Design a Group Decision Support System Model to Determine Accreditation of Early Childhood Education Institutions

Muhammad Syaukani1*, Abdul Kadir2

1STMIK Indonesia Banjarmasin, Indonesia
2Program Studi Teknik Informatika, Universitas Nahdlatul Ulama Kalimantan Selatan, Indonesia

*syaukani@stmik.id, kadir_budiluhur@gmail.com

Abstract. The accreditation process activities of Early Childhood Education and Non-Formal Education institutions are carried out in stages starting from the provincial level as a recommendation provided to the national level as the decision-maker for accreditation determination. The accreditation process is carried out manually. This process is carried out by assessors and secretariat staff in charge of receiving and checking accreditation documents and reporting the results of document checks and real conditions in the field, i.e., activities carried out by officers are often constrained by "fatigue conditions" and possible "data loss." These obstacles can be the cause of the objectivity of the accreditation process and even the possibility of "wrong value." To overcome these problems, we need a tool that is used for the decision making process. This study model the Group Decision Support System (GDSS) to determine the accreditation of early childhood education institutions. The developed GDSS can accommodate the need for joint decision making by involving the Decision Maker (DM) group, namely two assessors who act as providers of accreditation recommendations. The results of this study are in the form of a GDSS model named KPAUD using the hybrid method of Eckenrode, TOPSIS, and Borda. The Eckenrode method is used to calculate the weight value, TOPSIS is used for ranking alternative decisions, and Borda is used for voting.

1. Introduction

The Provincial Accreditation Agency for Early-Childhood and Non-Formal Education Institutions (BAP PAUD and PNF) is an independent agency formed based on the Law No.20 of 2003 concerning the National Education System and is an extension of the National Accreditation Agency for Early-Childhood and Non-Formal Education Institutions (BAN PAUD and PNF).

Since the beginning, the accreditation program for the Early-Childhood and Non-Formal Education Institutions is carried out manually. This manual process requires many officers (assessors and secretariat staff) who are in charge of receiving accreditation submission forms, examining submissions using manual instruments and reporting the results of examination of the submission forms and the real conditions of institutions on the field. The activities conducted by these officers often face some constraints in the form of "fatigue" and "data loss" possibility. These constraints can be the cause of the objectivity of the accreditation process and even the possibility of "wrong value/credit" given.
Given the current conditions, the Provincial Accreditation Agency for Early-Childhood and Non-Formal Education Institutions of South Kalimantan is independent in carrying out the processes above. Therefore, there is a need of an application for the decision making process. Decision making is a process of finding the best decision of all feasible alternatives. Group Decision Support System (GDSS) is a computer-based system that supports groups of people involved in a shared task (or goal) and which provides an interface for a shared environment. GDSS requires a model for simplifying and analyzing complex situations or systems. Through such model, the complex situations or systems can be simplified without eliminating the essentials, with the aim of facilitating the understanding. The modelling and the use of the model can provide a management framework for decision making [11]. The developed GDSS can accommodate the decision making process of the accreditation of early-childhood and non-formal education institutions. This process is used to assist assessors in group decision making, involving the Decision Maker (DM) group, including assessor 1 and assessor 2. This study developed a GDSS model which is used as a tool to determine the accreditation of early childhood education institutions.

2. Related Works
The role of the Multi Attribute Decision Making (MADM) model is widely applied in solving the problem of decision support systems in various fields, especially for the multi attribute decision making model that uses the TOPSIS method. Shirouyehzad et al. [8] used the TOPSIS method to evaluate projects based on safety criteria. The results of this study indicated that this method can be applied maximally. Shirouyehzad et al. [9] also used the TOPSIS Method to determine decision making in determining employee performance. Nadia et al. [4] used Fuzzy TOPSIS in creating solutions for decision makers when dealing with real data with multiple attributes and involves complex decision making processes in calculating operational risks involved in investment. This method is effective for providing more realistic solutions.

Wimatsari [5] conducted a study on solving the problem of fuzzy multi attribute decision making (FMADM) using the Fuzzy TOPSIS method. In this study, there were several criteria used, namely GPA (Grade Point Average), quotients from parents' income, number of dependent, the use of electricity, and the activity selection process. The final results of this study gave the largest rating with the smallest value of the FMADM TOPSIS calculation method that can help providing decision making alternatives.

Łatuszyńska [2] conducted a research on multiple criteria of decision analysis to support decision making by developing the TOPSIS method for solving interval data problems. Broumi [1] examined the TOPSIS method to handle information on interval neutrosophic uncertain linguistic variables, that the standard TOPSIS method could only process real numbers. This study proposed a modification of the TOPSIS method for MADM problems on attribute and weight values to be interval data. Saeed F and Dixit. A [6] conducted a research by making a decision making model to determine the accreditation of a higher education institution using the Naive Bayes’s method.

3. Proposed Design Model on Group Decision Support System
An assessor has to make a decision based on what the problems are, what the problems are encountered during the document visitation, what will be done, and what should be done. Decision making is part of an event.
Decision making system (DMS) is a methodology that supports decision making. DMS has 3 main components, namely data, models and interfaces. It uses a model to interpret from the real world into the computer world. Model is the process of simplifying the representation of a system from the real world [10]. The model represents a system from the real world into a simple prototype structure, because real world problems are very complex to be accurately described. The model has an important role, so that a DSS design will be based on how humans solve the problem of decision making. The decision making model will interpret aspects related to decision making from the real world into structures that are easily computerized to obtain a solution.

The group decision support system model for determining accreditation of proposed Early-Childhood Education institutions consists of several components, namely data management, model management and user interfaces. These components are described as follows.

Data management, in the decision support system model to determine the accreditation of Early-Childhood Education institutions, is the process of organizing and maintaining data used by the system in a database. The database contains data such as symptoms data as criteria, damaged data as alternatives, match rating data, and system users. In addition, data management is also carried out for data related to the establishment of a case base. Data access is carried out by the user through the interface.

Model management is used for regulating and maintaining the Group Decision Support System (GDSS) model to determine accreditation of Early-Childhood Education institutions. The developed GDSS model was used to assist the assessor team in Provincial Accreditation Agency for Early-Childhood and Non-Formal Education Institutions. This model is named KPAUD model. While the user interface is a means used to make users able to communicate with the system. In general, the description of the KPAUD model architecture can be seen in Figure 1.

![Architecture model KPAUD](image)

Figure 1. Architecture model KPAUD

Developing a GDSS requires a set of criteria and alternatives, then there are several Early-Childhood Education institutions that submit accreditation documents that can be used as alternatives (A1 = institutions_PAUD_1, A2 = institutions_PAUD_2 and A3 = institutions...
_PAUD_3 and so on as many institutions that submit accreditation documents) and there were 50 instruments that were used as criteria (C1 = Achievement of Development According to Age Group, C2 = Documentation of Achievement of Development, C3 = Curriculum Structure, C4 = Reference Curriculum, C5 = Curriculum Review, C6 = Service According to Age Group, C7 = Learning Load, C8 = Study Group, C9 = Developmental Aspects, C10 = Form and Substance of Educational Calendars, C11 = Socialization of Educational Calendars, C12 = Activity Plans, C13 = Weekly Activity Plans, C14 = Daily Activity Plans, C15 = Integrative Holistic Programs, C16 = Play Environment Settings, C17 = Organizing Activities, C18 = Time of Assessment, C19 = Assessment Technique, C20 = Academic Qualification of Educators, C21 = Educator Competence, C22 = Academic Qualifications of Education Personnel, C23 = Educational Competency, C24 = Educational Facilities, C25 = Learning Facilities, C26 = Land, C27 = Building, C28 = Facility, C29 = Ownership Status, C30 = Installation Infrastructure, C31 = Vision, Mission and Objectives, C32 = Socialization of Vision, Mission and Objectives, C33 = Annual Work Plan, C34 = Organizational Structure, C35 = Partnership Network, C36 = Implementation Guide, C37 = Administration, C38 = Management Information System, C39 = Scheduling, C40 = Reporting, C41 = Assessment Element, C42 = Documentation, C43 = Award, C44 = Financing Type, C45 = Funding Source, C46 = Usage Report, C47 = Administration, C48 = Assessment Guide, C49 = Assessment Technique, C50 = Reporting). Then the assessor as DM in giving a criterion value to the alternative using the standard of assessment is 0 = None, 1 = Not Completed, 2 = Appropriate, 3 = Complete and 4 = Yes.

The stages in the process to determine the accreditation recommendations of the Early Childhood Education institutions in this study used a group decision support system (GDSS) with reference to Figure 1. In completing the GDSS, there was a performance rating matrix X made firstly referring to alternative A=(i=1,2,...,m) where m is the number of alternatives of Early-Childhood Education institutions, with criteria C=(j=1,2,...,n) where n is the number of criteria, with a total 50 criteria. Table 1 shows the performance rating matrix in general.

The completion process of GDSS was started firstly by making the performance rating matrix X as shown in Table 2, with the matrix dimension (m x n) where m is the number of alternatives and n is the number of criteria. The column matrix is $X_{11}$ ... $X_{mn}$ and the row matrix is $X_{11}, X_{12} ... X_{1n}$. The matrix element $X_{mn}$ was scored, so that, in Table 1, there is an alternative performance rating matrix shown towards the criteria.

| Alternative | Criteria                  | Achievement of Development in Accordance with Age Groups (C1) | Documenting Achievement of Development (C2) | ... | Reporting (C50) |
|-------------|---------------------------|-------------------------------------------------------------|---------------------------------------------|-----|-----------------|
| A1=Institutions_PAUD_1 | X_{11}                  | X_{12}                                                | ...                                      | $X_{1n}$ |
| A2=Institutions_PAUD_2 | X_{m1}                  | X_{m2}                                                | ...                                      | $X_{mn}$ |

Based on Table 1 above, there were three stages to completing the GDSS process in this study, namely: 1) weighting stage with the Eckenrode method; 2) ranking alternative
decisions with the \textit{TOPSIS} method; and 3) voting stage with the \textit{Borda} method. The stages will be described as follows.

\subsection*{3.2. 1. Stages of Weighting using Eckenrode Method}
Weighting was used to determine the degree of importance of each criterion established in decision making. Assessors, as decision makers, have a level of importance to a criterion for determining accreditation recommendation decision making. Assessors, as decision makers (DM), who played a role in providing criteria weight values were Assessor 1 as DM1 and Assessor 2 as DM2. In this study the weighting (importance level) criteria refers to as follows; major = 4, minor = 3, and observed = 1.

Based on Table 1, there were 50 criteria that were given weight based on the importance of the criteria. For example, in this case, the C1 criterion "Achievement of Development in Accordance with Age Groups" is a criterion that is considered major, so DM1 gives a score of 4 (major). Criteria C2 "Documenting Achievement of Development" is a criterion that is considered major, so DM1 gives a score of 4 (major). C3 criterion "Curriculum Structure" is a minor criterion, so DM1 gives a score of 3 (minor). In the same way, the weighting of other criteria was also applied. The steps in calculating the weight value using the Eckenrode method, and the equation refers to [7] [10].

\subsection*{3.2. 2. Ranking Stages of Decisions Alternative using TOPSIS Method}
Based on Table 1, the performance rating matrix to which an assessor as a DM will provide an assessment of the criteria for alternatives, the value of the performance rating matrix was ranked for its alternative decision.

The alternative decision ranking process was solved using the \textit{TOPSIS} method which is integrated with the calculation of the value of the weighting criteria by the \textit{Eckenrode} method. The steps of the alternative decision ranking process were as follows:[9]

1. Step One: to calculate the normalized matrix.
2. Step Two: multiplication of the nominal value of the matrix with the results of the calculation of the value of the criteria weight (method eckenrode)
3. Step Three: to define ideal positive solution value and ideal negative value.
4. Step Three: calculate the distance of each alternative to the value of a positive ideal solution and a negative ideal solution.
5. Step Five: determined the value of the proximity of each alternative to the ideal solution (preference).

Results From the results of the alternative decisions ranking of each DM, the voting process will then be conducted using the Borda method.

\subsection*{3.2. 3. Voting Stages using Borda Method}
The voting process is needed to determine decisions that can be recommended as an alternative to group decisions. In this process, the assessor who act as decision makers (DM) in decision making are Assessor 1 as DM1 and Assessor 2 as DM2 [3].

\section*{4. Conclusion}
Design a Group Decision Support System (GDSS) model to determine the accreditation of early childhood education institutions. The design of the GDSS model was developed to provide solutions to problems that occur and accommodate the needs of joint decision making by involving the Decision Maker (DM) group, namely two assessors who act as providers of
accreditation recommendations. The results of this study are the design of the GDSS model, which is named the KPAUD model, the design of the GDSS model uses the hybrid method of Eckenrode, TOPSIS and Borda. The Eckenrode method is used to calculate the weight value, TOPSIS is used for ranking alternative decisions, and Borda is used for voting.

5. References

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