Decision Support System for The Selection of Achieving Student Using Analytical Hierarchy Process Method

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Submitted: 19/07/2021; Accepted: 30/07/2021; Published: 31/07/2021

Abstract – This study designed the Selection of Outstanding Students. To produce new findings in the world of technology, a lot of research has been carried out, especially for the world of education. One example is the selection of outstanding students where, this selection is needed by the school for external purposes, such as providing data on outstanding students to the Education Office, providing scholarships to students who excel, and making it easier for schools to enter every student in competitions in the world of education. The purpose of the research is that this selection system for high achieving students can be used by schools that want to select outstanding students, for example speed and accuracy in determining outstanding students. Because if this selection is done by someone, it will still experience inaccuracies or it could be subjective. The method used in this research is the Research and Development method or known as the research and development method. This research method is defined as a research method used in producing certain products and testing the effectiveness of these products, testing the system using the test case method with a white box testing and black box testing approach. The Analytical Hierarchy Process (AHP) method can help the process of determining outstanding students, based on trials using white box and black box testing resulting in a Cyclometric Complexity (CC) = 3, said to be appropriate and feasible to use and implement.

Keywords: Decision Support System; Selection; Student Achievement; Analytical Hierarchy Process

1. INTRODUCTION

School is a system of social interaction of an organization as a whole consisting of personal interactions related together in an organic relationship (Wayne in Soebagio Atmodiwiro's book). Meanwhile, based on Law No. 2 of 1989, schools are educational units that are tiered and continuous to carry out teaching and learning activities. According to Daryanto (1997), a school is a building or institution for learning and a place to receive and give lessons [1].

Currently determining the achievement of superior students several obstacles and tends to take a relatively long time, this is because the process of determining students and students who excel in achievement is only seen from report cards and does not use other references to determine their achievements, so the results obtained are not objective. A student's achievement is determined by various processes such as learning[2]. By learning students can gain knowledge widely, the success of a student in learning is also determined by indicators that are used as benchmarks in stating that a teaching and learning process can be said to be successful or not. Academic achievement is the result of behavioral changes that include the cognitive, affective, and psychomotor domains, which are a measure of student success. The cognitive domain is the 9 abilities that are always required of students to be mastered. Because mastery of abilities at this level is the basis for mastery of science [3].

Academic achievement is expressed as knowledge achieved on skills developed in certain subjects at school. It can be concluded that academic achievement is the amount of mastery of subject matter that has been achieved by students which are manifested in the form of values. Non-academic achievement is an achievement that cannot be measured and assessed using numbers, usually in terms of sports, scouts, PMR, or arts such as drum bands, painting, dance, and so on. This achievement is usually achieved by students when participating in extracurricular activities at school. Extracurricular activities are various school activities carried out in the context of opportunities for students to be able to develop their potential, interests, talents, and hobbies which are carried out outside normal school hours. The achievements obtained are of course based on the ability to know the knowledge possessed by each student so that this achievement will even really help to get a better life in the future[3].

Every educational institution always has a vision and mission that is oriented towards graduates who are smart and excel in achievement. Technological developments are moving very fast in producing and updating innovative products. This of course takes time and a process to be accepted by the wider community. One of the many areas of technology is a decision support system that was created to assist in decision making. A Decision Support System (DSS) is a part of a computer information system used by a company or organization which later the system will process data into information to take a specific semi-structured or unstructured decision. The decision support system is expected to help a decision holder to easily decide the problem above. One method that can be applied in a decision support system is the Analytic Hierarchy Process method.

Based on the background of the research above, we will discuss further to obtain the results of ranking students who excel quickly and objectively[4]. The results of this ranking will help the school in selecting outstanding students. This study aims to be able to design a decision support system for the selection of Achieving Students Using the Analytical Hierarchy Process Method and built with a Website-Based system at Muhammadiyah 1 Middle School Tolangohula, Gorontalo.

One of the studies ever conducted by Prima Sophisticated Kawuran Information Systems Study Program at Dian Nuswantoro University Semarang entitled Decision Support System for the selection of outstanding students using the

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Analytical Hierarchy Process (AHP) method[5]. This research aims to build software on “Decision Support System for Selection of Achieving Students Using Analytical Hierarchy Process (AHP)” which is expected to help in determining student achievement easily. Making this application using the Analytical Hierarchy Process (AHP) method, this method can solve problems with various criteria and can solve complex problems through a systems approach and deductive integration. The system development method used is the System Development Life Cycle (SDLC) method which consists of the planning stage, analysis stage, design stage, implementation stage use, and maintenance stage. The information generated from this system is the ranking of outstanding students based on criteria data and criteria weight data. The resulting ranking can be used to assist teachers in making decisions to determine outstanding students [1].

2. RESEARCH METHODOLOGY

2.1 Research Sites
This research was carried out at Muhammadiyah 1 Middle School Tolangohula Gorontalo

2.2 Research Methods
This research uses a Research and Development method or known as research and development method. This research method is defined as a research method used in producing certain products and testing the effectiveness of these products. In line with this, Sudaryono defines research and development as a process of data collection, data analysis that is carried out systematically and logically to achieve a certain goal. Research and Development is divided into 3 parts of research methods, namely:

a. Descriptive, which is used in the initial study to collect data on existing conditions, namely a comparison of the conditions of existing and future products, the conditions of the user, the conditions of the supporting and inhibiting factors.
b. Evaluative is used to evaluate a product development trial process.
c. Experiments are used to test the efficacy of the product to be produced.

2.3 AHP (Analytical Hierarchy Process)
AHP (Analytical Hierarchy Process) is a basic approach to decision-making. In this process, the decision-maker uses Pairwise Comparison which is used to form all priorities to determine the ranking of the alternatives. This method was developed by Thomas L., Saaty a mathematician who was first published in his book The Analytical Hierarchy Process in 1980[9]. AHP is a decision-making tool that describes a complex problem in a hierarchical structure with many levels consisting of objectives, criteria, and alternatives. The main tool of this model is a functional hierarchy with human perception as the main input[6]. Basically, the steps in AHP include:

a. Develop a hierarchy of problems encountered.
The problem to be solved is broken down into elements.

Based on the picture above, it can be seen that:
1. The lowest hierarchy contains alternatives (choices) in the analysis.
2. The second hierarchy is the sub-objective criteria used to analyze more specifically.
3. The third hierarchy is the objective criteria used to analyze.
4. The fourth hierarchy contains the analysis objectives (goals).

b. Assessment criteria and alternatives.
Criteria and alternatives were assessed through pairwise comparisons. According to Saaty, for various problems, a scale of 1 to 9 is the best scale in expressing opinions[7].
Table 1. Pairwise Comparison Scale

<table>
<thead>
<tr>
<th>Intensity of importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Both elements are equally important</td>
<td>Two elements contribute equally to the existing criteria</td>
</tr>
<tr>
<td>3</td>
<td>One element is slightly more important than the other</td>
<td>Experience and judgment slightly favor one element over another</td>
</tr>
<tr>
<td>5</td>
<td>One element is essential or very important than the other elements</td>
<td>Experience and judgment strongly favor one element over another.</td>
</tr>
<tr>
<td>7</td>
<td>One element is clearly more important than the other elements</td>
<td>One element strongly supported and dominated has been seen in practice.</td>
</tr>
<tr>
<td>9</td>
<td>One element is absolutely more important than the other elements</td>
<td>The evidence supporting the other elements has</td>
</tr>
<tr>
<td>2, 4, 6, 8</td>
<td>Values between two adjacent considerations</td>
<td>A compromise is needed between two considerations</td>
</tr>
</tbody>
</table>

Comparisons are made based on the decision maker’s policy by assessing the level of importance of one element against another element in the pairwise comparison process, starting from the top level of the hierarchy aimed at selecting criteria, for example, A, then taking the elements to be compared, for example, A1, A2, A3, A4, A5. Then the arrangement of the compared elements.

Table 2. Pairwise comparison matrix

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

To determine the value of the relative importance between elements, a number scale from 1 to 9 is used as shown in table 2. This assessment is carried out by a decision-maker who is an expert in the area of the problem being analyzed and has an interest in it. If an element is compared to itself, it is given a value of 1. If element i is compared to element j, it gets a certain value, then element j compared to element i is the opposite[8].

c. Prioritization

For each criterion and alternative, pairwise comparisons were performed. The relative comparison values are then processed to determine the ranking of alternatives from all alternatives. Priority determination through the following stages:
1. Square the matrix of pairwise comparisons.
2. Count the number of values for each row, then normalize the matrix.

d. Logical consistency.

All elements are logically grouped and ranked consistently according to a logical criterion. The weight matrix obtained from the pairwise comparison results must have a cardinal and ordinal relationship. The relationship can be shown as follows:

a. Cardinal relationship: \( a_{ij} \cdot a_{jk} = a_{ik} \)
b. Ordinal relationship: \( A_i > A_j \), \( A_j > A_k \) then \( A_i > A_k \)
c. Calculation of logical consistency is done by following these steps:
   1. Multiply the matrix with the corresponding priority.
   2. Add up the multiplication results per row.
   3. The result of the sum of each row is divided by the respective priority and the results are added together.
   4. The result of c divided by the number of elements, will get max.
   5. Consistency Index
      \( (CI) = (\lambda_{max} - n) / (n-1) \)
   6. Consistency Ratio = CR / RI, where RI is an index of random consistency. If the consistency ratio is 0.1, the calculation result can be justified.
   7. Calculate the value of lambda (\( \lambda \)) and Consistency Index (CI) and Consistency Ratio (CR), the formula:

\[
\lambda = \frac{\sum CV}{\Sigma n} \quad \text{................... (1)}
\]
\[
CI = \lambda - n \quad \text{................... (2)}
\]
\[
\frac{n - 1}{n - 1}
\]
\[ CR = \frac{CI}{RI} \] .......................... (3)

Where:
\[ \lambda = \text{Average value of vector consistency} \]
\[ CV = \text{Consistency Vector} \]
\[ N = \text{Number of factors being compared} \]
\[ CI = \text{Consistency Index} \]
\[ RI = \text{Random Index} \]
\[ CR = \text{Consistency Ratio} \]

In this case, RI (Random Index) is the average consistency index for numeric numbers taken randomly from the AHP comparison scale [9].

2.4 Proposed System

The proposed system is illustrated by the proposed system flowchart diagram below:

![Proposed System Flowchart Diagram]

**Picture 2. Context diagram of the proposed model**

In the proposed system, the teacher inputs 4 data consisting of student data, criteria data, criteria values and alternative values, then after the input is complete, the four data after being stored are processed using the analytic hierarchy process method. alternative, the alternative results will be used to make decisions in the selection of outstanding students[3].

2.5 Design Stage

The stages in the system design process are as follows:
1. Determine the object of research.
   It has been discussed previously that the object of research to be carried out at Junior High School 1 Muahammadiyah Tolangohula Gorontalo.
2. Literary Studies
   The data obtained indirectly come from documentation, literature, books, journals, and other information that has to do with the problem under study.
3. Data and information collection
   The quality of the information obtained is determined by the validity of the data obtained. Therefore, data collection must be carried out as carefully as possible.
4. Running System Analysis
   Analysis of the current system is carried out to find out the processes that have been running at the research site. By studying the weaknesses that exist in the existing system, a new system can be developed that can be used to develop a geographic information system for the location of oil palm land.
5. System Requirements Analysis
   System requirements analysis is carried out to determine the needs of the system being run. Includes necessary hardware and software.
6. Database Design
   Database design or database is an important part in an information system. Because it is an important part, the database must be designed as well as possible to guard against the possibility of data corruption. The database design technique used for the server is MySQL.
7. Interface Design
   Interface design is needed to make the program look more attractive and easy to use (user friendly). In particular, the appearance on the Website will be designed using techniques and materials in accordance with website development standards.

8. Program Design
   The program design must be in accordance with the planning that has been thoroughly researched before. A web-based decision support system using the analytic hierarchy process method for the location of the school in First High School 1 Gandasari village, Tolangohula sub-district, will be made a program using the PHP programming language to create a website.

3. RESULT AND DISCUSSION

3.1 System Design

3.1.1 Context Diagrams
   Context diagram is one of the levels in the data flow, it is usually used to define the context and system boundaries in a modeling. One of its tasks is to perform other external data storage.

![Figure 3. Context Diagram of the process of viewing information on the selection system of outstanding students](image)

In the context diagram there is also no information about the stored data and the appearance of the diagram is quite simple

In the context diagram above, it is used to see the external entities involved in the system, here it can be seen that there are 3 external entities involved, namely teachers, principals and students, then there is a flow of data flowing in each arrow, namely student data, criteria data, and report cards, the value of attitudes and behavior, the value of discipline, the value of loyalty, the value of neatness, and the value of alternative criteria.

3.2 Implementation

a. Desain GUI (Graphic User Interface) Server

![Figure 4. Website Application Display a](image)
This image is the initial page that will appear on the opened website, which contains the title and initial explanation about the website, on the left side it contains master data namely student data, criteria data, change passwords, and exits while the calculation contains criteria values, student alternative values, alternative results. This display is an additional student data input form (alternative) that is used to input or adds student data containing NIS, Student Name, Class, Gender, Telephone Number.

**Figure 5. Website Application Display b**

Criteria Comparison Value Form is the form used to input the Comparison Value. The value compared is the value of student a with student b, for example, the value of student a's report card is compared to the value of student b's report card, whether the value of student a is better or higher than the value of student b. Alternative Results Form is a form that contains the results of alternative assessments based on each of the existing criteria by going through several calculation stages, namely comparison values, normalization and eigenvalues of criteria and alternatives.

### 3.3 Software Testing

System testing is carried out to measure whether the system developed is appropriate and can run with the previously planned flow. In testing the system the author uses two methods, namely white box and black box.

#### 3.3.1 Black Box

The black box testing method focuses on the functional requirements of the software. Therefore, black box testing allows software developers to create a set of input conditions that will train all functional requirements of a program whether it runs as expected or vice versa.

**Table 2. Black Box Test**

<table>
<thead>
<tr>
<th>Input/Event</th>
<th>Fungsi</th>
<th>Hasil</th>
<th>Hasil Uji</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilih Menu <a href="#">Login</a></td>
<td>Menampilkan Form Login</td>
<td>Form Data Login siap di isi</td>
<td>Sesuai</td>
</tr>
<tr>
<td>Halaman SPK</td>
<td>Menampilkan Halaman SPK Keseluruhan</td>
<td>Halaman SPK ditampilkan keseluruhan</td>
<td>Sesuai</td>
</tr>
<tr>
<td></td>
<td>Menampilkan Form Input Data Siswa</td>
<td>Form Input siap di isi dengan NIS, Nama Siswa, Kelas, Jenis kelamin dan Nomor Telpon, kemudian tombol simpan dan batal.</td>
<td>Sesuai</td>
</tr>
<tr>
<td></td>
<td>Data Siswa [Input]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Kriteria [Input]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Nilai Kriteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Nilai Alternatif Siswa</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Website System Testing for each form that has been created.

### 4. CONCLUSION

A student's achievement is determined by various processes such as learning. By learning students can gain knowledge widely, the success of a student in learning is also determined by indicators that are used as benchmarks in stating that a
teaching and learning process can be said to be successful or not. the application of this system makes it easier for teachers and principals in the process of determining outstanding students so that the determination process is in accordance with the criteria possessed by prospective students at Muhamadiyah 1 Tolangohula Junior High School.

REFERENCES


