B.5 The Development of Assistant Selection Application of Information and Communication Technology Laboratory

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This research aimed to design a support system to facilitate the decision-making process in terms of selecting the acceptance of Integrated ICT (Information and Communication Technology) Laboratory assistants using the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The AHP method was used for the process of determining the weight of each criterion determined from the Integrated ICT Laboratory, Budi Luhur University, while the TOPSIS method was used to determine the ranking based on the calculated values.

The method used in this research was the waterfall method consisting of 4 stages, including the needs analysis stage, design, testing and implementation. For testing, User Interface Testing was used which aimed to determine whether the functionality of interface elements such as buttons and hyperlinks contained on each page was working properly. In addition, validation testing was also carried out which aims to determine whether the validations in the system had been running well.

The results showed that the decision support system designed using the Analytical Hierarchy Process (AHP) method had been tested to determine the weight of each criterion needed in the assistant selection process, it was attendance with 0.284, Competence 0.143, Project 0.414, Hardware 0.089 and interview with 0.070. Meanwhile, the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was able to determine the ranking based on the results of calculating the criteria values for each assistant candidate and the 2 people who occupied the top rankings were declared to have passed the selection. The test results showed that all system elements functioned as designed.

1 Introduction

The Integrated Information and Communication Technology (ICT) Laboratory is a computer laboratory that is used to support practicum courses at Budi Luhur University, such as teaching and learning activities, Mid-Semester Examinations, and Final Semester Examinations for practicum courses. Each activity is supervised by at least one assistant. Assistants are students who assist the operations of the Integrated ICT Laboratory. Before becoming an assistant, students who register must become a candidate for assistant who will later carry out the training process to become an assistant for one semester. During the training period, prospective assistants will be assessed on the basis of active, neatness, given projects, and so on. The project is given based on existing business processes in the Integrated ICT Laboratory, such as making systems and servers. So far, the calculation process for the selection of prospective assistants is made manually by the supervisor of the Integrated ICT Laboratory, so that supervisors as decision makers often have difficulty determining which prospective students should be selected as assistants. This difficulty is caused because there are several criteria that must be met by each prospective assistant, including 1). attendance value to assess the presence of prospective assistants in the teaching and learning process both theory and practice, 2). competency value consisting of personal competency; it is the individual's ability in matters relating to the development of one's personality, professional competency; it is the individual's ability in matters relating to the implementation and completion of certain tasks at work, and social competency; it is the ability of individuals in matters relating to life and social interests such as skilled in communicating effectively and pleasantly, being able to build a compact and dynamic team work, understanding and appreciating differences and having the ability to manage conflict, 3). project value in the form of an assessment of the work of the assigned project as well as the project implementation process in which the supervisor can assess the 3 competencies mentioned in the second point above, 4). Hardware is an assessment of the knowledge of prospective assistants about hardware, 5). The value of the interview is to find out whether the information written in the curriculum vitae is correct, how deep the prospective assistant understands the projects that have been done before, motivation to work as a laboratory assistant, motivation to live and self-confidence. The process of calculating the assessment of the criteria mentioned above manually, surely, takes a lot of time. In addition, giving no weighting for each criterion resulted in the assessment results for the selection of assistants being less reliable. In this case, each criterion has the same weight where the presence value is the same as the competency, project, hardware and interview scores. Each criterion should have its own weight that is adjusted to the needs of the laboratory. For example, the presence value should have less weight than the hardware value. Because if the presence of an assistant candidate is 100 but the hardware value is only 50, then based on the same weight the final score of the

assistant candidate will be higher than the other assistant candidates whose presence score is 50 and the hardware value is 90. The final score of the two assistant candidates clearly shows that the assistant candidate with a presence score of 100 who passed the selection even though his knowledge of hardware was not good. Whereas knowledge of hardware is more important than attendance in relation to work as an assistant at the Information and Communication Technology Laboratory. Inaccurate selection of Information and Communication Technology Laboratory assistants can reduce the quality of services related to teaching and learning activities, Mid-Semester Exams, and Final Semester Exams for practicum courses.

In order for the process of calculating the value of prospective assistants to be easy, fast and accurate, it is necessary to build a decision support system to assess prospective assistants who are eligible to be appointed as assistants by using a combination of the Analytical Hierarchy Process (AHP) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The AHP method is used to give weight to the established criteria so as to minimize subjective assessments of the importance of the criteria set by the decision maker. Determination of weights can be more reliable and accurate by using this AHP method, moreover the weight of a criterion represents the level of importance of the criteria. The greater the weight of a criterion, the more important the criterion is in supporting decision making. Meanwhile the TOPSIS method is also used in this study to determine alternative rankings based on established criteria whose weight values have been calculated using the AHP method. With ranking, supervisors can easily and quickly and accurately make decisions in the selection. The results of this ranking clearly show a worthy assistant candidate to be chosen as an ICT Laboratory assistant.

Based on the above background, this research aimed to develop a support system to determine the selection of acceptance for Integrated ICT (Information and Communication Technology) Laboratory assistants using the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods.

2 Literature Review

2.1 Decision Support System

The concept of a Decision Support System (DSS) was first used in the early 1970s by Michael S. Scott Morton by using the term Management Decision System. This concept is a mechanism based on the use of data and models to solve problems that are not structured (Ahmad, 2018: 28). According to Somya & Wardoyo (2019: 45) Decision Support System is used as a tool for decision makers to expand the capabilities of decision makers, but not to replace the judgment of decision makers.

This system is an information system interactive computer-based process that processes data with various models to solve unstructured problems so that it can provide information that can be used by decision makers in making a decision. In a decision support system, a person's intellectual resources are combined with the ability of computers to help improve the quality of the decisions taken. The stages of the decision-making process consist of several steps, including:

1. Intelligence. This stage is the process of tracing and detecting the scope of the problem and identifying the problem. Input data is obtained, processed and tested in order to identify problems.
2. Design. This stage is the process of finding, developing and analyzing alternatives that can be done. This stage includes the process of analyzing the problem, deriving solutions and testing the feasibility of the solution.
3. Selection. The process of selecting among various alternative actions that may be carried out is carried out. The election results will then be implemented in the decision-making process.
4. Implementation. This stage is carried out on the implementation of the system design that has been made at the design stage and implement alternative actions that have been selected at the selection stage.

Furthermore (Siagian, 2018:66) states that the definition of an ideal Decision Support System (DSS) includes:

1. DSS is a computer-based system with an interface between the machine/computer and the user.
2. DSS is intended to assist decision makers in solving problems at various levels of management and not to replace human positions as decision makers.
3. DSS is able to provide alternative solutions to semi/unstructured problems for individuals or groups and in a variety of decision-making processes and styles. DSS uses data, databases, and analysis of decision models. Decision Support System is an interactive information system that provides information, modelling, and manipulating data. The system is used to assist decision making in semi – structured situations and unstructured situations where no one knows exactly how decisions should be made.

2.2 Analytical Hierarchy Process (AHP).

The Analytical Hierarchy Process (AHP) is a technique to support the decision-making process that aims to determine the best choice from several alternatives that can be taken. AHP is a method developed by Thomas L. Saaty, a mathematician at the University of Pittsburgh, United States around the 1970s, and has undergone many improvements and developments to date (Ahmad, 2018:30).

Saaty in Buheli, Novian, Rohandi (2020:214) defines hierarchy as a representation of a complex problem in a multilevel structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on down to the last level of the alternative. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic, as shown in the following figure:

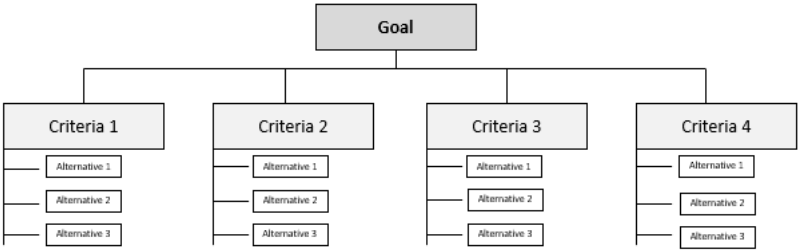

Figure1. Hierarchical Structure of AHP Method

AHP incorporates personal considerations and values logically. This process relies on imagination, experience, and knowledge to construct a hierarchy of problems and relies on logic and experience for judgment. Furthermore, according to Anggoro & Supriyanti (2019:164), there are several principles that must be understood in solving problems using AHP, including: 1. Hierarchical Preparation is a step simplification of the problem into parts that are the main elements, then into parts again, and so on hierarchically to make it clearer, making it easier for decision makers to analyze and draw conclusions on these problems. 2. Determining Priority, it is AHP performs pairwise comparisons between two elements at the same level. The two elements are compared by weighing the level of preference of one element against another based on certain criteria. 3. Logical Consistency as a rational principle in AHP. Consistency means two things, including: a) Similar thoughts or objects are grouped according to their homogeneity and relevance. b) Relationships between objects that are based on certain criteria and justify each other logically.

According to Syafitri, Yansyah, Musyofa (2020:11), basically, the procedures or steps in the AHP method include:

1. Defining the problem and determining the desired solution, then compiling a hierarchy of the problems encountered.
2. Determining the priority of elements, namely comparing the criteria and alternatives in pairs using a scale of 1 to 9 to express opinions, as shown in the following figure:

Importance of Intensity	Interpretation
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other element
7	One element is clearly more absolutely important than the other element
9	One element is absolutely important than the other element
2, 4, 6, 8	The values between two adjacent consideration values
Opposite	If activity i gets one point compared to activity j, then j has the opposite value compared to i

Figure 2. Paired Comparison Scale

After that the pairwise comparisons must be defined with the table so that the number of total n x [(n-1)/2] raters fruit, where n is the number of elements compared. And then calculating the eigenvalues and testing its consistency. If it is not consistent then retrieval can be performed. At least calculating the eigenvectors of each matrix pairwise comparison, which is the weight of each element to determine prority of elements at lowest level of Hierarchi to reach the goal.

2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

The TOPSIS method is a multi-criteria decision-making method that was first introduced by Yoon and Hwang in 1981. This method is one of the most widely used methods for solving practical decision-making. TOPSIS has a concept where the chosen alternative is the best alternative which has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. The more factors that must be considered in the decision-making process, the more difficult it is to make a decision on a problem. Moreover, if the decision-making effort of a particular problem, in addition to considering various factors/various criteria, it also involves several decision makers. Such problems are known as multiple criteria-decision making (MCDM) problems. In other words, MCDM can also be referred to as a decision making to choose the best alternative from a number of alternatives based on certain criteria.

TOPSIS method is used as an effort to solve the problem of multiple criteria-decision making. This is because the concept is simple and easy to understand, computationally efficient and has the ability to measure the relative performance of decision alternatives. The results of the TOPSIS implementation process can sort alternatives from the largest value to the smallest value or what is called the ranking of the alternatives that have been ranked and then serve as a reference for decision makers to choose the best desired solution. This method is widely used to complete practical decision making. (Ramos and Wardoyo, 2019).

Hamurcu & Eren (2020:6) state that, TOPSIS aims to determine positive ideal solutions and negative ideal solutions. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, while the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. While the cost criterion is the opposite of the benefit criterion, the smaller the value of the criterion, the more feasible it is to be selected.

3 Research Method

The method used in this research was the Waterfall method. It was called the Waterfall Method because each step taken must wait for the completion of the previous stage so that it can run sequentially (Rochmatin, Ridwan, Yalina, 2019:111). The following are the stages of developing a support system to determine the selection of assistants for the Integrated ICT (Information and Communication Technology) Laboratory:

1. Needs Analysis. What was carried at this stage was to analyze the system requirements. Needs analysis could be in the form of collecting data or information needed for system creation. The information needed was information on the selection criteria for the admission of ICT laboratory assistants. Data on the selection criteria were obtained through document analysis and interviews with the head of the ICT Laboratory and Supervisor. Meanwhile, data on the weighting of the criteria analysis was obtained through a questionnaire filled out by the Head of the ICT Laboratory.
2. Design. At this stage, the system modelling process was carried out which includes: function modelling, data modelling, data flow modelling in the system and interface design modelling. This was carried out by translating the system requirements that have been obtained in the previous stage into standard models that would be used in the next stage.
3. Testing.
   a. User Interface (UI) Testing. This user interface test aimed to determine the functionality of the interface elements (such as buttons and hyperlinks) contained on each page were working properly.

b. Validation Test. Validation testing aimed to determine whether the validation in the system, including username, password, alternative NIM, user password and alternative value points had been running well.

4. Implementation. The Analytical Hierarchy Process (AHP) method was used for the process of determining the weight of the criteria set by the Integrated ICT Laboratory, Budi Luhur University. The results of the weights processed by the AHP method would be used for the selection process for the assistant to the Integrated ICT Laboratory at Budi Luhur University. In this case, the criteria were divided into 5 (five) including: attendance value, competency value, project value, hardware value, and interview value.

The TOPSIS method was used to determine the ranking in the selection process for the assistant to the Integrated ICT Laboratory at Budi Luhur University. This method used the principle that the chosen alternative must have the closest distance from the positive ideal solution and the farthest from the negative ideal solution from a geometric point of view. The positive ideal solution itself was defined as the sum of all the best values that can be achieved for each attribute, while the negative-ideal solution consisted of all the worst values achieved for each attribute.

4 Results and Discussion

4.1 Needs Analysis

Based on document analysis and interviews, it was found that several important criteria were used in the selection process for ICT laboratory assistants at Budi Luhur University, which consisted of 1). attendance value to assess the presence of prospective assistants in the teaching and learning process both theory and practice, 2). competency value consisting of personal competency; it was the individual‘s ability in matters relating to the development of one‘s personality, professional competency; it was the individual‘s ability in matters relating to the implementation and completion of certain tasks at work, and social competency; it was the ability of individuals in matters relating to life and social interests such as skilled in communicating effectively and pleasantly, being able to build a compact and dynamic team work, understanding and appreciating differences and having the ability to manage conflict, 3). project value in the form of an assessment of the work of the assigned project as well as the project implementation process in which the supervisor can assess the 3 competencies mentioned in the second point above, 4). Hardware was an assessment of the knowledge of prospective assistants about hardware, 5). The value of the interview was to find out whether the information written in the curriculum vitae was correct, how deep the prospective assistant understands the projects that had been done before, motivation to work as a laboratory assistant, motivation to live and self-confidence.

From the criteria data, a questionnaire was developed to determine the comparison of each criterion (lowest 1 and highest 9) based on the opinion of the Head of the ICT Laboratory. The results of the questionnaire showed that the importance of the presence value to the competency value is 2, the presence value to the project value is 1, the presence value to the Hardware value is 4 and the presence value to the interview value is 2, the competence value importance to the hardware value is 2, the competency value The value of the project to the value of the interview is 3, the level of importance of the value of the project to the value of competence is 5, the value of the project to the value of hardware is 4, the value of the project to the value of the interview is 5 and the level of importance of the value of hardware to the value of the interview is 2. This data will then be calculated using the method Analytical Hierarchy Process (AHP) to produce the weight of each criterion.

In addition, based on the results of document analysis, data collected about students who registered as assistants to the Integrated ICT Laboratory of Budi Luhur University which is also needed in this research process alternative profile data in the form of Student Identification Number, name, address, gender, faculty and also alternative value data in each criteria which will be processed using the Technique For Order Performance By Similarity To Ideal Solution (TOPSIS) method to produce rankings that facilitate decision making in the selection of assistants to the Integrated ICT Laboratory of Budi Luhur University.

4.2 Design

Before designing the menu screen display, the menu display structure is designed as follows:

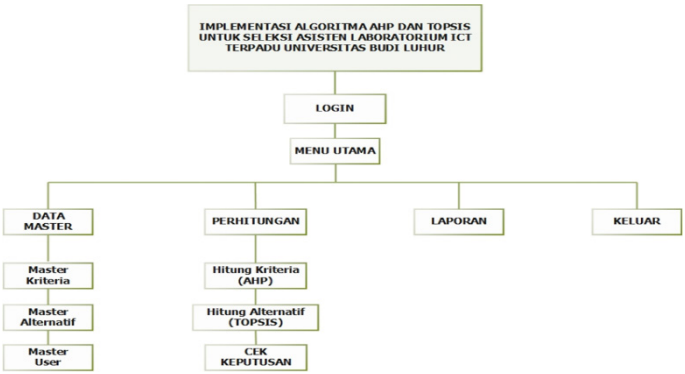

Figure 3. Menu display structure.

Figure 3 above showed that to enter the main menu screen design, the user was required to do the login stage first. In the design of the login form the user was asked to enter a username and password. After successfully logging in, you would enter the main menu screen design view. In the main menu there were some menus, including Home, Master, Calculations, Reports and the logout button at the top right of the logged in user name.

- **Master Data**
  In the master criteria data screen design, the user was able to see the existing criteria data. Then there was an add button to add data, a change button to change and a delete button to delete criteria data. In the alternative master data screen design, the user was able to see the available alternative data. Then there was an add button to add data, a change button to change and a delete button to delete alternative data. In the master user data screen design, logged in users can view existing user data. Then there was an add button to add data, a change button to change and a delete button to delete user data.
- **Calculations**
  The calculation criteria screen design was used for the process of filling out the results of the comparison questionnaire. There is a saved criteria name, a radio button to select a comparison between criteria and a calculate button to process calculations. In the alternative calculation screen design there were alternative names, criteria names, value text fields and calculate buttons. The design of the decision check screen would display the results for each alternative and the user was able to choose by giving a check mark for the alternative that passes the selection and selecting the assistant selection period.
- **Report**
  For the report screen design, there were 2 options for printing reports, including the criteria report and the decision result report.
- **Go out**
  In this design the user used the logout button to exit the system.

4.3 To ensure

To ensure the success of the test design, it was necessary to test the Application for the Implementation of the Analytical Hierarchy Process (AHP) Algorithm and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Tests were carried out to ensure that the results obtained were in accordance with the design objectives.

1. User Interface Test
   The results of the User Interface test on the Login Page and the main menu consisting of the criteria master page, alternative master, master user, criteria comparison page, criteria comparison results page, alternative value calculation page, alternative value calculation results and report pages show that all these systems function as intended.
2. Validation Test
   The results of the validation test on the alternative username and password, NIM (Student Identification Number) and alternative value points indicated that all of these systems were acceptable.

4.4 Implementation

Because the test results showed that all menus on the system could be accepted and function according to the design objectives, the support system for determining the selection of admissions for ICT laboratory assistants at Budi Luhur University can be implemented. Following

In this section, several screenshots of the application implementation of the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) implementation were described from the first run to completion.

1. Login Screen Display
   Before accessing this application, the user was required to do the login process first. Here's a screenshot of the login screen:

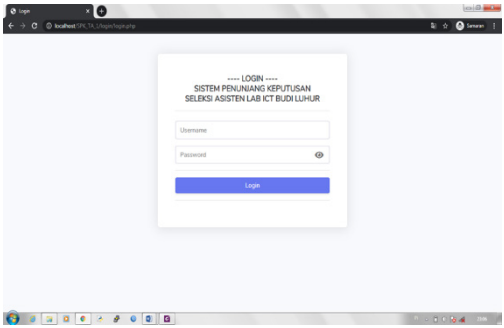

Figure 4. Login display

2. Main Menu Screen Display
   After the user has successfully logged in, the user would immediately enter the main menu display. In the main menu the user was able to access the master data menu, calculation transactions, and reports. Here's what the main menu looks like:

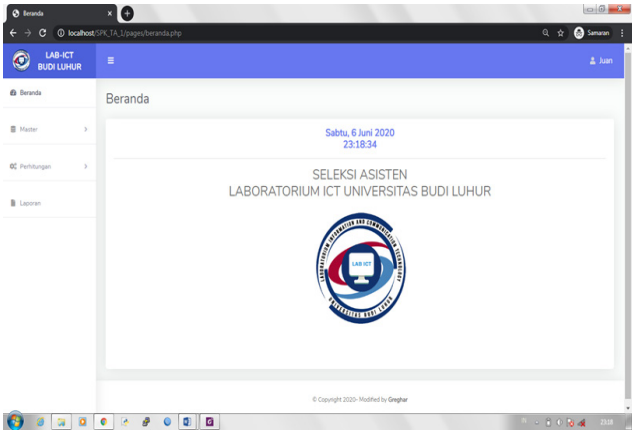

Figure 5. Main Menu Display

3. Criteria Data Menu Screen Display
   On the screen display showed the criteria master data and there were add, change, and delete buttons. Here's a picture of how it looks:

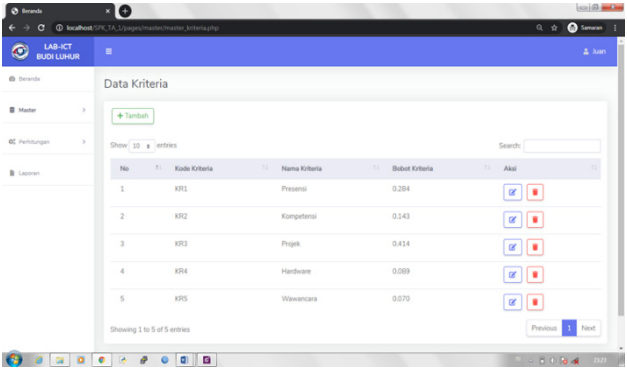

Figure 6. Criteria Master Menu Display

4. Alternative Data Menu Screen Display
   On the screen display showed alternative master data and there were add, change, and delete buttons. Here's a picture of how it looks:

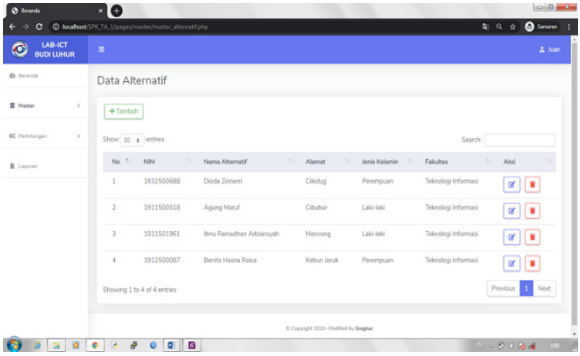

Figure 7. Display of Alternative Data Menu

5. Criteria Appeal Screen Display
   On this screen display, the names of the first and second criteria were compared to the radio button options and assessed on a paired scale. This view was filled in based on the questionnaire received. Here's a screenshot of the criteria comparison screen:

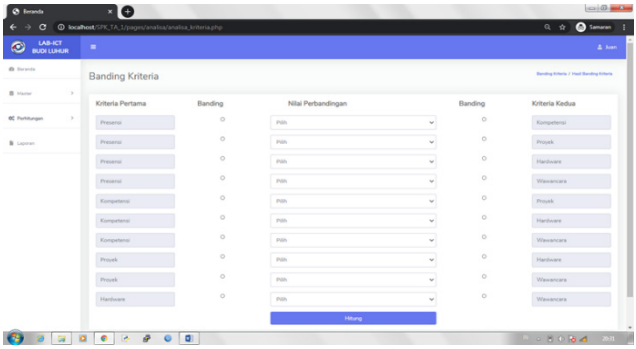

Figure 8. Criteria Comparative Display

6. Criteria Comparison Results Screen Display
   This display displayed the results of the calculation of the comparison of criteria based on the Analytical Hierarchy Process (AHP) method and displayed the results of the consistency test of the criteria weights and there was a data reset button to delete all data from the comparison results. The following was a screenshot of the criteria comparison results:

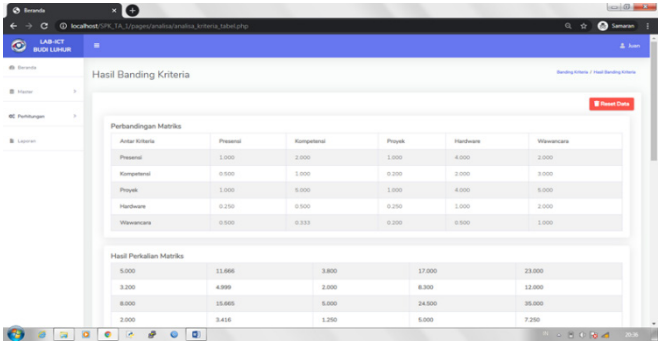

Figure 9. Display of Criteria Comparison Results

7. Alternative Compute Result Screen Display
   This display displayed the calculation results of the selection value based on the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method and there was a reset button to delete all calculation data and there was a decision check button to check or select the assistant acceptance decision. Here's a screenshot of the alternative calculation results:

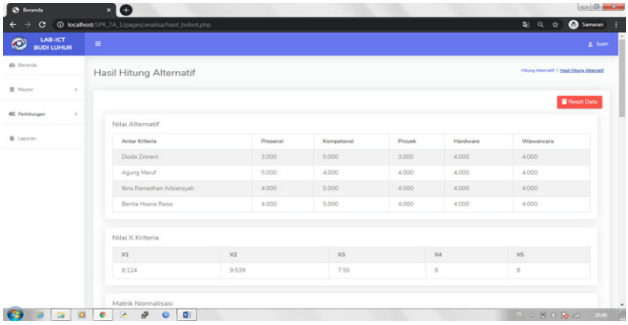

Figure 10. Display of Alternative Calculation Results

8. Decision Check Screen
   This view displayed the student identification number, name, final grade of alternative calculations. This display process was to provide assistant selection decisions based on the existing final scores. The following was a screenshot of the decision check:

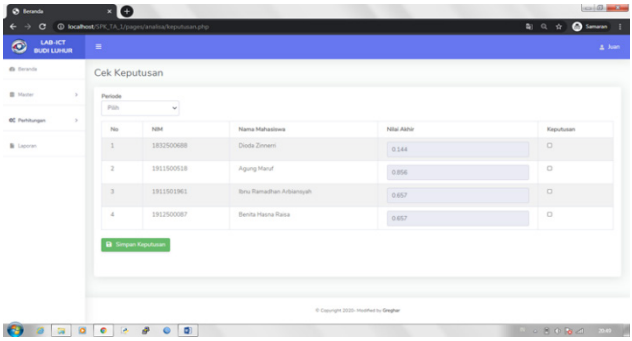

Figure 11. Decision Check Display

9. Decision Result Report Screen Display
   The screen display of the decision result report in Figure 10 below prints the results of the decision selection based on the decision of the Integrated ICT Laboratory which was supported by the final value of the calculation of the assistant selection according to the selected period. The following was a screenshot of the decision result report:

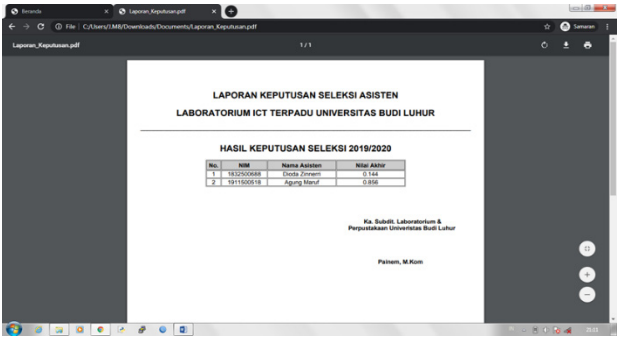

Figure 12. Display of Decision Result Report

5 Conclusion

The decision support system designed using the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method greatly facilitates the decision-making process for the selection of Integrated ICT Laboratory assistants. The AHP method was very suitable to be chosen to be used because this method was able to provide a weighted value for the established criteria, and can minimize subjective assessments of the importance of the criteria set by the decision maker, while the TOPSIS method was very useful in determining rankings based on established and predetermined criteria. the weight value was calculated.

This decision support system had been able to display selection recommendations based on the final value of the calculation of prospective assistants that were used as consideration and decision-making tools to select Integrated ICT Laboratory assistants easily, quickly and reliably

Literature

Ahmad, R (2018) Penggunaan Sistem Pendukung Keputusan dengan Menggunakan Metode AHP dalam Menyeleksi Kelayakan Penerima Beasiswa. METIK Jurnal Volume 2 No. 1 Tahun 2018 ISSN 2580-1503

Anggoro, A., Supriyanti, W (2019) Aplikasi Sistem Pendukung Keputusan Dengan Metode Ahp Untuk Pemilihan Siswa Berprestasi Di SMAN Kebakkramat. Jurnal PPKM, Vol. 6, No. 3, 163–171 ISSN(print): 2354-869X | ISSN(online): 2614-3763 163

Buheli, TA., Novian, D., Sulfiana (2020) Sistem Pendukung Keputusan Penerimaan Bantuan Nelayan dan Pembudidaya Menggunakan Metode AHP. DIFFUSION Journal of System and Information Technology Volume 1, No. 1, Desember 2020

Hamurcu, M., Eren, T (2020) Electric Bus Selection with Multicriteria Decision Analysis for Green Transportation. Sustainability Journal 2020, 12(7), 2777; https://doi.org/10.3390/su12072777

Rahmawati, MS., Iskandar, TH, Sulfiana (2019) Sistem Pendukung Keputusan Seleksi Penerima Beasiswa Program Indonesia Pintar di SMK Negeri 1 Sorong Dengan Menggunakan Metode Analytical Hierarchy Process Berbasis Dekstop. Jurnal INSECT Vol.5 No.1, 2019, ISSN: 2476-9010

Ramos, S., Wardoyo, R (2019) Perancangan Sistem Pendukung Keputusan Seleksi Asisten Dosen Menggunakan Kombinasi Metode Profile Matching dan TOPSIS Berbasis Web Service. Jurnal Ilmu Komputer dan Informatika Vol.5 No.1 Juni 2019, ISSN 2477-698X https://doi.org/10.23917/khif.v5i1.7924

Rohmatin, Ridwan, Yalina (2019) Penggunaan Metode Electre untuk SPK Pemilihan Makanan Sehat bagi Penderita Hipertensi. Jurnal Ilmiah Informatika Vol. 4 N0. 2/12/2019 https://journal.ibrahimy.ac.id/index.php/JIMI/article/view/580/571

Siagian, Y (2018) Seleksi Penerimaan Karyawan Baru Menggunakan Metode Topsis. Jurnal Mantik Penusa, 2(1). Retrieved from http://e-jurnal.pelitanusantara.ac.id/index.php/mantik/article/view/332

Somya, R., Wardoyo, R (2019) Perancangan Sistem Pendukung Keputusan Seleksi Asisten Dosen Menggunakan Kombinasi Metode Profile Matching dan TOPSIS Berbasis Web Service. Jurnal Khasanah Informatika e-ISSN:247-698X https://doi.org/10.23917/khif.v5i1.7924

Syafitri,Y., Yansyah, R., Musyofa (2020) Sistem Pengambilan Keputusan Penerimaan Beasiswa Berprestasi Di SMA Negeri 1 Natar Lampung Selatan. Jurnal Expert: ISSN 2088-5555 Vol. 10 No. 1 Edisi Juni 2020 http://jurnal.ubl.ac.id/index.php/expert/article/view/1491/1612