Stem-Inquiry Brainstorming: Critical and Creative Thinking Skills in Static Fluid Material

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Submission date: 17-Oct-2022 01:38AM (UTC+0700)
Submission ID: 1926689290
File name: Stem-Inquiry_Brainstorming.pdf (588.81K)
Word count: 7433
Character count: 41094

PERIÓDICO TCHÊ QUÍMICA
ARTIGO ORIGINAL

DEBATE DA ABORDAGEM STEM: HABILIDADE DE PENSAMENTO CRÍTICO E CRIATIVO EM MATERIAL DE FLUIDO ESTÁTICO

STEM-INQUIRY BRAINSTORMING: CRITICAL AND CREATIVE THINKING SKILLS IN STATIC FLUID MATERIAL

STEM-INQUIRY BRAINSTORMING: KEMAMPUAN BERPIKIR KRITIS DAN KREATIF PADA MATERI FLUIDA STATIS

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Received 15 July 2020; received in revised form 11 August 2020; accepted 30 October 2020

RESUMO

A abordagem de Ciência, Tecnologia, Engenharia e Matemática (STEM) tornou-se um objeto de pesquisa interessante. Vários estudos provaram que a abordagem STEM superou vários problemas de aprendizagem. Envolve muitos aspectos de ensino e aprendizagem, sejam os domínios cognitivo, afetivo ou psicomotor, que afetarão positivamente os resultados de aprendizagem dos alunos. Este estudo teve como objetivo descrever o efeito da abordagem STEM com o método Brainstorming nas habilidades de pensamento crítico e pensamento criativo de alunos na aprendizagem de física. Este estudo empregou pesquisa quase experimental com um desenho de grupo de controle não equivalente. A amostragem foi realizada por meio da técnica de amostragem aleatória simples com uma amostra total de 60 alunos do ensino médio. O instrumento usado neste estudo foi um instrumento de teste de ensaio para medir o pensamento crítico e as habilidades de pensamento criativo. A Análise Multivariada de Variância (MANOVA) foi utilizada como técnica de teste de hipóteses de pesquisa. Os resultados mostraram que a pontuação de significância das habilidades de pensamento crítico foi de 0,001 e a pontuação de significância das habilidades de pensamento criativo foi de 0,019. Assim, pode-se concluir que a aplicação da abordagem STEM com o método de Brainstorming é eficaz para melhorar o pensamento crítico e as habilidades de pensamento criativo dos alunos na aprendizagem de física, tanto por meio de testes multivariados quanto separados..

Palavras-Chave: *brainstorming, habilidades de pensamento criativo, habilidades de pensamento crítico, abordagem STEM.*

ABSTRACT

The Science, Technology, Engineering, and Mathematics (STEM) approach has become an interesting research object. Several studies have proven that the STEM approach has overcome various learning problems. It involves many teaching and learning aspects, either the cognitive, affective, or psychomotor domains, positively affecting the students' learning outcomes. This study aimed to describe the effect of the STEM approach with the Brainstorming method on critical thinking and creative thinking skills of students in physics learning. This study employed quasi-experimental research with a non-equivalent control group design. The sampling was done through the simple random sampling technique with a total sample of 60 high school students. The instrument used in this study was an essay test instrument to measure critical thinking and creative thinking skills. The Multivariate Analysis of Variance (MANOVA) was used as the research hypothesis testing technique. The results showed that the significance score of critical thinking skills was 0.001, and the significance score of creative thinking skills was 0.019. So, it can be concluded that the application of the STEM approach with the Brainstorming method is effective in improving students' critical thinking and creative thinking skills in learning physics, both through multivariate tests and separate tests.

Keywords: *brainstorming, creative thinking skills, critical thinking skills, STEM approach.*

ABSTRAK

Pendekatan Science, Technology, Engineering, and Mathematics (STEM) menjadi objek penelitian yang menarik. Beberapa penelitian membuktikan bahwa pendekatan STEM mampu mengatasi berbagai permasalahan dalam pembelajaran karena pembelajaran STEM melibatkan banyak aspek dalam kegiatan belajar baik dalam aspek kognitif, afektif maupun psikomotorik yang berdampak positif terhadap hasil belajar anak. Penelitian ini bertujuan untuk membuktikan pengaruh pendekatan STEM dengan metode Brainstorming terhadap kemampuan berpikir kritis dan kreatif siswa dalam pembelajaran fisika. Penelitian ini menggunakan jenis penelitian eksperimen semu (quasi experiment) dengan non-equivalent control group design. Pengambilan sampel dilakukan dengan teknik simple random sampling dengan jumlah sampel 60 siswa SMA. Instrumen yang digunakan dalam penelitian ini adalah instrumen tes essay untuk mengukur kemampuan berpikir kritis dan kreatif siswa. Pengujian hipotesis penelitian menggunakan Multivariate Analysis of Variance (MANOVA). Hasil penelitian menunjukkan untuk kemampuan berfikir kritis diperoleh nilai sig. 0,001 dan nilai sig. 0,019 untuk kemampuan berfikir kreatif sehingga dapat disimpulkan bahwa penerapan pendekatan STEM dengan metode Brainstorming efektif dalam meningkatkan kemampuan berpikir kritis dan berpikir kreatif siswa dalam pembelajaran fisika, baik melalui tes multivariat maupun tes terpisah

Kata Kunci: *brainstorming, kemampuan berfikir kreatif, kemampuan berfikir kritis, pendekatan STEM*

1. INTRODUCTION:

Global competition in education is one of the challenges that must be overcome quickly and responsively (Wurianto, 2018; Wijaya *et al*., 2016). this competition requires teachers to develop good lesson plans in the learning process (Harjono *et al*., 2019; Sukoco *et al*., 2019). Not only teachers but also students are required to be able to overcome their problems and the problems around them (Farida *et al*., 2018; Yulia, 2015). Some issues often identify in science learning (Nuangchalerm *et al*., 2019; Perdana et al., 2019; Pratiwi et al., 2019; Sari *et al*., 2019; Wartono et al., 2019) such as the low level of students' creative and critical thinking skills (Ekosari, 2018; Siswanto, 2018; Ismayati, 2016; Syukri *et al*., 2013), the low level of students' problem-solving skills (Amanah *et al*., 2017), and the low level of students' scientific literacy skills (Sari *et al*., 2019; El Islami *et al*., 2019).

Science learning covers various branches where physics is one of them. Learning physics is not only about memorizing theories and formulae, but students must also be able to understand the concepts well (Sari and Swistoro, 2018; Rivai and Yuliati, 2018). Students will understand the physics concept in a higher context based on scientific findings (Hanna et al., 2016; Indri, 2017). Thus, physics learning considers as a means to develop thinking and problem-solving skills for students (Rivai and Yuliati, 2018) because the concept of physics is closely related to the phenomenon in everyday life, one of which is in the static fluid subject (Rizalul, 2019; Sukma, 2018).

The data obtained through interviews with the eleventh-grade mathematics and science teachers during the pre-research on several public high schools in Lampung Province, Indonesia, revealed that students' critical thinking and creative thinking skills were relatively low. The results of pre-research tests supported the results of the interviews. These results were also strengthened by observations that showed that students' thinking skills in physics were lacking. However, in the industrial revolution 4.0 era, the skills to search, analyze, and connect the information to solve problems is needed. (Boonjeam *et al*., 2017).

Based on the creative and critical thinking of the students, whether from pre-research or research results throughout the world, it could be overcome by using the Science, Technology, Engineering, and Mathematics (STEM) learning approach. STEM approach applies the knowledge and skills at the same time to solve a problem because it requires students to use their skills in understanding, calculating, and analyzing empirical data (Syafei *et al*., 2020). The purpose of STEM learning is to upgrade the mindsets quality of the people in understanding and use science and innovation in technology products to compete globally (Indri, 2017; Kelley and Knowles, 2016).

STEM approach can integrate with any learning model that can train the knowledge of the students (Sagala *et al*., 2019). Among the models that can incorporate are problem-based learning, project-based learning, and cooperative learning combined with STEM to improve students' creative and critical thinking (Fathoni et al., 2020; Mu'minah and Aripin, 2019; Satriani, 2017). The STEM approach also makes students accustomed to finding solutions to solve any problems and

becomes the key to creating a globally competitive generation to become a reference for the future of education (Sagala *et al.*, 2019). Besides, the STEM approach can also increase the effectiveness of learning and can support future careers.

The use of the STEM approach in the learning process aims to train students to have hard skills and soft skills (Sunarno, 2018; Thahir *et al.*, 2020). In its application, STEM can collaborate with various learning methods (Ariani *et al.*, 2019). The learning method allows students to upgrade the skills they need to face competition in education. The learning method applied in this study was the brainstorming method. The brainstorming method chooses because this method is effective in training students to get used to thinking of good ideas and turning those ideas into results (Sunandar and Effendi, 2018; Seeber *et al.*, 2017). So, the use of the brainstorming method expects to support the application of the STEM approach.

Based on previous research, STEM has proved to train students to think critically (Sagala *et al.*, 2019; Syukri *et al.*, 2013; Ekosari, 2018) and creatively (Sagala *et al.*, 2019; Ismayani, 2016; Siswanto, 2018). Then, brainstorming has also been proven effective in improving students' critical and creative thinking skills (Widiana and Hernadi, 2018), increasing students' activity and learning outcomes (Yuni, 2017), and can improve students' problem-solving skills (Liani *et al.*, 2018).

There have been many studies that applied the STEM approach and the brainstorming method in the learning process. However, there has been no research that collaborated on the STEM approach with the six steps of the inquiry model from the National Research Council (NRC) and the brainstorming method. Thus, it was deemed essential to research to determine the effect of the STEM approach, collaborated with the brainstorming method, and see its impact on students' critical and creative thinking skills in physics learning.

Therefore, this study aimed to describe the STEM approach effect collaborated with the brainstorming method on the students critical and creative thinking skills in physics learning.

2. MATERIALS AND METHODS:

This research employed quasi-experimental research with a non-equivalent control group design (Dasgupta *et al.*, 2019). This study population was all students of class XI-MIPA (eleventh-grade of natural science class) at SMA Negeri 1 Sukoharjo (Sukoharjo 1 Public Senior High School) in Indonesia. Using the random sampling technique, selected grade XI-MIPA 1 as the experimental class and XI-MIPA 4 chosen as the control class. The total sample was 60 students 16-17 years, precisely 26 male students and 34 female students. The school and the students have agreed to participate in the study.

The instrument used in this research was a test instrument in the form of essay questions to measure students' critical (Appendix 2) and creative thinking skills (Appendix 1). Appendix 1 shows the critical thinking test, and Appendix 2 shows the creative thinking test. Before the treatments were given, pre-tests were administered to students to find out their initial knowledge. After that, the treatments were given to the sample classes, which then continued by administering post-tests. The post-tests were conducted to determine students' critical thinking and creative thinking skills after implementing the STEM approach and brainstorming methods. The STEM approach application with the six inquiry steps and the brainstorming method on static fluid material (only for the experimental class) is presented in table 1 in the form of a storyboard. The static fluid material chose because this material could easily find in everyday life.

In this study, the brainstorming method can increase the activeness and learning outcomes (Karim, 2017; Wardani, 2016; Yuni Tri Astuti, 2017), and presentation skills (Amin, 2017) of the students. The stages of the brainstorming method are (1) teacher orientation stage (teacher introduces new problems or situations to students); (2) analysis stage (the students identify relevant materials and problems or in other words, they identify the issues); (3) hypothesis stage (the students are allowed to express their opinions related to the issues); (4) incubation stage (the students work individually in their groups to establish their frame of thinking); (5) synthesis stage (the teacher opens a class discussion where the students asked to express and write their opinions as well as to decide which is the best); and (6) verification stage (the teacher chooses the best argument as to the best solution).

The research data were analyzed using prerequisite and hypothesis tests. The prerequisite tests consisted of the normality and the homogeneity test. Then, the hypothesis tested using a Multivariate Analysis of Variance (MANOVA). The students' critical and creative thinking skills data obtain after the treatment given to the sample class. The statistical tests performed

using the SPSS 20.00 program with a significance level of 5%. Before the data used in the hypothesis test, it must pass the Multivariate Analysis of Variance (MANOVA) test. The data required to pass the MANOVA test is the data must normally distribute and pass the homogeneity test.

3. RESULTS AND DISCUSSION:

The data of this study were the students' critical and creative thinking skills data. The data obtained from the experimental class, which consisted of 30 students, and the control class, which consisted of 30 students. The average pre-test and post-test scores can be seen in table 2.

Table 2 showed that the average score of students pre-tests on critical thinking in the experimental class was higher than the control class average pre-test score. The average score of students pre-tests on creative thinking in the experimental class was lower than the control class average score. After the treatment had been applied and then followed by the post-tests, the average score of students' critical thinking and creative thinking skills in the experimental class is higher than the average post-test score in the control class. However, the post-test score difference between the experimental class and the control class was not significant.

3.1 Prerequisite Test

The hypothesis testing was done by performing the Multivariate Analysis of Variance (MANOVA). Data on critical and creative thinking skills were obtained after the treatment had been given. The statistical calculation was assisted by SPSS 20.00 program with a significance level of 5%. Before the data used for hypothesis testing, it must pass the prerequisite tests because MANOVA requires the data to be normally distributed and homogeneously.

3.2 Normality Test

The normality of the data tested using the Kolmogorov Smirnov test assisted by the SPSS 20.00 program. The normality test results from the post-test of critical and creative thinking skills presented in table 3.

3.3 Homogeneity Test

After the data had been declared normal distributed, the next step was to find the homogeneity values. In this study, the homogeneity value calculated using the SPSS 20.00 program. The homogeneity test results are shown in Table 4. Table 4 shows the significant value of the group homogeneity test results, which is greater than 0,05. It concluded that the post-test scores were taken from homogeneous populations or the variance of each sample was the same. The homogeneity test results of the post-test are in table 5. Table 5 shows the significance values of the homogeneity test results separately. Based on table 5, it can be seen that the significance value was more than 0,05 based on the results of the post-test of critical thinking skills and creative thinking skills. It can be concluded that the post-test scores were taken from homogeneous populations or the variance of each sample was the same.

3.4 Multivariate Test

The hypothesis tested using the MANOVA (Multivariate Analysis of Variance) test assisted by the SPSS 20.00 program. MANOVA test results using multivariate test numbers in table 6. Table 6 shows that the significant value results using multivariate test numbers were less than 0,05 (H_0 rejected). So, applying the STEM approach to collaboration with the brainstorming method affected both variables (critical thinking skills and creative thinking skills). The tests of between-subjects effect can be seen in table 7. Table 7 shows the significant value of the MANOVA test between-subjects effect was smaller than 0,05 (H_0 rejected). It concluded that the STEM Approach that collaborated with the brainstorming method affected students' critical and creative thinking skills. This research results in line with the findings revealed by previous researchers, where the application of the STEM approach collaborated with the brainstorming method can improve critical thinking and creative thinking skills. Previous research stated that the STEM approach could enhance critical thinking and creative thinking skills (Ismayani, 2016; Siswanto, 2018). Other research related to the brainstorming method has proven that this method can improve critical thinking skills (Ardiansyah, 2018) and creative thinking skills (Widiana and Hernadi, 2018). It is because STEM learning requires students to integrate the four aspects of the STEM approach in learning. The four aspects of the STEM approach can encourage students to improve their thinking skills (Thahir *et al*., 2020). Besides, applying the STEM approach in learning can encourage students to understand natural phenomena based on science concepts, utilize technology, design tools or technology, and

interpret solutions from data and calculated results (Thahir *et al.*, 2020).

STEM approach realizes student-centered learning, so students can play an active role in the learning process (see Table 1). It makes students accustomed to finding solutions to a problem to continue to be actively involved in learning (Khoiriyah *et al.*, 2018). STEM learning trains students to develop critical thinking skills and problem-solving skills in the learning process. It can be seen from students' activity in group works and individual projects (Lutfi *et al.*, 2017). Through the STEM learning approach, which is a learning process that links science processes with science, engineering, and technology, can be presented in the learning to trigger students' learning interest and, at the same time, develop their skills.

The application of the STEM approach in this study cannot separate from the brainstorming method support. The brainstorming method in learning can increase spontaneous ideas, imagination, creativity, and flexibility (Zuhdi and Maulidyana, 2018). This method can also make the learning atmosphere more active and fun. In learning with the brainstorming method, students gather and have discussions or exchange ideas and express opinions with one another. The collaboration between STEM, 6-steps Inquiry, and brainstorming method is done to make students feel free and have to explore all spontaneous ideas and imaginations to understand science phenomena, utilize technology, and design and interpret solutions from data and calculated results (Thahir *et al.*, 2020).

The learning process that collaborates with the STEM approach and brainstorming method is student-centered. The teacher role is only as a facilitator and supervisor for students during the learning process. So, the teacher can encourage passive students to be active. The application of this approach and method makes students accustomed to discussing and expressing all ideas. It also can train student cooperation in group learning. It is the best answer to the post-test of students' critical and creative thinking skills to see the difference in students' responses after the STEM approach collaborated with the brainstorming method. Based on table 8 we can see the difference in students' answers between the experimental and control classes in completing the tests. The students from the control class were mostly incorrect in analyzing and evaluating the problems of the questions. In contrast, the students in the experimental class solved the problems by analyzing, evaluating, and creating. Even though most experimental class students answered correctly, the post-test average scores between the two classes were not different.

When answering the post-test questions, all students from both classes could answer satisfactorily. Furthermore, based on their answers in the post-tests, the level of students' critical thinking and creative thinking skills could be determined. If students can answer the questions well, it can be said that they have good critical thinking and creative thinking skills. The questions used in the post-test had been adjusted to the indicators of critical thinking and creative thinking. Since the experimental class students' answers were better than the answers of students in the control class, it can be concluded that the critical thinking and creative thinking skills of the experimental class students were higher than the control class students.

Before starting learning, the teachers must consider the vital thing: the teachers must prepare a lesson plan and learn media correctly. Thus, teachers will be required to think more critically and creatively to produce good and interesting learning so that learning goals can be more easily achieved.

4. CONCLUSIONS:

The use of the Science, Technology, Engineering, and Mathematics (STEM) approach collaborated with the brainstorming method was increasing students' critical thinking and creative thinking skills in physics learning effectively. On the other hand, learning by using the STEM approach collaborated with the brainstorming method can explore students' spontaneous ideas and imagination and trigger passive students to be more active. In this research, it could be seen that the STEM approach collaborated with the brainstorming method can be used as an alternative to teaching static fluid materials.

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Table 1. *Storyboard of the Application of STEM-based Inquiry Model with Brainstorming Method*

Inquiry steps	STEM	Teacher role	Students role
Problem orientation and present questions	- Science: The theory presented is static fluid - Technology: Showing a video about how a hydraulic pump works and showing a video of a car being lifted by a hydraulic jack.	- The teacher stimulates students' thinking activities by asking questions about events related to static fluid theory.	- Students try to answer some questions from the teacher.
		- The teacher displays videos about several phenomena/events in daily life related to static fluid theory using LCD.	- Students observe several events related to static fluid displayed by the teacher.
Making a hypothesis	- Science: The theory presented is static fluid - Technology: Showing a video about how a hydraulic pump works and showing a video of a car being lifted by a hydraulic jack.	- The teacher directs the students to understand the static fluid theory by making a hypothesis from their videos.	- Students construct a hypothesis from the results of their brief observation.
Planning and doing an investigation	- Science: The theory presented is static fluid - Technology: Making a simple hydraulic pump - Mathematics: Make a simple hydraulic pump formula from the application of static fluid theory	- The teacher divides students into groups and asks students to gather with groups.	- Students gather with their groups.
		- The teacher directs each group to plan a simple hydraulic pump by creating a simple hydraulic pump scheme.	- Each group plans the process of making a simple hydraulic pump according to the teacher's direction.
		- The teacher directs each group to make a simple hydraulic pump.	- Each group makes a simple hydraulic pump according to the teacher's direction.
		- The teacher gives instructions to students to conduct observations and retrieve data by comparing the difference between the pressure on the small injections with the massive injections.	- Each group observes and analyzes the concept of static fluid in a simple hydraulic pump they made.
Analysis and data	- Science: The theory presented is static fluid	- The teacher instructs each group to discuss	- Each group analyzes and

Inquiry steps	STEM	Teacher role	Students role
interpretation	- Technology: Simple water rocket - Engineering: Make a water rocket design - Mathematics: Write the formula for making water rockets based on the application of static fluid	**brainstorming** to analyze and interpret the data from the observations.	interprets the data by comparing the small injections' pressure with the massive injections.
		- The teacher directs and guides students in discussions with **brainstorming**.	- Students discuss with group mates by following the teacher's directions and guidance.
Making arguments	- Science: The theory presented is static fluid - Technology: PowerPoint, simple hydraulic pump	- The teacher instructs each group to have another discussion with brainstorming. This step is aimed to make students dare to come up with arguments about the results of their observations and strengthen their arguments by comparing them with static fluid theory.	- Students express all their arguments and thoughts about the observations and strengthen their thoughts with static fluid theory.
Concluding and presenting results	- Science: The theory presented is static fluid - Technology: PowerPoint, simple hydraulic pump - Mathematics: Write the formula of a simple hydraulic pump based on the application of static fluid theory.	- The teacher instructs each group to make a PowerPoint presentation and conclude all learning activities about static fluid theory.	- Each group makes a presentation and concludes the lesson.

Table 2. *Results of the Students Critical and Creative Thinking Skills*

Class		Critical Thinking	Creative Thinking
Experimental	Pre-test	43,4	40,7
	Post-test	68,5	70,5
Control	Pre-test	41,7	42,5
	Post-test	63,3	65,5

Table 3. *Normality Test*

Class		Sig.	Conclusion
Critical Thinking	Experimental	0,200	Normal
	Control	0,112	Normal
Creative Thinking	Experimental	0,133	Normal
	Control	0,200	Normal

Table 4. *Box Test of Equality of Covariance Matrices*

Box's M	0,381
F	0.122
df1	3
df2	605520.00
Sig.	**0,947**

Notes: Box's M = box's test of equality of covariance matrices; F = the approximate F statistic for the given effect and test statistic; df1 = the number one of degrees of freedom in the model; df2 = the number two of degrees of freedom in the model; Sig. = the p-value associated with the F statistic and the hypothesis and error degrees of freedom of a given effect and test statistic.

Table 5. *Levene Test of Equality of Error Variances*

Thinking Skills	**F**	**df1**	**df2**	**Sig.**
Critical thinking	0.004	1	58	0,949
Creative thinking	0,018	1	58	0,892

Notes: F = The approximate F statistic for the given effect and test statistic; df1 = The number one of degrees of freedom in the model; df2 = The number two of degrees of freedom in the model; Sig. = The p-value associated with the F statistic, the hypothesis, and error degrees of freedom of a given effect and test statistic.

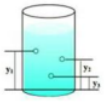
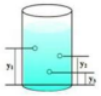
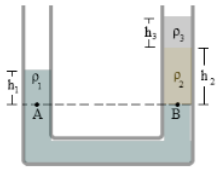
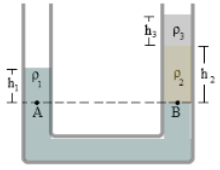
Table 6. *Multivariate Tests*

Effect		**Sig.**
Class	*Pillai's Trace*	0,002
	Wilk's Lambda	0,002
	Hotelling's Trace	0,002
	Roy's Largest Root	0,002

Table 7. *Tests of Between-Subjects Effects*

Source	**Dependent Variable**	**Sig.**
Class	Critical Thinking Skills	0,001
	Creative Thinking Skills	0,019

Table 8. *The Examples of Students' Answers on the Experimental class and the Control Class*

	Critical Thinking	
Experimental Class	Question: Look at the picture below!  Which hole has the most pressure? Why? Write a conclusion!	Answer: Y_3 has the most pressure because the Y_3 hole is closest to the bottom of the glass. The deeper the position of an object in the fluid, the greater the pressure.
Control Class	Question: Look at the picture below!  Which hole has the most pressure? Why? Write a conclusion!	Answer: Y_3, because it is closest to the bottom of the glass.
	Creative Thinking	
Experimental Class	Question: Look at the picture below!  Based on the picture, formulate the equation to determine the density of the third liquid!	Answer: Based on hydrostatic law, so: $P_A = P_B$ $P_1 = P_2 + P_3$ $\rho_1 g h_1 = \rho_2 g h_2 + \rho_3 g h_3$ $\rho_1 h_1 = \rho_2 h_2 + \rho_3 h_3$ $\rho_3 h_3 = \rho_1 h_1 - \rho_2 h_2$ So, to find the density of the third liquid, we can use: $\rho_3 h_3 = \rho_1 h_1 - \rho_2 h_2$ or $\rho_2 = \frac{\rho 1 h 1 - \rho 2 h 2}{h 3}$
Control Class	Question: Look at the picture below!  Based on the picture, formulate the equation to determine the density of the third liquid!	Answer: $P_A = P_B$ $P_1 = P_2 + P_3$ $h_1 \rho_1 = h_2 \rho_2 + h_3 \rho_3$

APPENDIX 1. Critical Thinking Test Instrument

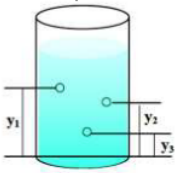
QUESTION SHEET
Material: Static Fluid

Direction:
- Pray before working on the question, then write your name and class on the answer sheet.
- Please answer the questions that are considered easy first.
- Write down the order of solving the problem, starting from writing down the known quantity and the questioned quantity. Provide a sketch (if possible) and then continue with the process of answering the questions.
- Believe in your abilities.

1. Bima places a clip on the surface of the water in the glass. However, Bima saw that the clip did not sink to the bottom of the glass. Consider the following statements:
   1. Boil the water
   2. Freeze the water
   3. Pour soap into the water
   4. Dye the water

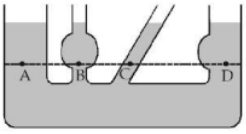
   To make the clip sinks, what must Bima do? Explain why!

2. Look at the picture below.



   Which hole has the most significant hydrostatic pressure? Why is that? Write your conclusion!

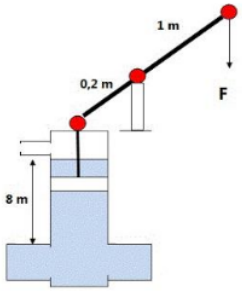
3. Look at the picture below.



   Analyze the image to determine whether one of the vessel's points has the most significant hydrostatic pressure? Explain based on the knowledge you have!

4. A metal C, which is a mixture of metal A and metal B, has a mass of 200 grams when weighed in air, whereas if it is weighed in water, the mass of the metal is 185 grams. With the density of metal A 20gram/cm^3 and the density of metal B 10 gram/cm^3, calculate the mass of metal A is?

5. A water pump with a cross-sectional pipe area of 75 cm^2 is used to pump water from a depth of 8 m (see picture).



   Analyze the image to determine the minimum force required to pump If it is known that the acceleration due to gravity is 10 cm^2, and when pumping, there is a friction force on the suction of 20 N while other friction is ignored.

6. A hydraulic jack with pipes 1 cm and 7 cm in diameter. How much force is required to lift an object with a mass of 1500kg?

7. Read the following illustration.
   Dina experimented by putting egg A into a glass A filled with water mixed with salt. After being observed, it turned out that the egg was floating. Then Dina puts egg B into a glass B filled with water without any mixture. Once observed, the eggs are either at the bottom of the liquid or sink.


Glass A


Glass B

   After reading and understanding the illustration above, determine what causes the conditions of glass A and glass B to be different?

8. A ship made of weighty metal can float on the seawater's surface, but a small rock, when thrown into the sea, will sink. Why is that?

APPENDIX 2. Creative Thinking Test Instrument

QUESTION SHEET
Material: Static Fluid

Direction:

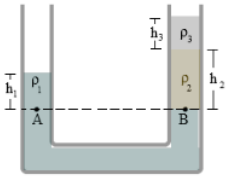
- Pray before working on the question, then write your name and class on the answer sheet.
- Please answer the questions that are considered easy first.
- Write down the order of solving the problem, starting from writing down the known quantity and the questioned quantity. Provide a sketch (if possible) and then continue with the process of answering the questions.
- Believe in your abilities.

1. In a tub filled with water, an ice floe with a density of 0.9g/cm^3. Explain the buoyancy force and formulate an equation to determine the total volume of ice if the volume of ice that appears on the water's surface is 50 cm^3.

2. Draw a picture of a block-shaped object in a vessel filled with water and oil. 50% of the volume of the block is in water, and 30% is in oil. The water density is 1 g / cm^3, and the density of oil is 0.8 g / cm^2. Based on the drawing that has been made, make a picture from the forces acting on the block and determine the block's density!

3. Draw a picture of the hydraulic jack where the left cylinder P has a cross-sectional area of 600 cm^2 and is given an M kg load. The right suction Q has a cross-sectional area of 20 cm^2, while its weight is negligible. Liquid filled the system with a density of 900kg/m^3. If F balanced system is 25 N, then analyze the image to find the Mass M (g = 10m/s^2).

4. Look at the picture below.



Based on the picture above, formulate an equation to determine the **ρ** of the third liquid (ρ_3).

5. A glass is full of water. There is an ice float so that some of the ice is above the surface of the water. If the ice melts, will the water spill? Draw a picture and associate it with Archimedes' Law.

Stem-Inquiry Brainstorming: Critical and Creative Thinking Skills in Static Fluid Material

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