Preliminary development of POEAW in enhancing K-11 students’ understanding level on impulse and momentum

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Abstract. We have been analyzed that there were limited research about Predict-Observe-Explain which use writing process with conceptual change text strategy. This study aims to develop a learning model namely Predict-Observe-Explain-Apply-Writing (POEAW) which is able to enhance students’ understanding level. The research method utilized the 4D model (Defining, Designing, Developing and Disseminating) that is formally limited to Developing Stage. There are four experts who judge the learning component (syntax, lesson plan, teaching material and student worksheet) and matter component (learning quality and content component). The result of this study are obtained expert validity test score average of 87% for learning content and 89% for matter component that means the POEAW is valid and can be tested in classroom learning. This research producing POEAW learning model that has five main steps, Predict, Observe, Explain, Apply and Write. To sum up, we have early developed POEAW in enhancing K-11 students’ understanding levels on impulse and momentum.

1. Introduction
Impulse and momentum is one of the fundamental concept in mechanics while the students are learning physics. This concept is taught to K-11 senior high school in Indonesia curriculum. Impulse and momentum concept have several sub concept, consist of linier momentum, the law of momentum conservation, impulse, collision, relationship of conservation of energy and momentum. This concept is important to be learned because it is dealing with every collision that often we act in daily experience. Many students hold difficulties to solve problem about impulse and momentum because they have lack understanding of the concepts and they get a problem in using vectors rule. Student think the relation between impulse and momentum in the form of equation [1] as shown by figure 1.

Figure 1. Collision of two balls [1]
Moreover, field study about physics teaching and learning in the impulse and momentum concept result that student just memorize about the kind of collision such as elastic collision and inelastic collision. They have not understand the relationship between the kind of collision and conservation of kinetic energy. Students have difficulty to solve the problem about one-dimensional motion in collision with different direction, as shown in Figure 1. The difficulties occurred because student thinks that momentum is scalar. The difficulty The one of problem that make students have difficulty to understand about concept because physics learning has been taught utilized classical teaching learning and it has not been able to increase students’ conceptual understanding [2-4]. As consequences, the lack of understanding about impulse and momentum concept should be able to make learning process is repaired, one of them through development of learning model.

To make a learning process more attractive is needed learning process which make students to active. An active learning sequence such as Predict-Observe-Explain (POE) is able to help the student replace their alternative conception, make them more open to adopting scientific conceptions and has probed students’ understanding of science concept [4-6]. The one of active learning utilize. POE have three main phase in consist predict, observe and explain. In POE strategy, students is requested to make a prediction about a problem. Then, they observe a demonstration or simulation which is showed by teacher. After that, they explain about the difference of their prediction and their observation.

There are several development of POE model which was done. One of them is Predict-Observe-Explain-Apply (POEA). POEA is developed by Syuhendri [6] from POE strategy and conceptual change text which utilized conceptual change text. Apply phase is added because to make a learning process that suitable with conceptual change model as mentioned by Posner [7-8]. In apply phase, students utilize new concept to solve new problem.

We have been analyzed that there is limited research about writing process in learning activity to improve students’ understanding. The result of learning process which integrate TTW strategy indicate that empower students’ metacognitive skills [9]. To integrate writing process in learning activity, we utilized Think-Talk-Write strategy in development of learning model. We have developed POEA strategy to Predict-Observe-Explain-Apply-Writing with integrating TTW strategy. So, integrating TTW strategy made POEA strategy have writing process and is generated to POEAW learning model that have five main phase in consist, predict, observe, explain, apply and write. This study aims to develop a learning model namely Predict-Observe-Explain-Apply-Writing (POEAW) which is able to enhance students’ understanding level.

2. Methods
The research method used the 4D model (Defining, Designing, Developing and Disseminating). This study was limited to developing stage. In defining and designing stage, literature analysis and study field was done about learning model that want to be developed. The researcher development learning model from POE strategy, conceptual change strategy and Think-Talk-Write strategy. Relationship between POE, conceptual change and Think-Talk-Write strategy is shown in Figure 2. Then designing material that will be used. In developing stage, validity test was measured by four experts to judge learning content and matter content. Learning component consist of syntax, syllabus, learning material and students’ worksheet and matter component consist of learning quality and content component. Disseminating stage will be done in future research. Construct and content validity test utilizing questionnaire with Likert’s scale of 1-4, be modified to percentage score (%).
Figure 2. Relationship between POEAW learning model, conceptual change strategy and TTW strategy

3. Results and Discussion
POEAW is learning model that was developed to enhance students' understanding level. The development of these learning model follows the 4D model (Defining, Designing, Developing and Disseminating).

Table 1. Integration of POEA strategy and TTW strategy

| POEA strategy [7] | TTW strategy | POEAW model |
|------------------|--------------|-------------|
| Predict (making prediction) | Think (finding information from outside or themselves) | Predict (making prediction) |
| Observe (doing observation or experiment) | Talk (communicating/discussing with teachers or friends) | This stage is identical to the Think stage in TTW |
| Explain (giving explanation of prediction) | Write (writing the discussion result) | Observe (doing observation or experiment) |
| Apply (applying new concept) | | This stage is identical to the Think stage in TTW |

3.1. Defining Stage
Development of POEAW begins with the defining step. In this step, the requirement of learning was defined. The requirement was done by literature analysis and field studies. The result of literature analysis is students should have concept understanding in order to mastering higher other cognitive abilities. Enhancing students’ understanding can be done by applied Predict-Observe-Explain (POE) model and conceptual change model. Writing process also can be used to make student more understanding the concept. Physics concept that be utilized in the learning model development is
impulse and momentum. The result field studies is teachers often use lecture methods, and teacher rarely use instructional media.

3.2. Designing Stage
After defining the requirement of learning, the researchers design a prototype of learning model and learning material i.e. syntax, syllabus, conceptual change text as learning material and student worksheet. The development of learning model use model POE and conceptual change model. There are four important condition that should be fulfilled to deliver conceptual change: (1) dissatisfaction; (2) intelligibility; (3) plausibility; and (4) fruitfulness [7-13]. Integration of conceptual change model and POE made the addition of Apply stage in POE [14]. So, development of POE produced POEA strategy [4]. Development of POEA was done by integrating it Think, Talk, Write (TTW) strategy. Integration of POEA strategy and TTW strategy is shown in Table 1.

3.3. Developing Stage
After going through the designing stage, the researcher developing syntax, lesson plan, teaching material, student worksheet and asking expert judgment. Syntax and learning activities is shown in Table 2.

| POEAW learning stage | Teachers’ Activities | Students’ Activities |
|----------------------|----------------------|----------------------|
| **Predict**          | Giving problem to students. Distribution The students’ Work sheet. | taking concept problem and discussing it with members of the group to prediction the solution of the problem. Group reports their prediction in class discussion and explaining their reason |
| **Observe**          | Showing Demonstration Or simulation to Confront Conflict cognitive. | Observing demonstration or simulation is shown by teacher. |
| **Explain**          | Asking explanation About students’ prediction and Their observation result. | Thinking about discrepancy between what they are thinking and happening. Explaining about the discrepancy. |
| **Apply**            | Giving new problem to be solved by students. | Returning to each group and discussing again about the new problem with groups. |
| **Write**            | Asking students to answer the problem in individual worksheet. | Writing their though after discussing the solution in individual worksheet. |

Validity test of learning component and matter component was done by four experts. Learning component consist of syntax, lesson plan, teaching material and student worksheet. Matter component consist of learning quality and content component. The result of validity test is shown in Figure 3 and Figure 4. Validity test score average for learning content is 87% and matter component is 89%. It means the POEAW is valid and can be tested in classroom learning.
3.4. Disseminating Stage
This research is limited to developing stage. Disseminating stage can be done in future research with apply impulse and momentum concept.

4. Conclusion
We have already developed a learning model to enhancing students’ understanding namely POEAW. POEAW has five main steps consist of, Predict, Observe, Explain, Apply and Write. Based on expert validity test, this learning model is valid and can be tested in classroom learning.

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