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WEB-BASED RECOMMENDATION DECISION SUPPORT SYSTEM FOR PROSPECTIVE VOCATIONAL HIGH SCHOOL STUDENTS USING THE AHP METHOD (CASE STUDY: SMKN 1 SUMENEP)

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Abstract

This study aims to develop a web-based Decision Support System (DSS) to provide objective and structured major recommendations for prospective students at SMKN 1 Sumenep. The method used is the Analytical Hierarchy Process (AHP) with eight evaluation criteria: Mathematics, Natural Sciences, Social Sciences, Indonesian Language, English Language, Interests, Talents, and Psychological Tests, with subcriteria of low, medium, and high, as well as eight available major alternatives. The system was developed using PHP, MySQL, and Bootstrap, featuring data management, pairwise comparisons, priority weight calculations, and automatic consistency testing. Test results showed that all comparison matrices had a Consistency Ratio (CR) value of less than 0.10, thus deemed consistent and suitable for use. This system is capable of generating recommendations for the top three majors along with their final scores and rankings, thereby helping prospective students make more informed decisions regarding their major selection and minimizing the risk of a mismatch between a student's abilities and the chosen major

INTRODUCTION

Vocational education in vocational schools plays an important role in preparing a competent workforce to meet the demands of Industry 4.0 in Indonesia, where the selection of the right majors is the main foundation of student success (Arifin, Indra, Insani, & Sulpiana, 2023). The choice of majors in Vocational High School (SMK) is often a challenge for prospective students due to uncertain interests, talents, and career prospects, which ultimately leads to a change of major rate of up to 20-30% in the early years of education and reduces the effectiveness of vocational learning as a whole (Arifin *et al*., 2023).

This problem is strengthened by data from the survey results of vocational schools in Madura in 2024 which shows that as many as 28% of students experience inconsistencies in the choice of majors, resulting in a high dropout rate of 12% and an increase in the workload of guidance and counseling teachers (Hernando, 2024). SMKN 1 Sumenep, as one of the vocational schools in Sumenep Regency with 8 available majors, faces a similar condition where prospective students still often choose majors based on trends or following friends, not based on their abilities and potential.

Although Decision Support System (SPK) methods such as AHP have proven effective in multi-criteria decision-making, their application to vocational school major recommendations is still limited, with only 15-20% of vocational schools adopting web-based systems (Arifin, Y.T, Safitri, 2023). Therefore, this study aims to develop a web-based SPK with the Analytical Hierarchy Process (AHP) method in the case study of SMKN 1 Sumenep, which is expected to be able to provide objective, structured, and real-time major recommendations to prospective students.

LITERATURE REVIEW

A. DECISION SUPPORT SYSTEM (SPK)

Decision Support System (SPK) is a computer-based system designed to assist decision makers in solving semi-structured and unstructured problems. SPK combines computing capabilities with human intelligence to generate better decisions (Haffandi & Hendrik, 2024). In the context of education, SPK plays a role in supporting the selection and recommendation process objectively based on measurable data.

B. METODE *ANALYTICAL HIERARCHY PROCESS* (AHP)

AHP is a multi-criteria decision-making method developed by Thomas L. Saaty in 1980. This method works by decomposing complex problems into hierarchies, then performing paired comparisons between elements to produce rational priority weights (Rizky, 2024). Consistency of assessment is measured using *Consistency Ratio* (CR), where a CR value < 0.10 indicates that the assessment is consistent and acceptable. The stages of AHP include: (1) decomposition of problems into a hierarchy of goals, criteria, and alternatives; (2) paired comparison assessment using the Saaty Scale (1–9); (3) matrix normalization and priority weight calculation; (4) Consistency test through calculation *Consistency Index* (CI) and CR; and (5) final synthesis to produce alternative ratings.

C. RELATED RESEARCH

Several previous studies have examined the application of AHP in similar contexts. Fatullah et al. (Fatullah, Hasanah, & Rizky, 2022) developed a web-based college selection SPK at SMAN 1 Kramatwatu using AHP and proved that the system is able to provide more objective recommendations than conventional methods. Fauzi et al. (Fauzi, Rismawati, & Nengsih, 2025) applied AHP to vocational selection at SMK 2 Triple J and produced a CR < 0.10 on the entire matrix. Kurniawan & Roestam (Kurniawan & Roestam, 2021) develop a similar SPK at SMKN 1 Muaro Jambi and validate the effectiveness of AHP in the vocational context. This study develops and complements these findings by integrating a web-based SPK system with real-time AHP calculation features and visualization of recommendation results through an interactive dashboard.

RESEARCH METHODS

A. RESEARCH DESIGN

This study analyzes the application of the AHP method in the decision support system for major recommendations at SMKN 1 Sumenep by considering academic scores, interest tests, aptitudes, and psychological tests. AHP was chosen because it produces objective decisions through paired comparisons, so that recommendations are in accordance with the interests and abilities of prospective students. The research framework is presented in the following chart:

Image 1. Diagram alur

The research begins with the identification of problems through observation and interviews, followed by the analysis of the functional and non-functional needs of the system. The design stage produces flowcharts, use case diagrams, and ERD as the basis for implementation. The development of the frontend and backend is carried out in parallel with the application of the AHP method, including the preparation of hierarchies, the input of paired comparisons, and the integration of automatic calculations into the system. The trial was carried out using data from prospective students of SMKN 1 Sumenep in 2025 to validate the consistency of the AHP calculation and the correctness of the recommendation results. The entire process is then documented in the form of a scientific report.

B. RESEARCH INSTRUMENTS

The hardware used includes a laptop with 8 GB of RAM and an Intel Core i5 processor. The software includes Visual Studio Code as a code editor, XAMPP as a local server, and a modern browser as a testing interface. The dataset is in the form of data on SMKN 1 Sumenep students for the 2025/2026 school year which was obtained through official permission from the school.

C. CRITERIA AND ALTERNATIVES

The system uses eight criteria determined based on input from SMKN 1 Sumenep, namely: the average score of Mathematics, Science, Social Studies, Indonesian, and English subjects (grades 7–9), as well as the score of Interest, Talent, and Psychological Tests. Each criterion has three subcriteria in the form of Low, Medium, and High

categories which are automatically categorized by the system. The eight alternative majors evaluated are presented in Table 1

Table 1
List of Alternatives

No.	Code	Name of the Department
1	RPL	Software Engineering
2	TKJ	Computer and Network Engineering
3	BD	Digital Business
4	PF	Film Production
5	AK	Accounting
6	MP	Office Management
7	DPB	Fashion Design and Production
8	PH	Hospitality

D. SYSTEM DESIGN

The system is designed using Use Case Diagrams, Flowcharts, and Data Flow Diagrams (DFDs). There are two main actors: Admins who are in charge of managing data, setting the weights of paired comparisons, and monitoring the results of recommendations; and Prospective Students who fill in academic score data and take the Interest, Talent, and Psychological Test tests. The system automatically categorizes grades into subcriteria (Low/Medium/High), runs ahp calculations, and displays the top three major recommendations along with the final score.

RESULTS AND DISCUSSION

A. SYSTEM IMPLEMENTATION

The SPK System for the Recommendation of the SMKN 1 Sumenep Department was successfully developed and implemented web-based using PHP, MySQL, and Bootstrap. The system interface consists of two panels: the Admin panel for data management and AHP configuration, and the Prospective Student panel for data filling and test taking. Some of the main features available include the main menu, management of department and criteria data, paired comparison input by the admin, filling in academic scores by students, conducting online Interest, Talent, and Psychological tests, as well as the display of recommendation results equipped with a report printing feature.

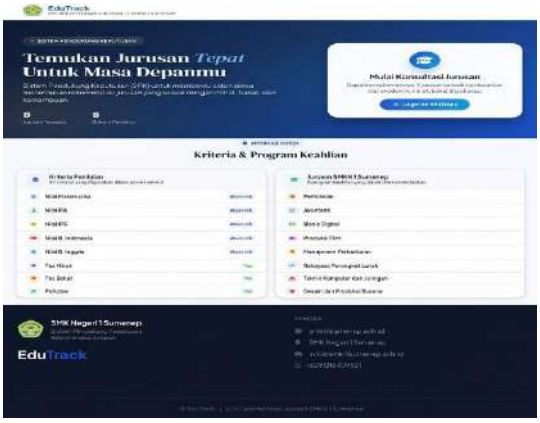

Image 2. Main menu view

The main menu display of the EduTrack system welcomes users with the title "SPK Recommended Majors of SMKN 1 Sumenep" and the tagline "Find the Right Major for Your Future", accompanied by information that the system includes 8 majors and 8 assessment criteria. Users can start a consultation through the "Login to EduTrack" button to get recommendations for the three best majors based on academic scores (Mathematics, SCIENCE, SOCIAL STUDIES, B. Indonesia, B. English), Interests, Talents, and Psychological Tests. This page also displays a list of available skill programs as well as the school's contact information at the bottom.

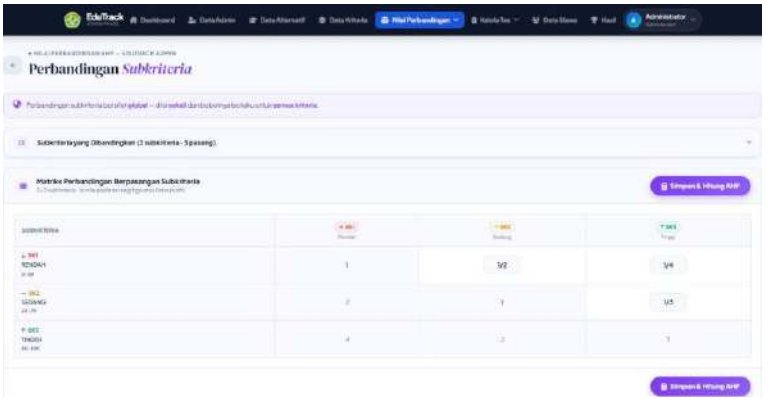

Image 3. Subcriteria comparison view

The Subcriteria Comparison page is used by administrators to populate a 3×3 paired comparison matrix globally, where the values of the upper triangle are manually filled in based on the AHP scale (SK1:SK2 = 1/2, SK1:SK3 = 1/4, SK2:SK3 = 1/3), while the bottom triangle is auto-populated as the other way around. The system then normalizes the matrix, calculating the priority weights (SK1 = 0.1373; SK2 = 0.2395; SK3 = 0.6232), and tested consistency with results λmax = 3.01834, CI = 0.00917, and CR = 0.01581. Since the CR < 0.1, the comparison is declared consistent and the weights are stored in the database as a reference for all criteria.

Image 4. Alternative comparison view of each criterion

The Alternative Comparison page is used by administrators to fill in a paired comparison matrix of 8×8 between majors on each criterion. The example in the Mathematics criteria shows that RPL is considered the most superior with a score of 6 for PH and 4 for AK. The system normalizes the matrix and calculates the priority weight, resulting in RPL (28.58%), TKJ (21.83%), BD (15.12%), PF (9.98%), DPB (8.33%), AK (7.77%), MP (5.22%), and PH (3.17%). The consistency test yielded $\lambda max = 8.18062$, $CI = 0.02580$, and $CR = 0.01830$, so that it was declared consistent ($CR < 0.10$). The same process is repeated for the other seven criteria.

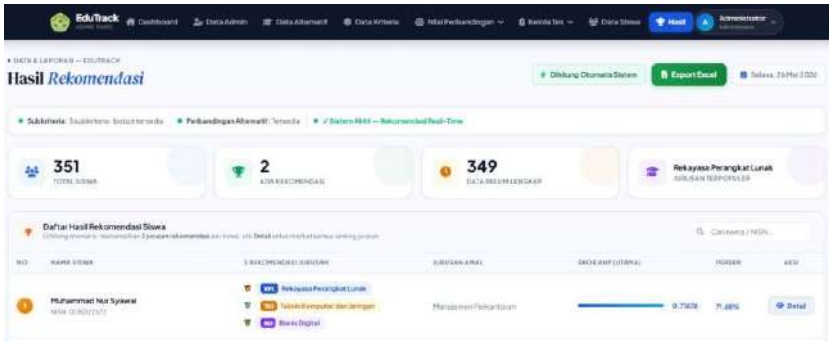

Image 5. Admin recommendation results display

The Recommendation Results page displays the system's main output in the form of major recommendations for each prospective student in real-time. The top of the page contains system status information, followed by statistics on the total number of students and the number of students who have been recommended. The main table displays the student's name, initial choice major, and the top three recommended majors along with their respective AHP scores and percentages.

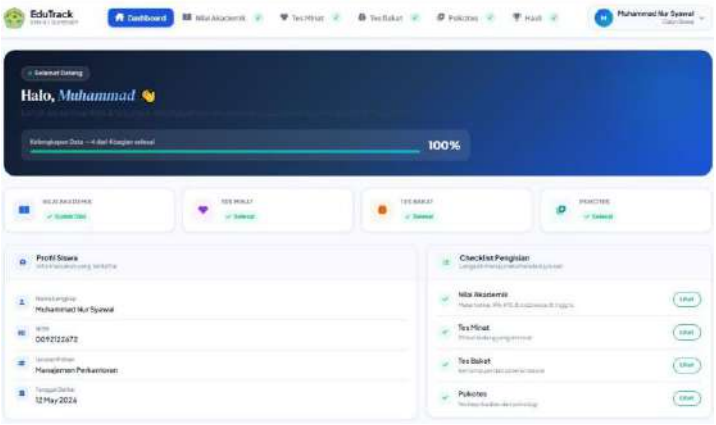

Image 6. Student dashboard view

The dashboard page displays personal greetings, indicators of data filling progress (0 out of 4 sections), and four main menus in the form of Academic Score cards, Interest Tests, Aptitude Tests, and Psychological Tests along with their work status. On the right side there is a student profile panel that contains the name, NISN, chosen major, and registration date, as well as a checklist of steps that must be completed before a major recommendation can be generated.

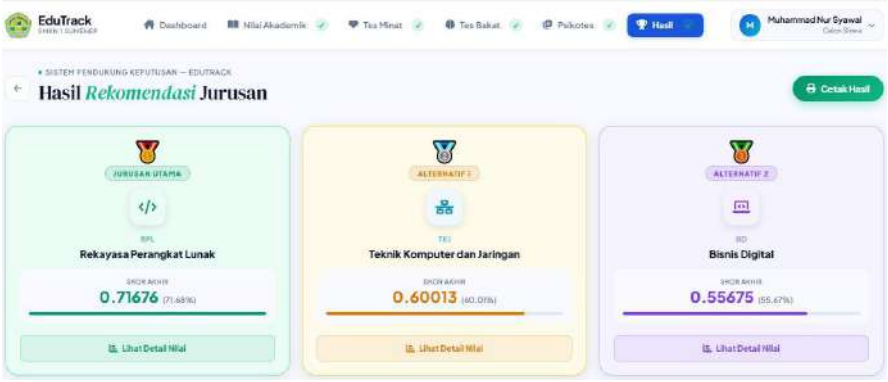

Image 7. View of student recommendation results

The Recommendation Results page displays the three best majors as a result of AHP's calculation based on academic scores and tests that students have filled out. The Main Major is RPL with a score of 0.71676, followed by Alternative 1 TKJ (0.60013) and Alternative 2 BD (0.55675). Each recommendation comes with a "View Value Details" button to see a breakdown of the value contribution per criterion.

B. AHP CALCULATION

The implementation of AHP is carried out in several stages. First, the hierarchy is built with the main goal of "Department Recommendations", eight criteria at the second level, and subcriteria (Low, Medium, High) at the third level. Second, paired comparisons are filled in by admins based on the Saaty Scale (1–9), both for subcriteria and for alternatives to each criterion.

Table 2 shows a paired comparison between the subcriteria. The High sub-criterion gets the highest priority, followed by Medium and Low, reflecting the principle that higher scores contribute more to the suitability of the major.

Table 2
Paired Comparison Subcriteria

Subkriteria	Low	Medium	Height
Low	1	1/2	1/4
Medium	2	1	1/3
Height	4	3	1

C. CONSISTENCY TEST

Consistency testing was carried out on all comparison matrices, both sub-criteria and alternatives to each criterion. The value of the Consistency Ratio (CR) is calculated using the formula CR = CI/IR, where CI = (λmax – n)/(n – 1) and IR are random consistency indexes based on the Saaty table. Table 3 summarizes the results of the consistency test for the entire matrix.

Table 3
Recap of Consistency Test Results

Matrix	λmax	MT	CR
Subkriteria	3,036	0,018	0,031 ✓
Alternative – Math	8,575	0,082	0,058 ✓
Alternative – IPA	8,614	0,088	0,062 ✓
Alternative – IPS	8,093	0,013	0,009 ✓
Alternative – B. Indonesia	8,041	0,006	0,004 ✓
Alternative – B. English	8,000	0,000	0,000 ✓
Alternatives – Interests	8,483	0,069	0,049 ✓
Alternative – Talent	8,437	0,062	0,044 ✓
Alternative – Psychological Test	8,381	0,054	0,039 ✓

Description: ✓ = CR < 0.10 (Consistent)

All comparison matrices obtained a CR value below 0.10, which means that all paired comparison assessments were consistent. Thus, the resulting weights can be declared valid and suitable for use as a basis for calculating the department's recommendations.

D. RECOMMENDED RESULTS

As an illustration of the test, the system was tested using student data on behalf of Muhammad Nur Syawal. After the system processes the student's academic grades and test results, the grades are converted to the appropriate subcriteria (Low/Medium/High), then multiplied by the priority weights that have been calculated through the AHP. Table 4 shows the results of the final recommendations.

Table 4
Results of Major Recommendations

Peringkat	Majors	Code	Final Score
1	Software Engineering	RPL	0,2041
2	Computer and Network Engineering	TKJ	0,1876
3	Digital Business	BD	0,1453

Based on these results, the system recommended the Software Engineering (RPL) major as the top choice with a score of 0.2041, followed by Computer and Network Engineering (TKJ) with a score of 0.1876, and Digital Business (BD) with a score of 0.1453. These three recommendations reflect the match between the academic and non-academic profiles of students and the characteristics of the available majors.

E. ADVANTAGES AND DISADVANTAGES OF THE SYSTEM

The system developed has several advantages, including: the recommendation process is objective and measurable based on data; AHP calculation is carried out automatically and in real-time; The results of the recommendations are available immediately after the data is filled; and there is a report print feature for documentation purposes. On the other hand, the system still has limitations, namely there is no automatic notification feature available, the weight of comparison still depends on the consistency of the admin in filling out the matrix, and the system does not yet support access through mobile applications.

CONCLUSION

This research succeeded in developing a web-based Decision Support System (SPK) for prospective students of SMKN 1 Sumenep using the AHP method. All stages of AHP, starting from determining criteria, comparing pairs, normalizing weights, to consistency tests, went well and produced results that could be scientifically accounted for. The CR value of the entire matrix was below 0.10, proving the consistency of the assessment. The system is able to generate recommendations for the three best majors along with the final score, so that it can help prospective students make more informed

major decisions and minimize the risk of incompatibility with the chosen major.

For further development, it is recommended that the system be equipped with a graph-based visual dashboard, a value data correction feature by admins, and developed into a mobile application to be more accessible anytime and anywhere.

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