*KORESPONDENSI JURNAL*

# Approaching Problem-Solving Skills of Momentum and Impulse Phenomena Using Context and Problem-Based Learning

Author:

**Yuberti, Sri Latifah, Adyt Anugrah,**

**Antomi Siregar, Misbah, Kittisak Jermsittiparsert**

**SEMESTER GANJIL**

**TAHUN AKADMIK 2019/2020**

Yuberti <yuberti@radenintan.ac.id>

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Cc: Kittisak Jermsittiparsert <Kittisak.J@chula.ac.th>

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# Preliminary Review of Manuscript EU-JER ID#1909140413

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**Editor - European Journal of Educational Research** <editor@eu-jer.com>      Wed, Sep 25, 2019 at 10:31 PM
To: yuberti@radenintan.ac.id
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**Kittisak Jermsittiparsert** <Kittisak.J@chula.ac.th>                    Tue, Oct 8, 2019 at 1:50 PM
To: Editor - European Journal of Educational Research <editor@eu-jer.com>
Cc: Yuberti <yuberti@radenintan.ac.id>

Dear Ahmet Cezmi Savas,

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ส่ง: 8 ตุลาคม 2562 13:12
ถึง: Kittisak Jermsittiparsert
สำเนาถึง: Yuberti
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# Approaching The Problem-Solving Skills of Momentum and Impuls Phenomena Using Context and Problem-Based Learning (C-PBL)

**Abstract:** The industrial revolution era 4.0 has now become a major topic in every country. Various sectors respond quickly to this problem, including education. In response to this, there are several aspects of skills that students must master. One of them is problem-solving skills. One of the aspects that influence the students' problem-solving skills is the context and problem-based learning model. The purpose of this study is to describe the effect of the model on students' skill to solve physics problems. The research method used is a quasi-experimental research design with non-equivalent control group design. The data analysis technique used Independent T-Test by PASW 18 with significance 5%. Based on the results of the Independent Sample T-Test can be concluded that there is an effect on the model that was applied with a significant gain of 0,00. The results showed that the context and problem-based learning (C-PBL) model affected the physics problem-solving skills.

**Keywords:** *Constructivism Model, Context and Problem Based Learning (C-PBL), Learning Model, Problem-solving Skills.*

## Introduction

Science is changing along with time, including cyber technology. Now, cyber technology is no longer a tool but is embedded in human life which later became the entry point of the Industrial Revolution Era 4.0 (Syamsuar & Reflianto, 2018). The world of education responds to this phenomena with the birth of education 4.0 to integrate cyber technology in learning (Priatmoko, 2018). The learning activity is aimed at improving students' skill and competence in achieving competence of attitudes, knowledge, and skills (Bao, Xiao, Koenig, & Han, 2018). Several aspects of 21$^{st}$-century skills must be mastered by students including learning and innovating skills consisting of critical thinking skills, problem-solving, communication and collaboration skills, creativity, and innovation, especially in science (S. Lestari, 2015; Mulhayatiah, Setya, & Suhendi, 2019).

Physics is one of the components of science. Studying physics will not be enough if only knowing and memorizing, but students must understand the concepts (Anwar et al., 2019;

Açıklama [u1]: The Problem-Solving Skills Approach of ...

Açıklama [u2]: Impulse

Açıklama [u3]: Independent Sample T-Test

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Açıklama [u5]: Redundant

Boisandi & Darmawan, 2017; Diani, Yuberti, & Syarlisjiswan, 2018; Kallesta & Erfan, 2018; Sari & Swistoro, 2018). Therefore, physics is also a mean for developing thinking skills and problem-solving skills for the students. Besides, physics material is closely related to events that we experience in everyday life (Pareken, Patandean, & Palloan, 2015; Sagala, Umam, Thahir, Saregar, & Wardani, 2019; Saregar et al., 2018; Sulistyaningrum, Prihandono, & Subiki, 2015).

One of the concepts of physics is the momentum and impulses which are related to daily life that will make it easier for students to solve a physics problem (Zafitri, Fitriyanto, & Yahya, 2018). The skill to solve problems will facilitate a person in finding solutions through a process that involves the acquisition and organization of information so that the problem can be resolved with excellent and correct steps (Amanah, Harjono, & Gunada, 2017; Kahar, Wekke, & Layn, 2018; Supeno, Subiki, & Rohma, 2018).

Açıklama [u6]: impulse

The pre-research test of problem-solving skills was conducted in the tenth-grade of SMA N 2 Bandar Lampung. Researchers provided a test in the form of multiple-choice questions about the basic concepts of kinematics motion of objects. The obtained result was that the average skill to solve physics problems was still low with a percentage of 40%. The low skill of students' problem-solving indicated that the students were still unable to understand the material. The low problem-solving skills in learning physics are usually caused by the lack of thought development efforts that lead students to actively solve a problem (Makrufi, Hidayat, Muhardjito, & Sriwati, 2016).

Açıklama [u7]: What is this? Must be clearly written.

One way to overcome the students' problem-solving skills is by applying a problem-based learning model (Hakim, 2015; Madio, 2016; Yusmanidar, Khaldu, & Mudatsir, 2017). If the problems are presented in a real-life context, context-based problems will form. The different learning model is continuously being developed for more effective and permanent learning (F. Lestari et al., 2019). One of the social constructivism models is the Context and Problem Based Learning (C-PBL) model where teaching and learning activities are in the form of groups, hence, cooperation is needed in finding concepts and directing students to focus on addressing events systematically and planned (Baran & Sozbilir, 2018; Malik, Kurnia Y, & Robiatus S, 2016). The C-PBL process involves students who are given scenarios to process hypotheses which in turn creates the development of individual learning needs (Harijanto, 2017).

Student needs for learning models that can actively involve them will make the learning process more meaningful, especially by using learning models that are appropriate to students' skills (Baran & Sozbilir, 2018). Learning through context-based problems using real-life contexts and problems to support students to control over their learning, the Context and Problem Based Learning (C-PBL) model results in better learning (Syahrul, Murni, & Siregar, 2019).

Related research that has been conducted by other researchers including Context and Problem Based Learning through integrated approaches can increase student confidence in solving problems in chemistry learning so that learning could be more efficient (Baran & Sozbilir, 2018), The Problem-Based Learning Model is proven effective in improving problem-solving skills compared to conventional learning models (Yulianti, 2018), the use of C-PBL increases communication skills, students' achievement, and students' interest in the material and skills in utilizing time effectively (Williams & Mckenzie, 2013).

A lot of researches on the use of context and problem-based learning model have been conducted but the difference of this research with the previously conducted one lies in the dependent variable that is the skill to solve problems and the application of the C-PBL model on the momentum and impulses material. So that the researchers consider it is necessary to research the application of context and problem based learning models and its effects on the skills to solve physics problems.

**Method**

*Research Goal*

The difference of this research with the previously conducted one lies in the dependent variable that is the skill to solve problems and the application of the C-PBL model on the momentum and impulses material. The purpose of this study is to describe the effect of the model on students' skill to solve physics problems.

*Sample and Data Collection*

The research method used is the quasi-experimental with non-equivalent control group design. The design in this research involved the experimental class and the control class. The research design is shown in Figure 1.

**Açıklama [u8]:** The following references should be included

- Implementing REACT strategy in a context-based physics class: Impulse and momentum example, 2012
- Designing, implementing and evaluating a context-based instructional materials on buoyancy force, 2012
- Examination of context-based problem-solving abilities of pre-service physics teachers, 2017
- Investigating the Effect of the Activities Based on Explanation Assisted REACT Strategy on Learning Impulse, Momentum and Collisions Topics, 2017
- Designing, implementing and evaluating a context-based instructional materials on buoyancy force, 2012
- Context-based physics studies: A thematic review of the literature, 2014

**Açıklama [u9]:** impulse
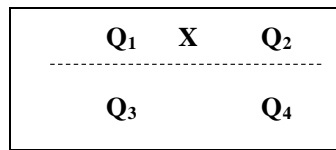
**Açıklama [u10]:** Must be separate title.

**Figure 1.** The Non-equivalent Control Group Design

**Note:**

$O_1$: Pretest in the experimental class

$O_3$: Pretest in the control class

X: Treatment with using Context and Problem Based Learning (C-PBL) model

$O_2$: Posttest in the experimental class

$O_4$: Post-test in the control class (Sugiyono, 2016).

The populations in this study were all students of the tenth grade of science major of SMAN 2 Bandar Lampung. Sampling was done using simple random sampling technique of two classes or 70 respondents with a range of 15-16-year-olds. The treatment in the experimental class was the Context and Problem-Based Learning (C-PBL) model and in the control class was Problem-Based Learning (PBL) model. The instrument used in this study was in the form of essay questions to measure problem-solving skills. However, before being given the treatment, a pretest was given to know the level of fundamental skill of students. The following is the flowchart in implementing the C-PBL learning model:
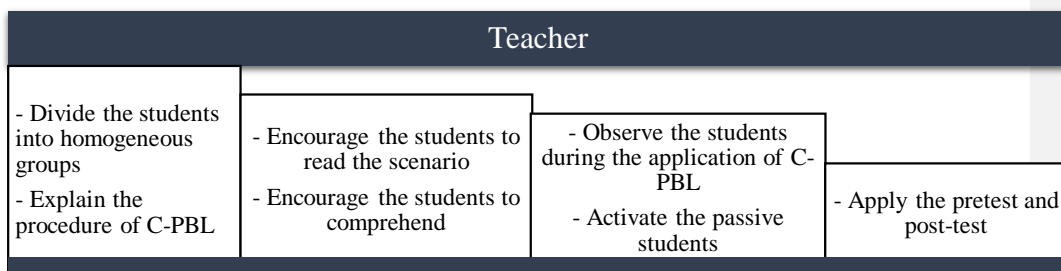


**Figure 2**. The Teacher's Role in the Application of C-PBL Model

| Students | | | | |
|---|---|---|---|---|
| Read and understand the scenario and decide what should be known | The students try to discover the answers for the problems through group discussion | The students identify what should they know to answer the problems and to conduct the research | Analyze the data and information gathered to find the conclusion | Presentation by the students |

**Figure 3**. The Students' Role in the Application of C-PBL Model

*Analyzing the Data*

To test the hypothesis, t-test was employed. The data of problem-solving skills were obtained after the sample was given treatments. The statistical test was carried out at a significance level of 5% using the PASW 18 program. In this study, the pre-requisite tests were conducted to test the normality and the homogeneity.

*Title*

**Findings**

Data in this study is the data of problem-solving skills. The data obtained from the experimental class with 34 students aged 15-16 years using the C-PBL model and the control class with 36 students aged 15-16 years using the PBL model. The data of students' physics problem-solving skills in the experimental class and the control class after the application of the learning models can be seen in Table 1.

**Table 1**. The Data of Physics Problem solving skills based on the Learning Models.

| Groups | Numbers of Data | Max score | Min score | Average | Std. Dev |
|---|---|---|---|---|---|
| Experimental (Model C-PBL) | 34 | 95 | 62 | 81,56 | 9,93 |
| Control (Model PBL) | 36 | 89 | 55 | 71,08 | 10,02 |

Table 1, shows the results of the physics problem-solving skills of each class. The table shows that the average score of the experimental class is higher than the control class with a relatively equal score distribution. Judging from the magnitude of the standard deviation which is approaching zero, the distribution is more uniform with the average data obtained.

**Açıklama [u11]:** The validity and reliability measures taken for the whole phase of the study should be displayed under the title of Validity and Reliability.

**Açıklama [u12]:** do not understand. Let's use academic language.

The percentage of the students' problem-solving skills' scores for each indicator of the experimental class and the control class in detail is presented in Figure 4.
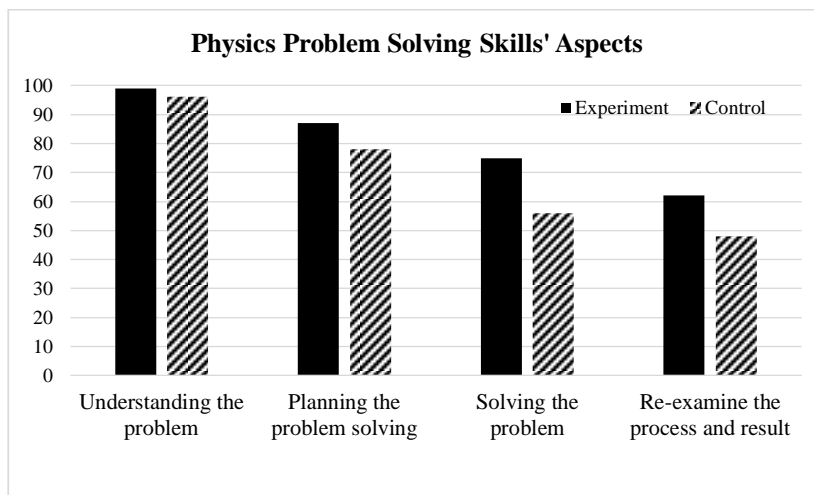


**Figure 4.** The Percentage Diagram of the Achievement of Physics Problem solving skills on each indicator.

Based on the results of the analysis of the problem-solving skills score data based on Figure 4, based on the four aspects, it appears that the highest score is in the aspect of understanding the problem in the experimental class and control class. In this aspect, the students must be able to identify and write a variety of information displayed from the questions asked, because in solving a problem, an important point that must be done first is to understand the problem. The results of this study are in accordance with the results of previous studies which suggested that the aspect of students' greatest problem-solving skills lies in the aspect of understanding the problem. (Yu, Fan, & Lin, 2015). Meanwhile, the lowest score is the aspect of re-examining the process and results.

**Açıklama [u13]:** this section should be in the "discussion" part.

**Prerequisite Test Analysis**

Hypothesis testing used in this study was Independent Sample $t$-Test. The test criteria were based on the probability value that is if the probability is (sig)> 0.05 then $H_o$ is accepted = no effect, if the probability is (sig) <0.05 then $H_o$ is rejected = there is an influence. The requirements that must be met before conducting a hypothesis test are the normality test and the variance homogeneity test. If the data is normally distributed then parametric statistical techniques can be done, whereas if the data is not normally distributed then the statistical technique that must be used is non-parametric statistics.

**Normality**

The normality test used was the Kolmogorov-Smirnov one-sample test on the PASW 18.00 program with the level significant of 5% or 0.05. Normality test was carried out in the experimental class and the control class in the pretest and posttest. The provisions of the normality test are if the significant value is > 0.05 then the data is normally distributed. Meanwhile, if the significant value is <0.05, the data are not normally distributed. The results of the normality test can be seen in Table 2.

**Table 2.** Normality Test Results

| Group | | Significance | Result |
|---|---|---|---|
| Experimental | Pretest | 0,082 | Normal |
| | Posttest | 0,200 | Normal |
| **Group** | | **Significance** | **Result** |
| Control | Pretest | 0,095 | Normal |
| | Posttest | 0,200 | Normal |

Table 2, the normality value of the pretest-posttest data in the experimental and control classes is sig> 0.05, so it can be concluded that the data are normally distributed.

**Homogeneity Test**

Homogeneity test was done to find out whether the experimental class and the control class have the same variance or not. In this study, the homogeneity of variances test was assisted by the PASW 18.00 program with a significance level of 5% or 0.05. Homogeneity test was performed on the pretest and post-test data in the experimental class and the control class. The provision of the homogeneity test is; if the significance value is > 0.05, then the data is homogeneous. Meanwhile, if the significance value is<0.05, the data is not homogeneous. The homogeneity test results can be seen in Table 3.

**Table 3.** Homogeneity Test Results

| Data | F | Significance | Criteria |
|---|---|---|---|
| Pretest | 1,677 | 0,112 | Homogeneous |
| Post-test | 0,989 | 0,717 | Homogeneous |

Table 3 shows that the homogeneity of the sig test value of students' problem-solving skills in the pretest and post-test is> 0.05, so it can be concluded that the data in the experimental and control classes have same or homogeneous variance.

**T-test**

T-test was done after it is known that the data is normally distributed and homogeneous (parametric statistics). The requirement of the t-test is if sig> 0.05 then $H_0$ is accepted = no difference or influence, if sig <0.05 then $H_0$ is rejected = no effect. The summary of t-test results is presented in Table 4.

**Table 4.** The result of Independent Sample t-Test

| Data | T | Significance | Result |
|---|---|---|---|
| Problem-solving skills | 4,400 | 0,000 | There is an influence |

The results of the Independent Sample t-Test, based on Table 4, it can be concluded that there is an influence on the model that was applied with a significant gain of 0,000 (sig <5%, $H_{0A}$ is accepted). This means that there is an influence on the model used. The posttest data shows the students' average problem-solving skills in the experimental group are 81.56 and in the control group is 71.08. These results explain that students who received treatments using the C-PBL model have higher problem-solving skills. To see an increase in students' physics problem-solving skills and find out how much influence C-PBL learning can be seen in Table 2.

**Table 5.** Results of Effect Size Analysis

| Class | AverageGain | Standard Deviation | Effect Size (d) | Category |
|---|---|---|---|---|
| Experimental | 0.66 | 0.17 | 0.69 | Medium |
| Control | 0.55 | 0.15 | | |

Table 5, the effect size results is 0.69, so it is included in the medium category. These results indicate that the Context and Problem Based Learning (C-PBL) model is quite effective in improving the skill to solve physics problems.

**Açıklama [u14]:** this section should be in the "conclusion" part

**Discussion and Conclusion**

Problem-solving skills are the skills of a person to find a solution through a process that involves obtaining and organizing information (Azizah, Yuliati, & Latifah, 2016). The C-PBL model applied provides higher physics problem-solving skills because, in this learning, the students are required to be able to solve problems presented in the context of physics applications in real life. This C-PBL model trains students to identify and find the factors that

cause physics problems in daily life, especially on the momentum and impulses material so that solutions can be found in solving the problem.

Problem-based learning model requires students to be able to solve contextual problems provided (Sanjaya, 2010). The use of context-based learning models that make problems the main focus can stimulate students during learning so that students can be active in exploring knowledge and can link their knowledge based on the events they experience in real life.

Previous research related to C-PBL can improve communication skills, achievement, and students' interest in learning and using time effectively (Azizah et al., 2016) is indeed true. Group discussions conducted by students during the C-PBL learning process make them understand and comprehend the concepts of the material independently. The C-PBL model can improve students' communication skills because during the discussion they have to express their opinions and ideas while identifying and finding solutions to problem-solving on the momentum and impulse material. Indirectly, the students are trained to be brave and confident in expressing the results of their thoughts to other members of the group. This is by previous research that discovers the C-PBL model can increase students' confidence (Jua, 2018).

The learning process using the C-PBL model is student-centered. The teacher's task in this learning model is only as a facilitator and supervises students during the discussion process so that if students are found passive in learning, the teacher must encourage the students to be active during the learning activities starting from analyzing a problem in daily life and then communicating the idea to members of the group. Thus, this learning model can also train the students to collaborate in group learning.
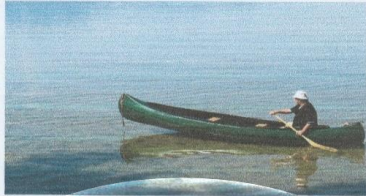
The following are the students' best answers from each of the experimental class and the control class. They are taken from the results of the pretest and posttest to see the difference in students' answers before and after the learning model is applied.

**Table 6.** Sample answers from the control class and experimental class

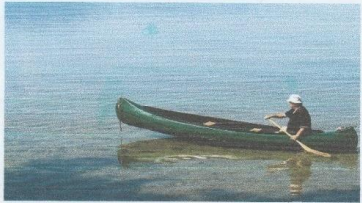| Pretest | |
|---|---|
| **Eksperimen** | 6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut!<br><br>Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg!<br><br>Jawaban :<br>Diketahui : $V_o$ = 2 m/s<br>$V_k$ = 4 m/s<br>$m_o$ = 60 kg<br>$m_k$ = 80 kg<br>Ditanya : $V_k'$ = ... ?<br>Jawab :<br>$P = P'$<br>$60 . 2 + 80 . 4 = (80 + 60) V_k'$<br>$120 + 320 = 140 V_k'$<br>$140 V_k' = 440$<br>$V_k' = \dfrac{440}{140}$<br>$V_k' = 3,14$ m/s |

A canoe is man-powered, small, and narrow boat although sometimes a sail is also placed. If someone who is on the canoe, as illustrated in the picture, jumps into the water with 2 m/s speed against the direction of the canoe which is sailing with the speed of 4 m/s. Determine the speed of the canoe when the person with 60 kg of weight jumps from the canoe which is weighted 80 kg.

Question in English version

| | |
|---|---|
| **Kontrol** | 6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut! <br><br>  <br><br> Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg! <br><br> Jawaban : <br> Diketahui : $V_0 = $ 2 m/s <br> $V_1 = $ 4 m/s <br> $m_1 = $ 60 kg <br> $m_2 = $ 80 kg. <br> Jawab : <br><br> $V = \dfrac{S}{t}$ |

### *Posttest*

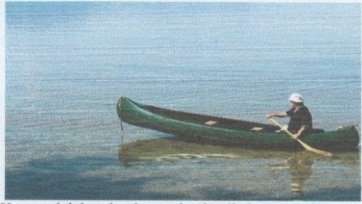| | |
|---|---|
| **Eksperimen** | 6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut! <br><br>  <br><br> Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg! <br><br> Jawaban : <br> Diketahui : $V_0 = V_k = 4$ m/s <br> $V_o' = -2$ m/s (berlawanan arah) <br> $m_o = 60$ kg <br> $m_k = 80$ kg <br> Ditanya : $V_k' = ...?$ <br> Jawab : <br><br> Peristiwa ini berlaku Hk. Kekekalan momentum <br> $P = P' \Rightarrow P = m.V$ <br> $m_o.V_o + m_k.V_k = m_o.V_o' + m_k.V_k'$ <br> $60.4 + 80.4 = 60.(-2) + 80.V_k'$ <br> $240 + 320 = -120 + 80.V_k'$ <br> $560 = -120 + 80.V_k'$ <br> $80.V_k' = 560 + 120$ <br> $V_k' = \dfrac{680}{80}$ <br> $V_k' = 8,5$ m/s <br><br> Jadi kecepatan kano saat orang tersebut melompat menjadi 8,5 m/s |
| **Kontrol** | 6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut! <br><br>  <br><br> Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg! <br><br> Jawaban : <br> Diketahui $V_1 = V_2 = 4$ m/s <br> $V_1' = -2$ m/s <br> $m_1 = 60$ kg <br> $m_2 = 80$ kg <br> Ditanya : $V_2' = ?$ <br> Jawab : <br> $P = P'$ <br><br> $m_1.V_1 + m_2.V_2 = m_1.V_1' + m_2.V_2'$ <br> $60.4 + 80.4 = 60.-2 + 80.V_2'$ <br> $240 + 320 = -120 + 80.V_2'$ <br> $560 = -120 + 80V_2'$ <br> $80V_2' = 560 + 120$ <br> $V_2' = \dfrac{680}{80}$ <br> $V_2' = 8,5$ m/s <br><br> Jadi Kecepatan Kano Sebesar 8,5 m/s |

Based on Table 6, we can see the comparison of answers of each student in the experimental class and control class in answering the question of pretest and post-test. When answering the pretest questions, before applying the learning model, most of them were wrong in analyzing the problems listed in the questions and wrong in using the formula so that the answers produced by the two students were wrong. After applying the different learning models in the two classes we see an increase in problem-solving skills in answering the problem. The experimental class students who were given the C-PBL model had more complicated answers than the control class students.

When answering the post-test questions, the two students from the experimental class and the control class can answer the questions well. However, there are differences in answers between students who got the C-PBL model in the experimental class compared to other learning model applied in the control class. The difference is known when students identified problems and make problem-solving plans. In the answer, a student of the experimental class explained "why when a person jumps into the water the speed is negative" by giving information that the person's direction of motion when jumping is the opposite of the canoe. This shows that the student understood the concept of events that occur in the problem. When making a problem-solving plan, the student explained why he must use the formula to solve the problem at hand.

Although the answers of the experimental class and control class students are equally correct, by explaining when answering the questions, the researcher knows that the student understands the physics concept not just understanding the mathematical concept. Thus, according to the researchers, the answers of the experimental class students were better than those of the control class. Learning physics is not only counting or understanding the mathematical concepts but the students must be able to interpret the physics meaning in every event that will facilitate students in learning physics. (Irwansyah, Sukarmin, & Harjana, 2018)

**Açıklama [u16]:** more references. mentioned above.

The teacher, before the lesson begins, must prepare in advance the context which will be given to students. Making scenarios is what the researchers think is quite difficult to do because the selection of scenarios needs to be adjusted to the material and its relation to real life. Thus, the teacher is indirectly required to think more creatively to produce a scenario that can be understood by the students.

Based on the analysis of the results and discussion, the conclusion obtained from this study is that there is an influence of the use of context and problem-based learning (C-PBL) model on the skill to solve physics problems. Also, the C-PBL model can improve students' communication skills, confidence, and student collaboration in group learning.

## Recommendation

In this study, it is clear that the C-PBL model can be used as an alternative to teaching, especially in the material of momentum and impulses. However, because the learning requires context, the teacher must be more creative and innovative so that the context made can be easily understood by students.

**Açıklama [u17]:** impulse

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**Açıklama [u18]:** All references must be reorganized in accordance with APA 6.

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# Approaching The Problem-Solving Skills of Momentum and Impuls Phenomena Using Context and Problem-Based Learning (C-PBL)

*Açıklama [T1]: Impulse*

*Açıklama [T2]: Unnecessary part in title*

**Abstract:** The industrial revolution era 4.0 has now become a major topic in every country. Various sectors respond quickly to this problem, including education. In response to this, there are several aspects of skills that students must master. One of them is problem-solving skills. One of the aspects that influence the students' problem-solving skills is the context and problem-based learning model. The purpose of this study is to describe the effect of the model on students' skill to solve physics problems. The research method used is a quasi-experimental research design with non-equivalent control group design. The data analysis technique used Independent T-Test by PASW 18 with significance 5%. Based on the results of the Independent Sample T-Test can be concluded that there is an effect on the model that was applied with a significant gain of 0,00. The results showed that the context and problem-based learning (C-PBL) model affected the physics problem-solving skills.

**Keywords:** *Constructivism Model, Context and Problem Based Learning (C-PBL), Learning Model, Problem-solving Skills.*

## Introduction

Science is changing along with time, including cyber technology. Now, cyber technology is no longer a tool but is embedded in human life which later became the entry point of the Industrial Revolution Era 4.0 (Syamsuar & Reflianto, 2018). The world of education responds to this phenomena with the birth of education 4.0 to integrate cyber technology in learning (Priatmoko, 2018). The learning activity is aimed at improving students' skill and competence in achieving competence of attitudes, knowledge, and skills (Bao, Xiao, Koenig, & Han, 2018). Several aspects of 21st-century skills must be mastered by students including learning and innovating skills consisting of critical thinking skills, problem-solving, communication and collaboration skills, creativity, and innovation, especially in science (S. Lestari, 2015; Mulhayatiah, Setya, & Suhendi, 2019) .

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*Açıklama [T4]: Only Lestari, remove S*

*Açıklama [T5]: Order authors alphabetically in parentheses https://apastyle.apa.org/learn/faqs/references-in-parentheses*

Physics is one of the components of science. Studying physics will not be enough if only knowing and memorizing, but students must understand the concepts (Anwar et al., 2019; Boisandi & Darmawan, 2017; Diani, Yuberti, & Syarlisjiswan, 2018; Kallesta & Erfan,

2018; Sari & Swistoro, 2018). Therefore, physics is also a mean for developing thinking skills and problem-solving skills for the students. Besides, physics material is closely related to events that we experience in everyday life (Pareken, Patandean, & Palloan, 2015; Sagala, Umam, Thahir, Saregar, & Wardani, 2019; Saregar et al., 2018; Sulistyaningrum, Prihandono, & Subiki, 2015).

One of the concepts of physics is the momentum and impulses which are related to daily life that will make it easier for students to solve a physics problem (Zafitri, Fitriyanto, & Yahya, 2018). The skill to solve problems will facilitate a person in finding solutions through a process that involves the acquisition and organization of information so that the problem can be resolved with excellent and correct steps (Amanah, Harjono, & Gunada, 2017; Kahar, Wekke, & Layn, 2018; Supeno, Subiki, & Rohma, 2018).

The pre-research test of problem-solving skills was conducted in the tenth-grade of SMA N 2 Bandar Lampung. Researchers provided a test in the form of multiple-choice questions about the basic concepts of kinematics motion of objects. The obtained result was that the average skill to solve physics problems was still low with a percentage of 40%. The low skill of students' problem-solving indicated that the students were still unable to understand the material. The low problem-solving skills in learning physics are usually caused by the lack of thought development efforts that lead students to actively solve a problem (Makrufi, Hidayat, Muhardjito, & Sriwati, 2016).

One way to overcome the students' problem-solving skills is by applying a problem-based learning model (Hakim, 2015; Madio, 2016; Yusmanidar, Khaldu, & Mudatsir, 2017). If the problems are presented in a real-life context, context-based problems will form. The different learning model is continuously being developed for more effective and permanent learning (F. Lestari et al., 2019). One of the social constructivism models is the Context and Problem Based Learning (C-PBL) model where teaching and learning activities are in the form of groups, hence, cooperation is needed in finding concepts and directing students to focus on addressing events systematically and planned (Baran & Sozbilir, 2018; Malik, Kurnia Y, & Robiatus S, 2016). The C-PBL process involves students who are given scenarios to process hypotheses which in turn creates the development of individual learning needs (Harijanto, 2017).

**Açıklama [T6]:** Remove F only Lestari

Student needs for learning models that can actively involve them will make the learning process more meaningful, especially by using learning models that are appropriate to students' skills (Baran & Sozbilir, 2018). Learning through context-based problems using real-life contexts and problems to support students to control over their learning, the Context and Problem Based Learning (C-PBL) model results in better learning (Syahrul, Murni, & Siregar, 2019).

Related research that has been conducted by other researchers including Context and Problem Based Learning through integrated approaches can increase student confidence in solving problems in chemistry learning so that learning could be more efficient (Baran & Sozbilir, 2018), The Problem-Based Learning Model is proven effective in improving problem-solving skills compared to conventional learning models (Yulianti, 2018), the use of C-PBL increases communication skills, students' achievement, and students' interest in the material and skills in utilizing time effectively (Williams & Mckenzie, 2013).

A lot of researches on the use of context and problem-based learning model have been conducted but the difference of this research with the previously conducted one lies in the dependent variable that is the skill to solve problems and the application of the C-PBL model on the momentum and impulses material. So that the researchers consider it is necessary to research the application of context and problem based learning models and its effects on the skills to solve physics problems.

## Method

*Research Goal*

The difference of this research with the previously conducted one lies in the dependent variable that is the skill to solve problems and the application of the C-PBL model on the momentum and impulses material. The purpose of this study is to describe the effect of the model on students' skill to solve physics problems.

*Sample and Data Collection*

The research method used is the quasi-experimental with non-equivalent control group design. The design in this research involved the experimental class and the control class. The research design is shown in Figure 1.
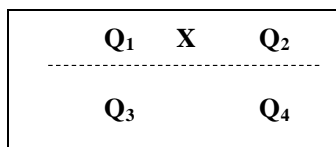
$$
\begin{array}{ccc}
Q_1 & X & Q_2 \\
\hdashline
Q_3 & & Q_4
\end{array}
$$

**Figure 1.** The Non-equivalent Control Group Design

**Note:**

$O_1$: Pretest in the experimental class

$O_3$: Pretest in the control class

X: Treatment with using Context and Problem Based Learning (C-PBL) model

$O_2$: Posttest in the experimental class

$O_4$: Post-test in the control class (Sugiyono, 2016).

The populations in this study were all students of the tenth grade of science major of SMAN 2 Bandar Lampung. Sampling was done using simple random sampling technique of two classes or 70 respondents with a range of 15-16-year-olds. The treatment in the experimental class was the Context and Problem-Based Learning (C-PBL) model and in the control class was Problem-Based Learning (PBL) model. The instrument used in this study was in the form of essay questions to measure problem-solving skills. However, before being given the treatment, a pretest was given to know the level of fundamental skill of students. The following is the flowchart in implementing the C-PBL learning model:

**Açıklama [T7]:** Provide more details on the treatment process. Teacher competencies for the application of C-PBL, lesson content, lesson design, lesson duration, in-class tasks/activities, pre - post test time, pre-post test exam content, exam validity etc
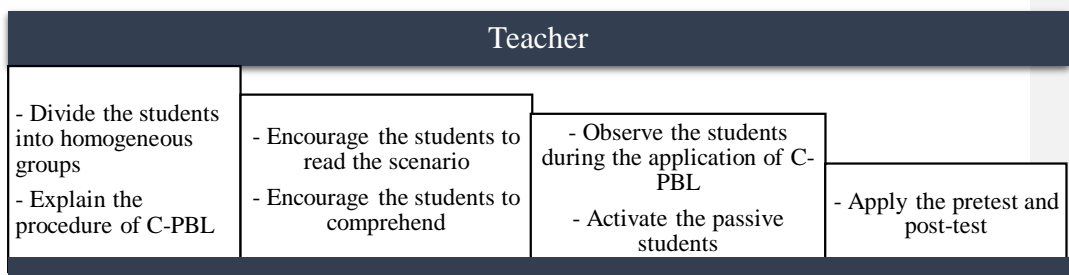
| Teacher | | | |
|---|---|---|---|
| - Divide the students into homogeneous groups<br>- Explain the procedure of C-PBL | - Encourage the students to read the scenario<br>- Encourage the students to comprehend | - Observe the students during the application of C-PBL<br>- Activate the passive students | - Apply the pretest and post-test |

**Figure 2**. The Teacher's Role in the Application of C-PBL Model

| Students | | | | |
|---|---|---|---|---|
| Read and understand the scenario and decide what should be known | The students try to discover the answers for the problems through group discussion | The students identify what should they know to answer the problems and to conduct the research | Analyze the data and information gathered to find the conclusion | Presentation by the students |

**Figure 3**. The Students' Role in the Application of C-PBL Model

*Analyzing the Data*

To test the hypothesis, t-test was employed. The data of problem-solving skills were obtained after the sample was given treatments. The statistical test was carried out at a significance level of 5% using the PASW 18 program. In this study, the pre-requisite tests were conducted to test the normality and the homogeneity.

**Findings**

Data in this study is the data of problem-solving skills. The data obtained from the experimental class with 34 students aged 15-16 years using the C-PBL model and the control class with 36 students aged 15-16 years using the PBL model. The data of students' physics problem-solving skills in the experimental class and the control class after the application of the learning models can be seen in Table 1.

**Table 1**. The Data of Physics Problem solving skills based on the Learning Models.

| Groups | Numbers of Data | Max score | Min score | Average | Std. Dev |
|---|---|---|---|---|---|
| Experimental (Model C-PBL) | 34 | 95 | 62 | 81,56 | 9,93 |
| Control (Model PBL) | 36 | 89 | 55 | 71,08 | 10,02 |

Table 1, shows the results of the physics problem-solving skills of each class. The table shows that the average score of the experimental class is higher than the control class with a relatively equal score distribution. Judging from the magnitude of the standard deviation which is approaching zero, the distribution is more uniform with the average data obtained.

The percentage of the students' problem-solving skills' scores for each indicator of the experimental class and the control class in detail is presented in Figure 4.
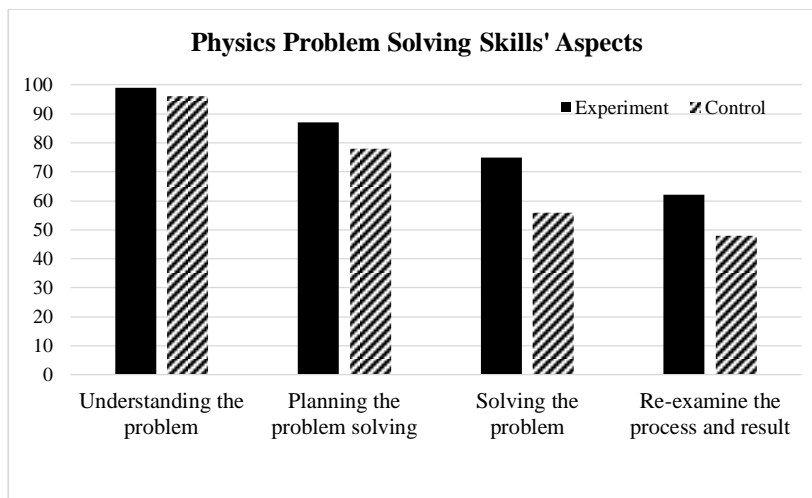
**Figure 4.** The Percentage Diagram of the Achievement of Physics Problem solving skills on each indicator.

Based on the results of the analysis of the problem-solving skills score data based on Figure 4, based on the four aspects, it appears that the highest score is in the aspect of understanding the problem in the experimental class and control class. In this aspect, the students must be able to identify and write a variety of information displayed from the questions asked, because in solving a problem, an important point that must be done first is to understand the problem. The results of this study are in accordance with the results of previous studies which suggested that the aspect of students' greatest problem-solving skills lies in the aspect of understanding the problem. (Yu, Fan, & Lin, 2015). Meanwhile, the lowest score is the aspect of re-examining the process and results.

**Prerequisite Test Analysis**

Hypothesis testing used in this study was Independent Sample t-Test. The test criteria were based on the probability value that is if the probability is (sig)> 0.05 then $H_o$ is accepted = no effect, if the probability is (sig) <0.05 then $H_o$ is rejected = there is an influence. The requirements that must be met before conducting a hypothesis test are the normality test and the variance homogeneity test. If the data is normally distributed then parametric statistical techniques can be done, whereas if the data is not normally distributed then the statistical technique that must be used is non-parametric statistics.

**Normality**

The normality test used was the Kolmogorov-Smirnov one-sample test on the PASW 18.00 program with the level significant of 5% or 0.05. Normality test was carried out in the experimental class and the control class in the pretest and posttest. The provisions of the normality test are if the significant value is > 0.05 then the data is normally distributed. Meanwhile, if the significant value is <0.05, the data are not normally distributed. The results of the normality test can be seen in Table 2.

**Table 2.** Normality Test Results

| Group | | Significance | Result |
|---|---|---|---|
| Experimental | *Pretest* | 0,082 | Normal |
| | *Posttest* | 0,200 | Normal |
| **Group** | | **Significance** | **Result** |
| Control | *Pretest* | 0,095 | Normal |
| | *Posttest* | 0,200 | Normal |

Table 2, the normality value of the pretest-posttest data in the experimental and control classes is sig> 0.05, so it can be concluded that the data are normally distributed.

**Homogeneity Test**

Homogeneity test was done to find out whether the experimental class and the control class have the same variance or not. In this study, the homogeneity of variances test was assisted by the PASW 18.00 program with a significance level of 5% or 0.05. Homogeneity test was performed on the pretest and post-test data in the experimental class and the control class. The provision of the homogeneity test is; if the significance value is > 0.05, then the data is homogeneous. Meanwhile, if the significance value is<0.05, the data is not homogeneous. The homogeneity test results can be seen in Table 3.

**Table 3.** Homogeneity Test Results

| Data | F | Significance | Criteria |
|---|---|---|---|
| *Pretest* | 1,677 | 0,112 | Homogeneous |
| *Post-test* | 0,989 | 0,717 | Homogeneous |

Table 3 shows that the homogeneity of the sig test value of students' problem-solving skills in the pretest and post-test is> 0.05, so it can be concluded that the data in the experimental and control classes have same or homogeneous variance.

**T-test**

T-test was done after it is known that the data is normally distributed and homogeneous (parametric statistics). The requirement of the t-test is if sig> 0.05 then $H_0$ is accepted = no

difference or influence, if sig <0.05 then$H_0$ is rejected = no effect. The summary of t-test results is presented in Table 4.

**Table 4.** The result of Independent Sample t-Test

| Data | T | Significance | Result |
|---|---|---|---|
| Problem-solving skills | 4,400 | 0,000 | There is an influence |

The results of the Independent Sample t-Test, based on Table 4, it can be concluded that there is an influence on the model that was applied with a significant gain of 0,000 (sig <5%, $H_{0A}$ is accepted). This means that there is an influence on the model used. The posttest data shows the students' average problem-solving skills in the experimental group are 81.56 and in the control group is 71.08. These results explain that students who received treatments using the C-PBL model have higher problem-solving skills. To see an increase in students' physics problem-solving skills and find out how much influence C-PBL learning can be seen in Table 2.

**Table 5.** Results of Effect Size Analysis

| Class | AverageGain | Standard Deviation | Effect Size (d) | Category |
|---|---|---|---|---|
| Experimental | 0.66 | 0.17 | 0.69 | Medium |
| Control | 0.55 | 0.15 | | |

Table 5, the effect size results is 0.69, so it is included in the medium category. These results indicate that the Context and Problem Based Learning (C-PBL) model is quite effective in improving the skill to solve physics problems.

**Discussion and Conclusion**

Problem-solving skills are the skills of a person to find a solution through a process that involves obtaining and organizing information (Azizah, Yuliati, & Latifah, 2016). The C-PBL model applied provides higher physics problem-solving skills because, in this learning, the students are required to be able to solve problems presented in the context of physics applications in real life. This C-PBL model trains students to identify and find the factors that cause physics problems in daily life, especially on the momentum and impulses material so that solutions can be found in solving the problem.

Problem-based learning model requires students to be able to solve contextual problems provided (Sanjaya, 2010). The use of context-based learning models that make problems the main focus can stimulate students during learning so that students can be active in exploring knowledge and can link their knowledge based on the events they experience in real life.

Previous research related to C-PBL can improve communication skills, achievement, and students' interest in learning and using time effectively (Azizah et al., 2016) is indeed true. Group discussions conducted by students during the C-PBL learning process make them understand and comprehend the concepts of the material independently. The C-PBL model can improve students' communication skills because during the discussion they have to express their opinions and ideas while identifying and finding solutions to problem-solving on the momentum and impulse material. Indirectly, the students are trained to be brave and confident in expressing the results of their thoughts to other members of the group. This is by previous research that discovers the C-PBL model can increase students' confidence (Jua, 2018).

The learning process using the C-PBL model is student-centered. The teacher's task in this learning model is only as a facilitator and supervises students during the discussion process so that if students are found passive in learning, the teacher must encourage the students to be active during the learning activities starting from analyzing a problem in daily life and then communicating the idea to members of the group. Thus, this learning model can also train the students to collaborate in group learning.
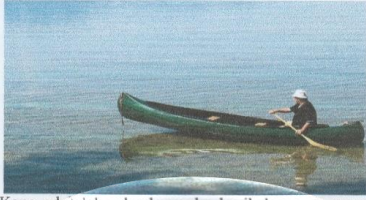
The following are the students' best answers from each of the experimental class and the control class. They are taken from the results of the pretest and posttest to see the difference in students' answers before and after the learning model is applied.

**Table 6.** Sample answers from the control class and experimental class

| Pretest | |
|---|---|
| **Eksperimen** | |

6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut!



Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg!

Jawaban :

Diketahui : $V_0 = 2$ m/s
$V_k = 4$ m/s
$m_o = 60$ kg
$m_k = 80$ kg

Ditanya : $V_k' = ...?$

Jawab :

$$P = P'$$

$$60 \cdot 2 + 80 \cdot 4 = (80 + 60) \, V_k'$$

$$120 + 320 = 140 \, V_k'$$

$$140 \, V_k' = 440$$

$$V_k = \frac{440}{140}$$
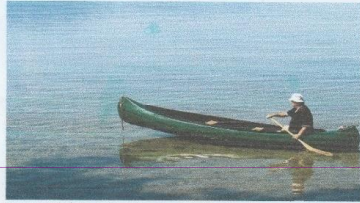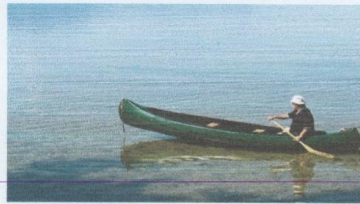
$$V_k = 3,14 \text{ m/s}$$

A canoe is man-powered, small, and narrow boat although sometimes a sail is also placed. If someone who is on the canoe, as illustrated in the picture, jumps into the water with 2 m/s speed against the direction of the canoe which is sailing with the speed of 4 m/s. Determine the speed of the canoe when the person with 60 kg of weight jumps from the canoe which is weighted 80 kg.

Question in English version

## Kontrol

6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut!



Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg!

Jawaban :

Diketahui : $V_0 = (2 m/s$
$V_1 = 4 m/s$
$m_1 = 60 kg$
$m_2 = 80 kg$

Jawab :

$V = \frac{s}{t}$

---

## *Posttest*

## Eksperimen

6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut!



Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg!
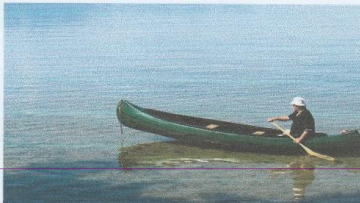
Jawaban :

Diketahui : $V_0 = V_k = 4 m/s$
$V_o' = -2 m/s$ (berlawanan arah)
$m_o = 60 kg$
$m_k = 80 kg$

Ditanya : $V_k' = ... ?$

Jawab :

Peristiwa ini berlaku Hk. Kekekalan momentum
$P = P' \Rightarrow P = m.V$
$m_o.V_o + m_k.V_k = m_o.V_o' + m_k.V_k'$
$60.4 + 80.4 = 60(-2) + 80.V_k'$
$240 + 320 = -120 + 80.V_k'$
$560 = -120 + 80.V_k'$
$80.V_k' = 560 + 120$
$V_k' = \frac{680}{80}$
$V_k' = 8,5 \ m/s$

Jadi kecepatan kano saat orang tersebut melompat menjadi 8,5 m/s

---

## Kontrol

6. Perhatikan gambar seseorang yang sedang mengendarai sebuah kano berikut!



Kano adalah sebuah perahu kecil dan sempit yang biasanya digerakan dengan tenaga manusia, tetapi juga lazim diberi layar. Jika seseorang yang sedang menaiki kano seperti tampak gambar diatas melompat ke dalam air dengan kecepatan 2 m/s berlawanan arah dengan gerak kano ketika kano bergerak dengan kecepatan 4 m/s. Tentukan kecepatan kano ketika orang tersebut melompat dimana massa orang 60 kg dan massa kano 80 kg!

Jawaban :

Diketahui : $V_1 = V_2 = 4 m/s$
$V_1' = -2 m/s$
$m_1 = 60 kg$
$m_2 = 80 kg$

Ditanya : $V_2' = ... ?$

Jawab :

$P = P'$
$m_1.V_1 + m_2.V_2 = m_1.V_1' + m_2.V_2'$
$60.4 + 80.4 = 60.-2 + 80.V_2'$
$240 + 320 = -120 + 80.V_2'$
$560 = -120 + 80.V_2'$
$80V_2' = 560 + 120$
$V_2' = \frac{680}{80}$
$V_2' = 8,5 m/s$

Jadi Kecepatan Kano Sebesar 8,5 m/s

Based on Table 6, we can see the comparison of answers of each student in the experimental class and control class in answering the question of pretest and post-test. When answering the pretest questions, before applying the learning model, most of them were wrong in analyzing the problems listed in the questions and wrong in using the formula so that the answers produced by the two students were wrong. After applying the different learning models in the two classes we see an increase in problem-solving skills in answering the problem. The experimental class students who were given the C-PBL model had more complicated answers than the control class students.

When answering the post-test questions, the two students from the experimental class and the control class can answer the questions well. However, there are differences in answers between students who got the C-PBL model in the experimental class compared to other learning model applied in the control class. The difference is known when students identified problems and make problem-solving plans. In the answer, a student of the experimental class explained "why when a person jumps into the water the speed is negative" by giving information that the person's direction of motion when jumping is the opposite of the canoe. This shows that the student understood the concept of events that occur in the problem. When making a problem-solving plan, the student explained why he must use the formula to solve the problem at hand.

Although the answers of the experimental class and control class students are equally correct, by explaining when answering the questions, the researcher knows that the student understands the physics concept not just understanding the mathematical concept. Thus, according to the researchers, the answers of the experimental class students were better than those of the control class. Learning physics is not only counting or understanding the mathematical concepts but the students must be able to interpret the physics meaning in every event that will facilitate students in learning physics. (Irwansyah, Sukarmin, & Harjana, 2018)

**Açıklama [T12]:** move dot/period to the end of citation

The teacher, before the lesson begins, must prepare in advance the context which will be given to students. Making scenarios is what the researchers think is quite difficult to do because the selection of scenarios needs to be adjusted to the material and its relation to real life. Thus, the teacher is indirectly required to think more creatively to produce a scenario that can be understood by the students.

Based on the analysis of the results and discussion, the conclusion obtained from this study is that there is an influence of the use of context and problem-based learning (C-PBL) model on the skill to solve physics problems. Also, the C-PBL model can improve students' communication skills, confidence, and student collaboration in group learning.

## Recommendation

In this study, it is clear that the C-PBL model can be used as an alternative to teaching, especially in the material of momentum and impulses. However, because the learning requires context, the teacher must be more creative and innovative so that the context made can be easily understood by students.

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