A Development of project-based learning (PBL) chemistry worksheet to form students’ habits of mind

R P Sari\textsuperscript{1}, M P Hasibuan\textsuperscript{1}, A G Haji\textsuperscript{2}, Nahadi\textsuperscript{3}, Sofiyan\textsuperscript{1}

\textsuperscript{1}Universitas Samudra, Langsa, 24416, Indonesia
\textsuperscript{2}Universitas Syiah Kuala, Banda Aceh, 23111, Indonesia
\textsuperscript{3}Chemistry Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

Email: ratihps@unsam.ac.id

Abstract. This study aims to develop a valid and effective chemistry worksheet on project-based learning (PBL) in order to shape and train students’ habits of mind. This is research and development (R & D) study with reference to the ADDIE procedural model that has been modified in previous studies with steps: potential problem observation, product design, design validation, implementation and evaluation. Worksheet validation is conducted by 2 validators with 3.8 validation results with a valid category. The result of this study on the implementation test on 20 students showed that the N-Gain test results of 0.73 with high categories and students’ habits of mind assessed through questionnaires. It also had an average score of 74.5 with good categories. The result of students’ habits of mind observation indicated that an increase in the three indicators from the first meeting to the last meeting. Based on the results of the study, it can be concluded that the development of chemistry worksheet on project-based learning is valid and effective to train and form students’ habits of mind. This research finding also indicated that there is a positive effect between habits of mind and student learning outcomes with a total effect of 68.4%.

1. Introduction
Globalization era and technology of information advancement is a future challenge for the Indonesian people. This is marked by the entry into force of the free market, creating the free traffic of goods and labor throughout the world. Thus, the demands of production technology are increasingly high, impacting to the need for higher the quality of human resources. It requires countries to face such competition. "To face the 21st century we are required to keep learning. We also have to learn in different ways because we are facing different era"[1]. Therefore, the Indonesian people must be able to prepare it by increasing human resources, to compete in the competition.

In line with this, Indonesia is welcoming its golden generation in 2045. The development of the Indonesian population can be seen from the growth of the productive age population. Currently, the population of Indonesian productive age is more than unproductive age [2]. Therefore, the big challenge is how to strive to transform abundant productive age of human resources into qualified and competent human resources for future needs.

Education has an important role to improve the quality of human resources. Improving the quality of education itself is a process that is integrated with the process of improving the quality of human resources. Thus, education is important to focus on to prepare the next generation of the nation and to produce qualified and competent future generations. Various efforts have been made by the government to realize quality higher education including, improving educational facilities, increasing the
professionalism of educators as well as developing a curriculum based on the Indonesian National Qualification Framework (KKNI).

Aside from human resources, the most important goal of education is developing mental habits that allow individuals to learn about what they want or need to understand everything related to their lives. Every individual encounter various problem, both academic and personal problems. Sometimes the problem is simple and easy to overcome, but often the problem is difficult to overcome. In situations where an individual does not know how to respond to the problem, intelligent behavior is needed to overcome it, in the sense of not only knowing but also knowing how to act. The ability to behave intelligently is referred to as productive thinking habits or productive thinking habits [3].

Habits of productive thinking developed by Marzano [4] in the learning dimension which includes: having attitudes and perceptions of learning (first dimension), acquiring and integrating knowledge (second dimension), expanding and refining knowledge (third dimension), using knowledge meaningfully (fourth dimension), and taking advantage of productive thinking habits. The first and fifth dimensions become important factors in the learning process because both dimensions are critical for the success of the other dimensions. Therefore, the provision of productive thinking habits becomes an emphasis to be studied in this study. Having habits of mind is needed, as stated by al-Assaf [5], education that synergizes various skills in life is expected to be able to solve life's problems.

Based on the results of field studies conducted in semester VI students of the Chemistry Education Study Program FKIP UNSAM, it is known that almost all students experience difficulties from just formulating problems, identifying variables, to organizing data. This shows that students cannot emphasize systematic thinking. This is because students have not studied nor done systematic thinking in previous times.

One of the factors causing students to have difficulties in constructing schemes in solving problems is the dis-integrated subjects learned. For example, biology has been taught separately from one concept to another or learning starts from basic skills gradually trained to realize more complex skills. As a result, students have difficulty developing thinking skills and do not get used to thinking in integrative particular knowledge schemes to answer the problems they face.

Habits of mind need to be instilled early because it will determine how someone will make important decisions [6]. Richard et al., [7] also suggested that Habits of Mind became a vehicle to explore ideas that would be rationalized through inquiry. Habits of mind require multiple skills, thus in this study tracing the three forms of habit categori... involving mind empowerment which includes self-regulation, critical thinking and creative thinking as a whole from the description of habits of mind proposed by Marzano & McTighe [4].

The above problems, especially in forming and practicing habits of mind (habit of thinking) can be overcome by providing challenging new experiences. Learning that provides a learning experience that demands and directs its participants to empower their minds so that they become accustomed to it in the future. This can be achieved if in the learning process effective project-based learning. The project-based learning, namely: identification and determination of the scope of the problem, formulation of hypotheses, data collection, data interpretation, development of conclusions and repetition. Project learning becomes a medium to develop character following the required values [8]. Thus, this learning apart from being oriented towards learning outcomes is also oriented towards the learning process.

Project learning can increase students' understanding of concepts [9]. In line with previous studies, Marlinda [10] states that project learning can improve student learning outcomes. The project model was chosen as a solution based on the results of several studies conducted by Sari, et al. [11] project learning improves achievement and analytical thinking skills. Besides, research conducted by Yance [12] shows that the project learning model is convincingly effective both in improving thinking skills, increasing self-confidence, having a more positive attitude, having an analytical mindset and increasing the activeness and learning achievement of students.

Based on the description of the theoretical study and the findings of the preliminary study described above, it is necessary to develop a project-based learning worksheet to form and train students' habits of mind. With this design, there is a great hope from the writer to create a challenging learning
situation to trigger the curiosity of students and be able to find answers on their curiosity so that it becomes a habit in empowering the mind.

2. Method
This research was conducted in Langsa city, located in the chemistry learning class from February 2019 to June 2019. The population in this study were all students of the sixth semester of chemistry education at the Faculty of Teacher Training and the University of samudra. The sampling technique used in this research is Purposive sampling technique or with certain considerations. The sample used is the sixth semester students with 20 students consideration that the class only consists of one unit and the subject matter of selectivity is only available in the sixth semester program.

This research is a type of research and development (R & D) with reference to the ADDIE procedural model. The ADDIE model is an approach that helps teachers to design efficient and effective teaching on any instructional product [13]. The ADDIE model that will be used in this study refers to the steps of the ADDIE model that have been modified in a previous study by Repdayanti, et all. [14]. The steps of the ADDIE research model are as follows: (1) Analysis Phase. The analysis carried out in the form of competency analysis, analysis of student characteristics and material analysis. (2) Design Stage. Activities carried out at the design stage include preparation of Product Making, preparation of the basic framework of LKPD, and preparation of assessment instruments. (3) Development Phase (Development). Activities at the development stage include product creation, validation, and revision. (4) Implementation Phase (Implementation). (5) Evaluation Phase.

The technique used in this study is a measurement technique using questionnaires and observations. The instruments used in this study are 1) validation sheet conducted by 2 validators who are competent in their fields 2) student observation sheets, 3) habits of mind questionnaire sheets 4) test questions in the material for selective subjects. Data obtained from expert validation sheets were analyzed to see the validity of worksheets developed in content and construct. Data obtained from observation sheets and questionnaires were analyzed to see the level of students' habits of mind. Data from test questions to assess correlations between habits of mind and student learning outcomes. Questionnaire habits of mind and test questions are given at the beginning and at the end of the lecture.

In preparing the questionnaire, researchers refer to good product indicators that have been put forward by experts, from indicators of good chemistry worksheet, appropriate open-ended indicators, and correct realistic problem indicators. Search results data productive thinking habits are analyzed using the rubric of productive thinking habits from Marzano [4]. Rubric sets the highest four and lowest one. Processing and data analysis of productive thinking habits is done by comparing scores of productive thinking habits early and late. To find out the increase in productive thinking habits, use the formula N-Gain [15] as follows:

\[ N\text{-}Gain = \left[ \frac{N_B - N_A}{N_{MAX} - N_A} \right] \times 100\% \] (1)

Information:

- \( N_A \) = HoM Begin
- \( N_B \) = HoM Final
- \( N_{MAX} \) = HoM Maximum

Data to calculate the effect was obtained by correlating each of the student response questionnaires and N-Gain habits of mind scores. Regression test is used to analyze how much influence the application of learning models in a scientific approach to the formation of Habits of mind by observing SPPS version 17 output values on Standardized Coefficients to analyze the contribution of each of the research data, while to see the overall contribution by observing the coefficient of determination \( R^2 \).

3. Result and Discussion
This research has been carried out following procedures designed and prepared previously. The results of expert validation on the average worksheet show valid categories. Following are the results of the
expert validation recapitulation chemistry worksheets of project learning-based form and train students' habits of mind.

Table 1. Results of Expert Validation Recapitulation

| No. | Aspect of Assessment                  | The score of the average | category |
|-----|--------------------------------------|---------------------------|----------|
| 1   | Eligibility of presentation          | 4                         | Valid    |
| 2   | Open-ended                           | 3.6                       | Valid    |
| 3   | Material/content feasibility         | 3.8                       | Valid    |
| 4   | Language feasibility                 | 3.7                       | Valid    |
|     | Average Number                       | 3.8                       | Valid    |

Results of chemistry worksheets were valid because of several factors including component content of the worksheet chemistry followed the indicators established in the instrument validity and descriptors used as a reference for evaluating eligibility by the validator. It also followed the habits of mind criteria. Furthermore, the validity of the worksheets spreadsheet has fulfilled aspects of the measurement of content and construct validity. The appearance of the chemistry worksheet presented by students is also important to note to attract other students to read it. The appearance of each sheet in the form of an educational image as a connector of material information at the same time can make students able to develop new theories that they find from the application of chemistry worksheet this.

The results of the research in limited trials are: 1) n-gain habits of mind 0.65 students who were in the medium category, 2) observation results showed 80% students with good categories and 20% others with very good categories, 3) students’ response towards the application of chemistry worksheets showed that 80% of students were interested in and 20% were very interested in the application of chemistry worksheets, 4) n-gain student test results were 0.69 in the medium category. The percentage description of the increasing habits of students in the implementation test was done by analyzing the normality level of the gain. The gain normality data was obtained through the average value of the questionnaire before and after learning takes place.

Based on the results of the analysis the average value of student questionnaires at the beginning of learning was 60.6 and the average value at the end of learning was 75.2 so that a gain of 0.62 was obtained. The gain value indicates a moderate category; it means that students' habits of mind have increased. Habits of mind can be formed when students can respond to answers to questions or problems that are not yet known so that they can observe how students remember and produce knowledge [3]. These indications are found in the Researcher's development product that students are guided to find answers to questions that are not yet known either through investigations or theoretical studies, after which they are given feedback on the processes that have been carried out. From the student questionnaire analysis, it was revealed that the application of feedback as a formative assessment by exploring and training students' productive thinking through various strategies had a positive impact on students. Positive impacts related to the formation of productive thinking are students are more creative, innovative, disciplined, and conscientious, know how to learn well and correctly, form new characters better, respect time, willing to work hard and can regulate self and others [17]. In line with this, the results of tracking habits of mind in the limited test as well as the implementation test appear to be increasing.

The results of observations show that in the form of preparing presentation material in hardcopy based on the material prepared, students were trained to develop habits of mind indicators through the feedback given after the presentation. Written feedback was given at the time of making presentation material by practicing habits of mind indicators such as 1) making good planning due to the deadline for collecting tasks, 2) using and searching for sourcebooks related to the task, 3) displaying the concepts presented in the presentation material accurately and clearly, 4) working in groups that required each group member to be considerate of one another, able to work together, to respect each other and not impose his/her own will, 5) trying the best to do his work and, 6) encouraging to be creative in presenting
presentation material in a hard-copy which was interesting and full of ideas in its presentation. The descriptions can be seen in the figure 1.

Figure 1. The results of the analysis of the observation sheet before and after given feedback

|                | Very Interested | Interested | Enough Interested | less Interested |
|----------------|-----------------|------------|-------------------|-----------------|
| Before Feedback| 10              | 70         | 15                | 5               |
| After Feedback | 20              | 80         | 0                 | 0               |

Figure 2. Distribution of percentage data with habits of mind indicators developed before and after feedback

Outlined from the three most prominent habits of mind categories between critical thinking, creative thinking, and self-regulation, the creative thinking category was at the highest position of the two other categories. That is because the chemistry worksheet project-based that researchers develop can make students create new and interesting things to display to other students. Applying ideas is a creative attitude because creativity is related to new ideas [18]. This means that ideas that have been designed can be applied as an interactive form of students. The results of the study of [19] found less interactive learning which was significantly lower in finding ideas and communicating those ideas. So, when students are accustomed to creating something new and different from the others from the beginning, it will automatically become a habit that results in new creativity. This follows the habits of mind indicator chart below:
In this section, some findings will be presented relating to the contribution of the application of chemistry worksheet-based project learning to habits of mind indicators. Comparison of the results of the correlation test before and after giving feedback shows significant results as shown in Table 2.

**Table 2. Results of Correlation Test of Project Based Learning Chemistry worksheet on Habits of Mind Indicators**

| Variable                                | After Given Feedback | Before Given Feedback |
|-----------------------------------------|----------------------|-----------------------|
| Chemistry worksheet on Project Based Learning to Habits Of Mind Indicators | Significant         | No significant        |

Providing continuous feedback at the implementation stage has an impact on the correlation test results. The results of the correlation test in the experimental class showed a significant correlation between the application of chemistry worksheet-based project learning to habits of mind indicators. When compared the correlation test conducted before giving feedback is not significant. Components of feedback both verbally and in writing that are left in balance in the form of corrections to errors or shortcomings of tasks made by students, lead students to conduct self-assessments. Information relating to errors and shortcomings of these tasks, helps students realize the difference in intentions that occur between the goals to be achieved with the knowledge, understanding and skills possessed by students to act to correct deficiencies and mistakes made in an effort to achieve these goals [20].

Immediate and timely feedback given to each assessment strategy applied in this study has a good influence on students’ habits of mind. Because if feedback is given immediately, students can immediately find out the weaknesses or lack of tasks and can make improvements to the next task so that students can improve the quality of their assignments. This is supported by sustainable opinion, [21] which states that feedback needs to be given immediately so that inappropriate student responses do not develop into unwanted habits.

Habits of mind that implemented to the students can identified the understanding and retention of students to the concepts which presented through chemistry worksheet basis project. Data N-gain formed habits of mind which presented through chemistry worksheet basis project was 0.73 which include to the high category. Data can be seen on the following table:
Table 3. Recapitulation Data N-Gain Habits of Mind

| Information                | Score | N\text{MAX-N}_A | Total | Criteria |
|----------------------------|-------|------------------|-------|----------|
| Data N-Gain Habits of Mind | 2.80  | 3.68             | 1.20  | 0.73     | High     |

Based on the data in Table 3 above, it can be seen that the increase is at high category. This proves that the Researcher's product was able to contribute positively towards the learning outcomes of their students. Na'imah [22] project-based learning model assisted by e-learning provides an opportunity for students to actively participate in learning that involves students in a learning process so as to be able to give a pleasant impression and generate motivation and interest in student learning. Having habits of mind will be a vehicle for someone to be able to explore ideas and rationalize everything through investigation. Developing the productive habits of mind depends on the teachers and their awareness and knowledge. It, also, depends on considering the dimensions of teaching and the teaching indicators for developing the habits of mind [23]. The worksheet that the researcher developed was to form and train students 'habits of mind, when students' thinking habits were formed, the students would not have difficulties when the problem was in front of him, especially if they were dealing with learning problems. So, when students have habits of mind will have a positive effect on their achievement or learning outcomes. To see the effect of giving a chemistry worksheet to productive thinking habits can be seen in the following regression table:

Table 4. Regression Table Test

| Model | R    | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|------|----------|-------------------|---------------------------|
| 1     | .827a | .684     | .667              | 2.683                     |

a. Predictors: (Constant), Questionnaires students response  
b. Dependent Variable: HoM

Referring to the table above, it can be concluded that the provision of chemistry worksheets has a positive effect on productive thinking habits of students with a total effect of 68.4%.

4. Conclusion

Based on the results of the study it can be concluded development of project learning chemistry worksheet valid and effective to train and form students habits of mind. The research findings also indicate a positive effect between habits of mind and student learning outcomes with a total effect of 68.4%.

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