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Learning Design of Problem Based Learning Model Based on Recommendations of Sintax Study and Contents Issues on Physics Impulse Materials with Experimental Activities

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Abstract

This study aims to design learning Problem Based Learning Model based on syntax study recommendations and content issues on Physics Impulse materials through experiments. This research is a development research with Kemp model. The reference for making the learning design is the result of the syntax study and the content of existing PBL implementation problems from Agustina research. This instructional design is applied to the physics material about Impulse done through experimental activity. Limited trials were conducted on the SWCU Physics Education Study Program students group Salatiga, while the validity test was conducted by high school teachers and physics education lecturers. The results of the trial evaluation are limited and the validity test is used to improve the designs that have been made. The conclusion of this research is the design of learning by using PBL model on Impuls material by referring the result of syntax study and the problem content of existing PBL implementation can be produced by learning activity designed in laboratory experiment activity. The actual problem for Impuls material can be used car crash test video at factory. The results of validation tests and limited trials conducted by researchers assessed that the design of learning made by researchers can be used with small revisions. Suggestions from this research are in making learning design by using PBL model to get actual problem can by collecting news that come from newspaper, YouTube, internet, and television.

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INTRODUCTION

Problem Based Learning Model (PBL) is a learning approach that uses real-world problems as a context for students to learn about problem-solving skills (Arends, 2007). This PBL model is also recommended to be used in the implementation of the revised 2013 curriculum (Kermendikbud, 2016). Problems posed by teachers in PBL are issues related to the real world and interesting so that students are trained to solve problems that require creative thinking (Bilgin et al, 2009). Creative thinking needs to be developed so that students are able to solve problems encountered everyday. Everyday events related to nature, many can be solved by the concept of physics, for that students need to learn the concept of physics.

The PBL learning model has a syntax consisting of five stages of learning: (1) organizing students into problems, (2) organizing students to learn, (3) assisting independent and group investigations, (4) developing and presenting works and exhibitions, 5) analyze and evaluate the problem-solving process.

Preliminary research has been done the study of syntax and the content of the problem to some lesson implementation plan (RPP) and student worksheet (LKS) model problem based learning (PBL). The results of the study indicate that most of the research results from the application of PBL model with Physics material which has been published in the form of RPP and LKS is not in accordance with the syntax and the content of the problem because not all stages in the PBL are written in the RPP and LKS. Unexpected syntax is organizing students into problems, helping independent and group investigations and analyzing and evaluating problem-solving processes. The content of the problem tends to be an issue that is not actual or unrelated to daily events. It gives the impression that the contents of the problem are made up, the issues raised more to the experimental objectives and not the actual problems and more likely to solve mathematical problems (Agustina et al., 2017).

Based on these problems it is very urgent to design the learning in accordance with the actual syntax and content issues based on the results of the study as a reference in the use of PBL model. The learning model design of PBL based on syntax study and the content of this problem is done on Physics material about Impulse.

Design a model with Physics materials using the topic Impulse because the material Impuls the problem raised can be a problem that is often encountered and that is not often encountered. The topic of Impulse is chosen because the events that often occur in everyday life have to do with Impuls based on news, newspapers, and social media. It is expected to assist students in analyzing the problems that exist in the universe related to Impulses.

If an object is subjected to force over a certain time interval known as an impulse, then the object will experience a momentum change. Impulse can be formulated as a result of multiplication of force with interval time duration work force. Mathematically written:

$\vec{I} = (F)\,\vec{\Delta}t$ .... (1)

The purpose of this research is to design the Learning Problem Based Learning Model based on the recommendation of syntax study and the content of the problem on the Physics Impuls material through experiment.

METHODS

This research is a development research with Kemp (1985) model. The reference for the design of learning is the result of the syntax study and the content of existing PBL implementation problems from Agustina et al. (2017). This instructional design is applied to the physics material about Impulse done through experimental activity. Limited trials were conducted on the SWCU Physics Education Study Program students group Salatiga, while the validity test was conducted by high school teachers and physics education lecturers. The results of the trial evaluation are limited and the validity test is used to improve the designs that have been made.

RESULTS AND DISCUSSION

The learning design using the PBL model on the Impulse material is done by referring the results of the syntax study and the problem content of the existing PBL implementation. Learning activities are designed in a laboratory experiment. The design of PBL learning model with Physics topic of Impuls that has been validated by one of Satya Wacana Christian High School Satya Christian teacher teacher and two lecturers of Satya Wacana Salatiga Christian University Satya Physics Education is shown in Table 1.

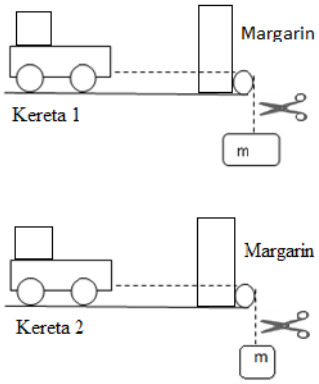
Table 1. Design of PBL Learning with bases om syntax study and content of problem

Core Competencies: 1. Understanding, applying and explaining, factual, conceptual, procedural, and metocognitive knowledge, in science, technology, art, culture, and humanities, with the insights of humanity, nationality, state, and civilization-related phenomena and events, and applying procedural knowledge In a specific field of study according to his or her talents and interests to solve the problem. 2. Try, process, and organize in the realm of concrete and abstract realms related to the development of the self-study in schools, and able to use methods according to the scholarship.				
Core Competence	Basic Competence		Indicator of Competence Achievement	
	1.1 Describing Momentum, Style and Impulse and its application in daily life.		1.1 Explain the notion of Impulse. 1.3 Finding the relationship between Impulse and Momentum mathematically. 1.5 Explain the application of Impulses in everyday life.	
	2.1. Presents real issues and proposed solutions related to the concept of Style, Impulse.		2.1 Explain Impulse understanding through discussion. 2.3 Finding the relationship between Impulse and Momentum mathematically. 2.4 Explain the applications and Impulses in everyday life through discussion.	
Steps of Model Problem Based Learning	Time Allotment	Suggestions from the PBL Study Results	Teacher Activities	Tudents Activities
Phase I (Organizing Students to Problems)	10’	Learning Motivation Presentation..	Kegiatan 2 The teacher opens the lesson with greetings to invite students to pray together. Teacher reviews previous meetings by asking students about Momentum materials that have been discussed at previous meetings.	Students answer greetings from the teacher and one of the students leads the prayer. Students answer questions given by teachers.
		Presentation of Learning Objectives. Presentation of actual problem given to the students.	Teacher reviews previous meetings by asking students about Momentum materials that have been discussed at previous meetings. Teacher plays video about car crash test at factory. After the teacher shows the video, then the teacher	Students listen to what is taught by the teacher. Students pay attention to the football video game and answer the supplementary questions given by

			asks the dribblers question: Based on the car crash test video at the factory, How was the situation before the car hit the wall? How's the car after crashing into the wall? How is the Momentum of the car before it hit the wall and after crashing into the wall, fixed or not?	the teachers. Students propose a hypothesis to the students.
		Summary of problems given to students.	In this event what caused the Momentum car change? Teacher asks students about any Factors that affect the magnitude of the change in Momemtum objects? Hypothesis: Style (F) Time (t) If the student gives a hypothesis that is not appropriate with the factors to be investigated then the teacher asks the question of the dribblers to lead the next learning activity the teacher asks: Does the magnitude of force and duration of the force acting on the object affect the magnitude of the change of momentum of the object?	
Tahap II (Organizing Students to Learn)	10’	Teachers invite students to discuss designing experiments.	Teachers invite students to discuss designing experiments to investigate the effect of Style and Time on the magnitude of the momentum change of objects as follows: How is the experimental design to investigate the influence of Style and Time on the magnitude of the change in Momentum? What objects will be used to observe the change in Momentum objects? (Objects that have masses, objects that have a force and a moving object) Can one use a train? (Can) How to give Style to a stylishly styled train? (Pulling a train with a rope connected to a hanging load, where load masses can be set) How to set the length of time working style on the train? (By cutting the rope on the load hanging on the train)	Students conduct discussions by answering questions provided by teacher-related experiments that will be designed to investigate the effect of Style and Time on changes in Momentum of objects. Students are free to express their opinions on experimental design.

		Info: To see the comparison of the magnitude of the change in Momentum the object is used 2 strollers simultaneously in each experiment. How do I see how big the changes in Momentum change from both trains? (By looking at the results of margarine bans hit by the train) How to keep the train stable when pulled by the load? (By adding a load on the train) From the discussion, what tools are needed to investigate the effect of Style and Time on the change in Momentum? ((Train, load, pulley, rope, margarine and scissors).	
	Teachers divide students into groups. Teacher gives student inquiries to solve actual problems. Teacher gives student inquiries to solve actual	Master divides the class into 6 groups: 3 groups to investigate whether Style influences the magnitude of the Momentum changes in objects and 3 groups to investigate whether Time affects the magnitude of the Momentum change of objects. The teacher gave the question led to design experiment to 3 groups that investigated the influence of the Style on the magnitude of the change of Momentum objects, as follows: Question led to design experiment: If we want to investigate whether the Style affects the magnitude of the Momentum change of matter, then: What are the independent variables or should be changed? (The force acting on the object (F)) How to change the size of his style? (By changing the mass of the load hanging) What are the control variables or to be made fixed? (Time (t)) and Train Mass (m)) How to set the time interval of the working force on the object to have the same value? (By cutting the rope	Students join their own groups according to the division by the teacher. • Students in groups who investigate the influence of Style, answer the question of herding.

		problems.	at the same load) What are the dependent or observed variables? (Changes in the magnitude of the momentum of the object (P)) How to determine the largest Momentum object change? (Judging from the deepest margarine pickings after being hit by a train) Teachers provide a questionnaire for designing trials to 3 groups that investigate the influence of Time on the magnitude of change of Momentum objects, as follows: Question led to design experiment: If we want to investigate whether Time affects the magnitude of the Momentum change of things, then: What is the free variable or should be changed? Time (t)) How to change the length of time the working force on the object? (By cutting the rope on the load at different time intervals) What are the control variables or to be made fixed? (Train mass (m) and Style (F)) How to make the Style that works on the same train? (By hanging the same Mass on the hanging load) What are the dependent or observed variables? (Changes in magnitude Momentum of objects (P)) How to determine the largest Momentum object change? (Judging from the deepest margarine pickings after being hit by a train)	Students of the group investigating the influence of Time, answering the dribblers' questions.
Phase III (Assisting Independent Investigation and Group)	30’		Experiment 2.1 (Investigating the Style Relationship to the Amount of Momentum Change) Available 2 trains with different load suspended and on top of the car placed the same mass load. Then 2 trains are released	

	simultaneously from the same position. After moving then the rope over the load is cut simultaneously. Info: Each group is asked to record the experiment.  $F_1 > F_2$ $m_1 > m_2$ $t_1 = t_2$ $M_1 = M_2$ Teachers encourage students in groups who investigate the influence of Style to gather information through incoming questions. Question Gazing Observing: What is the state of margarine after the car crashes? (Margarine) If the Car is given a different Style in the same time, what is the result of the same margarine detergent? (The resulting margarine filter is different). Which bigger penis, margarine on car 1 or car 2? (Margarine on the 1st car is bigger than the margarine on the car 2).	
Teachers encourage students to carry out experiments by collecting appropriate information.		Students answer questions given by teachers to gather information.
Teachers encourage	Observation result The margarine on the train 1 is larger than the margarine on the 2nd train. The teacher guides the students to analyze the experimental results to find explanations, solutions and draw conclusions by providing the	Students answer questions asked by teachers and solve problems through experiments.

	students to carry out experiments, seek explanations, and solutions.	following escort questions: The question draws a conclusion: Before the two trains are released how early is the train speed? (Zero initial speed) What is the momentum of the beginning of both trains? (Momentum start of second train zero) After the carriage is released and the load is pulled at the same time interval by different loads and until it hit the margarine, how is the beam generated by the two trains? (The bears that the two different trains carry), which Margarine is more stoned, hit by train 1 or train 2? (Hit by train 1) After the train is pulled by different loads at the same time interval, Do both trains have the same Momentum? (No), then which train has a greater Momentum, judging from the resulting suction? (Train 1) How does Momentum end to the two trains after being given different styles in the same time? (different) Which train has changed the momentum of the largest object, which gets the Biggest or Smallest Style? (Train 1 has the greatest Momentum of the trains 2) Does Style affect the magnitude of Momentum change? (yes) How does the style influence the magnitude of the change in Momentum? (The bigger the Style that works on the object, the greater the change in the Momentum of the object.) Is the Style proportional to the magnitude of the change of Momentum of the object? (The style is directly proportional to the momentum change of the object) Conclusion: The bigger the Style that works on the object, the greater the Momentum will change.

The force is directly proportional to the magnitude of the momentum of the object changes.

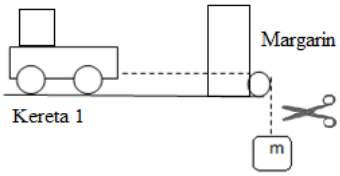
Mathematically:

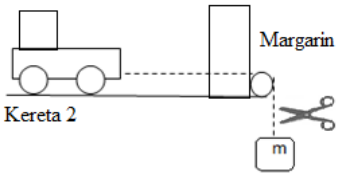
$$\Delta P \sim F$$

Trial 2.2 (Investigating the Relation of Time to the Amount of Momentum Change)

Provided 2 cars drawn by loads hung with the same mass on the car loaded with the mass of the same mass. Then 2 trains are released simultaneously from the same position. After moving then the rope over the load is cut at different times. Strap on Car Load 1 is cut first from strap on car load 2.

Info: Each group is asked to record the experiment.





$$F_1 = F_2$$
$$m_1 = m_2$$
$$t_1 > t_2$$
$$M_1 = M_2$$

Teachers encourage students in groups that investigate the influence of Time to gather information through incoming questions.

Question led to observe:

What is the state of margarine after being hit by the train? (Margarine Penyot)

If the Train is given the same Styles in different Time intervals, Are the resulted scrapings the same?

Teachers encourage students to carry out experiments, seek explanations, and solutions.

Siswa menjawab pertanyyan penggiring yang diberikan oleh guru dan menyelesaikan pemecahan masalah melaui eksperimen.

(Different margarine extracts are produced)
Does the time given to the train affect the margarine beater? (yes)
Which margin has a bigger purse, margarine on train 1 or train 2?
(Margarine on train 2 larger bigger than the margarine on train 1)
Observation result
The margarine on the train 1 is smaller than the margarine on the 2nd train.

Question led to draw conclusions:
Before the train is released how early train speed? (Zero initial speed).
What is the momentum of the beginning of both trains? (Momentum start of the second train zero).
After the carriage is removed and pulled at different time intervals by the same load, how is the runway generated by the two trains? (The bears that the two different trains carry) Which margin is the better one, hit by train 1 or train 2? (Hit by train 2) which has a time interval of working style for a while or longer? (Long time interval working style)
How does the end momentum to the two trains after being given the same style in different times? (different)
Which train has changed the momentum of the largest object, subject to style for a while or longer? (The longer styled train 2 which will experience the greatest Momentum change of the body from the train 1 which is stylish only briefly)
What is the effect of Time on the magnitude of the change in Momentum? Directly proportional or inversely proportional? (The time is directly proportional to the momentum change of the object,

			the greater the time interval of the working force on the object, the greater the change in the Momentum of the object.) Conclusion: The larger the time interval of work on the object, the greater the change in the Momentum of the object.) The time interval of the working force on the object is directly proportional to the magnitude of the change in the momentum of the object. Mathematically: $\Delta P \sim t$	
Tahap IV (Mengembang-kan dan Mepresentasi-kan Hasil Karya serta Pameran)	20’	Teacher asks student to make report of problem solving. Teacher asks student to present problem solving result.	Teacher asks each group to make reports of troubleshooting process and record experiment in video form. Teacher asks representatives of each group to investigate the influence of Style and Time to present reports on powepoint slides and display experimental videos performed on each group.	Students make reports of experiments that have been done and record experiments that have been done. Students who are appointed by each group to represent their group forward the class to present the reports that have been made by each group.
Tahap V (Menganalisis dan Mengevaluasi Proses Pemecahan Masalah)	20’	Teachers help students analyze the problem-solving process that is given to students. Teachers evaluate the problem-solving process that is given to students.	The teacher analyzes the problem-solving process by asking 'From the car crash test at the factory, how did the car go before hitting the wall? How's the car after crashing into the wall? The teacher evaluates the problem-solving process by asking students about what factors affect the magnitude of the Momentum change of things? (Style (F) and Time (t)), How does the force influence the magnitude of the Momentum change of the object?	Students answer questions given by teachers. Students answer questions given by teachers.

	(The bigger the Style the greater the Momentum changes things), How is the effect of Time on the magnitude of the Momentum change of things? (The bigger the time the greater the Momentum changes things). The teacher directs the students to draw conclusions from the learning process by explaining that the magnitude of Momentum change in Physics is called the Impulse experienced by an object. Impulses are influenced by Style and Time. Information: Transformation Momentum = Impuls $\Delta P = I \rightarrow I = F.\Delta t$ $m\,.\Delta v = F.\Delta t$ Teacher gives problem-solving questions related to the magnitude of Momentum change as follows: Have you ever seen Boxing matches on TV? Boxing players often use boxing gloves to extend the working style of the Impuls. If the contact time is longer then the force acting on the Impulse, like what? If the force that works on a small Impulse, how is the pain experienced by the boxer when he receives a blow? A ball of mass of 0.5 kg is initially silent, then the ball is kicked with a force of 10 N. The length of the foot touches the ball of 0.1 s, Calculate (a) The impulse experienced by the ball? (B) Ball speed after being kicked?	Students listen to the teacher's direction to conclude the learning process that has been done. Students answer questions given by teachers.

Validation test on Stage I (Student Organizing to Problem) that has been done by validator indicate that video given to student at the beginning of activity less appropriate with experiment will be done so that researcher do revision. Previously the video to be aired was a video about football games. The videos and questions are judged to be inconsistent with the experiments to be performed in the lesson. The validator suggests converting a football video game with a crash test video test vehicle in the factory. While the limited trial of PBL model learning design in Stage I (Student Organizing to Problem) students have been able to understand the formulation of problems given by the teacher in the form of question - the question of herding.

Validation test on Stage II (Organizing Students for Learning) which has been done by the validator shows that no revisions and validation results indicate that the assessment of draft questions designing the given experiment can be understood and answered correctly by the student so that the assessment given is good enough against The design of teacher activities and student activities by the validator. While the trial is limited to the design of PBL model learning in Stage II (Organizing Students for Learning) that some students have been able to answer and understand the questions - penggiring design experiments provided by the teacher.

Validation tests in Stage III (Assisting Independent and Group Investigations) indicate that no revisions and validation results show that the experimental questions made have been assessed well by the validator. While a limited trial of PBL model learning design in Stage III (Assisting Independent Investigation and Group) there are some students have been able to answer the question of dribbers observing the experiment and able to experiment properly to solve the problems given by the teacher.

Validation test at Phase IV stage (Developing and Presenting Results of Work and Exhibition) shows that there is no revision and validation result indicate that teacher have direct student to make report and present result of problem solving which has been assessed good by validator. While the limited trial of PBL model learning design in Phase IV (Developing and Presenting Results of Work and Exhibition) that all students have been able to make a report of problem solving.

Validation test on Stage V (Analyzing and Evaluating Problem Solving Process) shows that no revisions and validation results indicate that the teacher has helped students analyze and evaluate the problem-solving process given to students who have been assessed well by the validator.

While a limited trial of PBL model learning design on Stage V (Analyzing and Evaluating Problem Solving Process) that some students have been able to answer questions given by teachers in analyzing and evaluating the problem-solving process.

Figure 1. Limited trials with students

CONCLUSION

The conclusion of this research is the design of learning by using PBL model on Impuls material by referring the result of syntax study and the problem content of existing PBL implementation can be

produced by learning activity designed in laboratory experiment activity. The actual problem for Impuls material can be used car crash test video at factory. The results of validation tests and limited trials conducted by researchers assessed that the design of learning made by researchers can be used with small revisions.

Suggestions from this research are in making learning design by using PBL model to get actual problem can by collecting news which come from newspaper, YouTube, internet, and television.

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