

Decision Support System for Ranking of Students in Learning Management System (LMS) Activities using Analytical Hierarchy Process (AHP) Method

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Abstract Learning Management System (LMS) is part of E-Learning which is used as a means of online learning. However, the use of LMS is not in accordance with Minister of Education and Culture Regulation (PERMENDIKBUD) No 23 of 2016 which contains education assessment standards. This is because the LMS only focuses on the content that is used as a medium for student learning without any assessment or ranking given by the teacher. The purpose of this study is to provide an evaluation of the student learning process in the form of ranking students' activities in LMS using the AHP (Analytical Hierarchy Process) method so that student learning media is in accordance with PERMENDIKBUD No. 23 of 2016. The AHP method was chosen to assist teachers in ranking students so that it is not subjective. The method used can help teachers to determine student ranking from student activities that are ranked criteria in LMS. From the ranking criteria that are processed using the AHP method, the results obtained in the form of a ranking obtained by each student.

1. Introduction

In the world of education, one of the interesting things is about Learning Management System (LMS). Learning and teaching activities using learning management systems (LMS) have become a common phenomenon in education [1]. LMS is a web-based software tool for distributing, tracking, and managing courses via the Internet. There are at least three ways to utilize LMS [2]. First, an LMS can be used to supplement traditional face-to-face classroom teaching (face-to-face in class). In such cases, LMS functions as an electronic repository for subject matter. Second, educators who teach in class can choose to use a "blended" approach by mixing traditional classes. And finally, LMS can be used in distance education for courses that are fully online [3]. Decision Support System is a very sophisticated computer-based information. This system is used by executives, managers and policy makers in managing corporate finance, marketing, planning and operations [4]. A decision support system requires models - theories and calculations that explain how things work. In this study using the AHP calculation method. Analytical Hierarchy Process (AHP), a special mathematical tool in the science of decision making, is used to present the best decision-making model of alternatives that exist [5].

In the traditional learning process (face to face in class) there are learning process standards and learning assessment standards, this has been regulated in Minister of Education and Culture Regulation (PERMENDIKBUD) No. 23 of 2016 which contains education assessment standards [6]. The content in LMS is in accordance with the learning process standards. But there is no evaluation standard. Assessment standards are the process of gathering and processing information to measure the



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achievement of student learning outcomes [7]. In this case after students carry out the learning process, then the teacher provides an assessment and ranking of student activities in the LMS, grades and ranking of students can be seen on the viweboard or dashboard menu in the LMS [8,9]. Previous research only discusses various student activities in LMS, starting from doing assignments, chatting, downloading and uploading subject matter, but does not provide a selection of students who have high grades and then rank each student who is logged in LMS. From the description, it can be concluded that learning through LMS media cannot replace traditional learning because after the learning process there is no assessment and ranking given by the teacher. This study aims to determine the ranking of students in the learning process using LMS. AHP method is used for ranking students after students do activities in the LMS.

2. Literature Review

2.1. *Learning Management System (LMS)*

Currently, the use of ICT (Information of Technology) in education varies in different countries and educational institutions, but the use of technology in Indonesia is mostly higher education institutions, learning using LMS and Virtual Learning Environment (VLE) [10]. LMS is used to gather students in one virtual class. LMS and E-Learning are generally useful for students, especially for students who have a place to stay far from school or students who are sick, because the learning process continues despite the constraints of distance and time [11]. One of the advantages of online learning is that it can help in creating standardized content. However, the disadvantages of online learning content are fixed / static structures, which cannot be flexibly adjusted to suit individual students [12]. LMS also called digital learning environment, online learning environment, course management system or virtual learning environment, is a web-based platform that allows teachers to create online courses [13].

2.2. *Analytical Hierarchy Process (AHP)*

Analytical Hierarchy Processs (AHP) techniques are one of the approaches used in determining the relative importance of a set of attributes or criteria. AHP is designed to solve complex multi-criteria problems. Many quantitative methods have been tried to evaluate the implementation of new technologies. AHP has previously been used in evaluating advanced technology by Shang and Sueyoshi [14]. AHP is a mathematical decision making technique provided from the Expert Choice package. AHP allows users to convert intangible factors into numerical values and evaluate weights (preferences) through a series of comparisons using factors involved in decision making situations. The aim of the AHP is to provide the relative importance of the factors involved and to present the best decision making [15,16]. According to Saaty, the basic structure of AHP starts from the purpose of certain decisions and places them at the top of the structure of the AHP hierarchy. The objectives are then broken down into secondary areas that contribute to achieving that goal, called criteria. The belief that complex decision making problems are decomposed into smaller and simpler decision making problems that contribute to achieving initial goals. This criterion is sometimes decomposed into more sub-criteria.

2.3. *Learning activities through the Learning Management System (LMS)*

The implementation of teacher-centered approaches in the current digital era is irrelevant because the amount of content freely available is provided on the internet that allows students to access it at any time [17]. Web-based learning management system (LMS) is considered as an important tool in enhancing e-learning at the level of more educational institutions. LMS allows students to access subject matter without being limited by time or location, and use the communication features in learning activities [18].

2.4. *Ranking Decision Support System with AHP Method*

Decision making is a complex problem, whose ideas and principles seem not to be well understood or practiced through convincing logic. Multi criteria decision making method aims to determine the best decision from several alternative decisions. AHP was introduced by Saaty as a method that can be used to solve complex and unstructured problems [15]. The task of decision making in this method is completed in four steps. First, Generate a decision hierarchy for the decision problem element. Second, make a comparison of decision elements in pairs and make a comparison matrix. Third, estimate the relative priority of elements using the "eigenvalue" method. Fourth, Synthesis of relative priority from the previous step to achieve the weight of the final decision [19]. developed a decision support system for the problem of selecting multi-criteria machines for flexible manufacturing systems (FMS). AHP technique is used for selection. proposed a multi-attribute decision making model to help decision makers deal with machine selection problems for a Flexible Manufacturing System [20].

3. Description model

3.1 Samples and data collection

There are 15 students who take part in LMS activities. Student activities in the LMS that become assessments and ranking are students doing assignments, daily tests, quizzes and practicum. Student activity data at LMS is downloaded, the results are downloaded in MS. Excel. The results of the data in the form of MS.excel are processed using the AHP method to produce student rankings.

3.2 Ranking student activities using the AHP method

After students do activities in the LMS, then a calculation of student grades is made, the final result being a ranking. the ranking process requires many criteria. These criteria are intended so that teachers in determining student rankings are not subjective, student ranking must be based on quantitative data obtained from student activities. AHP method is the right method for ranking students. Because the AHP method, the decision maker (teacher) must determine the value of the Preference Vectors from the criteria and alternatives that have been selected to get a ranking of student activities in the LMS. Criteria for selected student activities are students doing assignments, daily tests, quizzes and practicum. While the alternatives chosen were 15 students from class XII. Student activity data on the LMS is downloaded and then given a value to rank using the AHP method. Student ranking can be used as an illustration of the abilities and competencies of students in each subject. Ranking of student activities in LMS is described as follows:

4. Result

To determine the ranking of students in activities in LMS using the AHP method requires several stages. There are 10 stages to determine student ranking using the AHP method, as follows: Step 1: identify the problem. at this stage the problem of determining the ranking of students in the LMS is solved using the AHP method. Step 2: determine the decision making criteria. The criteria used to determine student rank in the LMS are based on the activities carried out at the LMS. These activities are students doing assignments, Daily Repeat, Quiz and Practicum. Step 3: After determining the criteria, the next stage determines alternative decision making. The alternative in this study is 15 students. Steps 1-3 are described in the hierarchy below

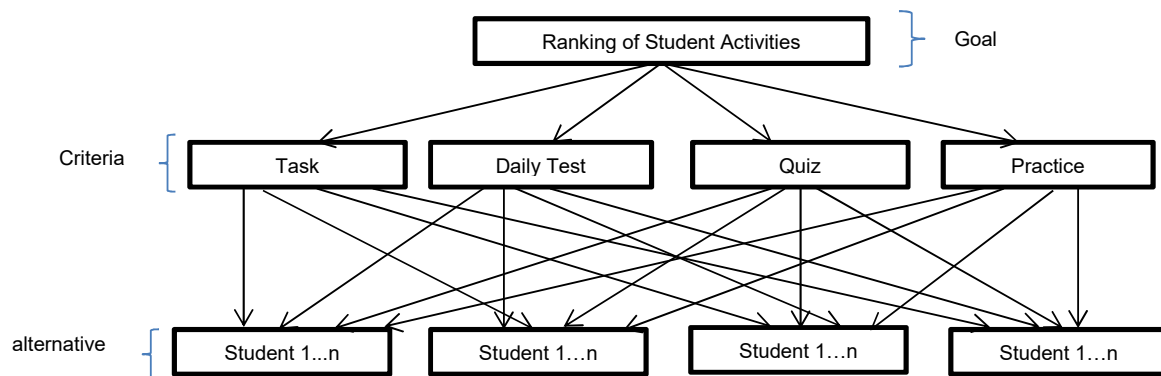


Figure 1. The hierarchy of student rankings in LMS

4.1. Criteria calculation

Step 4: Determine the criteria weights. The weighting of criteria values in the AHP method is obtained by making a pairwise comparison matrix that illustrates the relative contribution or influence of each element on each criterion with other criteria. After weighting the pairwise comparison matrix is obtained as follows:

Table 1. Pairwise comparison matrix

CRITERIA	TASK	DAILY TEST	QUIZ	PRACTICE
TASK	1	5	2	3
DAILY TEST	1/5	1	1/2	1
QUIZ	1/2	2	1	3
PRACTICE	1/3	1	1/3	1

Step 5: Make normalization comparisons between criteria. Normalization value is obtained by dividing the criteria column by the total column so that the Eigen Vector value is obtained.

Table 2. Matrix normalization results

KRITERIA	TASK	DAILY TEST	QUIZ	PRACTICE	Score	CM	Number of rows	EV
TASK	0,49	0,56	0,52	0,38	0,49	4,08	1,94	0,49
DAILY TEST	0,10	0,11	0,13	0,13	0,12	4,07	0,46	0,12
QUIZ	0,25	0,22	0,26	0,38	0,28	4,05	1,10	0,28
PRACTICE	0,16	0,11	0,09	0,13	0,12	4,04	0,49	0,12

Step 6: Determine the consistency factor of the criteria matrix. In the criteria matrix, it is necessary to have a Consistency Ratio (CR) or check the consistency of the matrix. Where CR can be calculated by referring to the Random Index (RI) which can be taken with the provisions in accordance with the number of criteria used. RI is as a divisor of the Consistency Index (CI) to get CR results. The following equation to calculate the value of the Consistency Index and Consistency Ratio is then followed by the Random Index value: $CI = (\lambda_{max} - n) / (n - 1)$ and $CR = CI / RI$. To get the maximum Lambda (λ_{max}), which is by multiplying Priority Vector with Eigen Vector that has been obtained previously. And the results can be seen as follows:

Table 3. Results of calculation the criteria matrix Consistency

Matrik Pairwise Comparison				EV	Total	Total	16,24
1,00	5,00	2,00	3,00	0,49	1,98	λ_{maks}	4,06
0,20	1,00	0,50	1,00	0,12	0,47	CI	0,0201
0,50	2,00	1,00	3,00	0,28	1,12	CR	0,0223
0,33	1,00	0,33	1,00	0,12	0,49	Hasil	Consistent

So, from the matrix above can be determined the Consistency Ratio (CR) is 0.0223. $CR < 0.1$, then the matrix is declared consistent.

4.2. Alternative Calculation

Step 7: Determine the weights of the alternatives based on criteria. The alternative in this study is students. Calculations and alternative conversion of students into the matrix as follows:

Table 4. Values of the comparisons between alternative criteria

	Stud ent 1	Stud ent 2	Stud ent 3	Stud ent 4	Stud ent 5	Stud ent 6	Stud ent 7	Stud ent 8	Stud ent 9	Stud ent 10	Stud ent 11	Stud ent 12	Stud ent 13	Stud ent 14	Stud ent 15
Student 1	1	1/2	3	4	1/3	2	1/2	1/3	2	4	1	2	3	4	1/3
Student 2	1/5	1	4	6	1/6	3	1	2	1	1/2	1/3	1	4	6	1/6
Student 3	5	1/5	1	1/2	1	1/3	4	5	1/6	1	4	1/5	1	1/2	1
Student 4	3	1	1/5	1	3	2	2	3	4	2	2	1	1/5	1	3
Student 5	1/3	1/5	1	1/5	1	6	5	5	4	7	1/3	1/5	1	1/5	1
Student 6	1/7	7	1/3	7	1/3	1	4	3	2	2	1/4	7	1/3	7	1/3
Student 7	7	5	7	5	1/5	1/5	1	5	5	7	6	5	7	5	1/5
Student 8	1	5	1/3	1/3	1/7	7	1/5	1	3	2	2	5	1/3	1/3	1/7
Student 9	5	1/3	3	3	7	1/3	3	5	1	4	3	1/3	3	3	7
Student 10	1/3	3	4	1/5	1/7	1/2	2	4	3	1	4	2	4	1/5	1/7
Student 11	2	1/2	1/3	2	4	1	4	3	2	3	1	1/2	3	4	1/3
Student 12	3	1	2	1	1/2	1/5	1	5	5	2	3	1	4	6	1/6
Student 13	1/3	4	5	1/6	3	7	1/5	1	3	2	2	2	1	1/2	1
Student 14	2	2	1/7	4	6	1/3	3	5	1	4	1/3	4	1/5	1	3
Student 15	6	5	5	4	5	1/2	2	4	3	1	1/2	1/5	1	1/5	1

Step 8 : Make a normalized comparison between alternatives in relation to each criterion

Step 9 : Determine the total value for the priority of each alternative. From each alternative related to each criterion with the weight of each criterion and then count the number of alternatives

Table 5. Alternative normalization results

	Stude nt 1	Stud ent 2	Stud ent 3	Stud ent 4	Stud ent 5	Stud ent 6	Stud ent 7	Stud ent 8	Stud ent 9	Stud ent 10	Stud ent 11	Stud ent 12	Stud ent 13	Stud ent 14	Stud ent 15
Student 1	1,00	0,50	3,00	4,00	0,33	2,00	0,50	0,33	2,00	4,00	1,00	2,00	3,00	4,00	0,33
Student 2	0,20	1,00	4,00	6,00	0,17	3,00	1,00	2,00	1,00	0,50	0,33	1,00	4,00	6,00	0,17
Student 3	5,00	0,20	1,00	0,50	1,00	0,33	4,00	5,00	0,17	1,00	4,00	0,20	1,00	0,50	1,00
Student 4	3,00	1,00	0,20	1,00	3,00	2,00	2,00	3,00	4,00	2,00	2,00	1,00	0,20	1,00	3,00
Student 5	0,33	0,20	1,00	0,20	1,00	6,00	5,00	5,00	4,00	7,00	0,33	0,20	1,00	0,20	1,00
Student 6	0,14	7,00	0,33	7,00	0,33	1,00	4,00	3,00	2,00	2,00	0,25	7,00	0,33	7,00	0,33
Student 7	7,00	5,00	7,00	5,00	0,20	0,20	1,00	5,00	5,00	7,00	6,00	5,00	7,00	5,00	0,20
Student 8	1,00	5,00	0,33	0,33	0,14	7,00	0,20	1,00	3,00	2,00	2,00	5,00	0,33	0,33	0,14
Student 9	5,00	0,33	3,00	3,00	7,00	0,33	3,00	5,00	1,00	4,00	3,00	0,33	3,00	3,00	7,00
Student 10	0,33	3,00	4,00	0,20	0,14	0,50	2,00	4,00	3,00	1,00	4,00	2,00	4,00	0,20	0,14

	Student 1	Student 2	Student 3	Student 4	Student 5	Student 6	Student 7	Student 8	Student 9	Student 10	Student 11	Student 12	Student 13	Student 14	Student 15
Student 11	2,00	0,50	0,33	2,00	4,00	1,00	4,00	3,00	2,00	3,00	1,00	0,50	3,00	4,00	0,33
Student 12	3,00	1,00	2,00	1,00	0,50	0,20	1,00	5,00	5,00	2,00	3,00	1,00	4,00	6,00	0,17
Student 13	0,33	4,00	5,00	0,17	3,00	7,00	0,20	1,00	3,00	2,00	2,00	2,00	1,00	0,50	1,00
Student 14	2,00	2,00	0,14	4,00	6,00	0,33	3,00	5,00	1,00	4,00	0,33	4,00	0,20	1,00	3,00
Student 15	6,00	5,00	5,00	4,00	5,00	0,50	2,00	4,00	3,00	1,00	0,50	0,20	1,00	0,20	1,00

Step 10: Make a decision. Optimal alternative is the number of multiplications between the weight of each alternative and the weight of each criterion, so that the highest value is obtained. The following are the ranking results that have been obtained from the calculation of Decision Support Systems using the AHP (Analytical Hierarchy Process) method.

Table 6. Student rank on the calculation result of AHP method

ALTERNATIVE	CRITERIA	TASK	DAILY TEST	QUIZ	PRACTICE	EV (CRITERIA)	RESULT	RANK
Student 7	FAHROJI	0,55	0,48	0,52	0,10		0,48	1
Student 9	FAJRUL IMAN	0,49	0,38	0,42	0,08		0,41	2
Student 5	ALDI WIGUNA	0,39	0,34	0,36	0,07		0,34	3
Student 15	KISSI ANANDA	0,38	0,37	0,33	0,07	0,49	0,33	4
Student 6	BAROKAH	0,35	0,30	0,33	0,07	0,12	0,31	5
Student 14	IRHAMNA	0,31	0,31	0,34	0,07	0,28	0,29	6
Student 1	ABDUL AJIS	0,23	0,41	0,44	0,09	0,12	0,29	7
Student 4	AGUS-SULAEMAN	0,31	0,26	0,29	0,06		0,27	8
Student 2	ABDUL AZIZ AL HAQ	0,25	0,34	0,27	0,05		0,24	9
Student 13	IMAM MAULANA	0,26	0,29	0,28	0,06		0,24	10
Student 8	FADULLAH	0,28	0,24	0,26	0,05		0,24	11
Student 3	ADE RIZKI	0,25	0,37	0,22	0,04		0,23	12
Student 11	IBNU MAULANA	0,25	0,26	0,26	0,05		0,23	13
Student 12	ILHAM MAULANA	0,25	0,25	0,21	0,04		0,21	14
Student 10	FIRMANSYAH WIJAYA	0,24	0,20	0,22	0,04		0,21	15

5. Conclusion

Learning Management Systems (LMS) change the teaching and learning process. Currently students use the LMS platform to access their subject matter. LMS aims to support teaching and learning using technology. However, there is a problem in terms of a teacher, the problem is that teachers in learning using LMS cannot measure or assess students' abilities and rankings. This is because the LMS is not in accordance with Minister of Education and Culture Regulation (PERMENDIKBUD) No 23 of 2016 which contains education assessment standards. Therefore it is necessary to make a study to measure student activity in LMS. This study can be used as a fundamental guide for a teacher who wants to know his student competencies through activities carried out by students at LMS. This study was designed to identify important decision-making factors relating to ranking learning activities of students in LMS using AHP. From the results of calculations using the AHP method, obtained ranking of students from the highest value to the lowest student grades. The results of the ranking calculation are useful for teachers to determine student competencies.

6. References

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