Analyzing Problem Solving Difficulties on Applied Military Operation Research

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(Received: 8-10-2021; Reviewed: 10-10-2021; Revised: 21-11-2021; Accepted: 24-11-2021; Published: 20-12-2021)

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Abstract

Operations Research is a scientific discipline that can be used to help make decisions in all fields. In the military field, the application of operations research is very much so that every officer must be able to apply it in carrying out his duties. Indonesian Navy officers received education about operations research, especially the analytic hierarchy process when they attended the Staff and Command College. A total of 20 student officers were examined to find out the difficulties they faced in solving problem solving for the analytic hierarchy process material through written answers to questions and in-depth interviews using Polya's problem-solving steps. The results obtained are that all officers did not experience problems at the time of problem identification. However, almost half of them experienced problems when planning solutions, carrying out calculations and conducting reviews. The recommendation submitted is to use a software application so that the calculations are correct and fast.

Keywords: Difficulties, Problem-Solving, Polya, Operation Research.

INTRODUCTION

The military has a very heavy duty both in times of war and in times of peace. In times of war it was clear they had to risk their lives to fight and win the battle. Meanwhile, in times of peace, the military is always relied on to carry out emergency activities for natural disasters, humanitarian disasters and health disasters, as it is currently in the form of a pandemic. Therefore, a professional, educated and trained military is needed. The process of professional development is carried out through Education and Training. In military education, a strong positive culture is needed to support the development of the professional spirit of the students. The learning method used should be able to support the professional development and independent learning of students. In addition, military schools should be places where every student acquires and strengthens the competencies they need in life and in their military profession (Kozina, 2019). Besides that, the current conceptualization of professional military education finds its relevance in order to achieve the right pattern of professional education and material (Libel, 2021).

A very important material in the military education curriculum, especially officers is military decision-making techniques. This technique is needed by officers to make strategic, tactical and technical decisions on the battlefield and in organizational management. A very well-known technique in the

military world to support decision making is operations research which can include: linear programming, stochastic analysis, and selection of weighted criteria.

The problem faced in learning decision-making techniques, especially operations research, is how officers with different backgrounds are able to use techniques in operations research to support decision making. Therefore, research is needed to find out what difficulties are faced by officers in using operations research techniques and what needs to be done to reduce or even eliminate these difficulties and be able to use operations research techniques optimally.

METHOD

Research Approach and Research Subjects

The approach used in this study is a qualitative approach with the data analyzed is a combination of a polya analysis of the results of the written work carried out then identifying the difficulties of solving the problem by student officers, and structured interviews conducted on them. The results of the next study were concluded by using the triangulation method as a technique to validate the accuracy of the results and data interpretation was a triangulation technique. Triangulation is the process of strengthening evidence from different data types (Creswell, 2012). The strengthening of the evidence referred to in this study is to check the accuracy of the results and interpretation of data from the same source with different techniques, namely through student work and interviews. Triangulation activities are carried out through the stages of data reduction, data presentation, and drawing conclusions.

Samples as well as research subjects were 20 student officers consisting of 5 officers each from the corps: operation, engineering, electronics, supplies, and marines. All research subjects will work on written questions by answering all the questions that have been designed using the Polya problem solving step on the first day. On the second day they will take turns answering questions orally according to Polya's problem-solving steps.

Research Steps

Next, the steps taken are to combine Steps in the analysis of job results and in-depth interviews in a structured way using an interview guide, in detail as follows:

- a. Ask questions in writing, including:
 1. Identify the problem in detail from the problem presented
 2. Second, make a problem-solving plan
 3. Third, implement a problem-solving plan
 4. Fourth, review the results of problem-solving work
- b. Conduct in-depth interviews with interview guides on issues raised through:
 1. Identify the problem in detail from the problem presented
 2. Second, make a problem-solving plan
 3. Third, implement a problem-solving plan
 4. Fourth, review the results of problem-solving work
- c. Triangulation to check the results of written answers and interviews
- d. Making a conclusion

Diagrammatically, the research steps were carried out as follows.

Figure 1. Research Steps

The problems that must be solved by Student Officers to implement operations research materials, especially the Analytic Hierarchy Process in assignments in the Navy according to the level of an officer, are as follows.

In carrying out its main tasks, the Navy is required to have the readiness of soldiers and defense equipment. Reporting on the readiness of the Indonesian Navy soldiers and defense equipment is a very important issue in the House of Representatives to be able to score the proposed budget. Therefore, it is necessary to make a study to be able to provide a weighting for the readiness of the Indonesian Navy in carrying out its duties supported by the weighting of the defense equipment and soldiers, accompanied by the weighting of each criterion on the two dimensions. These results can then be used as a reference in calculating the strength of the defense equipment and soldiers as a whole, and partially. The problem you need to work on is to complete the calculation of the Indonesian Navy's preparedness weighting in carrying out these tasks, by answering the following questions.

1. Explain, what do you know about this issue?
2. Explain, what is being asked about this issue?
3. Explain, what concepts or theories support this problem solving?
4. Explain, what formulas are needed?
5. Explain, what are the steps to do this problem correctly?
6. Explain, can the calculation process be carried out according to the plan?
7. Explain, how the method used to solve this problem?
8. Do the weight calculation work to completion!
9. Explain, what are difficulties in processing and calculating?
10. Explain, how do you double-check each step of the solution?
11. Explain, how are the results of the re-examination regarding the correctness of the calculation results?
12. Explain, are you sure you answered correctly?

Problem Solving Aspects Polya

Steps for solving problems from Polya are arranged starting from Understanding the problem, planning a solution, implementing the plan and judicial review. From these steps, a list of questions for both interviews and written questions is compiled which is used as a guide for problem solving steps so that nothing is missed from all these steps in detail. More details are presented as follows (In'am, 2014), (Pratikno & Retnowati, 2018), (Ernawati & Sutiarso, 2020).

1. Understanding the Problems. Understanding a problem is a very important activity that must be carried out before carrying out problem solving activities so that there are no mistakes in interpreting the problem and at the same time solving it. There are various ways to understand the problem, namely: 1) What do you know about this issue? 2) What is being asked about this issue?, and 3) What are the important conditions that need to be considered in this case?.
2. Planning a Solution. After understanding the problem, the next step is to make an appropriate plan to solve the problem. There are several things that need to be considered in solving a problem, namely: 1). What concepts or theories support this problem solving? 2). What formulas are needed? 3). What are the steps to do this problem correctly?
3. Implement the Plan. The next stage after understanding the problem and planning to obtain a solution to the problem is implementing a plan for problem solving. The stages in solving the problem include: 1). Can the calculation process be carried out according to the plan? 2). Explain how the method used to solve this problem? 3). Are there any difficulties in processing and calculating?
4. Look Back. To ensure that what has been done produces the correct output, a Back-checking step is needed, which is a process to review the answers obtained. Important points in the review include: 1). How do you double-check each step of the solution? 2). How are the results of the re-examination regarding the correctness of the calculation results? 3). Are you sure you answered correctly?

Tabularly, the details of Polya's Steps can be arranged in a list of questions as follows.

Table 1. Interview Questions using Polya's Steps

Polya's Steps	List of Interview questions
1. Understanding the problem	1. What do you know about this issue? 2. What is being asked about this issue? 3. What are the important conditions that need to be considered in this case?
2. Planning a Solution	1. What concepts or theories support this problem solving? 2. What formulas are needed? 3. What are the steps to do this problem correctly?
3. Implement the Plan	1. Can the calculation process be carried out according to the plan? 2. Explain how the method used to solve this problem? 3. Are there any difficulties in processing and calculating?

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4. Look Back
1. How do you double-check each step of the solution?
 2. How are the results of the re-examination regarding the correctness of the calculation results?
 3. Are you sure you answered correctly?
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Source: (In'am, 2014), (Pratikno & Retnowati, 2018), and (Ernawati & Sutiarto, 2020).

RESULT AND DISCUSSION

Result

a. Subjects of Research

In this study, the sample or research subjects were Student Officers at the Indonesian Navy command and staff school. They consist of officers with the rank of Major and have more than 10 years of experience as Indonesian Navy Officers. Therefore, they are quite representative of the intermediate officer level in the Indonesian Navy. The need to have the ability in decision-making techniques also goes hand in hand with experience and rank. The number of research subjects were 4 people each from the corps: operations, engineering, electronics, supplies, and marines.

b. The result of problem solving is in accordance with the Polya Steps performed in writing.

The result of the written solution of the problem posed above with Step Polya, can be presented as follows.

Table 2. Written Answers from Research Subjects

Indicators	Number of Subject																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Explain, what do you know about this issue?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Explain, what is being asked about this issue?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Explain, what concepts or theories support this problem solving?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Explain, what formulas are needed?	D	N	N	N	N	D	N	N	N	N	N	N	D	N	N	N	D	N	N	D
Explain, what are the steps to do this problem correctly?	D	N	N	N	N	D	N	N	N	N	N	N	D	N	N	N	D	N	N	D
Explain, can the calculation process be carried out according to the plan?	D	N	N	N	N	D	N	N	N	N	N	N	D	N	N	N	D	N	N	D
Explain, how the method used to solve this problem?	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Do the weight calculation work to completion!	D	D	N	D	N	D	N	N	D	N	N	N	D	N	N	D	N	N	D	D
Explain, what are difficulties in processing and calculating?	D	N	N	N	N	D	N	N	N	N	N	N	D	N	N	D	N	N	D	D
Explain, how do you double-check each step of the solution?	D	D	N	D	N	D	N	N	D	N	N	N	D	N	N	D	N	N	D	D
Explain, how are the results of the re-examination regarding the correctness of the calculation results?	D	D	N	D	N	D	N	N	D	N	N	N	D	N	N	D	N	N	D	D
Explain, are you sure you answered correctly?	D	D	N	D	N	D	N	N	D	N	N	N	D	N	N	D	N	N	D	D

Source: Results of written answers (processed)

Information:

D = With difficulties

N = No Difficulties

Based on the results of the assessment of each indicator in the assessment carried out on the 35 research subjects above, several percentages of the greatest difficulties were generated in the twelve indicators, with the following results.

Figure 2. Percentage of Difficulties in problem solving

c. In-depth Interview Results

The results of in-depth interviews to find out why there are difficulties in solving these problems using applied operational research, namely analytic hierarchy process which is analyzed using problem solving steps using Polya. The question posed is whether there are difficulties at the stage according to the indicators, and why it happened. Based on the above, the results can be tabulated as follows.

Table 3. Summary of the results of in-depth interviews of research subjects

No	Question	Conclusion of Answers
1.	Do you find it difficult to answer the question: "Explain, what is being asked about this issue?". If no, move on to the next indicator. If yes, why?	No difficulties. The issues include daily problems in Indonesian Navy. So, they met the similar problems before attend the study.
2.	Do you find it difficult to answer the question: "Explain, what concepts or theories support this problem solving?". If no, move on to the next indicator. If yes, why?	No difficulties. The issues include daily problems in Indonesian Navy. So, they met the similar problems before attend the study.
3.	Do you find it difficult to answer the question: "Explain, what formulas are needed? ". If no, move on to the next indicator. If yes, why?	No difficulties. The issues include daily problems in Indonesian Navy. So, they met the similar problems before attend the study.
4.	Do you find it difficult to answer the question: "Explain, what are the steps to do this problem correctly?". If no, move on to the next indicator. If yes, why?	Met the difficulties.
5.	Do you find it difficult to answer the question: "Explain, can the calculation process be carried out according to the plan?". If no, move	Yes

on to the next indicator. If yes, why?	
6. Do you find it difficult to answer the question: "Explain, how the method used to solve this problem?". If no, move on to the next indicator. If yes, why?	Yes
7. Do you find it difficult to answer the question: "Do the weight calculation work to completion!". If no, move on to the next indicator. If yes, why?	Yes
8. Do you find it difficult to answer the question: "Do the weight calculation work to completion!". If no, move on to the next indicator. If yes, why?	Yes
9. Do you find it difficult to answer the question: "Explain, what are difficulties in processing and calculating?". If no, move on to the next indicator. If yes, why?	Yes
10. Do you find it difficult to answer the question: "Explain, how do you double-check each step of the solution?". If no, move on to the next indicator. If yes, why?". If no, move on to the next indicator. If yes, why?	Yes
11. Do you find it difficult to answer the question: "Explain, how are the results of the re-examination regarding the correctness of the calculation results?". If no, move on to the next indicator. If yes, why?	Yes
12. Do you find it difficult to answer the question: "Explain, are you sure you answered correctly?". If no, move on to the next indicator. If yes, why?	Yes

Source: Interview data (processed)

In addition to the 12 indicators from the 4 steps of Polya mentioned above, the research subjects, namely the officers, were also asked about what is recommended for improving the teaching process in this operation research discipline?

The answer from the research subject is: that all of the subjects agree to use computer software to make the calculations right. Various suggestions on using the software: the most of which are 14 officers using super decision, then using a spreadsheet of 4 officers and there are 2 officers who suggest using the R programming language.

d. Triangulation Results

Based on the results of a written self-assessment about the difficulties in solving operations research problems and triangulation with the results of structured in-depth interviews, it can be explained the difficulties they experienced.

1. Student officers have no difficulty in understanding the problems presented and are able to identify well what needs to be known and asked.
2. Some officers, almost half of them, have difficulty planning in detail analytical problem solving.
3. Some officers, almost half of them, who have difficulty in planning also have difficulty solving the problem analytically. nor are they sure of the completed answer.

4. The officers also had difficulty re-checking the problem solving they had done.
5. All officers, both those who have been able to solve the problem analytically and those who are unable to solve the problems given, agree to propose using operation research application software to help solve the problem in order to obtain results that are believed to be correct.

Discussion

From the results of written job analysis and interviews, then triangulation was carried out to produce an interesting picture of the abilities and difficulties of Indonesian Navy student officers who were attending education in staff and command schools. Their main difficulty is in technical calculations, checking and ensuring that the results of their work are correct. This can be explained that Indonesian Navy officers are people who are already quite senior in rank and position as well as assignment experience. So as to be able to understand well the applied problems that need to be calculated as the implementation of operational research theory. This will encourage them to like and use operational research techniques. However, technical difficulties in the calculation, and checking Back is a separate obstacle. Therefore, it is necessary to use application software in this applied operational research technique such as using Super Decision for weight calculations using analytic hierarchy process. This will greatly support the acceleration, accuracy and confidence of the truth of the results.

This is in accordance with previous research (Li et al., 2017). Learning basic theory at the same time, paying attention to specific issues to build an effective mathematical model, through mathematical experiments to improve learning and use of mathematical optimization software, and achieve good results. Thus, several difficulties in studying operations research for Military officers were identified, and an effort to overcome them was to combine them using widely available operation research software such as Super decision, R Language Programming for Operation Research or spreadsheet.

CONCLUSIONS AND SUGGESTIONS

Simpulan berisi rangkuman singkat atas hasil penelitian dan pembahasan. Simpulan adalah temuan The results of the analysis of the polya steps in solving the problems given in the operations research course, in this case the analysis hierarchy process, show that there are no difficulties in explaining the problem, what is known and asked. Difficulties in the second, third and fourth stages is still quite high, almost half of the research subjects. The highest difficulty in manual calculations. The next difficulty is planning and checking the results of the calculations that have been done. It is recommended to combine it with existing analytic hierarchy process software so as to avoid calculation errors and optimize the ideas generated. Based on the results of this study, it is recommended to study the use of operation research software in Operation Research learning for Indonesian Navy officers.

ACKNOWLEDGEMENT

We would like thank everyone that involved in this research. We also would like to thank our colleagues from Faculty of Mathematics and Science - Indonesian Defense University, who have provided insights and expertise that greatly assisted the research.

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