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IMPLEMENTATION OF THE GUIDED INQUIRY MODEL LEARNING TO REDUCE MISCONCEPTIONS OF STATIC FLUID MATERIALS STUDENTS OF STATE JUNIOR HIGH SCHOOL 19 SAMARINDA SEMESTER II, 2019/2020 ACADEMIC YEAR

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Abstract

This classroom action research (CAR) aimed to describe teacher performance in implementing laboratory-based guided inquiry with the main target of reducing the number of students' misconceptions about static fluid material. Three indicators of the success of the action, namely: (1) the implementation and quality of static fluid learning using guided inquiry, (2) changes in student activity and motivation shown from cycle to the next cycle, and (3) a decrease in the number of target students experiencing fluid misconceptions (MK). Implementation, learning quality, and student activity were collected using observation and documentation techniques. The number of MK students was determined based on the results of the conception test on static fluid material before and after the action. CAR was conducted at SMP Negeri 19 Samarinda with the source of teacher observations, the learning process in class, and students of class VIII-A. The data were analyzed descriptively. Reflection and evaluation of data is the final step in the action research process. The results of this CAR show that the three indicators for the success of the action have been achieved. Static fluid learning using laboratory-based guided inquiry can be carried out with very good qualifications. Increased activity and motivation showed by students during the learning process from cycle to cycle. The number of target students who experience liquid fluid misconceptions has decreased from cycle to cycle.

Keywords: Guided inquiry, Misconceptions

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INTRODUCTION

One of the topics in science learning in junior high school is static fluid. In this topic, there are several concepts that must be mastered by students correctly, students do not have misconceptions. Misconception is a wrong idea or view about a concept that someone has; different from the concept agreed upon and considered correct by the experts (Ibrahim, 2012). Mastery of the correct concept can help students in solving a problem, because with the mastery of the correct concept can precisely know the concept that is suitable for use in problem solving. Facts in the field, it turns out that students still find misconceptions about static fluid material (Puspita et al., 2009). Another fact is that one of the physics concepts that is weakly mastered by students is the concept of static fluid. Many basic concepts of static fluid are not mastered well by students (Goszewski, Moyer, Bazan, & Wagner, 2013). The misconceptions of static fluid that are often experienced by students are errors in determining hydrostatic pressure, determining the weight of objects in the fluid, and not connecting the weight of displaced water with buoyancy (Zulkhruf, Khaldun, & Ilyas, 2016).

above facts also occur to students at SMP Negeri 19 Samarinda. This fact is based on the experience gained by the researcher during 11 years as a science teacher at this school. Fluid misconceptions almost occur in grade VIII students at this school from year to year. The same case is feared to also happen to class VIII students in the 2019/2020 school year, especially class VIIIA. Class VIIIA was given special attention because it was noted that students in this class (1) had a low level of activeness and learning motivation and (2) it was suspected that the number of students with misconceptions about science concepts was the most in this class (empirical experience). After conducting a diagnostic test of static fluid misconceptions (using the Certainty of Response Index, CRI method) it was found that a large number of classes VIIIA students had misconceptions about the concept of static fluid. A large number of students experience misconceptions on the material Hydrostatic Pressure and Archimedes' Principle. The proportion of conception status of students who know the concept (TK), do not know the concept (TTK), and misconceptions (MK) is 23% : 25% : 52%). The number of MK students is more than double the number of TK students. This fact is a signal that there is a problem in class VIIIA that requires serious handling by researchers as science teachers.

Researchers have a responsibility to change students' misconceptions into knowing concepts. Barke et al. (2009) reminded that in the practice of learning teachers should not assume that misconceptions will just disappear. The most proper action to correct students' misconceptions in the field of science is scientific inquiry (laboratory-based inquiry). Students with misconceptions can be classified into individuals who need guidance, therefore the planned action in correcting misconceptions is the implementation of guided inquiry. The selection of the implementation of laboratory-based guided inquiry as the chosen action is based on a framework of thought (theoretical framework) as follows.

Misconceptions relate to how students acquire concepts (Haris, 2012). Teaching methods are one of the factors that cause misconceptions in students (Suparno, 2013). Misconceptions can occur because the learning method used by the teacher has not involved students in observing activities (Al-Kassami, Tomo, & Erwina, 2013). Learning that tends to be teacher centered such as lectures also causes a static fluid misconception because students are less actively involved in the learning process (Anggraini, Sahala, & Arsyid, 2013). Based on these two statements, the researcher chooses a learning method or model that creates student centered learning as an action to correct students' misconceptions on static fluid material. Guided inquiry learning model (guided inquiry) is a learning model that emphasizes the concept discovery process and the relationship between concepts. In this model, students are involved in designing experimental procedures and doing them in the laboratory. Students play a more dominant role, while the teacher guides students in the right direction. The guided inquiry model can increase students' learning motivation because students find learning concepts for themselves through direct experience (Sukma; Komariyah; & Syam, 2016). Furthermore, Barthlow (2011) recommends that students' misconceptions can be replaced with true concepts with an inquiry learning model. The syntax of the inquiry learning model guides students to construct concepts starting with posing problems, searching for information (from various related libraries), designing experiments to test the conjectures made, conducting experiments, collecting data, organizing data, analyzing data, and making conclusions and abstracting conclusions made into concepts that are accommodated in his brain. Suyono (2015) states that inquiry-based science learning will make students understand the concepts, principles, laws, and theories in science that are full of meaning and are accommodated correctly and strongly in their brain schemes. The theoretical study above is in line with the results of previous studies which reported that the inquiry learning model or strategy can overcome students' misconceptions (Barthlow, 2011; Awan, & Ali, 2013; Yunianingsih & Suyono, 2013)

Based on the literature review, guided scientific inquiry (laboratory-based inquiry) is the right choice to correct the misconceptions of class VIIIA students on static fluid material. Class action in the form of the implementation of guided inquiry learning (laboratory-based) theoretically can increase student learning activity and motivation and involve students in the process of observing in order to build concepts. Class action in the form of the implementation of guided inquiry learning is predicted to reduce the number of students with misconceptions in class VIIIA on static fluid material.

METHOD

The method section requires the author to describe in detail how the research has been carried out. The components in the method section include research design, research objectives, collection techniques, and data analysis techniques.

Research design

This research was a Classroom Action Research, which is a qualitative research method that encourages teachers to be reflective in teaching practice in order to improve learning practices in the classroom through action (McNiff, 2013). The action variable (treatment) in this CAR is the implementation of laboratory-based guided inquiry and the dependent variable used as an indicator of success is the reduction in the number of students' misconceptions on static fluid material.

Research target

data collection and research were conducted in Junior High School 1 9 Samarinda. All students of class VIII A SMP Negeri 19 Samarinda numbered 35 participants consisting of 24 female students and 11 male students.

Data collection technique

Two main techniques of data collection, namely observation and tests. The implementation of the observation technique was assisted by a learning observation sheet (accompanied by a rubric) which was used to obtain data on the learning process. The test technique is intended to determine the status of students' conceptions before and after the action. The diagnostic test for students' misconceptions on static fluid material was prepared by researchers accompanied by a Certainty of Response Index (CRI). CRI which developed by Hasan et al. (1999) is a measure of the level of confidence / certainty of respondents in answering each question (question) given.

Technique data analysis

CAR data is sourced from the process of implementing the action and the impact of the action. Research data from both process and product dimensions were analyzed descriptively. Three indicators of the success of the action, namely: (1) the implementation and quality of the implementation of static fluid learning using guided inquiry, (2) changes in student activity and motivation shown from cycle to cycle, and (3) a decrease in the number of target students experiencing static fluid misconceptions from cycle to cycle. cycle to cycle.

RESULTS AND DISCUSSION

1. Analysis of Students' Initial Conceptions for Determining *Worksheet Content*

Students still find misconceptions about static fluid material (Puspita; Sutopo; and Yuliati, 2029). Many basic concepts of static fluid are not mastered well by students (Goszewski, Moyer, Bazan, & Wagner, 2013). The misconceptions of static fluid that are often experienced by students include errors in determining hydrostatic pressure, determining the weight of objects in a fluid, and determining buoyancy (Zulkhruf, Khaldun, & Ilyas, 2016). The same fact also happened to class VIIIA students of SMP Negeri 19 Samarinda. After conducting a diagnostic test of students' conceptions as an initial test of students' conceptual understanding on the concept of static fluid, it was found evidence that a large number of classes VIIIA students had misconceptions about the concept of static fluid. The proportions of TK, TTK, and MK students are presented in Figure 1.

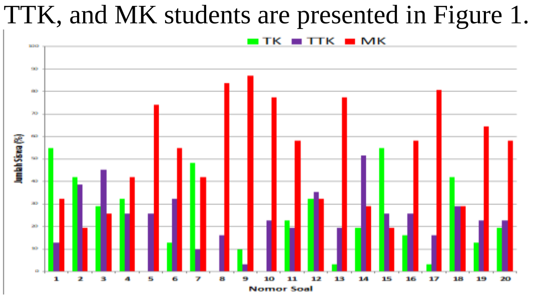

Figure 1. Percentage of TK, TTK, and MK Students on 20 Static Fluid Problems

The proportion of MK students (students experiencing misconceptions) is much higher than the proportion of students who know the concept (TK). Conditions like this should not be allowed. Researchers who are teachers in class VIIIA have a responsibility to address this problem. Problems like this should be handled according to the recommendations of educational experts including

Barke et al. (2009) who reminded that in practice the teacher should not assume that misconceptions will just disappear. The researcher who is also a science teacher at SMP Negeri 19 Samarinda, seeks to choose learning actions to correct the problem of static fluid misconceptions in students, especially students of class VIIIA. The researcher chose laboratory-based guided inquiry to reduce the chances of students having static fluid misconceptions. This selection of lab-based guided inquiry refers to various propositions that lead researchers to this choice. Providing guarantees for the implementation and quality of learning actions, researchers have designed a lesson plan that was developed based on the guided inquiry learning model and implemented it with high sincerity. To support the quality of the implementation of learning actions both from the teacher's and students' perspective, the researcher has also developed a *worksheet*. This *worksheet* contains instructions and a list of activities according to the stages of laboratory-based guided inquiry. The concept chosen to be the priority content in the *worksheet* is the concept that causes a large number of students to experience MK.

The results of determining priority concepts on static fluid materials are presented in Figure 2. The concept is stated to cause a large number of students to have misconceptions if they have a CRIS value > 2.5 and a fb value < 0.5 (Hasan et al., 1999). All items identified showed misconceptions with high intensity in almost all numbers, which showed problematic concept areas, except for numbers 1 and 15.

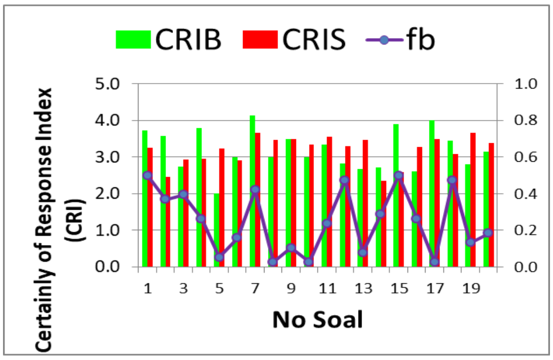

Figure 2. Comparison of the Average CRIB and CRIS with the Correct Fraction on the Concept Understanding Test Before Learning with Inquiry

Questions 2, 4, 8, 10 were evaluated to detect students' conceptions with the indicator "Analyzing hydrostatic pressure at certain points." The data in Figure 2 is evidence that a large number of students of SMP Negeri 19 Samarinda have experienced MK on the concept of hydrostatic pressure. Many MK students use this concept because students do not make a relationship between hydrostatic pressure and its depth position in the fluid, but instead relate it to irrelevant factors such as the size and area of the bottom of the vessel. Another wrong preconception of students revealed from students' responses to questions 12 to 18 is that students do not have a good understanding of buoyancy. Student responses to questions number 19 and 20 reveal students' preconceptions that mass and weight of objects are the only factors that cause objects to sink/float in a fluid. Based on the results of this analysis, two static fluid concepts are defined as content in the worksheet, namely the concept of hydrostatic pressure and the concept of buoyancy.

2. Syntax Implementation and Quality of Inquiry Learning Model

Cycle I learning actions were carried out in 2 meetings, Tuesday, January 15, 2020, with an allocation of 3 × 35 minutes for hydrostatic pressure material, 10:00-11:45 and Thursday, January 17, 2020, for the post test with an allocation of 2 × 35 minutes at 10:00-1110 (2 hours of lessons). Based on the results of the reflection of the first cycle, the researcher decided to do the second cycle. The action of learning cycle II was carried out in three meetings. The first and second meetings were for delivering material and conducting experiments on buoyancy. The third meeting is to conduct the posttest at the end of the second cycle. The first meeting, January 22, 2020, with an allocation of 3 × 35 minutes, the second meeting was held on January 24, 2020, with an allocation of 2 × 35 minutes. Based on the results of the second cycle of reflection, the researcher decided to conduct the third cycle to correct the deficiencies in the second cycle. The action of learning cycle III was carried out in one meeting (3 × 35 minutes) on Tuesday, January 28, 2020. This meeting consists of delivering material and conducting experiments on the factors that affect the state of objects in a fluid, whether they float, float, or sink. Data on the implementation and quality of lab-based guided inquiry learning actions in the three cycles given by two observers are presented in Table 1.

Table 1. Assessment of Implementation and Quality of Learning Actions

No	Aspects observed/assessed	CYCLE I		CYCLE II		CYCLE III	
		Average	**Category**	**Average**	**Category**	**Average**	**Category**
I	**A. Introduction** 1. Linking learning with prior knowledge 2. Motivate students 3. Delivering learning objectives 4. Divide into study groups	4.5	Very Well	4.56	Very Well	4.5	Very Well
	B. Core activities 1. Orient students to the problem 2. Guiding hypotheses 3. Designing experiments/ working on *worksheets* 4. Doing an experiment 5. Analyze data	4.1	Well	3.5	Well	4.1	Well
	C. Closing Guiding students to conclude learning	4	Well	4	Well	4	Well
II	**Time Management**	3	Enough	3	Enough	3	Enough
III	**Enthusiasm** 1. Enthusiastic students 2. Enthusiastic teacher	4.25	Well	4.25	Well	4.25	Well

If you pay attention to the data in Table 1, it can be given an analysis that: (1) the implementation of guided inquiry learning has been conducted and has been assessed with good and very good mode, (2) Time management has received adequate assessment from observers. Thus, it can be interpreted that in general the implementation of learning goes according to the learning scenario in the lesson plan and learning goes well.

Preliminary activities in cycle I received a very good assessment. This quality is maintained when carrying out learning actions in cycle II and cycle III. The other learning stages that received good ratings each needed to be improved in quality. Time management which is still getting sufficient assessment needs attention to be improved in the implementation of actions in cycles II and III. The time management that still needs improvement is also felt by the learning teacher. This seems very likely to happen because the lab-based inquiry stage requires quite a bit of time. The action of laboratory-based guided inquiry learning is proven to be carried out with good qualifications. The first CAR success indicator has been achieved.

3. Results of Observation of Student Activities and Motivation

Activities and signs of the emergence of student motivation were observed and recorded both by the research teacher and by two observers from fellow teachers. Inquiry learning generally creates a situation that represents the occurrence of high student activity and motivation. High student activity correlates with the need for study time. This is in line with the observations of the observer on time management which is considered to be of sufficient quality. A lot of time is needed to provide opportunities for students to discuss with the teacher. Including the need for time to pay attention to student activities in designing experiments which was also considered sufficient by one of the two observers.

The students' motivation to discuss with the teacher is very high, especially related to the experimental data obtained. Unfortunately, the high motivation of students cannot be matched by the availability of sufficient time. Students do not have more opportunities to discuss learning about experimental data with the teacher. The negative impact of this condition is that students talk with classmates about data and conclusions, not with the teacher and sometimes they become disoriented. Classes are scheduled for 3 lesson hours or one hour and 15 minutes, but in the implementation of the first cycle of action it took an hour and 30 minutes to complete all stages of this inquiry-based learning activity. This time does not include an additional 15 minutes to introduce how the tool works and time for students to explore it under various conditions. In 50 minutes, it is impossible to complete the experiment and discuss.

Researchers as science teachers with 11 years of work experience are well aware that lack of time in the implementation of inquiry learning is something that is very natural. Student activities in lab activities aside from being positive are often accompanied by the emergence of deviant activities such as talking to friends outside of the learning topic. Deviant activities like this while not interfering with the main activity can still be tolerated. Analysis of student activity and motivation was also carried out by researchers from the source of the learning videos made. The results of the video analysis concluded that in general students made progress over time in collaborative work and scientific work. Collaboration and scientific work can be used as a representation of student activity and motivation. The action of laboratory-based guided inquiry learning on static fluid material from the first, second, and third cycles is able to condition students to play a more active role in learning so as to generate motivation to learn. The second CAR success indicator has been achieved. Increased student activity has the opportunity to improve students' misconceptions. This is in accordance with the opinion of Anggraini, Sahala, & Arsyid (2013) which states that the cause of the static fluid misconception is that students are less actively involved in the learning process.

4. Decrease in the Number of Students with Misconceptions

The proportions of TK, TTK, and MK students in each pre-cycle and cycle are presented in Figure 3 to Figure 6. The conception before action and the conception of each cycle are deliberately side by side for the sake of evaluation/reflection. The number of MK students is twice the number of TK students. As many as 78% of class VIIIA students are in the TTK and MK categories. An alarming situation (Figure 3).

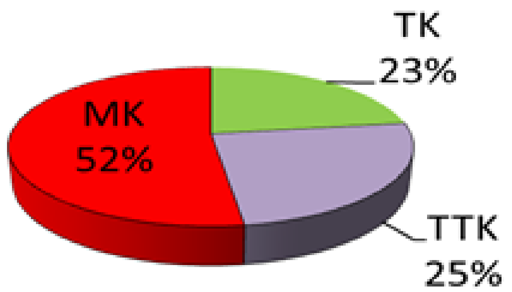

Figure 3. Proportion of Class VIIIA TK, TTK, and MK Students on the Concept of Static Fluids before Cycle I Action

Figure 4 shows an improvement in students' conceptions before and after being given learning actions using guided inquiry. This is a sign of progress in student learning achievement in class VIIIA, although it is not optimal because the shift in students' conceptions has not been from MK status to TK, it is still shifting to TTK status.

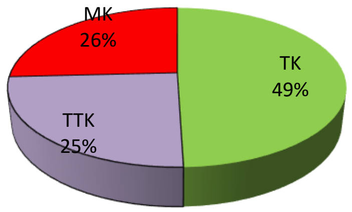

Figure 4. Proportion of Class VIIIA with TK, TTK, and MK Students on the Concept of Static Fluids After Cycle I

The act of guided inquiry learning has a positive impact on efforts to reduce the number of students with misconceptions. The portion of class VIIIA students who have concept knowledge status is more than twice the students with misconceptions at the end of the second cycle of learning (Figure 5).

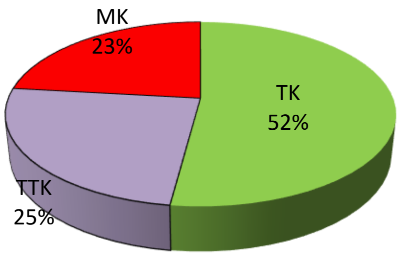

Figure 5. Proportion of TK, TTK, and MK students on the concept of buoyancy (cycle II)

The act of guided inquiry learning that received good and very good ratings had a very good impact on understanding the concepts of sinking, floating, and floating in class VIIIA students. The percentage of students who know the concept (TK) is greater than the status of other conceptions, TTK and MK on all the questions about the concepts of sinking, floating, and floating that are tested (Figure 6).

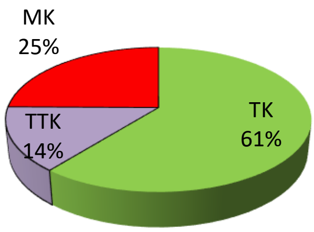

Figure 6. Proportion of TK, TTK, and MK Students on the concept of sinking, floating, and floating (cycle III)

The action of lab-based guided inquiry learning is proven to be able to reduce the number of MK students on static fluid material. The third CAR success indicator has been achieved. The action of laboratory-based guided inquiry learning on static fluid material has a positive impact which is marked by a reduction in the number of students with static fluid misconceptions from cycle to cycle. This fact is following various opinions expressed by experts as follows. Guided inquiry learning model (guided inquiry) is a learning model that emphasizes the concept discovery process and the relationship between concepts. In this model, students participate in designing experimental procedures and doing them in the laboratory. Students play a more dominant role, while the teacher guides students in the right direction. The guided inquiry model can increase students' learning motivation because students find learning concepts for themselves through direct experience (Sukma; Komariyah; & Syam, 2016). Furthermore, Barthlow (2011) recommends that students' misconceptions can be replaced with true concepts with an inquiry learning model. The syntax of the inquiry learning model guides students to construct concepts starting with posing problems, searching for information (from various related libraries), designing experiments to test the conjectures made, conducting experiments, collecting data, organizing data, analyzing data, and making conclusions and abstracting conclusions made into concepts that are accommodated in his brain. Suyono (2015) states that inquiry-based science learning will make students understand the concepts, principles, laws, and theories in science that are full of meaning and are accommodated correctly and strongly in their brain schemes.

5. Other Findings from CAR Class

Researchers also have some field notes during learning in the CAR class. Researchers have used these notes to make improvements in the next cycle. Some notes based on the researcher's observations in cycle I include:

a. Students find it difficult to prepare a well-designed experiment. Students design experiments that are not aligned with the research question, test hypotheses by manipulating variables that have no relationship to the research question or hypothesis, cannot convert abstract or theoretical variables into measurable or observable variables or students fail to identify variables that can be manipulated and observed in research questions or hypotheses.
b. Students who usually have a lower understanding of science show undirected trial and error behavior in inquiry learning than students who are more knowledgeable and therefore need more frequent teacher guidance.
c. It is still found that the contents on the worksheets are wrong, especially in the formulation of problems and hypotheses, the information obtained is mostly only formulating questions, not yet in the category of good problem formulation, this happens because students are not at all accustomed to formulating problems to be investigated.
d. Students still need special guidance in completing worksheets, this is because students do not understand the framework and objectives and do not have basic operational concepts related to the logic of discovering a physics concept. They only measure, analyze according to the teacher's instructions/directions but to find concepts from the experimental results, they are not used/trained or have never been.
e. When conducting experiments there were still some students who were less active. The number of tools used is limited, so researchers have to make large groups so that the responsibility for completing the task together becomes uneven.

Some notes based on the researcher's observations in cycle II and cycle III include:

a. Students still need special guidance in completing the worksheet. Students are still difficult to formulate the concept that is being built even though students already have experimental data. Teachers still must provide guidance on how to define concepts based on the data they have.
b. In the second and third cycles of learning, the discussion phase which should be in the final phase, is often present in all other phases during inquiry-based learning, occurring at any time during the learning. The reason researchers often discuss is that in all phases of learning, some students show passivity, especially students with low self-study and self-management skills. Without discussion, teacher initiation, student response, and feedback from the teacher-it will be exceedingly difficult to push students to the next phase.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Three indicators of the success of the action have been achieved. Static fluid learning using laboratory-based guided inquiry can be carried out with very good qualifications. Increased activity and motivation shown by students during the learning process from cycle to cycle. The number of target students who experience liquid fluid misconceptions has decreased from cycle to cycle.

Based on the evidence of the achievement of the three indicators of success of the above actions, it can be concluded that the implementation of laboratory-based guided inquiry is the right choice to reduce the number of students' misconceptions in class VIIIA on static fluid material. The action hypothesis has been tested and found to be scientifically acceptable.

Suggestion

The CAR conducted by the research teacher assisted by his teacher colleagues has been declared successful. Based on the results of this CAR, the following suggestions are proposed:

a. Actions to reduce the burden of misconceptions on students have been formulated. This formulation can be used as an option for efforts to improve student achievement who are declared problematic. This formula is of course adapted to the specific problems of students in each class. That is, the corrective action taken by the teacher is very dependent on the problems faced by students in a class.
b. Teacher professionalism in the design and implementation of this CAR must be maintained by the teacher concerned and by related parties, for example in the form of dissemination and funding.
c. *best practices* are used as positive habits for teachers who continuously improve learning in order to improve the quality of learning and help their fellow teachers in solving learning problems at school. The school can include the CAR program in the school program plan including its budgeting.

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