

Decision Support Sytem For Student Extracurricular Activity Selection Using The Forward Chaining Method Based On Individual Preferences

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Abstract—Extracurricular activities play an important role in developing students’ interests, talents, and character at school. However, many students face difficulties in choosing extracurricular activities that match their interests and abilities. Therefore, this study aims to design and develop a recommendation system application for extracurricular activities using the *forward chaining* method at SMK Letris Indonesia 2. The *forward chaining* method is used in a rule-based system to provide appropriate recommendations based on student data, such as interests, talents, and input preferences. The result of this study is a web-based application capable of providing automatic and accurate extracurricular recommendations. System testing was conducted to evaluate the effectiveness of the recommendations generated. Based on a user satisfaction rate of 81.13%, the system is expected to assist students in determining the most suitable extracurricular options according to their interests and abilities.

Index Terms—Extracurricular, Forward Chaining,, Recommendation, Rule-Based System, SMK Letris Indonesia 2

I. INTRODUCTION

Education serves as the foundation for developing individuals’ skills, character, and potential. Beyond academic learning, extracurricular activities act as a supportive medium to strengthen these aspects. Several studies have demonstrated that student participation in extracurricular activities can enhance academic performance, social skills, and emotional well-being [?]. Furthermore, these activities foster the development of talents and organizational skills aligned with the demands of modern education [?]. At the vocational high school (SMK) level, extracurricular activities play a crucial role in expanding technical skills relevant to students’ majors, thereby preparing them for the workforce.

Extracurricular activities aim to nurture students’ potential, including their interests and talents. Through participation, students gain organizational experience, broaden their knowledge and perspectives, enhance their abilities, and develop problem-solving skills relevant to the activities [?]. However, many students struggle to identify their interests and talents when selecting extracurricular activities. Often, they join activities based on peer influence rather than personal inclination [?]. Consequently, students may only be active at the initial stages and later realize that the chosen activities do not align with

their potential, leading to disengagement and limited development of their talents [?].

SMK Letris Indonesia 2, a vocational school offering 24 extracurricular activities spanning religious, academic, and sports domains, utilizes these programs as a platform for talent development beyond regular academic learning. However, the processes associated with extracurricular activities, such as registration, data management, and result presentation, are still conducted manually, which is time-consuming. Moreover, students tend to choose activities manually or follow their peers without a recommendation system from the school or teachers based on their interests and talents. This mismatch between activities and students’ potential often results in low participation and enthusiasm.

These challenges underscore the need for a technological solution to assist students in selecting extracurricular activities aligned with their potential. Recent studies highlight that data-driven approaches can enhance student engagement in non-academic educational activities [?]. With approximately 500 students in 2025, SMK Letris Indonesia 2 requires an efficient tool to address the limitations of human resources. Therefore, a web-based decision support system utilizing an expert system approach is proposed. This expert system is designed to emulate the decision-making process of an expert, offering a cost-effective solution when expert personnel are unavailable or limited, thereby improving the effectiveness of education at SMK Letris Indonesia 2.

Although the *forward chaining* method has proven effective in educational recommendation systems with high accuracy in limited sample scales [2], its application in the context of extracurricular activities at the SMK level remains underexplored. Previous research has primarily focused on diagnostic aspects [?], leaving the complexity of diverse extracurricular choices unaddressed. Additionally, there is a lack of integration of student feedback to dynamically update recommendation rules. Studies suggest that such systems can provide tailored recommendations, enabling students to select extracurricular activities that align with their talents and interests, thereby fostering enthusiasm and active participation [?]. At SMK Letris Indonesia 2, the current extracurricular selection process relies on subjective opinions without data analysis or automated updates, necessitating the development of a more

adaptive and integrated system.

The proposed application employs the *forward chaining* method, which processes existing data and applies inference rules to generate conclusions or recommendations based on student input. This method is well-suited for recommendation systems that leverage user data in the reasoning process, making it an appropriate choice for this context.

II. THEORETICAL BASIS

A. Recommendation Systems

Recommendation systems are designed to assist users in making choices by suggesting specific items [12]. In education, these systems help students select activities aligned with their interests, enhancing engagement in learning processes. Rule-based recommendation systems effectively filter options based on user data, making them highly relevant for extracurricular activity selection at the SMK level [?].

The *knowledge-based recommendation* approach relies on user attributes and characteristics, using predefined personalization rules stored in a database to address individual needs [13]. Unlike methods dependent on interaction history, this approach generates recommendations using available information without requiring historical data [14]. Users specify criteria, and the system processes this input to provide tailored recommendations.

Recommendation systems employ several techniques:

- 1) *Collaborative Filtering*: Relies on similarities in user behavior or interaction patterns to generate recommendations.
- 2) *Content-Based Filtering*: Suggests items based on the characteristics of previously selected items.
- 3) *Knowledge-Based*: Generates recommendations using user attributes and specific needs, independent of historical data.
- 4) *Hybrid Filtering*: Combines methods like *Content-Based* and *Collaborative Filtering* to enhance recommendation accuracy and effectiveness.

B. Extracurricular Activities

Extracurricular activities enable students to explore their interests, talents, and creativity, optimizing their potential and shaping character outside academic learning [?]. These activities foster achievements aligned with talents, strengthen personal identity, and teach additional responsibilities, boosting confidence and potential development. Extracurricular activities at schools include:

- 1) *Group-Based Activities*: Such as Scouts, Paskibra, and Red Cross Youth.
- 2) *Academic Activities*: Including English Club, Accounting Club, and Programming Club.
- 3) *Sports Activities*: Such as futsal, basketball, and taekwondo.

C. Forward Chaining Algorithm

The *forward chaining* method is a data-driven approach that starts with available facts to derive conclusions as solutions to problems. The inference engine evaluates rules in the knowledge base against these facts, generating conclusions based on relevant rules [?]. Rules are checked against facts, activating further rules until a final solution is reached [?].

D. Forward Chaining Workflow

The *forward chaining* process, as depicted in Figure ??, involves processing initial facts using logical *AND/OR* operators to reach a final decision:

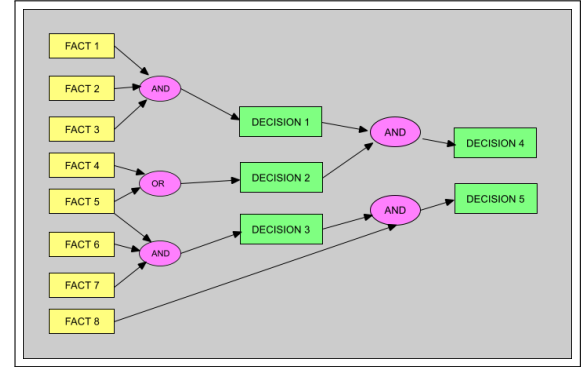


Fig. 1. Workflow *Forward Chaining*

- 1) *Fact*: Initial known information.
- 2) *AND/OR*: Decisions are made if all (AND) or any (OR) conditions are met.
- 3) *Rules*: Logical rules (e.g., Rule 1 uses AND, Rule 2 uses OR) generate decisions.
- 4) *Decision*: Conclusions become new facts, culminating in a final decision.

E. End User Computing Satisfaction (EUCS)

The *End User Computing Satisfaction* (EUCS) framework evaluates user satisfaction with computer systems or applications [19]. As shown in Figure 2, it assesses satisfaction across five dimensions [?]:

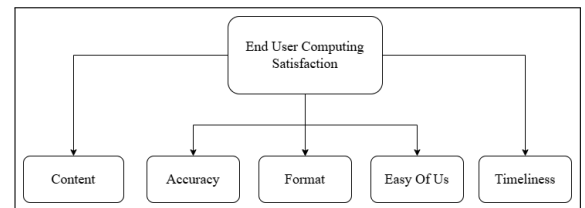


Fig. 2. *End user computing satisfaction*

- 1) *Content*: Satisfaction based on the informativeness of the application's content.
- 2) *Accuracy*: Accuracy of system-processed data.
- 3) *Format*: Satisfaction with the application's layout and aesthetics.

- 4) *Ease of Use*: Intuitiveness and simplicity of the system's interface.
- 5) *Timeliness*: Timeliness of information or results provided by the system.

F. Likert Scale

The Likert scale, developed by Rensis Likert in 1932, measures attitudes by asking respondents to agree or disagree with statements [18]. In its development, this scale is widely used to assess respondent perceptions toward a phenomenon with five available answer choices as shown in Table I [22].

TABLE I
LIKERT SCALE FOR SATISFACTION MEASUREMENT

No	Answer Choice	Score
1	Strongly Disagree	1
2	Disagree	2
3	Neutral	3
4	Agree	4
5	Strongly Agree	5

Next, a calculation is required to determine the level of user satisfaction using the following formula [?]:

Description:

- SS = Number of respondents who answered Strongly Agree
- S = Number of respondents who answered Agree
- N = Number of respondents who answered Neutral
- TS = Number of respondents who answered Disagree
- STS = Number of respondents who answered Strongly Disagree

The level of user satisfaction can be categorized according to the criteria shown in Table II [?]:

TABLE II
USER SATISFACTION CRITERIA

No	Calculation Result (%)	Description
1	81–100	Very Satisfied
2	66–80.99	Satisfied
3	51–65.99	Moderately Satisfied
4	35–50.99	Less Satisfied
5	0–34.99	Not Satisfied

G. Literature Review

The literature review refers to prior studies relevant to the current research, serving as references and comparisons. Several studies related to this research are presented below.

Based on the literature review, previous studies have demonstrated the effectiveness of the *forward chaining* method in recommendation systems. The first study by Putri et al. [?] proved that an expert system using *forward chaining* can accurately recommend majors based on students' interests and talents, providing a strong theoretical foundation for the method's effectiveness in educational decision-making systems.

The second study by Mulyana et al. [?] specifically addressed the application of an expert system for extracurricular recommendations at an SMK, which is highly relevant to

this research. It demonstrated that integrating biodata and questionnaires can produce a structured and efficient recommendation system. However, it had limitations in handling overlapping interests and did not include user satisfaction evaluation metrics.

Overall, the novelty of this research lies in applying the *forward chaining* method to recommend extracurricular activities at SMK, a topic rarely explored in expert system research. By using carefully designed weighted questionnaires and validated *IF-THEN* rules, this study offers an innovative solution to support the development of relevant non-academic skills. Additionally, it addresses gaps in prior research by incorporating the handling of overlapping interests and evaluating user satisfaction as a metric of system success.

III. RESEARCH METHODOLOGY

1) Literature Study

At this stage, the research involves studying theories related to the research topic. Additionally, an interview with an extracurricular activity coordinator is conducted to gather information about the school and details regarding the management of extracurricular activities at SMK Letris Indonesia 2 to support this research.

2) System Design

This stage involves designing the system, including the creation of the system flowchart, designing the database schema for the application, and designing the application's user interface and appearance.

3) System Programming

Following the system design stage, the programming phase begins, starting with the development of the application using the *Express* framework, followed by the implementation of the *knowledge base* and the *forward chaining* method into the application.

4) System Testing and Evaluation

After completing the system programming, a series of tests, including functional, performance, and compatibility testing, are conducted to ensure the system is free from bugs or errors.

5) System Improvement

This stage focuses on identifying and resolving issues, such as minor bugs or system design deficiencies. After improvements are made, the testing and evaluation stage is repeated until no errors are found in the system.

6) User Satisfaction Testing

Once the system is refined and passes testing, user satisfaction testing is conducted by distributing a questionnaire form using the *EUCS* method. The results are analyzed using the Likert scale to measure the level of user satisfaction with the system.

7) Report Writing

The final stage involves compiling a report as the official documentation of the entire system development process and its outcomes. This report serves as evidence that the research was conducted thoroughly and addresses the formulated problem.

A. Data Collection and Analysis

This stage involves the analysis of the system requirements at SMK Letris Indonesia 2. During this phase, data collection and analysis are conducted to obtain and evaluate the gathered information. The process includes several key steps: data collection, data processing, knowledge representation, and the formulation of questions based on the established knowledge.

In this study, data were collected to understand students' preferences for extracurricular activities at SMK Letris Indonesia 2, South Tangerang.

1) Interviews

Interviews were conducted at the research site, SMK Letris Indonesia 2. An interview was held with Mr. Hadi Solihin, M.Pd, the vice principal for public relations, and Mr. Riki Handoko, S.Pd, an extracurricular activity coordinator. The purpose of the interviews was to gather information about the school's profile and details regarding the management of extracurricular activities at SMK Letris Indonesia 2.

2) Observation

The research was carried out at SMK Letris Indonesia 2, South Tangerang. This location was chosen because the school offers a variety of extracurricular activities, and students are required to participate in at least one activity. However, many students face confusion in selecting activities that align with their interests.

1) *Extracurricular Activities:* Table III lists the extracurricular activities at SMK Letris Indonesia 2. This data was obtained through interviews with the extracurricular activity coordinator. As of the 2024/2025 academic year, there are 24 active extracurricular activities, with the following details:

TABLE III
LIST OF EXTRACURRICULAR ACTIVITIES

Activity Code	Activity Name
A01	Tahfidz
A02	Hadroh / Marawis
A03	Traditional Dance
A04	Basketball
A05	Volleyball
A06	Taekwondo
A07	Football
A08	Badminton
A09	Theater Arts
A10	Videography
A11	Paskibra
A12	English Club
A13	Scouts
A14	Accounting Club
A15	Esports
A16	PMR (Youth Red Cross)
A17	Music Arts
A18	RPL/Programmer
A19	Karate
A20	Tapak Suci
A21	Futsal
A22	Ratoh Jaroe Dance
A23	Athletics
A24	Modern Dance

2) *Data Grouping Based on Types of Extracurricular Activities:* This table categorizes extracurricular activities into five main groups: religious, academic, arts and creativity, sports, leadership and discipline, and social and humanitarian. This categorization is based on the type and primary focus of each extracurricular activity, intended to facilitate students in selecting activities that align with their interests and personal development needs.

TABLE IV
LIST OF EXTRACURRICULAR ACTIVITIES BY CATEGORY

Category	Code	Extracurricular Name
Arts and Creativity	A03	Traditional Dance
	A09	Theater Arts
	A17	Music Arts
	A22	Ratoh Jaroe Dance
	A24	Modern Dance
Sports	A04	Basketball
	A05	Volleyball
	A06	Taekwondo
	A07	Football
	A08	Badminton
	A19	Karate
	A21	Futsal
	A15	Esports
	A23	Athletics
Technology and Digital	A18	RPL/Programmer
	A10	Videography
Organization and Social	A11	Paskibra
	A13	Scouts
	A16	PMR (Youth Red Cross)
Academic	A12	English Club
	A14	Accounting Club
Religious	A01	Tahfidz
	A02	Hadroh/Marawis

TABLE V
INDICATOR CODES AND NAMES FOR EXTRACURRICULAR ACTIVITY INTERESTS

Indicator Code	Interest Name
MK01	Personal Interest
MK02	Team Sports
MK03	Individual Sports
MK04	Martial Arts
MK05	Dance Movements
MK06	Creative Arts
MK07	Digital Technology
MK08	Social Organization
MK09	Religious
MK10	Academic

3) Interest Criteria Data:

B. Relationship Rules Between Extracurricular Activities and Student Preference Interests

Tables VI, VII, and VIII illustrate the relationship between students' preference interests and the types of extracurricular activities available. The rules in this relationship are determined based on input from the extracurricular activity coordinator at SMK Letris Indonesia 2. Each row in the tables

represents an extracurricular activity, while each column indicates a specific category of student preferences. If an activity aligns with a particular preference, it is marked in the table. These tables enable the system to analyze the preferences selected by students and provide initial recommendations for the most suitable extracurricular activities.

TABLE VI
RELATIONSHIP BETWEEN INTERESTS AND EXTRACURRICULAR
ACTIVITIES (PART 1: A01–A08)

Interest	A01	A02	A03	A04	A05	A06	A07	A08
MK01	V	V	V	V	V	V	V	V
MK02	-	-	-	V	V	-	V	-
MK03	-	-	-	-	-	-	-	V
MK04	-	-	-	-	-	V	-	-
MK05	-	-	V	-	-	-	-	-
MK06	-	-	-	-	-	-	-	-
MK07	-	-	-	-	-	-	-	-
MK08	-	-	-	-	-	-	-	-
MK09	V	V	-	-	-	-	-	-
MK10	-	-	V	-	-	-	-	-

TABLE VII
RELATIONSHIP BETWEEN INTERESTS AND EXTRACURRICULAR
ACTIVITIES (PART 2: A09–A16)

Interest	A09	A10	A11	A12	A13	A14	A15	A16
MK01	V	V	V	V	V	V	V	V
MK02	-	-	-	-	-	-	-	-
MK03	-	-	-	-	-	-	V	-
MK04	-	-	-	-	-	-	-	-
MK05	-	-	-	-	-	-	-	-
MK06	V	-	-	-	-	-	-	-
MK07	-	V	-	-	-	-	-	-
MK08	-	-	V	-	V	-	-	V
MK09	-	-	-	-	-	-	-	-
MK10	-	-	-	V	-	V	-	-

C. System Design

In the system design stage, technical design arrangements are carried out to build an extracurricular activity recommendation system application with *forward chaining*. Before the process of creating the extracurricular activity recommendation system, system design is conducted which can serve as a reference in creating the system. The design process includes application flow design in the form of *use case diagrams*, *flowcharts*, *database schemas* and interface design in the form of wireframes.

TABLE VIII
RELATIONSHIP BETWEEN INTERESTS AND EXTRACURRICULAR
ACTIVITIES (PART 3: A17–A24)

Interest	A17	A18	A19	A20	A21	A22	A23	A24
MK01	V	V	V	V	V	V	V	V
MK02	-	-	-	-	V	-	-	-
MK03	-	-	-	-	-	-	V	-
MK04	-	-	V	V	-	-	-	-
MK05	-	-	-	-	-	V	-	V
MK06	V	-	-	-	-	-	-	-
MK07	-	V	-	-	-	-	-	-
MK08	-	-	-	-	-	-	-	-
MK09	-	-	-	-	-	-	-	-
MK10	-	-	-	-	-	-	-	-

D. System Testing and Improvement

At this stage, the web-based extracurricular recommendation system will undergo checking and testing to ensure the system runs without *errors* or *bugs*. Testing also verifies compliance with the initial design. If problems are found, improvements are immediately carried out by developers to guarantee the accuracy of recommendation results. Testing of the extracurricular activity system is conducted to ensure the functionality, accuracy, and usability of the *forward chaining*-based recommendation system in accordance with the needs of students and supervisors at SMK Letris Indonesia 2. RetryClaude can make mistakes. Please double-check responses.

IV. RESULTS AND DISCUSSION

A. Web Implementation

This section discusses the implementation of the *website* interface display from the decision support system for determining extracurricular activities that has been developed. The implemented display includes user interfaces for a number of main features, such as the *login* page, *dashboard*, interest assessment questionnaire, and extracurricular data management page. Each interface is designed with attention to aspects of ease of use and accessibility, so that it can be used by various groups of users with different backgrounds.

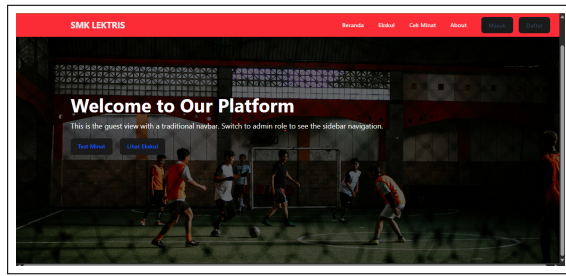


Fig. 3. User dashboard interface

In figure 4 is an informative interface designed to provide a complete overview of various activities offered at SMK Letris Indonesia 2, enabling students to learn about extracurricular activities before following the recommendation process or interest test. The purpose is to provide detailed information about 24 extracurricular activities,

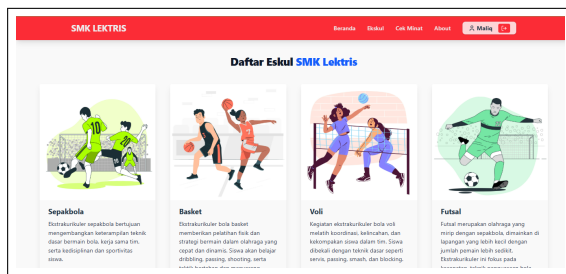


Fig. 4. Diagnosis interface implementation

The page in figure 5 is an interactive interface designed to identify the interests of each SMK Letris Indonesia 2 student towards extracurricular activities through filling out a questionnaire, which becomes the basis for the *forward chaining* process in the system.

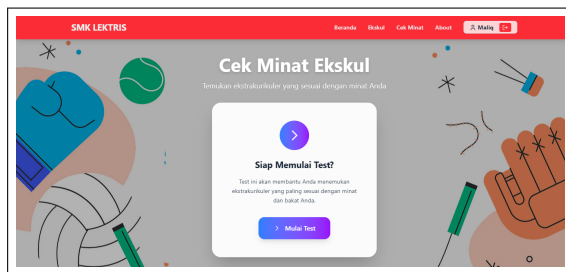


Fig. 5. Diagnosis results interface with CF calculations

The extracurricular activity recommendation results page is the main interface that displays the system output based on the forward chaining process after students complete the questionnaire. This page is accessed through the "check interest" button in the navbar after the data processing is complete, which will generate extracurricular activity recommendations. Its purpose is to provide clear information to students about activities that match their interests and abilities.

B. Case Validation Results

The facts used in the first case study are the answers from the user. In the first case study with the first rule, it is known

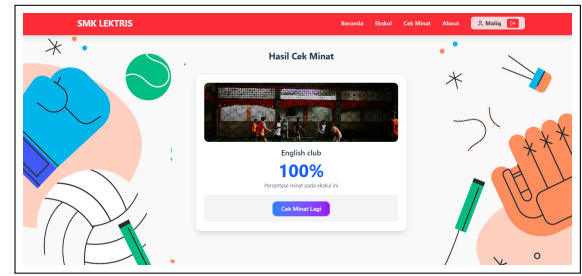


Fig. 6. Educational knowledge base interface

that the user chose the academic field and answered C53, C54, C55, C56 with yes, except for C57, C58, C59, C60 which should not be based on the rules. RetryClaude can make mistakes. Please double-check responses.

TABLE IX
MINAT DAN JAWABAN

No	Kode Indikator	Jawaban
1	C53	Ya
2	C54	Ya
3	C55	Ya
4	C56	Ya
5	C57	Tidak
6	C58	Tidak
7	C59	Tidak
8	C60	Tidak

Based on the facts that can be seen in Table IX, this case will result in theater arts extracurricular activity with 100% recommendation. This is because the user answered "Yes" to the theater arts interest questions from the creative arts field.

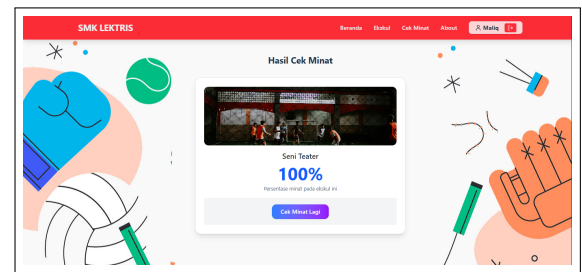


Fig. 7. Educational knowledge base interface

C. User Satisfaction Evaluation

User satisfaction evaluation was conducted using the End User Computing Satisfaction (EUCS) method to measure user acceptance of the developed TB diagnosis expert system. The EUCS method evaluates user satisfaction across five key dimensions: content, accuracy, format, ease of use, and timeliness. Each dimension was assessed through two specific statements, resulting in a total of ten evaluation questions using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

After distributing the questionnaires, data was collected from 82 students as respondents. Students were asked to

evaluate the provided statements by choosing one of five options on a Likert scale, namely strongly disagree (STS), disagree (TS), neutral (N), agree (S), and strongly agree (SS). This data was analyzed to understand student preferences and perceptions.

TABLE X
EUCS EVALUATION RESULTS

Question	SD	D	N	A	SA	Dimension
Q1	1	2	20	29	30	Content
Q2	1	2	19	28	32	Content
Q3	2	0	20	27	33	Accuracy
Q4	1	3	17	26	35	Accuracy
Q5	1	2	17	27	35	Format
Q6	1	2	13	34	32	Format
Q7	2	7	24	16	33	Ease of Use
Q8	3	6	21	20	32	Ease of Use
Q9	1	3	20	23	35	Timeliness
Q10	0	0	22	33	27	Timeliness

SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree

From the user satisfaction test that has been conducted using End User Computing Satisfaction, all final results of the variables were obtained using the Likert Scale formula. These percentages can be seen in Table ??.

The satisfaction percentage for each dimension was calculated using the weighted average formula, where each response level was assigned a corresponding weight (SD=1, D=2, N=3, A=4, SA=5) and computed against the maximum possible score. Table XI presents the average satisfaction scores for each EUCS dimension based on responses from 34 participants.

TABLE XI
EUCS DIMENSION SATISFACTION RESULTS

No	Dimension	Percentage	Category
1	Content	81.09%	Very Satisfied
2	Accuracy	81.96%	Very Satisfied
3	Format	82.83%	Very Satisfied
4	Ease of Use	77.44%	Satisfied
5	Timeliness	81.34%	Very Satisfied
Overall Satisfaction		81.13%	Very Satisfied

The calculation results show that the overall user satisfaction level toward the decision support system for extracurricular activity selection reaches 81.13%. Based on user satisfaction indicators, this value falls into the very satisfied category. This high level of satisfaction indicates that the system is able to meet user expectations in various aspects measured through the End User Computing Satisfaction method. This finding also shows that the developed system can be well accepted by users as a tool to help determine suitable extracurricular activities and is easy to use.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

Based on the design, development, and testing stages that have been conducted, it can be concluded that the expert

system for determining extracurricular activities has been successfully developed using the forward chaining method. All information related to student interests, types of extracurricular activities, and recommendation results were compiled based on input from the extracurricular coordinator and SMK Letris Indonesia 2. After going through the forward chaining-based system testing process and validation by experts, this system proved to be accurate and capable of providing recommendations that meet expectations. The user satisfaction measurement results using the End User Computing Satisfaction method show a satisfaction level of (81.13%). Therefore, this system can be used as an effective tool in determining extracurricular activities according to student interests.

B. Recommendations

In implementing this website-based expert system application for determining extracurricular activities, there are certainly shortcomings, so there are several suggestions that can be used as guidelines for future application development, including:

- 1) With the new system, maintenance and care of hardware and software must be considered so that the system can run properly.
- 2) This website-based application can be developed in the future into an Android application that can be downloaded from the Play Store and used by schools.

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