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Determining the Best Laboratory Head Performance: A Data-Driven Approach to Enhanced Decision Making Using the SAW Method

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Abstract

In today's fast-paced world, vocational schools play a pivotal role in shaping the future of the workforce. These schools focus on providing practical training to students, enabling them to acquire skills that are in demand in various industries. As a result, laboratory management is crucial and requires attention. This study aims to determine the laboratory head's best performance. The study employs a quantitative approach, utilizing the SAW method and the Decision Support System, and a descriptive analysis that compares the results of the principal's assessment with those of peers. Assessment is done using formulas that are Likert-scaled. The research was conducted at Putra Samodera Shipping Vocational School, Yogyakarta, Indonesia, where there are four laboratories, namely: a nautical laboratory, a commercial ship engineering laboratory, a language laboratory, and a computer laboratory. According to the results, the head of the commercial ship engineering laboratory performed the best. There is no difference between the assessments of the principal and peers, but the best performance according to the criteria is not the same. Based on each criterion, the head of the commercial ship engineering laboratory excels in planning, evaluation, and development requirements. All laboratories are driven to improve the work safety culture in the laboratory and school environments. These results may reflect how the laboratory head can improve quality and professionalism. Other vocational schools can incorporate the implications of this study into their decision support systems and enhance them with various techniques to advance the discussion in future studies.

Keywords: DSS, SAW, employee performance, laboratory head, vocational school.

1. INTRODUCTİON

The existence of vocational schools is increasingly seen as necessary because graduates are expected to work immediately. Vocational schools carry out more practices in their learning, either through internships, laboratories, or information technology. According to research on Central Java Island, the success rate of vocational schools is 70% due to teaching patterns and 85% due to laboratories, with other factors making up the remaining percentage (Wahjusaputri & Bunyamin, 2022). These institutions must prioritize enhancing vocational education quality through adequate laboratory facilities and practical learning experiences to meet the demands of the ever-evolving job market (Purwaningrum et al., 2022). Practical learning is included in teaching performance (TP), which is learning output (Hasan et al., 2019). In this digital era, schools also need to improve their digital skills. Research results from (Guillén-Gámez et al., 2023) show a significant influence on digital skills and behaviors. Information technology is also an integral part of the learning process. Therefore, the existence of a computer lab is fundamental. Laboratory management will benefit schools, students, and stakeholders (Setiawati, 2023). Besides, at the shipping vocational school, there is a nautical and commercial ship engineering laboratory because many graduates of maritime vocation are absorbed in the logistics and supply chain sectors (Rustina, Teguh, et al., 2023)

Besides, the performance of laboratory employees plays a significant role in supporting the performance of vocational education. In addition to the educational process itself, teachers' performance as educators can have a substantial impact on the quality of education. In other words, low-quality education can arise from the inadequate performance of teachers responsible for imparting knowledge. Put simply, the provision of substandard education could occur due to the insufficient effectiveness of the teachers tasked with disseminating knowledge. The quality of education, whether high or low, isn't just determined by the educational process but can also be impacted by the subpar performance of teachers in their role as educators (Sudibjo & Prameswari, 2021). Vocational teachers are also required to be able to meet the needs of social and work life in the future.

However, not all vocational schools have well-equipped laboratories, and some that do have them are not adequately managed. Employee performance appraisals can be used in decision-making regarding employee development. As a result, it is essential to develop an employee performance appraisal system that management can use to choose the best employees (Fatkhudin et al, 2023). At the same time, research related to performance in vocational schools is still limited (Puruwita et al., 2022). According to research from (Gustalika et al., 2021), the criteria for practicum assistants include academic criteria (last semester's Cumulative Achievement Index), microteaching, personality, and interview

results. Meanwhile, research (Pangestu, 2019) on laboratory assessment is more about physical criteria, namely practice area, atmosphere, temperature, lighting, maintenance, and workstation. In contrast, this research adapted criteria for planning, organizing, evaluation, development, occupational health, and safety (Wati, 2020).

The objective of this study is to determine the best performance of laboratory heads in vocational schools that cater to shipping, considering the significance of these issues. This will be achieved by utilizing the simple additive weight method, which is a well-established and widely used approach in performance evaluation. This study will also compare performance based on the assessment of the principal with peers as well as based on criteria. The outcome of this study will be of great significance to the institution, as it will allow for the identification of areas that require improvement and ultimately lead to the enhancement of the quality of education provided.

2. LİTERATURE REVİEW

2.1 Performance of the Head of the Shipping Vocational School Laboratory

2.1.1 Planning

Planning in the laboratory of a vocational school is an obligation to ensure that the facilities are built with the flexibility to accommodate changes in the curriculum and meet the needs of students and teachers. Efficient laboratory operations require proper planning and modern equipment for research, control, and testing (*Scientific Equipment and the Laboratory. Nature*, 1940). The selection of media in learning is essential to get students closer to real-life cases and increase learning effectiveness (McMahon, G., 1966). Implementing more efficient performance planning is necessary to enhance productivity. (Ulker & Bakioglu, 2019), As well as quality document management (Setiawati, 2023). Curriculum planning should be based on student needs (Mallillin & Mallillin, 2020).

2.1.2 organizing

Organizing a laboratory is important because it can provide complete lessons, offer scientific work skills, foster curiosity and self-confidence, and increase skills in using tools and media to seek truth (Wasliman et al., 2023). Lab management must be effective in achieving learning objectives and fostering student independence. Common challenges in lab organization include the need for project managers with agile skills, a lack of full-time leadership, dependence on self-driven employees, and the absence of formal leaders, leading to a need for creative feedback and support for creativity (Wasliman et al., 2023)., It is beneficial to engage in regular conversations about compliance, promote skepticism toward data, and establish standard operating procedures (Antes et al., 2019).

2.1.3 Evaluation

Performance evaluation involves setting standards, measuring performance, maintaining good performance, and taking corrective actions for poor performance (Bungai & Perdana, 2018). During the evaluation phase, a practical performance test will be conducted (Sudarsono et al., 2024). A study in Taiwan developed a performance evaluation system covering professional standards, criteria, and appropriate mechanisms to guarantee the highest quality of teachers (Wu et al., 2018). Contrary to the previous opinion, according to (Cadez et al., 2017), performance evaluation can inhibit creativity and innovation in teaching and learning because it often focuses on standardized metrics and outcomes rather than the individual needs and strengths of students. By examining multiple criteria and evaluating alternatives more comprehensively, decision support systems (DSS) such as Simple Additive Weighting can assist in overcoming this limitation (Albreiki, 2021).

2.1.4 Development

The level of investment in local vocational education, including human, material, and financial resources, is influenced by the quality of regional economic development, which impacts the level of development of vocational education (Xiong & Chang, 2022). Laboratory integration into the process should be increased through digitalization, automation, quality management systems (Huf, W., 2022), and better organization and evaluation. Virtual laboratories have been developed to support distance learning in Indonesian vocational high schools, providing a different learning style and increasing student achievement levels (Bima et al., 2021). Work innovation and creativity must have the support of leaders by building organizational culture (Khan et al., 2020), thus supporting the development of ideas.

2.1.5 Occupational health and safety

Occupational health and safety management aims to proactively mitigate accidents and incidents of sickness (Badri et al., 2018). Workplace risk assessments are needed to protect workers' health and safety (Landberg et al., 2018). According to the Directorate of Primary and Secondary Education Personnel Development, Directorate General of Teachers and Education Personnel, Ministry of Education and Culture RI 2018, performance appraisals of laboratory employees should also be assessed for their applicability to occupational safety and health. Assessing the risks of identified hazards in occupational health and safety involves considering foreseeable events as well as exposures that can cause harm and the possibility of occurrence (Jensen et al., 2022). As a shipping vocational school, occupational safety and health need to be implemented because many graduates work in sectors related to ports. The port is responsible for overseeing activities at the port, including

the enforcement of rules and regulations relating to safety, security, the environment, and other violations (Rustina, Wening, et al., 2023). That is why there are laboratories of nautical and engineering for commercial ships at the Shipping Vocational Schools. The influence of safety culture on individual safety performance is substantial, as it leads to a decrease in workplace accidents and fatalities. Promoting a comprehensive safety culture is imperative to fostering optimal employee safety performance (Naji et al., 2022).

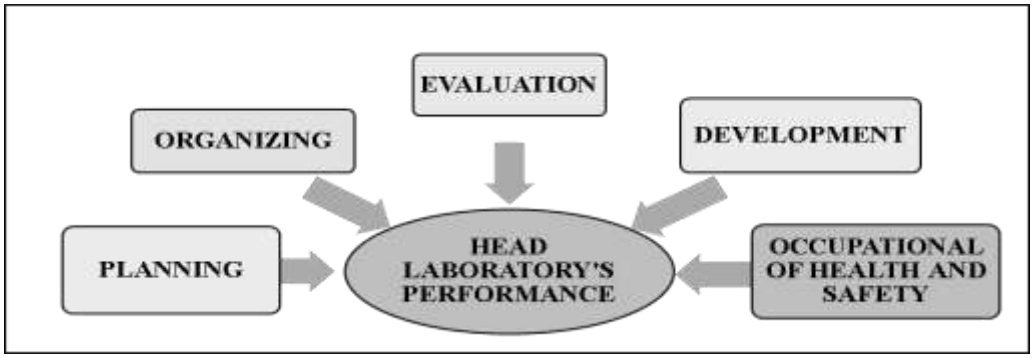

Figure 1: Performance Criteria for the Head of Laboratory

2.2 Simple Additive Weight

2.2.1 Understanding and SAW Steps

The Simple Additive Weight (SAW) method is widely recognized for multiple attribute decision-making (MADM). SAW is an appropriate performance appraisal system that uses weighted criteria to identify the best employee performance and decide career paths or promotions (Rizka et al., 2023). Decisions are taken based on utility value. When faced with the MADM problem, utility value refers to the alternative method with the highest utility value. The SAW method requires normalizing the decision matrix (X) at a scale appropriate to all available evaluation projects. The SAW method can determine the weighted addition efficiency for each option for all attributes. Assigning weights to each criterion based on relative importance, rating laboratory heads on each criterion, and calculating the weighted score (Pangestu, 2019).

SAW is just one method in the decision support system. There are several others, including the Analytic Hierarchy Process (AHP), Weight Product (WP), Profile Matching, Performance Prism, Multi-Factor Evaluation Process (MFEP), Graphic Rating Scale, Balance Scorecard, Profile Matching, and more. SAW is a classic method that can be applied to find the best alternative. SAW steps include identifying the criteria for evaluating laboratory head performance (Wati, 2020).

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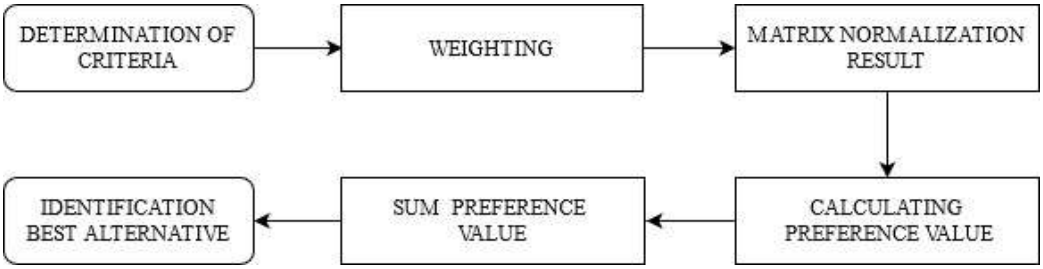

Figure 2: SAW Steps

The criteria based on laboratory heads' performance assessment guidelines, namely C1: planning, C2: organization, C3: evaluation, C4: development, and C5: occupational health and safety, with the weight of successive criteria, are C1 = 0.30, C2 = 0.25, C3 = 0.20, C4 = 0.10, and C5 = 0.15., If the factor or attribute criterion is about type cost, a formula is used for value normalization: rij=min {xij} xij. At the same time, if the factor or attribute criterion is about type benefit, then the formula is used: rij=xijmax {xij}. Therefore, its synthesized performance is pi=∑mj=1wjrij, where pi = synthesis performance value or preference value of the I-th alternative; wj = weight of the criterion to j; rij = normalized rating selected from the I-th alternative against the j-th criterion to be a proportional unit; and the criteria are assumed to be independent of each other. If the performance metrics are comparable, we do not need to transfer the data matrix to the selected normalized scoring scale (Dsn, n.d.).

2.2.2 Advantages and Disadvantages of SAW

There are several advantages associated with this approach. Firstly, it allows for compensation for various factors. Secondly, it is intuitive for decision-makers. Thirdly, it involves simple calculations. Fourthly, it eliminates the need for extensive programming. Lastly, it aids in visually comparing things and determining their differences (Taherdoost, 2023). However, the SAW method also has disadvantages. The disadvantages: Converting less stringent criteria to more stringent criteria (or employing the formula mentioned later) in the central idea and converting negative values of the rig to positive ones. The results obtained may not always exhibit logical coherence. Additionally, it is necessary to supply the weights of the qualities (Taherdoost, 2023), namely those related to ranking issues and leadership effectiveness, so it is challenging to achieve objectivity (Terttiaavini et al., 2023).

3. RESEARCH METHOD

This research study was conducted at Putra Samodra Shipping Vocational School to assess the best performance of the heads of the Nautical, Commercial Ship Engineering, Language, and Computer laboratories. The assessment included five criteria based on the School Laboratory Personnel Performance Assessment form (Directorate of Primary and Secondary Education Personnel Development, Directorate General of Teachers and Education Personnel, Ministry of Education and Culture RI 2018), i.e., planning, organizing, evaluation, development ideas, and occupational safety and health. The principal was assessed using these criteria on a Likert scale. The research used a quantitative approach to determine the best laboratory head performance, the Simple Additive Weight (SAW) method. After that, a descriptive analysis of the assessment by teachers and 31 education staff was also done using the same questionnaire.

4. Result

4.1 Determination of Criteria

Table 1: Criteria and Indicators of Head Laboratory Performance

Criteria	Operational Definition
Planning	Laboratory activity plan documents, annual programs, work procedures, instructions, and formulations.
Organizing	The laboratory's organizational structure, activity schedule documents, attendance lists, and rules of conduct are prominently displayed.
Evaluation	Lab supervision records, technician appraisals, and performance evaluations.
Development	Document laboratory development in education and research and record management outcomes for best practices.
Occupational health and safety.	The lab has the proper safety equipment. Occupational health and safety used to handle hazardous substances.

4.2 Weighting

Table 2: Criteria, Weight, and Attributes of Head Laboratory Performance

CRITERIA	WEIGHT	ATTRIBUTE
Planning	0,30	Benefit
Organizing	0,25	Benefit
Evaluation	0,20	Benefit
Development	0,10	Benefit
Occupational Health and Safety	0,15	Benefit

4.3 Normalization Matrix Determination

Table 3: Normalization Matrix Determination

	C1	C2	C3	C4	C5
A1	2	3	2	2	2
A2	3	3	3	2	3
A3	2	1	2	1	1
A4	2	2	1	2	2
Benefit	3	3	3	2	3
	C1	C2	C3	C4	C5
A1	0,66667	1	0,66667	1	0,66667
A2	1	1	1	1	1
A3	0,66667	0,33333	0,66667	0,5	0,33333
A4	0,66667	0,66667	0,33333	1	0,66667

4.4.1 Calculating and Summing Preference Values

Table 4: Calculating and Summing Preference Value

	C1	C2	C3	C4	C5	RESULT
A1	0,2	0,33333	0,13333	0,1	0,1	0,86667
A2	0,3	0,33333	0,2	0,1	0,15	1,08333
A3	0,2	0,08333	0,13333	0,05	0,05	0,51667
A4	0,2	0,16667	0,06667	0,1	0,1	0,63333
W	0,3	0,25	0,20	0,1	0,15	

4.5 Identify the Best Preferences

The best performance in a row is Head of Commercial Ship Engineering Laboratory (A2 = 1,0833), Head of Business Ship Nautics Laboratory (A1 = 0,8667), Head of Computer Laboratory (A3 = 0,6333), and Head of Language Laboratory (A4 = 0,51667). It is important to seek input from diverse individuals as internal validation to thoroughly assess laboratory performance. This input includes up to 31 educators and staff members with a minimum of 5 years of work experience and a bachelor's education level who can provide their insights by completing the same questionnaires that principals use in their assessments. Respondent data is sorted by education and length of work, as shown in Figure 3. By engaging all stakeholders in this collaborative effort, the evaluation will be comprehensive and inclusive of all parties' perspectives.

Furthermore, performance analysis was conducted according to peers, namely teachers and education staff, where respondent data according to gender and tenure is presented clearly in Figure 3.

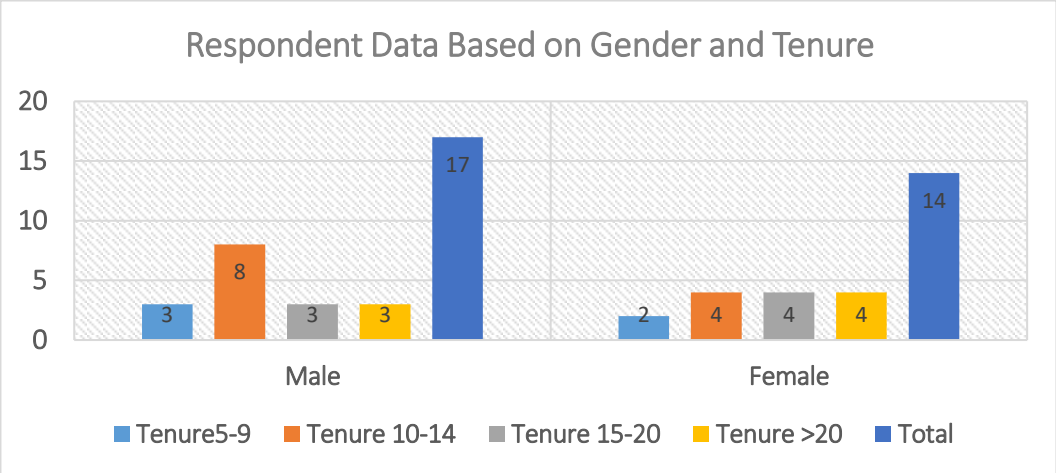

Figure 3: Respondent Data

Figure 4 shows that the total performance of each laboratory head is ranked the largest: A2 = 344, A1 = 329, A4 = 323, and A3 = 297. In this case, there is no difference in the order of the best performance of the head of the laboratory according to the principal and peers. In the context of employee performance management, the data described reflects a structured approach to evaluating and ranking the performance of laboratory heads. The clear ranking based on performance scores allows for an objective assessment of each

individual's effectiveness in their role. The consistency in ranking between the principal and peers suggests alignment in their perceptions of who the top-performing laboratory heads are, which is valuable for ensuring fairness and accuracy in performance evaluations.

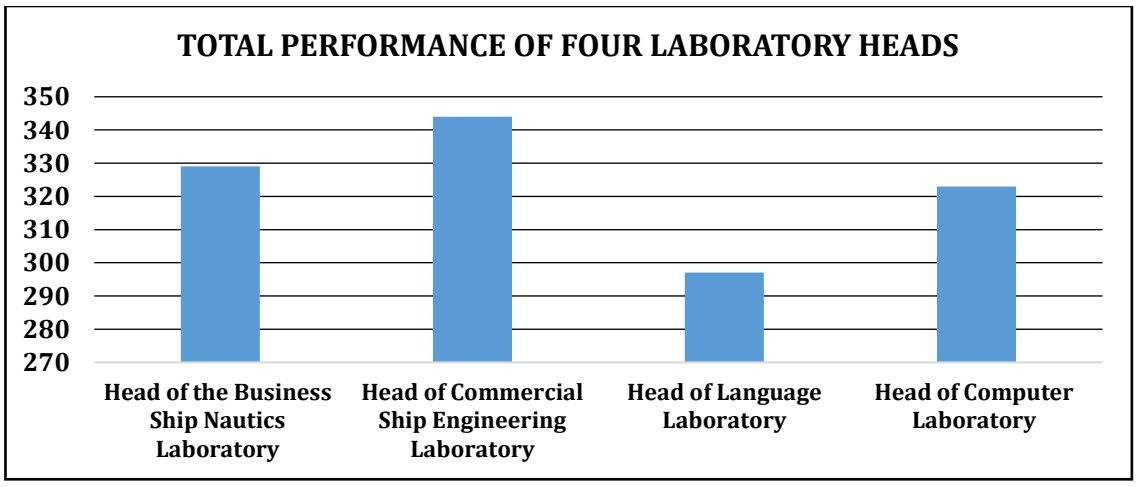

Figure 4: Total Performance of Four Laboratory Heads

If examined in greater detail, the comparison of the performance of the four laboratory heads is based on the following criteria, as shown in Figure 5.

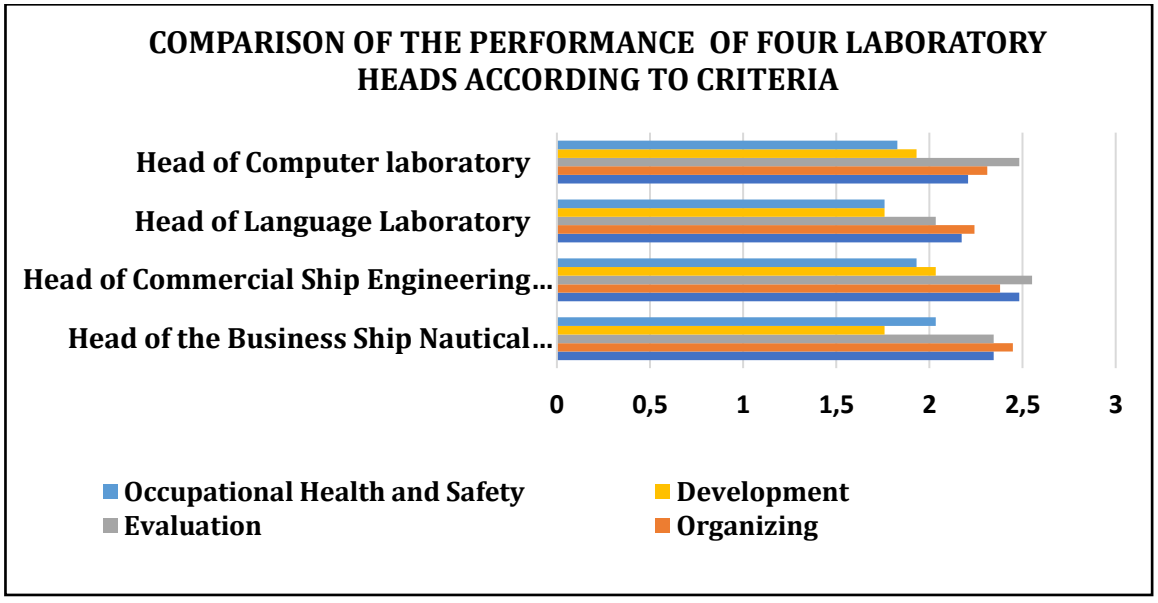

Figure 5: Comparison Of The Performance Of Four Laboratory Heads According To Criteria

As per the planning criteria, the average values for the largest row are A2 = 2,5, A1 = 2.33, A4 = 2.2, and A3 = 2.13. The average values for the organizanizing criteria are : A1 = 2.47, A2 = 2.40, A1 = 2.47, A4 = 2.33, and A3 = 2.23. The evaluation criteria are: A2 = 2.57, A1 = 2.37, A4 = 2.5, and A3 = 2.03. The development criteria for the largest average value in a row are A2 = 2.03, A4 = 1,93, A1 = 1,77, and A4 = A3 = 1,77. The occupational health and safety criteria are A1 = 2,033 , A2 = 1,973, A3 = 1,933, and A4 = 1,73. This analysis provides a valuable understanding of the usefulness of each laboratory head's leadership. This information will identify areas of success and areas for improvement to enhance the overall performance of the laboratory. The data presented highlights the evaluation of different criteria for each laboratory head. The average values for planning, organizational, evaluation, development, and occupational health and safety criteria provide a comprehensive overview of each head's performance in various areas. A2 Has a dominant performance in planning, evaluation, development, and occupational health and safety. A1 is very likely to improve because it already has excellent laboratory management. A3 and A4 can look at A2's performance as an example of best practice. By comparing these criteria, organizations can gain valuable visions into the strengths and weaknesses of each head's leadership. This analysis can help identify areas where each head excels and areas that require improvement, ultimately enhancing overall laboratory performance.

5. DİSCUSSİON

The performance of the A2 gets the best achievement, followed by the A1, so it can produce graduates who are more competent in engineering. Based on the application of the SAW method in this study will help schools objectively identify the strengths and weaknesses of the performance of laboratory heads. According to the analysis of each criterion, the head of the commercial ship engineering laboratory has a very high value in planning and evaluation. Employees with solid planning abilities demonstrate the ability to establish unambiguous objectives, efficiently prioritize tasks, and proactively foresee future challenges (Parke, 2018). Meanwhile, the high final performance evaluation will improve the quality of teachers and is very useful in solving the problem of dissatisfaction in vocational schools (Wu et al., 2018). These two criteria, namely planning and evaluation, are critical to mastering for someone who has a position in school and help develop employee performance in laboratories and schools. These can help schools make the right decisions to improve the effectiveness of laboratory management.

The head of the Nautical Laboratory achieves the highest performance in laboratory management. Although planning is not the best, it can be covered with high performance in

laboratory management because the evaluation of the activity is carried out simultaneously with the time of the activity. Flexibility in laboratory management is necessary when planning is inadequate. Organizing skills can assist students in increasing motivation, learning at their own pace, and reducing stress (Muzaffarjon et al., 2023). Organizing skills are beneficial in the nautical laboratory, as using simulators in education assists students in autonomously mastering complex material and increases the visibility of lessons through visual aids.

While A4 and A3 can improve motivation and performance by learning and implementing strategies from A2 and A1, the computer and language laboratory head can improve the value of learning and motivate his staff to achieve better performance. In addition, there is a need to strengthen the principles of occupational safety and health in the school environment. Learning best practices from A2 and A1 and contributing to the progress of Putra Samodera Shipping Vocational School can help improve the overall quality of education at Putera Samodera Shipping Vocational School. Other vocational schools that want to evaluate the laboratory head's performance can replicate and adapt this research methodology and findings.

6. CONCLUSİON

According to the SAW method analysis, the best performers are the head of the commercial ship engineering laboratory, the head of the nautical laboratory, the head of the computer laboratory, and the head of the language laboratory. Peer evaluations of the entire performance show no differences in the rankings of the best performers. According to each criterion, the head of the commercial ship engineering laboratory excels in planning, evaluation, and development criteria. While the head of the nautical laboratory excels at organizing the laboratory and occupational health and safety, The head of the computer laboratory and language laboratory can adapt the strategy of the commercial ship engineering laboratory and nautical laboratory. Nevertheless, all laboratories are expected to improve the work safety culture in the laboratory and school environments. Based on these findings, the school can provide awards to encourage employees to achieve more. Putra Samodera Shipping Vocational School can use the research result to improve the laboratory head's performance and learning quality. Implementing the recommendations from this study can help schools achieve their goals of producing competent and work-ready graduates. The results of this study may reflect how the laboratory head can improve quality and professionalism.

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