Research Article

Selection of Head of Study Program using Weighted Aggregated Sum Product Assessment (WASPAS) method

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Abstract: Selecting a Head of Study Program is a crucial strategic decision in education, particularly in Vocational High Schools. At the Software Engineering Study Program Vocational School Sitibanun Sigambal, Labuhanbatu, Rantau Prapat, this process becomes highly complex due to the involvement of various criteria, such as Psychotest Scores, IQ Tests, Communication Skills, Cognitive Tests, and Teaching Experience. The Weighted Aggregated Sum Product Assessment (WASPAS) method, which combines the Weighted Sum Model (WSM) and Weighted Product Model (WPM), is utilized to enhance the accuracy and efficiency of decision-making. This method enables a more objective and structured selection process by leveraging information technology. Based on implementing the Decision Support System (DSS) using the WASPAS method, it can be concluded that it is highly effective in determining the best Head of Study Program rankings, considering the complex criteria and the need for accurate decisions. This DSS facilitates the selection process with results that are more objective, transparent, and aligned with the School's needs and priorities, thus aiding in achieving the School's mission of providing high-quality education.

Keywords: WASPAS; Decision Support System; Quality; Criteria; efficiency

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1. Introduction

Selecting a Head of Study Program is a critical strategic decision in education, particularly at the Vocational High School level. The Head of the Study Program is responsible for leading and directing the program to align with the School's vision and mission while ensuring optimal educational quality. One of the biggest challenges in selecting a Head of Study Program is choosing the best candidate from several qualified applicants. At the Software Engineering Study Program Vocational School Sitibanun Sigambal, Labuhanbatu, Rantau Prapat, the Head of the Study Program selection process requires an objective and structured approach to ensure that the results truly reflect the School's needs and priorities. Sitibanun School is committed to providing high-quality education at the Vocational High School level, and selecting the right Head of Study Program is a crucial step in achieving this mission [1].

The Weighted Aggregated Sum Product Assessment (WASPAS) method was introduced by Zavadskas, Turskis, and Serafinas in 2012 as a multi-criteria decision-making (MCDM) method [2]–[4]. WASPAS combines two well-known MCDM approaches, namely the Weighted Sum Model (WSM) and the Weighted Product Model (WPM), to enhance the accuracy and efficiency of decision-making [5], [6]. WSM operates by summing the criteria values multiplied by their respective weights, while WPM multiplies the weighted criteria values. The WASPAS method merges these two models to produce a more robust decision [7], [8].

The WASPAS method is a combination of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM), which requires linear normalization of the decision matrix elements [8]. This method has been proven effective in various studies. It provides more consistent and reliable results in situations requiring multiple criteria evaluation [7]–[9]. WASPAS is also relatively easy to implement and involves simple calculations [9], making it suitable for various applications, including quality assessment, alternative selection, and decision-making in business, engineering, and management. By integrating both models, WASPAS delivers more robust recommendations and is less susceptible to bias, making it a popular method in decision-making studies [4], [8], [10]. The study "Selection of Contract Employees Using the WASPAS Method" successfully solved the problem of selecting contract employees for permanent positions, providing objective results that support decision-making in this context [11]. In the study [3], the decision support system using the WASPAS method effectively assisted CV. Asli Pematangsiantar Motor in selecting the best-used motorcycles.

At the Software Engineering Study Program Vocational School Sitibanun Sigambal, The Head of Study Program selection is not solely based on teaching experience but also on other aspects such as managerial skills, innovation in teaching, academic qualifications, and communication abilities. The relevant criteria for selecting the Head of Study Program in the Software Engineering Study Program Vocational School Sitibanun Sigambal case include Cognitive Tests, IQ Tests, Communication Skills, Psychotests, and Teaching Experience. Each of these criteria is then weighted according to its importance to the overall performance of the Head of Study Program. With these various criteria, the decision-making process for selecting a Head of Study Program becomes highly complex if it is solely based on intuition or experience.

Today, information technology plays a crucial role in daily life, with its ability to lighten heavy workloads, accelerate communication, and enhance the speed and accuracy of data processing [12]–[16]. Additionally, information technology aids in communication and the dissemination of information [17]. To achieve more objective and transparent results, the application of the WASPAS method [19-21]]in selecting the Head of the Software Engineering Study Program Vocational involves several key stages, leveraging technological advancements to improve objectivity and efficiency in the decision-making process [15], [16], [18]. Based on previous research success, the WASPAS method can effectively identify the best Head of Study Program.

2. Method

The research methodology encompasses a series of activities, procedures, or steps undertaken in a study. This methodology is designed to ensure that the research is conducted in a structured manner and aligns with the established objectives. At this stage, various steps are outlined to facilitate the resolution of existing problems and collect relevant data to obtain the necessary information, as illustrated in Figure 1.

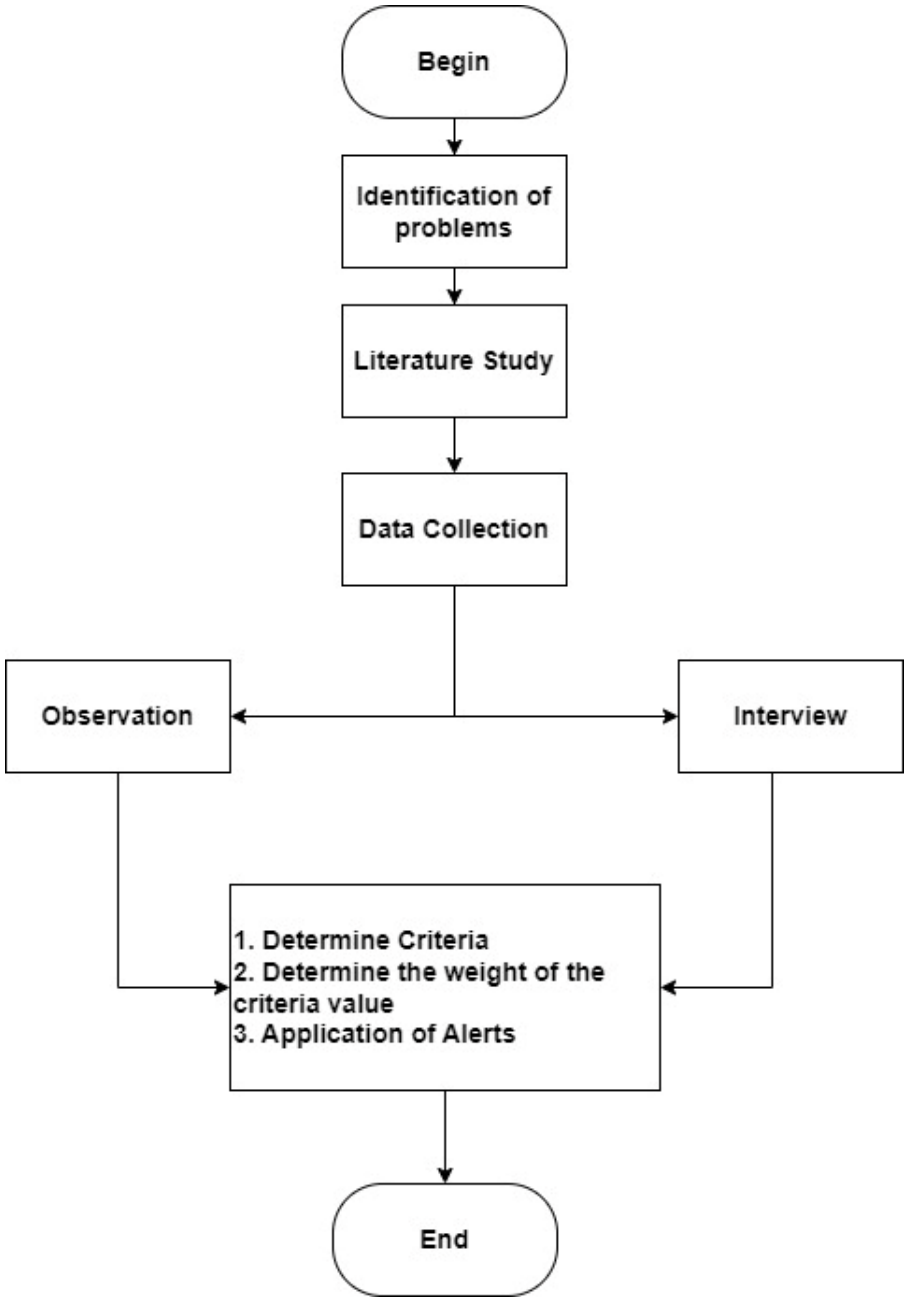

Figure 1. Research Framework

From the framework in Figure 1, the criteria are determined as shown in Table 1.

Table 1. Criteria

Criteria	Keterangan	Weight	Benefit / Cost
C1	Psychological Test	30	Cost
C2	IQ Test	20	Benefit
C3	Communication Test	20	Benefit
C4	Cognitive Test	10	Benefit
C5	Teaching Experience	20	Cost

Table 1 has five criteria, with three criteria categorized as Benefits and two as Costs. The specific Criteria and their Weights can be seen in Table 2.

Table 2. Criteria and Criteria Weights

Criteria	Option	Value
Psychological Test	<60	1
	>= 60 and < 75	2
	>= 75 and < 90	3
	>= 90	4
IQ Test	< 120	1
	>= 120 and < 130	2
	>= 130 and < 140	3
	>= 140	4
Communication Test	<60	1
	>= 60 and < 75	2
	>= 75 and < 90	3
	>= 90	4
Cognitive Test	<60	1
	>= 60 and < 75	2
	>= 75 and < 90	3
	>= 90	4
Teaching Experience	0 years	1
	1-2 years	2
	3-4 years	3
	>= 5 years	4

This study will process data from 15 Head of Study Program candidates to be evaluated to select the best Head of Study Program. The data required for the evaluation process is presented in Table 3.

Table 3. Head of Study Program Candidates and Criteria Scores

Alternative	C1	C2	C3	C4	C5
ALT-01	3	1	1	3	4
ALT-02	2	2	1	4	3
ALT-03	1	3	2	3	4
ALT-04	1	3	2	3	4
ALT-05	3	2	2	3	4
ALT-06	2	2	2	1	4
ALT-07	3	3	3	3	3
ALT-08	4	3	2	3	2
ALT-09	3	3	2	4	3
ALT-10	3	3	3	3	2
ALT-11	4	3	4	1	4
ALT-12	4	1	4	3	4
ALT-13	1	1	4	3	1
ALT-14	2	4	3	2	4
ALT-15	4	3	2	2	1

Moreover, from the data of each alternative, the minimum and maximum values for each criterion can be seen in Table 4.

Table 4. Minimum and Maximum Values of Each Criterion

Criteria	Information	Minimum Value	Maximum Value
C1	Psychological Test	1	4
C2	IQ Test	1	4
C3	Communication Test	1	4
C4	Cognitive Test	1	4
C5	Teaching Experience	1	4

3. Result and Discussion

Based on the data presented in the table above, the steps in applying the WASPAS Method to determine the best Head of Study Program selection can be outlined as follows:

1. Creating the Decision Matrix

$$\begin{bmatrix} 3 & 1 & 1 & 3 & 4 \\ 2 & 2 & 1 & 4 & 3 \\ 1 & 3 & 2 & 3 & 4 \\ 1 & 3 & 2 & 3 & 4 \\ 3 & 2 & 2 & 3 & 4 \\ 2 & 2 & 2 & 1 & 4 \\ 3 & 3 & 3 & 3 & 3 \\ 4 & 3 & 2 & 3 & 2 \\ 3 & 3 & 2 & 4 & 3 \\ 3 & 3 & 3 & 3 & 2 \\ 4 & 3 & 4 & 1 & 4 \\ 4 & 1 & 4 & 3 & 4 \\ 1 & 1 & 4 & 3 & 1 \\ 2 & 4 & 3 & 2 & 4 \\ 4 & 3 & 2 & 2 & 1 \end{bmatrix}$$

2. Creating the Normalized Decision Matrix Formula as the equation 1.

$$X_{ij} = \frac{X_{ij}}{Max_i X_{ij}} \quad (1)$$

If the criterion is a cost, can be seen in Equation 2.

$$X_{ij} = \frac{Min_i X_{ij}}{X_{ij}} \quad (2)$$

For Criterion 1 (C1), which is a cost, the formula in equation 3.

$$X_{ij} = \frac{Min\ Value\ \ C1}{X_{ij}} \quad (3)$$

X_{11}=	X_{12}=	X_{13} =	X_{14} =	X_{15} =	X_{16} =	X_{17} =	X_{18} =	X_{19} =	X_{110} =	X_{111} =	X_{112} =	X_{113} =	X_{114} =	X_{115} =
1/3	1/2=	1/1	1/1	1/3	1/2	1/3	1/4	1/3	1/3	1/4	1/4	1/1	1/2	1/4
=0.33	0.5	=1	=1	=0.33	=0.5	=0.33	=0.25	=0.33	=0.33	=0.25	=0.25	=1	=0.5	=0.25

For Criterion 2 (C2), which is a benefit, the formula is equation 4.

$$X_{ij} = \frac{C2}{Max\ Value\ \ C2} \quad (4)$$

X_21	X_22	X_23	X_24	X_25	X_26	X_27	X_28	X_29	X_210	X_211	X_212	X_213	X_214	X_215
= 1/4	= 2/4	= 3/4	= 3/4	= 2/4	= 2/4	= 3/4	= 3/4	= 3/4	= 3/4	= 3/4	= 1/4	= 1/4	= 4/4	= 3/4
=0.25	=0.5	=0.75	=0.75	=0.5	=0.5	=0.75	=0.75	=0.75	=0.75	=0.75	=0.75	=0.25	=1	=0.75

Furthermore, For Criterion 3 (C3), which is a Benefit, the formula in equation 5.

$$X_{ij} = \frac{C3}{Max\ \ Value\ C3} \quad (5)$$

X_31	X_32	X_33	X_34	X_35	X_36	X_37	X_38	X_39	X_310	X_311	X_312	X_313	X_314	X_315
= 1/4	= 1/4	= 2/4	= 2/4	= 2/4	= 2/4	= 3/4	= 2/4	= 2/4	= 3/4	= 4/4	= 4/4	= 4/4	= 3/4	= 2/4
=0.25	=0.25	=0.5	=0.5	=0.5	=0.5	=0.75	=0.5	=0.5	=0.75	=1	=1	=1	=0.75	=0.5

Moreover, for Criterion 4 (C4), which is a Benefit, the formula in equation 6.

$$X_{ij} = \frac{C4}{Max\ Value\ \ C4} \quad (6)$$

X_41	X_42	X_43	X_44	X_45	X_46	X_47	X_48	X_49	X_410	X_411	X_412	X_413	X_414	X_415
= 3/4	= 4/4	= 3/4	= 3/4	= 3/4	= 1/4	= 3/4	= 3/4	= 4/4	= 3/4	= 1/4	= 3/4	= 3/4	= 2/4	= 2/4
=0.75	=1	=0.75	=0.75	=0.75	=0.25	=0.75	=0.75	=1	=0.75	=0.25	=0.75	=0.75	=0.5	=0.5

For Criterion 5 (C5), which is Cost, the formula in equation 7.

$$X_{ij} = \frac{Min\ Value\ \ C5}{X_{ij}} \quad (7)$$

X_51	X_52	X_53	X_54	X_55	X_56	X_57	X_58	X_59	X_510	X_511	X_512	X_513	X_514	X_515
= 1/2	= 1/4	= 1/3	= 1/4	= 1/4	= 1/4	= 1/4	=1/3	= 1/2	= 1/3	= 1/4	= 1/4	= 1/1	= 1/4	= 1/1
=0.33	=0.5	=1	=1	=0.33	=0.5	=0.33	=0.25	=0.33	=0.33	=0.25	=0.25	=1	=0.5	=0.25

Thus, the normalized results for each alternative can be presented in the following matrix:

$$\begin{bmatrix} 0.33 & 0.25 & 0.25 & 0.75 & 0.25 \\ 0.5 & 0.5 & 0.25 & 1 & 0.33 \\ 1 & 0.75 & 0.5 & 0.75 & 0.25 \\ 1 & 0.75 & 0.5 & 0.75 & 0.25 \\ 0.33 & 0.5 & 0.5 & 0.75 & 0.25 \\ 0.5 & 0.5 & 0.5 & 0.25 & 0.25 \\ 0.33 & 0.75 & 0.75 & 0.75 & 0.33 \\ 0.25 & 0.75 & 0.5 & 0.75 & 0.5 \\ 0.33 & 0.75 & 0.5 & 1 & 0.33 \\ 0.33 & 0.75 & 0.75 & 0.75 & 0.5 \\ 0.25 & 0.75 & 1 & 0.25 & 0.25 \\ 0.25 & 0.25 & 1 & 0.75 & 0.25 \\ 1 & 0.25 & 1 & 0.75 & 1 \\ 0.5 & 1 & 0.75 & 0.5 & 0.25 \\ 0.25 & 0.75 & 0.5 & 0.5 & 1 \end{bmatrix}$$

3. Calculating the Alternative Value (Qi)

Calculating the alternative value (Qi) for each option to determine the ranking of alternatives. The option with the highest Qi will be selected as the best motorcycle. The calculation of Qi is as follows:

$$Q_{i1} = 0{,}5 \sum (0{,}33 * 3) + (0{,}25 * 2) + (0{,}25 * 2) + (0{,}75 * 1) + (0{,}25 * 2)$$

$$+ 0{,}5 \prod (0{,}33)^3 * (0{,}25)^2 * (0{,}25)^2 * (0{,}75)^1 * (0{,}25)^2 = 1{,}625003391$$

$$Q_{i2} = 0{,}5 \sum (0{,}5 * 3) + (0{,}5 * 2) + (0{,}25 * 2) + (1 * 1) + (0{,}333 * 2)$$

$$+ 0{,}5 \prod (0{,}5)^3 * (0{,}5)^2 * (0{,}25)^2 * (1)^1 * (0{,}33)^2 = 2{,}33344184$$

$$Q_{i3} = 0{,}5 \sum (1 * 3) + (0{,}75 * 2) + (0{,}5 * 2) + (0{,}75 * 1) + (0{,}25 * 2)$$

$$+ 0{,}5 \prod (1)^3 * (0{,}75)^2 * 0{,}5^2 * (0{,}75)^1 * (0{,}25)^2 = 3{,}378295898$$

$$Q_{i4} = 0{,}5 \sum (1 * 3) + (0{,}75 * 2) + (0{,}5 * 2) + (0{,}75 * 1) + (0{,}25 * 2)$$

$$+ 0{,}5 \prod (1)^3 * (0{,}75)^2 * (0{,}5)^2 * (0{,}75)^1 * (0{,}25)^2 = 3{,}378295898$$

$$Q_{i5} = 0{,}5 \sum (0{,}33 * 3) + (0{,}5 * 2) + (0{,}5 * 2) + (0{,}75 * 1) + (0{,}25 * 2)$$

$$+ 0{,}5 \prod (0{,}33)^3 * (0{,}5)^2 * (0{,}5)^2 * (0{,}75)^1 * (0{,}25)^2 = 2{,}125054253$$

$$Q_{i6} = 0{,}5 \sum (0{,}5 * 3) + (0{,}5 * 2) + (0{,}5 * 2) + (0{,}25 * 1) + (0{,}25 * 2)$$

$$+ 0{,}5 \prod (0{,}5)^3 * (0{,}5)^2 * (0{,}5)^2 * (0{,}25)^1 * (0{,}25)^2 = 2{,}125061035$$

$$Q_{i7} = 0{,}5\sum(0{,}33 * 3) + (0{,}75 * 2) + (0{,}75 * 2) + (0{,}75 * 1) + (0{,}33 * 2)$$
$$+ 0{,}5\prod(0{,}33)^3 * (0{,}75)^2 * (0{,}75)^2 * (0{,}75)^1 * (0{,}33)^2 = 2{,}708821615$$

$$Q_{i8} = 0{,}5\sum(0{,}25 * 3) + (0{,}75 * 2) + (0{,}5 * 2) + (0{,}75 * 1) + (0{,}5 * 2)$$
$$+ 0{,}5\prod(0{,}25)^3 * (0{,}75)^2 * (0{,}5)^2 * (0{,}75)^1 * (0{,}5)^2 = 2{,}500205994$$

$$Q_{i9} = 0{,}5\sum(0{,}33 * 3) + (0{,}75 * 2) + (0{,}5 * 2) + (1 * 1) + (0{,}33 * 2)$$
$$+ 0{,}5\prod(0{,}33)^3 * (0{,}75)^2 * (0{,}5)^2 * (1)^1 * (0{,}33)^2 = 2{,}583622685$$

$$Q_{i10} = 0{,}5\sum(0{,}33 * 3) + (0{,}75 * 2) + (0{,}75 * 2) + (0{,}75 * 1) + (0{,}5 * 2)$$
$$+ 0{,}5\prod(0{,}33)^3 * (0{,}75)^2 * (0{,}75)^2 * (0{,}75)^1 * (0{,}5)^2 = 2{,}876098633$$

$$Q_{i11} = 0{,}5\sum(0{,}25 * 3) + (0{,}75 * 2) + (1 * 2) + (0{,}25 * 1) + (0{,}25 * 2)$$
$$+ 0{,}5\prod(0{,}25)^3 * (0{,}75)^2 * (1)^2 * (0{,}25)^1 * (0{,}25)^2 = 2{,}500068665$$

$$Q_{i12} = 0{,}5\sum(0{,}25 * 3) + (0{,}25 * 2) + (1 * 2) + (0{,}75 * 1) + (0{,}25 * 2)$$
$$+ 0{,}5\prod(0{,}25)^3 * (0{,}25)^2 * (1)^2 * (0{,}75)^1 * (0{,}25)^2 = 2{,}250022888$$

$$Q_{i13} = 0{,}5\sum(1 * 3) + (0{,}25 * 2) + (1 * 2) + (0{,}75 * 1) + (1 * 2)$$
$$+ 0{,}5\prod(1)^3 * (0{,}25)^2 * (1)^2 * (0{,}75)^1 * (1)^2 = 4{,}1484375$$

$$Q_{i14} = 0{,}5\sum(0{,}5 * 3) + (1 * 2) + (0{,}75 * 2) + (0{,}5 * 1) + (0{,}25 * 2)$$
$$+ 0{,}5\prod(0{,}5)^3 * (1)^2 * (0{,}75)^2 * (0{,}5)^1 * (0{,}25)^2 = 3{,}001098633$$

$$Q_{i15} = 0{,}5\sum(0{,}25 * 3) + (0{,}75 * 2) + (0{,}5 * 2) + (0{,}5 * 1) + (1 * 2)$$
$$+ 0{,}5\prod(0{,}25)^3 * (0{,}75)^2 * (0{,}5)^2 * (0{,}5)^1 * (1)^2 = 2{,}875549316$$

Based on the calculations using the formula, the ranking of each alternative is obtained using the WASPAS method, as shown in Table 5.

Table 5. Results of Calculations Using the WASPAS Method

Alternative	Final Grade Results	Rank
ALT-01	1,625003391	15
ALT-02	2,33344184	11
ALT-03	3,378295898	2
ALT-04	3,378295898	2
ALT-05	2,125054253	14
ALT-06	2,125061035	13
ALT-07	2,708821615	7
ALT-08	2,500205994	9
ALT-09	2,583622685	8
ALT-10	2,876098633	5
ALT-11	2,500068665	10
ALT-12	2,250022888	12
ALT-13	4,1484375	1
ALT-14	3,001098633	4
ALT-15	2,875549316	6

Therefore, the conclusion from the best calculation results using the WASPAS method indicates that the alternative with the highest value is vehicle ALT-13, with a final score of 4.1484375.

5. Conclusion

Based on the decision support system that has been developed, the WASPAS method is highly effective for ranking the best Head of Study Program. The system utilizes various criteria to assess and compare candidates, including Psychotest Scores, IQ Tests, Communication Skills, Cognitive Tests, and Teaching Experience. With the help of the WASPAS method, selecting the best Head of Study Program becomes more targeted and objective, facilitating a more accurate decision-making process.

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