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Application of Multiple Representation-Based VIFOCA Problem Solving Strategies in Physics Learning

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A B S T R A K

Kesulitan siswa dalam menyelesaikan masalah fisika diidentifikasi dari berbagai faktor, antara lain kurangnya pemahaman siswa yang baik tentang bagaimana menerapkan langkah-langkah strategi pemecahan masalah fisika. Oleh karena itu, perlu dilakukan inovasi strategi yang sederhana dan mudah digunakan oleh siswa dalam proses penyelesaian masalah fisika dengan melakukan tinjauan literatur. Penelitian bertujuan untuk menganalisis strategi pemecahan masalah vifoca berbasis multiple representasi dalam pembelajaran fisika. Penelitian ini menggunakan metode campuran, studi literatur dengan meta analisis menggunakan 22 subjek penelitian dari jurnal nasional, jurnal nasional terakreditasi Sinta, AIP Conference, dan artikel dari jurnal internasional terindeks Scopus pada rentang tahun 2018-2022. Survei terhadap 82 responden yang meliputi dosen dan mahasiswa digunakan untuk mengetahui tanggapan terhadap penerapan strategi pemecahan masalah fisika. Studi literatur menunjukkan rumusan strategi pemecahan masalah fisika yang diberi nama VIFOCA yang terdiri dari tiga langkah kerja yaitu: (1) visualisasi, (2) formulasi, dan (3) perhitungan. Respon positif berdasarkan hasil survei menunjukkan bahwa strategi VIFOCA dapat digunakan untuk menyelesaikan permasalahan fisika, langkah kerjanya sistematis, mudah diterapkan, dan lebih praktis. Kajian lanjutan strategi VIFOCA dapat dilakukan secara komprehensif yang diterapkan secara empiris dalam pembelajaran fisika untuk mengetahui keefektifan strategi VIFOCA dalam menyelesaikan permasalahan fisika.

A B S T R A C T

Students' difficulties in solving physics problems were identified from various factors, including students' poor understanding of how to apply the steps of a physics problem solving strategy. Therefore, it is necessary to innovate strategies which both simple and easy to use by students in the process of solving physics problems by conducting literature reviews. The study aimed at analyzing multiple representation-based vifoca problem solving strategies in physics learning. This research used mixed methods, literature study with meta-analysis using 22 research subjects from national journals, Sinta-accredited national journals, AIP Conference, and articles from Scopus-indexed international journals in the 2018-2022 range. The survey of 82 respondents including lecturers and students, were used to determine the responses to the application of physics problem solving strategies. The literature study shows the formulation of a physics problem solving strategy that is named VIFOCA, which consists of three work steps, namely: (1) visualization, (2) formulation, and (3) calculation. Positive responses based on survey results showed that the VIFOCA strategy can be used to solve physics problems, the work steps are systematic, easy to apply, and more practical. VIFOCA strategy follow-up studies can be carried out in a comprehensive manner that is empirically applied in physics learning to determine the effectiveness of the VIFOCA strategy in solving physics problems.

1. INTRODUCTION

Problem solving is one of the skills that must be possessed in the 21st century. This has implications for learning physics in universities. Problem solving is an ability that needs to be trained, so that students can apply it in life. To achieve this, various factors need to be considered, one of which understands the concept. Understanding of physics concepts is an important factor in solving physics problems. Students have never received basic knowledge and physics skills at the previous school level. This has an innate effect that many students have basic concepts and initial abilities that are still lacking, which is reinforced by the survey results that 42.6% of students did not like physics lessons at their original school, and there were around 67% of students who understood the basic concepts. This fact becomes a problem for students in participating in learning, which hinders students in understanding physics material, doing exercises, and solving problems contained in physics problems. Mastery of physics concepts owned by students is still low so that it will have an impact on students' ability to solve a physics problem, and low problem solving has an impact on physics

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learning outcomes (Handayani et al., 2018; Rahmana et al., 2022). Such student physics learning outcomes should be suspected to occur due to a lack of students' physics problem-solving abilities. Physics is a subject that emphasizes processes and products, not just products (Amanah et al., 2017; Kohl & Finkelstein, 2007). The problems solving is process uses systematic strategic steps to find answers. Therefore need for an understanding of physics problem solving strategies.

Understanding of the problems solving strategy used is also one of the obstacles. Students do not understand what they have to do when faced with physics problems, how to solve them, the physics concepts that are applied, and the formulas used. Students are familiar with problem solving by writing known, asked, and answered steps. Students still do not understand well how to use physics problem solving strategies. The initial survey showed only 35% of students were able to apply strategies in physics problem solving. The survey also showed that 86.1% of students used "known", "asked", and "answered" problem solving strategies. This fact has an effect on students when they are faced with different and new problems in the context of questions or questions with a higher level, they cannot do much, meaning that students cannot solve the given problem. Solving physics problems requires the ability to construct knowledge in the form of concepts and principles, theories, related physical laws. As the results of the literature review stated that while trying to solve physics problems, students often express that they understand the questions, they know the laws of physics on which the problem is based. They have solved many similar problems, but the new problem is different from the previous problems. Therefore, they cannot solve the problem (Ince, 2018; Sartika et al., 2019). Students are familiar with the steps of solving physics problems by simply writing down known, asked, and answered. Lack of understanding in using work steps, or applying problem solving strategies, makes it difficult for students to solve physics problems. Innovative physics learning strategies are needed to be simplified so that they are easier and more practical to use.

Physics learning outcomes are still low and students still do not understand systematic problems solving steps. Errors in solving physics problems that are often experienced by students are not following the steps of solving the problem correctly. A weak understanding of the principles and rules of physics, make the students do not understand the problem. Thus, they do not have enough motivation (Rohmah et al., 2018; Veronica et al., 2018). In working on physics problems given by the teacher, students more often directly use mathematical equations without doing analysis, guessing the formulas used, and memorizing examples of problems that have been done to work on other problems. Students experience difficulties when dealing with complex problems. When working on questions, students have difficulty solving questions in the form of descriptions. They have not been able to describe an event from the problem and determine variables that are known and asked. There are still many students who look confused when using equations (Azizah et al., 2015; Hanisa et al., 2019). Understanding in using work steps, makes it difficult for students in the process of solving physics problems. Therefore, it is necessary to develop learning strategies or classrooms which are able to provide provisions and practice problems solving skills to students. Physics problems contain the complexity of relationships between concepts, so that, a good understanding of concepts is needed in solving physics problems (Anwar, 2021; Trianggono, 2017). Learning physics involves interrelationships between concepts to explain natural phenomena and problem solving. The context and problem-based learning model affected the physics problems solving skills (Munfaridah et al., 2022; Yuberti et al., 2019). Studying the subject matter of physics means solving and discovering why and how phenomena occur. The introductory physics course was designed based on a problem-based approach that incorporated the use of everyday life examples and multiple representations. The inquiry collaborative tutorial-based blended learning model was effective in improving problem-solving skills (Haeruddin et al., 2020; Halim et al., 2021). Problem solving steps can be done by several steps; (1) focus the problem, (2) describe the physics, (3) plan the solution, (4) execute the solution, dan (5) evaluate the answer. Based on this description, the ability to solve physics problems can be trained through the application of appropriate problems solving strategies.

Problems solving abilities include a number of skills, including skills for finding, identifying, selecting, evaluating, organizing, considering various alternatives, and interpreting information. Problems solving studies according to those who are “experts and novices”. Expert problem solvers first try to understand a problem by considering physics laws and formulas, then try to solve it through mathematical methods. Novice problem solver try to understand a problem by considering physics laws and formulas, then try to solve it through mathematical methods (Haeruddin et al., 2020; M et al., 2017). The role of metacognition in the problem-solving process is inseparable from the students’ thinking process. These metacognitive strategies play an important role in planning the learning process, use of appropriate skills, and strategies for problem solving, in evaluating the process, and to conduct adequate self-assessments (Akben, 2020; Haeruddin et al., 2020). Problems solving can use various models, approaches, methods, and strategies. Learning with modelling Instruction is cantered on students' ability to construct physics concepts and be able to solve problems with the ideas they already have. With scaffolding, students are able to solve problems that exceed their ability. In principle, scaffolding means dividing the main problem into several sub-problems, each of which is easier to be solved (Atwina Aspiranti

Ndoa, 2022; Rokhmat et al., 2019). Previous study stated that problem solving can use Target Variable Strategy (TVS). It can translete the problem statement. TVS can be done through three stages, namely: (1) translating the problem of visual, (2) drawing the sketch, (3) finding the known-variable, so that the solution can be determined (Abdullah, 2018). The way of presentation of the problem (text, images, graphics, tables, etc.) affects the information used in solving problems and the steps followed (Eryilmaz Toksoy, 2022; Sartika et al., 2019). Problem solving is carried out in steps, namely: first, students visualize physics problems into visual representations, so that they can classify known variables to solve problems. Second, students change the visualization that was made in the first stage into a description. Third, students think of solutions to solve problems using mathematical calculations. Fourth, students solve problems using a solution design that has been made mathematically. In the last stage, students evaluate the results of problem solving obtained by checking the completeness of the answers, units, and scores (Fitriyani et al., 2019; Utomo et al., 2021). The problems solving strategies from various researchers that have been described, there are opportunities to apply multiple representations in solving physics problems.

The use of multiple representations in teaching a concept allows students to learn the concept in various ways. Multiple representation becomes an entity to explore the ability of students to uncover an understanding of concepts, mindsets, and their imaginative power towards problems faced through various perspectives (Dinçer, 2022; Kusumawati et al., 2020). Physics is a theoretical science, understanding the concepts requires actual visual representations and models. The procedure is designed to ensure students will conceptually reason about the problem first, using relevant scientific principles and laws, before jumping to selecting mathematical equations. It is possible that students' problem-solving strategies are influenced by problem representations (verbal, mathematical, graphical, etc.) (Candido et al., 2022; Park, 2020). The ability of multiple representations of students based on mathematical representations, verbal, pictures, and graphics respectively. Multiple representations enable science educators or teachers to display science concepts via verbal, pictorial, graphic, diagram, table, or mathematical equation simultaneously. Students need representation not only mathematical representation, but also verbal and visual (Abdurrahman et al., 2019; Kortemeyer, 2016; Vegisari et al., 2020).

Findings from physics education research show that the application of multiple representations is needed by teachers in learning such as pictures, diagrams, written explanations, and mathematical expressions to improve problem-solving skills. Visualization of the relevant physical quantities by providing multiple representations such as tables, strobe pictures, and diagrams (Hochberg et al., 2020; Lucas & Lewis, 2019). Multiple representations can use text, pictures, force diagrams, tables, and mathematical symbols or equations. Types of multiple representations in physics learning include graphs, tables, and other sorts of complex representations (Chang et al., 2021; Conceição et al., 2021). Multiple representations can use macroscopic representation, sub microscopic representation, and symbolic representation. These happen by delivering stimuli at the beginning of learning that do not display information in the form of tables, pictures, or graphs with contexts that are not routine, and in question exercises students tend to be mathematically verbal by directly applying formulas and calculations (Chusni et al., 2022; Syahri et al., 2021). The use of multiple representations is vital to study in the context of problem-solving so that they have guidance in understanding the problem and solving it better. The use of multiple representations is one of the important skills that is needed by students to succeed in learning physics (Murshed, 2020; Umrotul et al., 2022).

From what has been described, it is possible to simplify multiple representation-based problems solving strategies in physics learning. Based on the description of multiple representations in physics learning above, the novelty of this research is that physics problem solving strategies are simpler, practical, easy to remember, and easy to use. The research problems in this study were: (1) how to solve multiple representations-based problems solving strategies in learning physics which is simpler, practical and easy to use in solving physics problems, (2) how do respondents respond to the application of problems solving strategies. The study aimed to analyze multiple representation-based vifoca problem solving strategies in physics learning.

2. METHOD

This research was a preliminary study, which used a qualitative approach, literature study, and surveys with descriptive analysis techniques. Literature study was carried out through meta-analysis of articles from various sources such as national journals, Sinta accredited national journals, AIP Conferences, and articles from indexed international journals Scopus in the 2018-2022 range. These were obtained from google scholar and publish or perish, and searched with multiple representation keywords, and physics problem solving ability. Retrieval of research data was done by collecting articles that discuss the concept of solving physics problems and multiple representations in physics learning, which summarized research article data in the form of research themes, main analysis, and physics material, physics problems solving strategies, as well as the multiple representation models used, extracting the concept of solving physics problems, the concept of multiple representations in solving physics problems. The research sample was taken using a purposive sampling technique to obtain data or information in accordance with the research study. The sample taken from 22 articles on physics problem solving, and multiple representations. The distribution of 22 research subject articles in Table 1.

Table 1. Distribution of Problems Solving Articles

No	Researchers	Main Analysis	Approach/Strategy
1.	(Ince, 2018)	Literature Review	Experts and novices
2.	(Abdurrahman et al., 2019)	quasi-experiment	Sketching strategy
3.	(Yuberti et al., 2019)	quasi-experiment	Problem based
4.	(Sartika et al., 2019)	quasi-experiment	Target Variable Strategy (TVS)
5.	(Rokhmat et al., 2019)	quasi-experiment	Strategy Scaffolding
6.	(Herayanti et al., 2020)	R&D	Inquiry collaborative tutorial
7.	(Haeruddin et al., 2020)	R&D	Metacognition
8.	(Akben, 2020)	quasi-experiment	Problem Posing
9.	(Halim et al., 2021)	quasi-experiment	Problem base instruction
10.	(Eryilmaz Toksoy, 2022)	quasi-experiment	Presentation (text and graph)

The article data on problem solving would be extracted to formulate a new concept of a physics problem solving strategy. The concept of problems solving strategies would be combined with the concept of multiple representations as a basis for formulating new strategic concepts in solving physics problems. Multiple representation article data is presented in Table 2.

Table 2. Distribution of Multiple Representation Articles

No	Researchers	Main Analysis	Material	Representation Model
1.	(Kusumawati et al., 2020)	R&D/ pre-experiment	Motion	verbal, diagram, graphs, mathematics
2.	(Lucas & Lewis, 2019)	multimethod	motion & force	visual, verbal, & mathematical expression
3.	(Abdurrahman et al., 2019)	quasi-experiment	energy concepts and forms of energy	verbal & visual
4.	(Vegisari et al., 2020)	pre-experiment	mass and spring	verbal, image, mathematical, graphical
5.	(Hochberg et al., 2020)	quasi-experiment	pendulum motion	visual
6.	(Chusni et al., 2022)	pre-experiment	physical and chemical	macroscopic, sub-microscopic, and symbolic
7.	(Conceição et al., 2021)	lesson study	kinetic energy	visual
8.	(Chang et al., 2021)	Exploratory	torque and rotation	table, diagram, mathematics symbols
9.	(Syahri et al., 2021)	quasi-experiment	Hess' law	macroscopic, submicroscopic, and symbolic
10.	(Munfaridah et al., 2022)	quasi-experiment	thermodynamics	diagrams, pictures, equations, and verbal descriptions
11.	(Chusni et al., 2022)		natural science learning	verbal, image, physical, and mathematics
12.	(Liaw et al., 2022)	quasi-experiment	Kinematics	visual representation

The article data was analyzed using the following steps: (1) identifying the type of research and research variables that have been found, enter them into the appropriate variable column, (2) extracting the concepts needed in the research study, namely the concept of physics problem solving strategies and multiple concepts representation, (3) formulating a new concept of physics problem solving strategy based on multiple representations, (4) surveying the application of VIFOCA physics problem solving strategy. Respondents on a small scale as a sample were 83 respondents consisting of lecturers and students in the Mathematics Education study program, Faculty of Mathematics and Natural Sciences, Indraprasta PGRI University. The data collection instrument used a questionnaire consisting of 7 statements using the Likert scale as presented in **Table 3**, which was distributed via google form to find out the response to the application of the VIFOCA problem-solving strategy in learning physics, after being applied in learning physics.

Table 3. VIFOCA Strategy Implementation Response Questionnaire

No.	Statements	Likert Scale				
		5	4	3	2	1
1.	Can be used for steps in solving physics problems					
2.	Easy to be applied					
3.	Practicality					
4.	Systematic work steps					
5.	Application to multiple choice questions					
6.	Application to essay questions					
7.	Application to questions with easy, medium, and difficult categories					

3. RESULT AND DISCUSSION

Result

Literature review of physics problem solving strategies can be simplified based on multiple representation theory. Physics problem solving can be done through representation in various forms, such as visual, verbal, and mathematical. The VIFOCA strategy is a physics problem solving strategy consisting of work steps, stages to be used in answering physics questions, especially for calculating physics questions. VIFOCA is an abbreviation of the words Visualizations, Formulation, and Calculation. This strategy simplifies the processes, procedures, and steps in solving existing physics problems, and makes it easy to remember and use. The VIFOCA strategy consists of 3 (three) main steps, namely Visualization (describing), Formulation (formulating), and Calculation (counting), as shown in the following Figure 1.

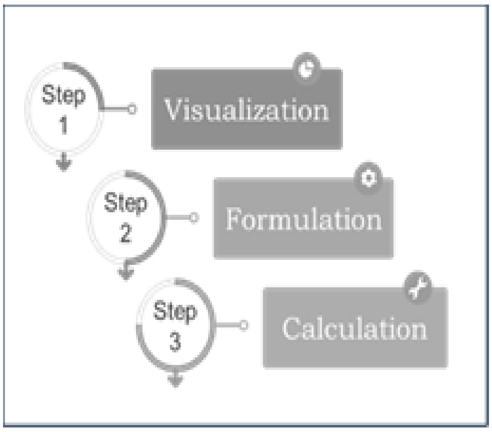

Figure 1. VIFOCA Problem Solving Strategy Steps

The VIFOCA strategy is used to solve physics problems, with work steps or problems solving stages. The use of this strategy is carried out sequentially based on work steps or stages. In the first stage, namely visualization (describing), where students are able to describe the situation of physics questions, what is known and asked, describe information, data, and facts of physical quantities related to the problem. The second stage is formulation, where students are able to connect the problems in the problem with theories, principles, related physical laws to be able to solve the problem. Able to describe physics formulas based on related concepts. The third stage is calculation, at this stage, students apply mathematical skills as a basis for calculations and final solutions to find answers. The following flowchart is show in Figure 2 for using the VIFOCA strategy in solving physics problems.

Based on the flowchart, the procedure for using the VIFOCA strategy is: starting from (a) problems in physics questions, (b) describing, identifying information, data, facts contained in the questions equipped with pictures, illustrations, shaping, tables, graphs, analogies, (c) find concepts, and apply formulas, as well as formula formulations into a mathematical equation, (d) perform calculations based on procedural steps. The procedure for solving physics problems with the VIFOCA strategy can be seen in the following Table 4.

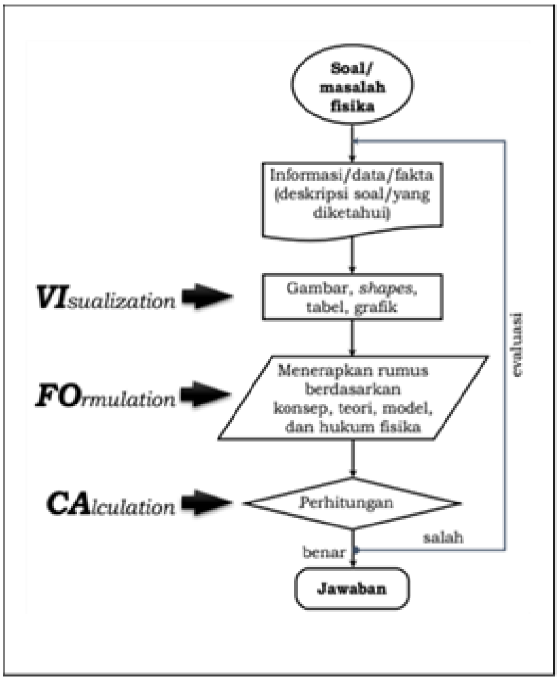

Figure 2. VIFOCA Strategy Usage Procedure Flowchart

Table 4. Description of VIFOCA Strategy Implementation Procedures

No.	level/step	Description	Output
1.	Visualization	Identify, and write down, the known physical quantities, complete with tables, pictures, illustrations, and analogies, then describe the questions.	Information, data and facts, illustrations, shaping, tables, graphs, and analogies.
2.	Formulation	Apply formulas, algebra, based on concepts, models, theories, and physical laws that are appropriate to the context of the question, then formulate the formula into an equation.	Formulas and formulations, as well as equations or combinations of formulas.
3.	Calculation	Enter the value of the physical quantity based on the equation formed, then do the calculations, the necessary mathematical operations.	Counting process, algebra, final result.

Based on Table 4, if the calculation results are correct, and the correct answer will be obtained. However, if the results of the calculations are inaccurate or wrong, then the evaluation is carried out, then re-checking starting from the identification stage of data, facts and information related to physical quantities. Then, the unit conversion system, as well as the conceptual approach used to the formulation of equations, the calculation process, until obtained correct result. The VIFOCA strategy has been implemented in learning and conducted a limited survey of 6 lecturers and 76 students, bringing a total of 82 respondents. Specifically, the survey results are based on statements of attitudes that strongly agree to strongly disagree are as follows. The VIFOCA strategy can be used for solving physics problems, with survey results as in the following **Table 5**.

Table 5. VIFOCA Strategy Implementation Survey Results

No	Statement	Scale				
		5	4	3	2	1
1.	Can be used for steps to solving physics problems	35.4%	42.7%	13.4%	4.9%	3.7%
2.	Easy to applied	37.8%	42.7%	11.0%	2.4%	6.1%
3.	Practicality	34.1%	37.8%	18.3%	3.7%	6.1%
4.	Systematic work steps	32.9%	43.9%	14.6%	2.4%	6.1%

No	Statement	Scale				
		5	4	3	2	1
5.	Application to multiple choice questions	24.4%	48.8%	15.9%	6.1%	4.9%
6.	Application to essay questions	40.2%	32.9%	20.7%	3.7%	2.4%
7.	Application to questions with easy, medium, and difficult categories	35.4%	45.1%	9.8%	4.9%	4.9%

Table 5 shows that there are 3 (3.7%) respondents who strongly disagree, 4 (4.9%) disagree, as many as 11 (13.4%) express doubt, and as many as 35 (42.7%) stated that they agree, and as many as 29 (35.4%) respondents stated that they strongly agree. The VIFOCA strategy consists of 3 (three) work steps, namely first visualization (describing), second formulation (formulating), and third calculation (counting). However, there were still 18 respondents who disagree and doubted, so the VIFOCA strategy made it possible to make improvements or refinements. The distribution of data in shows that there were 5 (6.1%) respondents who strongly disagreed, 2 (2.4%) disagreed, 9 (11%) expressed doubt, and 35 (42.7%) stated that they agreed, and as many as 31 (37.8%) respondents stated that they strongly agree. Based on the results of this limited survey, it can be said that the VIFOCA strategy can facilitate solving physics problems. However, the VIFOCA strategy will be continued to be improved and perfected. It is from the survey, there are still respondents who give an attitude of disapproval and doubt. The distribution of the data shows that 5 (6.1%) respondents stated that they strongly disagreed, 3 (3.7%) stated that they did not agree, 15 (18.3%) expressed doubt, and 31 (37.8) %) stated that they agree, and as many as 28 (34.1%) respondents stated that they strongly agreed. The VIFOCA strategy consists of 3 (three) work steps that are practically used, namely first visualization (describing), second formulation (formulating), and third calculation (counting). However, there were still 23 respondents who disagreed and doubted that the VIFOCA strategy could be corrected or perfected. The distribution of the data in the table above shows that 5 (6.1%) respondents stated that they strongly disagreed, 2 (2.4%) stated that they did not agree, 12 (14.6%) expressed doubt, and 36 (43.9%)) stated that they agreed, and as many as 27 (32.9%) respondents stated that they strongly agreed. The VIFOCA strategy consists of 3 (three) work steps, namely first visualization (describing), second formulation (formulating), and third calculation (counting). The steps for solving the problem are carried out sequentially or systematically. However, there were still 19 respondents who disagreed and doubted that the VIFOCA strategy could be corrected or perfected.

There are 4 (4.9%) respondents who strongly disagreed, 5 (6.1%) disagree, 13 (15.9%) say they are doubtful, and 40 (48.8%) agreed, and as many as 20 (24.4%) respondents stated that they strongly agreed. The VIFOCA strategy can be used to solve physics problems in multiple choice questions. However, there were still 22 respondents who disagreed and doubted, so the VIFOCA strategy made it possible to make improvements or refinements. There were 2 (2.4%) respondents who strongly disagreed, 3 (3.7%) disagreed, 17 (20.79%) expressed doubt, and 27 (32.9%) stated that they agreed, and as many as 33 (40.2%) respondents stated that they strongly agreed. The VIFOCA strategy can be used to solve physics problems in essay or essay questions. However, there were still 22 respondents who disagreed and doubted, so the VIFOCA strategy made it possible to make improvements or refinements. The distribution of the data in the table above shows that there were 4 (4.9%) respondents who strongly disagreed, 4 (4.9%) disagreed, 8 (9.8%) expressed doubt, and 37 (45.1%)) stated that they agreed, and as many as 29 (35.4%) respondents stated that they strongly agreed. The VIFOCA strategy consists of 3 (three) work steps of visualization (describing), formulation (formulating), and calculation (counting) which can be applied to physics questions with varying levels of difficulty ranging from easy, medium to difficult categories. However, there were still 16 respondents who disagreed and doubted, so the VIFOCA strategy could be corrected or perfected.

The survey findings described above can be used as a consideration and reference for conducting further studies. It is necessary to repair and refine the VIFOCA strategy prototype so that it becomes an effective and efficient strategy that can be used in the process of solving physics problems. The work steps in the VIFOCA strategy need to be tested and more comprehensively analyzed for each work step in the VIFOCA strategy both in the visualization, formulation, and calculation steps, validation tests and field testing in a broader scope, so as not to rule out prototypes. VIFOCA strategy can be refined or additional work steps. Solving physics problems usually starts with understanding the problem or problem situation described in terms of known physical variables or quantities, information, data and facts in the problem, what is being asked, and using what concepts, models, theories, and physical laws to apply. used to solve the problem. For lay students, the obstacle they face is understanding the context of the problem. If they experience problems in reading the situation or context of the problem, then they will have difficulty solving or solving the problem. Therefore, we need a way that can be easily understood and applied by novice students in solving problems or answering physics questions. By understanding the characteristics, patterns, models of physics problems that often arise, it is possible to create or develop a physics problem solving model that can be applied to answer and solve physics questions with strategies that are easy to remember and practical to use.

Discussion

The VIFOCA strategy uses easy and simple work steps including visualization (describing), formulation (formulating), and calculation (counting). Previous study concluded that students' success in solving physics problems was influenced by the format of the representation of the problems (Kohl & Finkelstein, 2007). Representations can be done, among others, verbal, pictures, graphics and mathematics. The importance of using visualizations in physics has been researched extensivelyThe ability to switch between various representations is an invaluable problem-solving skill in physics (Bollen et al., 2017; Prain & Waldrip, 2006). The abtsrak phenomenon that is a problem in physics can be visualized in order to obtain a solution to the problem. Visualization of a phenomenon can eliminate the abstract nature of a physical phenomenon. Thus the problem on the phenomenon will become easier to solve. The role of visual representation helps students in generating students' memory as obtained from prior knowledge, as reported by Cock, that learners have a limited working memory, and instructional representations should be designed with the goal of reducing unnecessary cognitive load (Poluakan & Runtuwene, 2018; Suyatna et al., 2017). Based on this description, physics visualization is a cognitive process in physics problems solving.

VIFOCA's physics problem solving strategy aligned with that the steps of solving physics problems go through 5 stages (Heller et al., 1992). First,visualize the problem, namely visualizing the problem into a descriptive visual representation, identifying variables and basic concepts. Second, describe the problem in physics description, namely changing the visual representation into a physical description by making a diagram of the coordinate system. In the VIFOCA method, the first stage to the second stage is a work step visualization. Third phase, plan the solution by plotting a representative mathematical solution. In the VIFOCA method, this stage is a work stepformulation (Hong et al., 2012; Wicaksono et al., 2017). The fourth stage are executing the plan, and performing mathematical operations. In the VIFOCA method, the fourth stage is a work step calculation. While the fifth stage from Heller, et al, is checking and eveluating the solutions obtained by checking the completeness of the answers, signs, units and values. In the VIFOCA method, there is not a clear re-check or evaluation step, only the implementation procedure emphasizes. It is if the answer from the calculation results is incorrect, then return to the work step visualization (Abdullah, 2018; Wang et al., 2021).

The VIFOCA strategy can be applied as a strategy in solving physics problems and can be the potential of multiple representation-based instruction in physics courses. Students so far have been familiar with the steps "know", "ask", and "answer", in solving physics problems. However, this step is not a strategy for solving physics problems. It is proven that when students are faced with new problems in physics problems, many students cannot solve physics problems by simply writing "known", "asked", and "answered" (Kohl & Finkelstein, 2007; Munfaridah et al., 2022). The VIFOCA strategy is a work step in representing a problem contained in a physics problem, in visual, verbal, and mathematical forms. The VIFOCA strategy has simple and easy-to-remember work steps, that is describing problem situations, where students' express knowledge in understanding phenomena or problems contained in physics problems, multiple representations and through semiotic choices within these representations to explain the science concept (Abdurrahman et al., 2019; Nielsen et al., 2022). Using multiple representations to display science concepts will make them more comprehensible. Visual representations can be in the form of pictures, graphs, or tables according to or represent the problem situation contained in the problem. Verbal representations can be in the form of formulas, formulas or equations that are in accordance with the applied concepts, theories, physical laws. Mathematical representation is an expression that is poured in a mathematical operation, the calculation steps needed to obtain a result or answer. The success of students in solving physics problems is by building representations and how to use these representations. The results of the study state that student's learning outcomes are better after applying multiple representations compared to students' learning outcomes before applying multiple representations. Using multiple representation strategies can enhance the transformation of multiple representations during learning and problem solving and understanding of content knowledge (Murshed, 2020; Toding et al., 2019).

The VIFOCA strategy can be applied by students who have prior knowledge and sufficient basic concepts. The research findings showed that animated representation was found to be critical to the prediction of student conceptual change (Liaw et al., 2022). This is an interesting subject for discussion, can the VIFOCA strategy be applied to all levels of questions? The survey results show that the VIFOCA strategy can be applied at the easy medium, and difficult question levels. Understanding of concepts, theories, laws of physics is important in solving physics problems. The application of the VIFOCA strategy can be said to be a continuation of their way of answering physics questions, namely "knowing", "asking", and "answering", so that students are not confused when dealing with new and different questions. Therefore the steps are continued by describing, formulating, and counting. Application of the VIFOCA strategy as a work step guides them in solving physics problems. However, these results show that the VIFOCA strategy can be applied to all levels of quantitative questions," can the VIFOCA strategy be applied to qualitative questions?" This is also an interesting subject for discussion. The calculation step in the VIFOCA strategy can also be interpreted as a consideration step, estimating towards solving or solving a problem.

4. CONCLUSION

The VIFOCA strategy is a simplifying strategy of various physics problem solving strategies through three stages or work steps, namely visualization (describing), formulation (formulating), and calculation (caunting). The VIFOCA strategy is intended for entry-level students who have basic knowledge or low initial concepts of physics, which aims at helping them easier to solve problems, easy to remember and easy to be applied. Application of the VIFOCA strategy in learning physics is to facilitate students in learning physics problem solving. The VIFOCA strategy with simple and practical work steps helps students to express knowledge in the form of visual, verbal and mathematical representations. The VIFOCA strategy can be applied in several type and level of questions. It directs technically the work steps to be carried out in order to solve problems easily until the students find the right answer. However, it still has deficiencies, and must be refined through more comprehensive follow-up studies. The VIFOCA strategy is suggested to be implemented in physics learning with guidance, direction and control from the lecturer. The conditions that can support the successful implementation of the VIFOCA strategy are understanding the concepts of quantities and units (physical quantity) includes unit conversions, as well as procedural skills.

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