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MCDM-AHP and CODAS Collaboration Techniques for Selection of Expert Education Personnel

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Abstract: Educational progress is largely determined by human resources who have the best qualifications, with the ability of human resources to provide hope for educational development for a creative and potential future. The ability of human resources to create various variants of knowledge that can be developed to enlighten the progress of thinking through education to create expert education personnel. The aim of this research is to provide techniques to guarantee the quality of the selection process for expert education personnel for the competitive progress of mastering educational technology who are able to independently increase the creative and potential thinking of graduates. To achieve this, of course, strict collaboration techniques are needed in the selection process to obtain expert education personnel. The method proposed in this research is MCDM-AHP in collaboration with CODAS. These two methods can collaborate in providing guarantees for an optimal selection process for education personnel through eight selected assessment criteria and twelve alternatives. From the results obtained, the highest priority was obtained by ALT10 with a weight of 0.229. This gain goes through the stages of normalizing criteria and alternatives with the optimization results of both. With the research results that have been described in detail, the collaboration of the MCDM-AHP and CODAS methods can be used as a measuring tool for optimal assessment of the acquisition of decision support results and can be used as a comparison with other methods for measuring the level of optimization of results.

Keywords: CODAS, Collaboration, Expert education personnel , MCDM-AHP, Selection.

INTRODUCTION

Expert education personnel are the main focus for advancing education with graduates who have creativity and potential in the future (Soukalová & Gottlichová, 2015). To build a varied learning system, expert education personnel are needed who combine a lot of learning materials and learning models, so that learning formats can be varied, increasing the effectiveness of the learning process, which can be explored on a large scale to create high levels of creativity. (Baraibar-Diez et al., 2024). There are many ways to innovate to create progress in various aspects of educational life such as the use of technology (Baraibar-Diez et al., 2024), curriculum development (Caliph & Lee, 2024),(Geletu & Mihiretie, 2023), development of learning patterns (Tian et al., 2023),(Vermunt et al., 2023), exploration of learning materials, teaching modes, such as distance learning, blended learning, or synchronous and asynchronous. a chronological teaching system, dealing with many learning profiles and learning techniques in a class. This can be done by expert education personnel. So the big question is how to carry out the selection process for expert educational personnel in a particular field of science, such as forensics (Spain et al., 2022). You can also pay attention to certain methodologies to carry out tests on personnel that can be carried out appropriately (Nalbant, 2024).

This research is related to the selection of expert education personnel, because the process of selecting expert education personnel using multi-criteria is so important that it becomes difficult to determine the ranking, so an effective collaborative method is needed to carry out the selection process for expert education personnel. The collaborative process that can be used is Multi-criteria Decision Making (MCDM-AHP) (Calvin, 2024),(Hamidah et al., 2022) which was collaborated with the Combinative Distance-Based Assessment (CODAS) method with distance-based assessment (Peng & Garg, 2018). These two methods have reliability in terms of the selection process by looking at the importance of these two methods, they can be collaborated into one unit and are in line with their use.

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The Multi-criteria Decision Making-Analytic Hierarchy Process (MCDM-AHP) method is a pioneer in the ranking process, this method will be used specifically to provide an assessment of a number of criteria used as a barometer for measuring eight criteria, namely education, grade point average, length of teaching time, micro teaching, age, distance, methodic, and didactic. MCDM is the key to weighting criteria as a correction for assessments between criteria (Brodny & Tutak, 2023). All criteria used are divided into two different understandings of application. There is an understanding that is said to be the biggest is the best (BB) or the lowest is the best (LB) (Akmaludin, Samudi, et al., 2023), The eight criteria used it is broken down into a) seven BB categories and b) only one LB category, namely distance. Determination of the criteria ranking results is obtained from the magnitude of the eigenvector values which will be tested for feasibility using two approaches, namely feasibility testing with mathematical algebra matrices (Bezushchak, 2022),(Araújo et al., 2022) and testing the feasibility of expert choice apps (Saaty, 2003),(Yunus et al., 2013). The feasibility of the two approaches must reach identical values, this proves the feasibility of the eigenvector value (Bunimovich & Shu, 2018) The MCDM-AHP method provides decision support that is feasible to be used in collaboration with other methods and this is the main requirement for the feasibility of the eigenvector value. (Akmaludin, Sihombing, et al., 2023).

The Combinative Distance-Based Assessment (CODAS) method is functionally similar to the ranking process, but is more strengthened in processes related to alternative selection. (Badi & Kridish, 2020). In this research, twelve alternatives (A1-A12) were used which were strictly selected through the CODAS stage. A number of alternatives must first achieve weighted normalization results to be processed using the CODAS method as a description of the exact position of each alternative as measured by the maximum and minimum values of all alternatives for each criterion to be selected. (Wątróbski et al., 2022a),(Saputra & Purba, 2022). In this way, all alternatives are given a weight that comes from obtaining eigenvector values that have passed the feasibility test to determine the negative ideal solution point. At this position stage, the processing process will be divided into two parts as distance determinants, namely Euclidian distance and Taxicab distance to be formed as relative assessment matrices with two derived equations to reach alternative rankings.

Contributions that can be shown to this research are: 1) providing researchers with an overview of the collaboration methods that have been described and can be used as an optimal selection process through two stages of normalization, namely testing the eigenvector values through the MCDM-AHP method as a weighting for all alternatives, so that provide feasibility values for optimal results to support decision making. To provide optimal value, a proof approach must be taken, namely using a mathematical algebra matrices approach and proof using expert choice apps, because the concept of collaboration between the two methods must reach the condition of feasibility of collaboration as the main requirement. The second normalization stage for alternatives associated with the collaboration method. 2) Achieving optimal results, the eigenvector value will be used as a multiplier for each column of criteria for all alternatives that will be selected using the CODAS method which is simulated with all alternatives to determine the negative ideal solution point as the starting point to be carried out. Euclidean and taxicab quantities as forming relative assessment matrices as determinants in the process of ranking all alternatives.

LITERATURE REVIEW

Multi-criteria Decision Making (MCDM)- Analytic Hierarchy Process (AHP)

Multi-criteria Decision Making (MCDM) is part of a decision making method that has many development criteria and can be combined with the Analytic Hieararchy Process (AHP) method or other methods so that it can be used as strong decision support. (Bhol et al., 2024). The uniqueness of MCDM can be combined with expert choice apps as an approach to testing whether eigenvector values are acceptable or not. On the other hand, testing the feasibility of eigenvector values can be proven using a mathematical algebra matrices approach in its application using multiplication matrices through the concept of iteration which is measured by the difference in eigenvector values which have a value of zero which indicates that the eigenvector value has been said to have found the optimal point (Ye, 2008),(Bao et al., 2015). AHP is an applied crystallization of MCDM discovered by Saaty and MCDM is superior in its class (Cooper, 2017).

There are many process stages that can be outlined in an algorithm for the MCDM-AHP process which starts from questionnaire instrumentation which is input from a number of respondents based on the criteria used as a measure of the number of comparisons that will be used to be given to experts who understand the comparison questions using (1). The discussion of this research is to resolve problems related to the selection of expert education personnel with uses eight criteria with twelve alternatives, so the processing of criteria and alternatives must be simplified into the concept of two-dimensional matrices and can be arranged using (2).

Several features that often occur in the use of MCDM are a) alternatives, which are different objects and have the same opportunity to be chosen by decision makers. b) attributes, which are often also referred to as decision criteria. c) there is a conflict between one criterion and another, some criteria in general, for example, cost type criteria will experience conflict with benefit type criteria. d) decision weight, which is a value that shows the relative importance of each criterion. Decision weights can be collaborated with the MCDM-AHP method based

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on research results through questionnaire instrumentation. e) decision matrces, a matrces with size mxm containing matrices elements that represent the rating of alternatives against the criteria.

$$C = \frac{n*(n-1)}{2} \quad (1)$$

$$M_{(b,k)} = \begin{bmatrix} a_{(1,1)} & a_{(1,2)} & a_{(1,3)} & \cdots & a_{(1,k)} \\ a_{(2,1)} & a_{(2,2)} & a_{(2,3)} & \cdots & a_{(2,k)} \\ a_{(3.1)} & a_{(3,2)} & a_{(3,3)} & \cdots & a_{(3,k)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{(b,1)} & a_{(b,2)} & a_{(b,3)} & \cdots & a_{(b,k)} \end{bmatrix} \quad (2)$$

Determining consistency can be measured based on the consistency index (CI) which is applied according to (3) and the consistency ratio (CR) which is applied using (4). The search for these two values must be assisted by a random index (RI) table which is measured based on the number of orders used in the form of pairwise matrices, pay attention to table 1 how to use order matrices.

$$CI = \frac{(\lambda \max - n)}{(n-1)} \quad (3)$$

$$CR = \frac{CI}{RI} \quad (4)$$

Before being applied in collaboration with other methods, the CR acquisition value must first be proven correct using two approaches, namely the mathematical algebra matrices approach and the test approach using expert choice apps. If it is proven correctly, this means that the eigenvector value can be applied to the method used as a collaboration between the two, in this case using CODAS.

Table 1. Random Index (Alonso & Lamata, 2006)

N-ordo	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.6	0.9	1.12	1.24	1.32	1.41	1.45	1.48	1.51	1.48	1.56	1.57	1.58

Combinative Distance-based Assessment (CODAS)

The Combinative Distance-based Assessment (CODAS) method is an alternative method for determining ranking based on the desired ideal negative solution determined using Euclidean and Taxicab distance measurements assisted by relative assessment matrices. (Wątróbski et al., 2022b),(Aro et al., 2022). The evaluation results show that the CODAS method is more efficient and consistent with other methods, and the sensitivity analysis shows the stability of the results of the proposed method. Ranking using CODAS is calculated from the highest value to the smallest (Ulandari et al., 2021). This method is functionally similar to the MCDM-AHP method, thus, the CODAS method can be collaborated with this method which is seen from the inherent functional similarities and provides more accurate results.

The application of the CODAS method has several structured stages (Prasetyo et al., 2021),(Akmal Siahaan, 2022) which starts from determining the decision matrices which are prepared according to the criteria used from a number of alternatives used, the layout of the matrices can be arranged based on (5) and through the arrangement of these matrices it is very necessary to pay attention to the contradictions of each declaration of criteria through the type of cost or benefit criteria, which are outlined by using (6) as a normalization matrix for alternatives.

$$X = [x_{(i,j)}]_{nxm} = \begin{bmatrix} x_{(1,1)} & x_{(1,2)} & \cdots & x_{(1,m)} \\ x_{(2,1)} & x_{(2,2)} & \cdots & x_{(2,m)} \\ \vdots & \vdots & \ddots & \vdots \\ x_{(n,1)} & x_{(n,2)} & \cdots & x_{(n,m)} \end{bmatrix} \quad (5)$$

$$n_{(i,j)} = \begin{cases} \dfrac{x_{(i,j)}}{\max\limits_{i} \ x_{(i,j)}} \ if\ j \in N_b \ where\ b = benefit \\ \dfrac{\min\limits_{i} x_{(i,j)}}{x_{(i,j)}} \ if\ j \in N_c \ where\ c = cost \end{cases} \quad (6)$$

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Through the normalization results obtained, to find out the clear position of each element of the normalization matrices, it is necessary to multiply by the weight of each criterion that has been obtained through the first stage, namely based on the eigenvector value obtained based on the optimization value based on the test results with these two approaches. By obtaining the optimal eigenvector, a search for weighted normalization decision matrices can be carried out using (7).

$$r_{(i,j)} = w_j \quad n_{(i,j)} \; where \; w_j(0 < w_{(i,j)} < 1 \; ; and \; \sum_{j=1}^{m} w_j = 1 \tag{7}$$

The negative ideal solution obtained through (8) is the lowest value of each criterion used to determine the Euclidean and Taxicab distances from the negative ideal solution, which can be found using (9) and (10).

$$ns = [ns_j]_{(1xm)} \tag{8}$$

$$E_i = \sqrt{\sum_{j=1}^{m} (r_{(i,j)} - ns_j)^2} \tag{9}$$

$$T_I = \sum_{j=1}^{m} |r_{(i,j)} ns_j| \tag{10}$$

The number of each alternative for Euclidean and Taxicab acquisition is the main basis for determining relative assessment matrices using (11) with the derivative using (12). Until in the end a two-dimensional matrix will be arranged as a total search process for each alternative with the highest value as the highest ranking priority and followed by the next lowest value up to the smallest value as the last ranking which forms a decision support system.

$$Ra = [h_{(i,k)}]_{(nxn)} \tag{11}$$

$$h_{(i,k)} = (E_i - E_k) + (\,\Psi.\,(E_i - E_k) * (T_i - T_k)) \tag{12}$$

METHOD

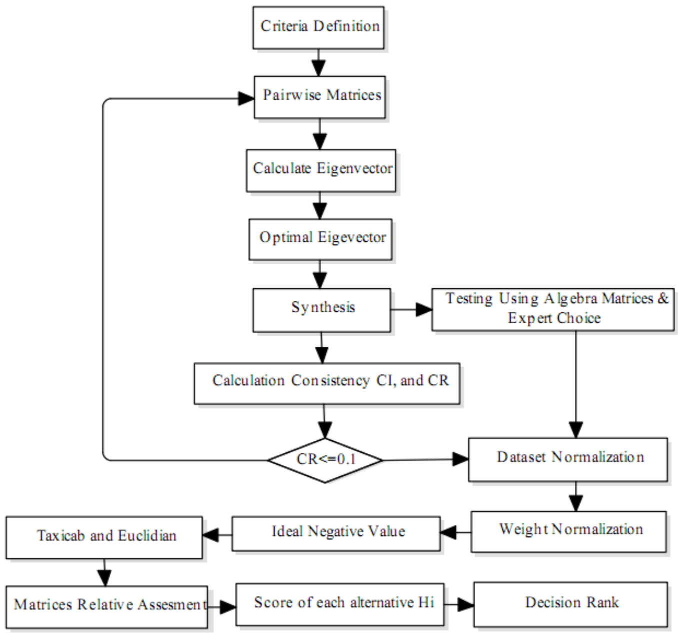

Fig. 1. MCDM-AHP-CODAS Algorithm

RESULT

Selecting personal education experts is a very important thing to do, because it uses eight criteria and there are criteria that conflict with other criteria, resulting in the need for a normalization process for the two stages of the collaboration method applied. The collaborative methods that will be used are Multi-criteria Decision Making (MCDM-AHP) and Combinative Distance-based Assessment (CODAS). Functionally, these methods have

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similarities in solving problems, so researchers will apply collaboration between the two methods. The basis used in determining the criteria can be seen in table 1, where there are eight criteria and there are differences in the types of criteria, namely the C6 criterion has a cost type, while the others have a benefit type. The number of comparisons that can be made to examine the criteria used can be done using (1) and the arrangement of pairwise matrices can be done using (2).

Tabel 1. Criteria dan Type

Criteria	Code	Criteria Name	Type B/C
C1	EDU	Education	B
C2	GPA	Grade Point Average	B
C3	LTT	Length of Teaching Time (Year)	B
C4	MTC	Micro Teaching	B
C5	AGE	Age	B
C6	DIS	Distance (km)	C
C7	MET	Methodic	B
C8	DID	Didactic	B

Table 1 is the result of expert filtering in determining the selected potential criteria and data entry was carried out with the help of questionnaire instrumentation which was processed using arithmetic scale conversion to geometric scale and AHP scale to form pairwise matrices as seen in Table 2 to determine the eigenvector values including five an iterative process to achieve the optimal value of the eigenvector which can produce a synthesis value.

Table 2. Pairwise matrices using mathematical algebra matrices

Criteria	EDU	GPA	LTT	MTC	AGE	DIS	MET	DID	Eigenvector
Education (EDU)	1.000	1.322	2.17	2.215	3.117	3.295	4.498	5.398	0.244
Grade Point Average (GPA)	0.756	1.000	2.49	2.589	4.473	5.137	5.754	4.692	0.266
Length of Teaching Time	0.460	0.401	1.00	1.848	2.475	3.768	3.911	3.126	0.154
Micro Teaching (MTC)	0.451	0.386	0.54	1.000	2.573	2.493	3.267	3.426	0.124
Age (AGE)	0.321	0.224	0.40	0.389	1.000	2.762	2.344	3.291	0.083
Distance (Km) (DIS)	0.303	0.195	0.26	0.401	0.362	1.000	1.588	1.329	0.050
Methodic (MET)	0.222	0.174	0.25	0.306	0.427	0.630	1.000	1.452	0.041
Didactic (DID)	0.185	0.213	0.32	0.292	0.304	0.752	0.689	1.000	0.038
λ max =	8.297			Consistency Index (CI) =		0.042			
				Consistency Ratio=		0.030	(Acceptable)		

To prove the correctness of the results of identical pairwise matrices, you can use the expert choice apps shown in Table 3 and the synthesis results from pairwise matrices can be seen in Fig. 2 with the difference in results seen in the magnitude of the inconsistency value as shown in Table 2, namely 0.03.

Table 3. Pairwise matrices using expert choice apps.

	EDU	GPA	LTT	MTC	AGE	DIS	MET
EDU	1.322	2.172	2.215	3.117	3.295	4.498	5.398
GPA		2.493	2.589	4.473	5.137	5.754	4.692
LTT			1.848	2.475	3.768	3.911	3.126
MTC				2.573	2.493	3.267	3.426
AGE					2.762	2.344	3.291
DIS						1.588	1.329
MET							1.452
DID	Incon 0.03						

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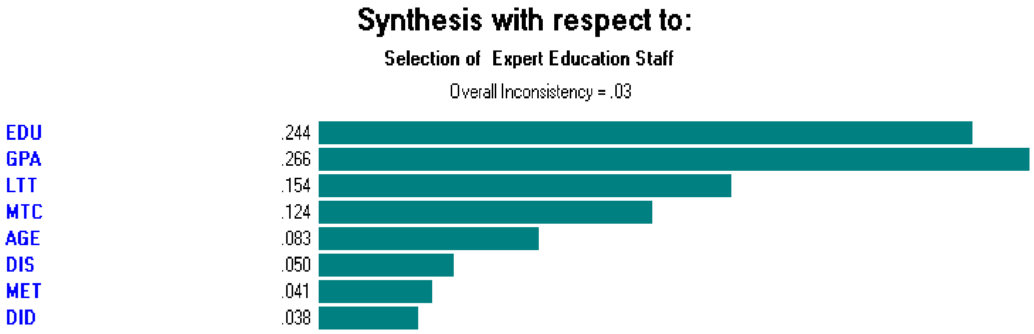

Fig. 2. Sythesis of criteria.

Pay attention to Fig. 2 explains the results of the synthesis of the criteria used to obtain an inconsistency value for the process results with a value of 0.03. This proves very good results in entering input into the questionnaire from experts who have determined these eight criteria. Consistency values such as CI and CR can be tested using an iterative process first, so that five iterations occur to obtain the optimal eigenvector value which is characterized by no difference between the last eigenvector value and the previous eigenvector value using (3) and (4) can be used To get the consistency quantity, specifically to get the CR value, it is very much influenced by table 1 regarding the use of the number of order matrices, namely the random index. This provides code that the eigenvector value is optimal and can be used as a collaborative process with the CODAS method.

The collaboration process between MCDM-AHP and CODAS began to be carried out because the optimal eigenvector value had been found which was included by testing two approaches, namely the approach using mathematical algebra matrices through five stages of iteration until there was no difference between the last eigenvector value and the previous eigenvector value and the second approach through expert applications. choice with the discovery of an inconsistency value of 0.03 and identically the optimal eigenvector value has the same proof as the discovery of the optimal eigenvector value as a door to collaboration with other methods.

At the CODAS method stage, it starts with the discovery of decision matrices as a dataset that has been normalized, providing a CODAS calculation process that will be ready for the calculation process. Pay attention to table 4 which depicts the normalized dataset for a number of alternatives that are adjusted to determine the criteria that are adjusted to the type of criteria, whether there is a conflict or no and the criteria weights can be taken from the calculation process of the MCDM-AHP method, so that the weighted normalization can be shown in table 5 which has been accumulated using (5) as an alternative arrangement and (6) can be used to search for weight normalization.

Table 4. Dataset normalization

Alt.\ Criteria	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**
A_1	0.556	0.955	0.564	0.987	0.879	1.000	1.000	0.842
A_2	0.778	0.832	0.200	0.856	0.818	0.545	0.947	0.895
A_3	0.778	0.843	0.291	0.898	0.848	0.857	0.905	0.821
A_4	0.556	0.981	1.000	0.956	1.000	0.800	0.916	0.905
A_5	0.556	0.891	0.327	0.922	0.788	0.923	0.895	0.947
A_6	0.778	0.867	0.136	0.823	0.788	1.000	0.842	0.979
A_7	1.000	0.944	0.527	0.928	0.848	0.600	0.874	1.000
A_8	0.778	0.840	0.136	0.853	0.788	0.857	0.968	0.916
A_9	0.556	1.000	0.718	0.966	0.909	0.667	1.000	0.884
A_{10}	1.000	0.965	0.845	0.973	0.939	0.480	0.905	0.968
A_{11}	0.556	1.000	0.382	1.000	0.788	0.923	0.968	0.926
A_{12}	0.778	0.851	0.145	0.824	0.848	0.706	0.979	0.895

In table 4 are alternatives that have gone through a normalization process, while table 5 is a normalization result that has been processed with the weight values of each criterion used with the CODAS method obtained based on calculations in MCDM-AHP where the total weight gain must follow the conditions for fulfilling the total bobo which has a total value of 1, this has been determined according to (7).

Table 5. Weighted normalization

Alt.\Criteria	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**
Weight	**2.440**	**2.66**	**0.154**	**0.124**	**0.083**	**0.050**	**0.041**	**0.038**
A_1	1.356	2.539	0.087	0.122	0.073	0.050	0.041	0.032

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A_2	1.898	2.213	0.031	0.106	0.068	0.027	0.039	0.034
A_3	1.898	2.241	0.045	0.111	0.070	0.043	0.037	0.031
A_4	1.356	2.610	0.154	0.119	0.083	0.040	0.038	0.034
A_5	1.356	2.369	0.050	0.114	0.065	0.046	0.037	0.036
A_6	1.898	2.305	0.021	0.102	0.065	0.050	0.035	0.037
A_7	2.440	2.511	0.081	0.115	0.070	0.030	0.036	0.038
A_8	1.898	2.234	0.021	0.106	0.065	0.043	0.040	0.035
A_9	1.356	2.660	0.111	0.120	0.075	0.033	0.041	0.034
A_{10}	2.440	2.568	0.130	0.121	0.078	0.024	0.037	0.037
A_{11}	1.356	2.660	0.059	0.124	0.065	0.046	0.040	0.035
A_{12}	1.898	2.263	0.022	0.102	0.070	0.035	0.040	0.034

Table 5 is a powerful process source to be fully used for the CODAS method stages in determining distances based on negative ideal values to determine euclidean and taxicab. The negative ideal value can be obtained through the sum of each criterion used which has been accumulated with the weight of each criterion as a weighted normalization which can be searched using (8), so that the negative ideal value has an important role in the euclidean distance value that can be searched using (9) and the taxicab distance value can be found using (10). The ideal negative value solution can be shown in table 6, as a reference for the two Euclidean distances. Meanwhile, the magnitude of the Euclidean value can be shown in table 7 which was obtained with the support of the ideal negative value solution.

Table 6. Ideal negative value solution

NS	1.356	2.213	0.021	0.102	0.065	0.024	0.035	0.031

Table 7. Euclidean

Alt.\Criteria	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**
A_1	0.000	0.106	0.004	0.000	0.000	0.001	0.000	0.000
A_2	0.294	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A_3	0.294	0.001	0.001	0.000	0.000	0.000	0.000	0.000
A_4	0.000	0.158	0.018	0.000	0.000	0.000	0.000	0.000
A_5	0.000	0.024	0.001	0.000	0.000	0.000	0.000	0.000
A_6	0.294	0.009	0.000	0.000	0.000	0.001	0.000	0.000
A_7	1.176	0.089	0.004	0.000	0.000	0.000	0.000	0.000
A_8	0.294	0.000	0.000	0.000	0.000	0.000	0.000	0.000
A_9	0.000	0.200	0.008	0.000	0.000	0.000	0.000	0.000
A_{10}	1.176	0.126	0.012	0.000	0.000	0.000	0.000	0.000
A_{11}	0.000	0.200	0.001	0.000	0.000	0.000	0.000	0.000
A_{12}	0.294	0.002	0.000	0.000	0.000	0.000	0.000	0.000

Table 7 is a euclidean that describes alternative negative ideal solutions as well as taxicab acts as an alternative negative ideal solution and both of these will be used as a reference for determining two-dimensional relative assessment matrices which function for ranking a number of alternatives. The taxicab values can be seen in Table 8.

Table 8. Taxicab

Alt.\Criteria	**C_1**	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**
A_1	0.000	0.326	0.066	0.020	0.008	0.026	0.006	0.001
A_2	0.542	0.000	0.010	0.004	0.003	0.003	0.004	0.003
A_3	0.542	0.028	0.024	0.009	0.005	0.019	0.003	0.000
A_4	0.000	0.397	0.133	0.016	0.018	0.016	0.003	0.003
A_5	0.000	0.156	0.029	0.012	0.000	0.022	0.002	0.005
A_6	0.542	0.092	0.000	0.000	0.000	0.026	0.000	0.006
A_7	1.084	0.298	0.060	0.013	0.005	0.006	0.001	0.007
A_8	0.542	0.021	0.000	0.004	0.000	0.019	0.005	0.004
A_9	0.000	0.447	0.090	0.018	0.010	0.009	0.006	0.002
A_{10}	1.084	0.355	0.109	0.019	0.013	0.000	0.003	0.006
A_{11}	0.000	0.447	0.038	0.022	0.000	0.022	0.005	0.004
A_{12}	0.542	0.050	0.001	0.000	0.005	0.011	0.006	0.003

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Based on the results obtained from tables 7 and 8, it provides a basis for determining two-dimensional relative assessment matrices. The calculation process can use (11) with detailed derivatives using (12) so that the ranking system can be calculated based on the largest value. Starting from the largest value to the smallest value as a ranking. The largest value represents the highest rank and the smallest value represents the smallest rank. The results obtained from the relative assessment matrices. The threshold value that can be taken is in the range of 0.1 to 0.5. In this study, the threshold used was 0.2; the results can be seen in table 9.

Table 9. Matrices relative assessment

ALT	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
A1	0.000	-0.178	-0.177	-0.063	0.090	-0.183	-0.920	-0.178	-0.094	-0.929	-0.089	-0.179
A2	0.186	0.000	-0.002	0.117	0.287	-0.009	-0.798	-0.001	0.086	-0.812	0.093	-0.002
A3	0.190	0.002	0.000	0.121	0.292	-0.007	-0.808	0.001	0.088	-0.823	0.095	-0.001
A4	0.066	-0.118	-0.118	0.000	0.161	-0.125	-0.898	-0.118	-0.032	-0.910	-0.026	-0.120
A5	-0.082	-0.250	-0.248	-0.140	0.000	-0.253	-0.933	-0.249	-0.169	-0.938	-0.165	-0.250
A6	0.199	0.009	0.007	0.129	0.302	0.000	-0.809	0.008	0.097	-0.825	0.104	0.007
A7	1.393	1.151	1.137	1.286	1.553	1.122	0.000	1.145	1.250	-0.045	1.266	1.139
A8	0.188	0.001	-0.001	0.119	0.289	-0.008	-0.802	0.000	0.087	-0.817	0.094	-0.002
A9	0.099	-0.086	-0.087	0.032	0.195	-0.093	-0.871	-0.086	0.000	-0.884	0.006	-0.088
A10	1.475	1.228	1.213	1.366	1.639	1.197	0.047	1.222	1.328	0.000	1.346	1.215
A11	0.092	-0.091	-0.092	0.026	0.187	-0.098	-0.867	-0.092	-0.006	-0.879	0.000	-0.093
A12	0.191	0.003	0.001	0.121	0.292	-0.006	-0.805	0.002	0.089	-0.820	0.096	0.000

Based on table 9 for each alternative value, a thorough accumulative process is carried out to provide a round value for each alternative, so that the ranking system used to support decision making will produce a weight value for each alternative as a ranking. These results can be seen in table 10.

Tabel 10. Alternative rank

ALT	Weight of Alternative	Rank
A5	13.276	1
A3	12.397	2
A9	-0.772	3
A6	-0.838	4
A1	-0.851	5
A10	-0.854	6
A8	-0.855	7
A12	-1.863	8
A2	-1.914	9
A7	-2.239	10
A11	-2.900	11
A4	-3.677	12

DISCUSSIONS

The collaboration of MCDM-AHP and CODAS methods provides an optimal solution in supporting decision making which has been proven by the results of this study on the selection of expert education personnel. Seeing from the very long stages, it can be divided into two stages of completion as shown in the algorithm. The first stage is in the MCDM-AHP section which plays a role as a determinant of the weighting value of the eight criteria that produce the eigenvector value to the optimal point. The optimal eigenvector value has been proven using two approaches, namely the first approach using mathematical algebra matrices and the second approach using an application in the form of expert choice apps, this is done to provide clarity that the eigenvector value is at the optimal point. The principle is that the eigenvector value has met the rules and can be collaborated with other methods, in this study the collaboration applied using the CODAS method. It is indeed true that every research using the MCDM-AHP method must do this, this proves that the MCDM-AHP method greatly supports real research that is applied using the help of questionnaire instrumentation to strengthen decisions accurately through the assessment of eigenvector acquisition through the process of converting the scale from the arithmetic scale to the geometric scale and to the AHP scale. The results of the acquisition will be used to collaborate with other methods. CODAS also has the same function as MCDM-AHP, which is located in the ranking method, so it is very suitable if these two methods are collaborated, of course through the applicable rules in the form of finding the optimal point on its criteria. The CODAS method is a method that uses a negative ideal solution with the

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formation of relative assessment matrices based on euclidean distance and taxicab distance to obtain a ranking with the help of the assessment threshold function shown in the acquisition of negative and positive values.

CONCLUSION

A decision support system using the MCDM-AHP and CODAS collaboration method can provide optimal decision support results, so from the results of this research it can be concluded that the optimal weighting value must be obtained first for the method collaboration process. For both methods, a normalization process must also be carried out, both for the criteria adapted to the type of criteria and for all alternatives to indicate that both have located the actual data range. Final decision support from the collaboration of the two methods provides ranking results with optimal results. The highest result was A5 with a weight of 13,276, followed by A3 with a weight of 12,397. The ranking can of course be adjusted to the amount to be taken so it can be flexible.

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REFERENCES

Akmal Siahaan, M. (2022). Sistem Pendukung Keputusan Penilaian Kinerja Pegawai Negeri Sipil Menggunakan Metode (Combinative Distance – Based Assessment) Pada Kantor Camat Sei Kepayang. *Bulletin of Information Technology (BIT)*, *3*(3), 195–205. https://doi.org/10.47065/bit.v3i3.336

Akmaludin, A., Sihombing, E. G., Rinawati, R., Handayanna, F., Sari Dewi, L., & Arisawati, E. (2023). Generation 4.0 of the programmer selection decision support system: MCDM-AHP and ELECTRE-elimination recommendations. *International Journal of Advances in Applied Sciences*, *12*(1), 48. https://doi.org/10.11591/ijaas.v12.i1.pp48-59

Akmaludin, Samudi, Palasara, N., Harmono, F. P., Widianto, K., & Muharrom, M. (2023). MCDM-AHP and PROMETHEE methods integrated for base service strategy vendor evaluation and selection. *International Journal of Advances in Applied Sciences*, *12*(4), 384–395. https://doi.org/10.11591/ijaas.v12.i4.pp384-395

Alonso, J. A., & Lamata, M. T. (2006). Consistency in the analytic hierarchy process: a new approach. *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, *14*(4), 445–459. https://doi.org/10.1142/S0218488506004114

Araújo, J., Bentz, W., Cameron, P. J., Kinyon, M., & Konieczny, J. (2022). Matrix theory for independence algebras. *Linear Algebra and Its Applications*, *642*, 221–250. https://doi.org/10.1016/j.laa.2022.02.021

Aro, J. L., Selerio, E., Evangelista, S. S., Maturan, F., Atibing, N. M., & Ocampo, L. (2022). Fermatean fuzzy CRITIC-CODAS-SORT for characterizing the challenges of circular public sector supply chains. *Operations Research Perspectives*, *9*(July), 100246. https://doi.org/10.1016/j.orp.2022.100246

Badi, I., & Kridish, M. (2020). Landfill site selection using a novel FUCOM-CODAS model: A case study in Libya. *Scientific African*, *9*. https://doi.org/10.1016/j.sciaf.2020.e00537

Bao, S., Tang, L., Li, K., Ning, P., Peng, J., & Guo, H. (2015). To appear in : Received Date : Accepted Date : Abstract : *Journal of Colloid and Interface Science*, *Ii*, 110495. https://doi.org/10.1016/j.jfa.2024.110495

Baraibar-Diez, E., Odriozola, M. D., & Llorente, I. (2024). Exploring learning congruence and the availability of diverse educational resources: A study conducted in the field of management education. *International Journal of Management Education*, *22*(2), 100985. https://doi.org/10.1016/j.ijme.2024.100985

Bezushchak, O. (2022). Automorphisms and derivations of algebras of infinite matrices. *Linear Algebra and Its Applications*, *650*, 42–59. https://doi.org/10.1016/j.laa.2022.05.020

Bhol, S. G., Mohanty, S., & Pattnaik, P. K. (2024). Machine Learning as a Service Cloud Selection: An MCDM Approach for Optimal Decision Making. *Procedia Computer Science*, *233*(2023), 909–918. https://doi.org/10.1016/j.procs.2024.03.280

Brodny, J., & Tutak, M. (2023). Assessing the energy security of European Union countries from two perspectives – A new integrated approach based on MCDM methods. *Applied Energy*, *347*(April). https://doi.org/10.1016/j.apenergy.2023.121443

Bunimovich, L., & Shu, L. (2018). Generalized eigenvectors of isospectral transformations, spectral equivalence and reconstruction of original networks. *Linear Algebra and Its Applications*, *551*, 104–124. https://doi.org/10.1016/j.laa.2018.04.007

Caliph, S. M., & Lee, C. Y. (2024). Online teaching and learning of a pharmacy curriculum designed for active learning and professional skills development – A report of students' perceptions and learning experience in two international campuses. *Currents in Pharmacy Teaching and Learning*, *16*(2), 119–123. https://doi.org/10.1016/j.cptl.2023.12.017

Calvin, R. (2024). ScienceDirect Hybrid MCDM Career Recommendation System for Information System Student Using AHP , VIKOR and Weighted Euclidean Distance. *Procedia Computer Science*, *234*, 364–372.

*name of corresponding author

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e-ISSN : 2541-2019
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https://doi.org/10.1016/j.procs.2024.03.016

Cooper, O. (2017). the Magic of the Analytic Hierarchy Process (Ahp). *International Journal of the Analytic Hierarchy Process*, *9*(3), 372–379. https://doi.org/10.13033/ijahp.v9i3.519

Geletu, G. M., & Mihiretie, D. M. (2023). Professional accountability and responsibility of learning communities of practice in professional development versus curriculum practice in classrooms: Possibilities and pathways. *International Journal of Educational Research Open*, *4*(December 2022), 100223. https://doi.org/10.1016/j.ijedro.2022.100223

Hamidah, M., Mohd Hasmadi, I., Chua, L. S. L., Yong, W. S. Y., Lau, K. H., Faridah-Hanum, I., & Pakhriazad, H. Z. (2022). Development of a protocol for Malaysian Important Plant Areas criterion weights using Multi-criteria Decision Making - Analytical Hierarchy Process (MCDM-AHP). *Global Ecology and Conservation*, *34*(October 2021), e02033. https://doi.org/10.1016/j.gecco.2022.e02033

Nalbant, K. G. (2024). A methodology for personnel selection in business development: An interval type 2-based fuzzy DEMATEL-ANP approach. *Heliyon*, *10*(1), e23698. https://doi.org/10.1016/j.heliyon.2023.e23698

Peng, X., & Garg, H. (2018). Algorithms for interval-valued fuzzy soft sets in emergency decision making based on WDBA and CODAS with new information measure. *Computers and Industrial Engineering*, *119*(288), 439–452. https://doi.org/10.1016/j.cie.2018.04.001

Prasetyo et al., 2021. (2021). *Sistem Seleksi Penerima Bantuan Program Keluarga Harapan*. *09*(03).

Saaty, T. L. (2003). Decision-making with the AHP: Why is the principal eigenvector necessary. *European Journal of Operational Research*, *145*(1), 85–91. https://doi.org/10.1016/S0377-2217(02)00227-8

Saputra, N. A. B., & Purba, H. S. (2022). Rancangan Sistem Manajemen Skripsi Berbasis Web Menggunakan Metode Rapid Application Development (RAD). *JURIKOM (Jurnal Riset Komputer)*, *9*(5), 1621. https://doi.org/10.30865/jurikom.v9i5.5012

Soukalová, R., & Gottlichová, M. (2015). The Impact of Effective Process of Higher Education on the Quality of Human Resources in the Czech Republic. *Procedia - Social and Behavioral Sciences*, *174*, 3715–3723. https://doi.org/10.1016/j.sbspro.2015.01.1104

Spain, R. D., Hedge, J. W., Ohse, D., & White, A. (2022). The need for research-based tools for personnel selection and assessment in the forensic sciences. *Forensic Science International: Synergy*, *4*(September 2020), 100213. https://doi.org/10.1016/j.fsisyn.2021.100213

Tian, W., Sun, S., Wu, B., Yu, C., Cui, F., Cheng, H., You, J., & Li, M. (2023). Development and validation of a deep learning algorithm for pattern-based classification system of cervical cancer from pathological sections. *Heliyon*, *9*(8), e19229. https://doi.org/10.1016/j.heliyon.2023.e19229

Ulandari, N. W. A., Pivin Suwirmayanti, N. L. G., Warma Putra, I. P., & Astiti, N. M. (2021). Spk Seleksi Penerima Beasiswa pada ITB Stikom Bali dengan Metode Codas. *Jurnal Teknik Informatika UNIKA Santo Thomas*, *06*, 206–216. https://doi.org/10.54367/jtiust.v6i2.1497

Vermunt, J. D., Vrikki, M., Dudley, P., & Warwick, P. (2023). Relations between teacher learning patterns, personal and contextual factors, and learning outcomes in the context of Lesson Study. *Teaching and Teacher Education*, *133*(April), 104295. https://doi.org/10.1016/j.tate.2023.104295

Wątróbski, J., Bączkiewicz, A., Król, R., & Sałabun, W. (2022a). Green electricity generation assessment using the CODAS-COMET method. *Ecological Indicators*, *143*(September). https://doi.org/10.1016/j.ecolind.2022.109391

Wątróbski, J., Bączkiewicz, A., Król, R., & Sałabun, W. (2022b). Green electricity generation assessment using the CODAS-COMET method. *Ecological Indicators*, *143*(March). https://doi.org/10.1016/j.ecolind.2022.109391

Ye, Q. (2008). Optimal expansion of subspaces for eigenvector approximations. *Linear Algebra and Its Applications*, *428*(4), 911–918. https://doi.org/10.1016/j.laa.2007.08.021

Yunus, R. M., Samadi, Z., Yusop, N. M., & Omar, D. (2013). Expert Choice for Ranking Heritage Streets. *Procedia - Social and Behavioral Sciences*, *101*, 465–475. https://doi.org/10.1016/j.sbspro.2013.07.220

*name of corresponding author