carried out by participants, there are recommendations that come out based on tests that have been done previously, then underneath there is user information, namely to find out the data of participants who took the test and display the questions and answers that have been selected by the participants when doing the test. test.

Source: Research Result

School Admin User Interface

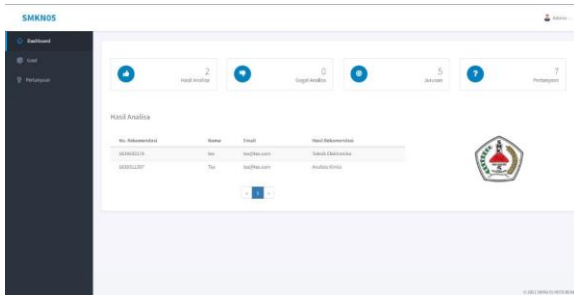
Table 3 is the results of the program made for test takers in choosing majors at SMKN 05 Bekasi.

Table 3. Implementation of the Admin User Program

User Interface

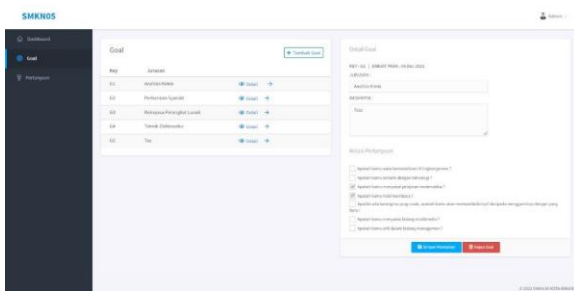
Function

Admin Dashboard View



The sidebar menu contains the dashboard, goals, and questions for each menu to find out where the admin position is currently accessing which menu, and on the dashboard menu a navigation bar (navbar) is created which contains a menu of analysis results, failed analysis, majors and also questions and when incorrect. one menu is selected then the system will display it.

Goal Menu Display (Department)

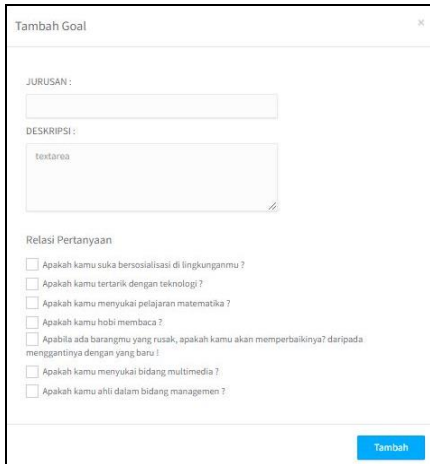


On the goal menu, there are three columns, namely Goal which contains a key as a distinguishing mark between one goal and another. Then there is the Detail Goal, which is to find out the details of the goal such as the name of the department and the description of the department and finally there is the Question Relationship, which is useful for knowing what majors are suitable for participants based on the answers chosen.

User Interface

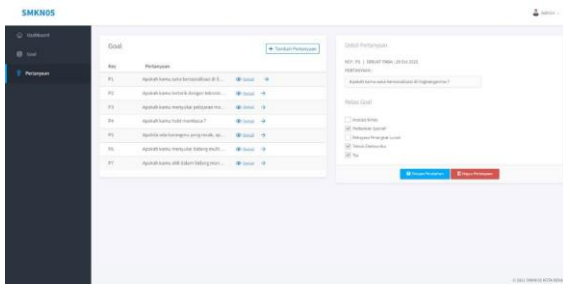
Function

View Add Goal



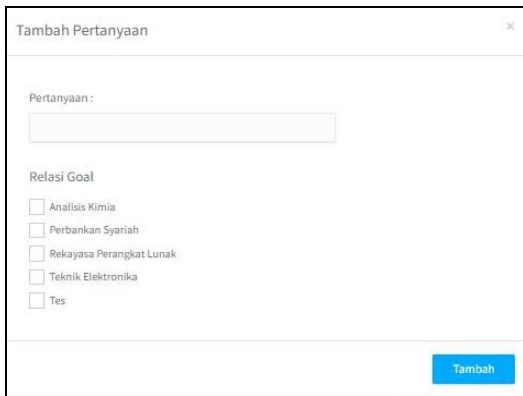
Display to add goals or available majors, admins must enter the name of the new department complete with a description of the department and fill in the question relation column according to or related to the major to be made.

Questions View



The display contains three columns, namely Goal and in the goal there is a key to distinguish one question from another. Question Details is to see the contents of the question and the Goal Relationship to find out the question is more suitable to be entered according to the department.

Add Question View



Display added questions, in the system body there are 2 columns, namely the column for the contents of the question that must be entered in the question and the column for selecting the goal relation in the form of a major that corresponds to the question and 1 button added.

Source: Research Result

3.4. Test Result

Table 4 is the results of the tests that have been carried out on recommender system for Selecting Majors at SMK9 05 Bekasi.

Table 4. Program Test Results

Menu	Scenario	Expected Results	Test Result
<i>Login</i>	Admin login using username and password.	Admin managed to enter the main menu.	Succeed
Participant Dashboard	Displays the participant dashboard.	The system successfully displays the participant dashboard.	Succeed
	Displays test rules.	The system successfully displays the test rules.	Succeed
	Displays the identity form.	The system successfully displays the identity form.	Succeed
Test	Fill in the identity.	Participants successfully filled out the identity form.	Succeed
	Answer all questions.	All questions answered	Succeed
	Does not answer all questions.	All questions are not answered.	Succeed
	Check the recommendations.	Recommendation results will appear if all questions are answered by participants.	Succeed
Admin Dashboard	Show admin dashboard	Admin has successfully logged into the admin dashboard.	Succeed
	View the analysis results	Admin managed to see the data analysis results.	Succeed
	Viewing failed data analysis	Admin managed to see the data failed to analyze.	Succeed
	View majors	Admin managed to see the available majors at SMKN 05 Bekasi.	Succeed
	View questions	Admin managed to see the questions that will be given to test takers.	Succeed
<i>Goals Menu</i>	Displays the goals menu.	Admin has successfully entered the goal menu.	Succeed
	View goal details	The admin managed to see the goal details in the form of the name of the department, description and relationship questions.	Succeed
	Add goals.	Admin has successfully added a new goal.	Succeed

Menu	Scenario	Expected Results	Test Result
Question Menu	Displays the question menu.	Admin has successfully entered the question menu.	Succeed
	View question details.	The admin managed to see the details of the questions in the form of questions and goal relationships.	Succeed
	Adding a question.	Admin successfully added a new question.	Succeed

Source: Research Result

4. Conclusion

By the recommender system for majors selection at SMKN 05 Bekasi, it can be concluded: (1) Students know about what majors are in accordance with their interests and talents, (2) For students who are have no willingness or afraid to consult the Counseling Guidance section, there is no need to worry, because the results of the recommendations majors from the system can be used as a reference in choosing majors, (3) SMKN 05 Bekasi has new technology in the process of testing department recommendations, and will also save time because the results of the test can be directly known together.

In order for the system to be more optimal in the future, other methods can be used to be further developed, add data security features, and provide a similar recommender system for the mobile platform.

Author Contributions

Ira Wardani proposed the topic; Ira Wardani, Prima Dina Atika, and Herlawati conceived models and designed the experiments; Prima Dina Atika, and Herlawati conceived the optimisation algorithms. Prima Dina Atika, and Herlawati conceived analysed the result.

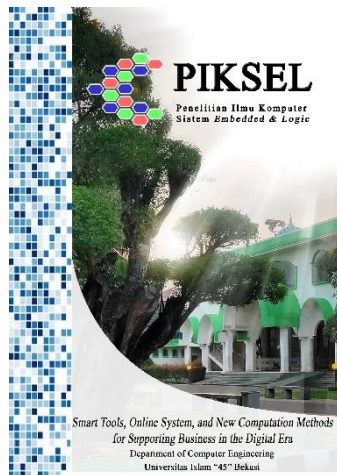
Conflicts of Interest

The author declare no conflict of interest.

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