

The development of PBL-based science module to improve students' creative thinking skill in MTsN Subang anak

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Abstract

The purpose of this study was to produce module based on PBL to improve creative thinking skills which are valid, practical and effective to use in learning science. The design of this study is research and development by using 4-D model which consists of Four phase. The results of development phase, showed that module based on PBL model to improve the creative thinking skills of learners is valid by mean of (0,88), For the practicality, the mean of questionnaire responses learners towards the product was 87.20, categorized as very practical; the mean of questionnaire responses of teachers was 92.75, also categorized as very practical. The result of the develop phase showed that the product met the criteria of effectiveness as the data obtained showed that there was improvement of learners competences: cognitive, affective, psychomotor, as well as creative thinking skills. The mean value of cognitive competence was 84.00; affective competence was 84.65; and psychomotor competence was 82.73. Mean while, the mean value of creative thinking skills improvement was average and low in every meeting.

Keywords: creative thinking skills, problem based learning model, module



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Introduction

Education is important for the development progress of a country because it is one of the factors that support human intellectual changes. Under the Law Number 20 Year 2003 [12], education is an intentional and planned effort to create an learning atmosphere and learning process so that students actively develop their potential to have spiritual power of religion, self-control, personality, intelligence, noble character, as well as skills needed by themselves, nation, and state.

Various efforts have been made by the government to improve the quality of learning and education. One of those is to update the curriculum. Curriculum is a set of plans and arrangements regarding the objectives, contents, teaching materials, and ways used as guidelines for the implementation of learning activities so as to achieve certain educational goals.

The current curriculum is the curriculum of 2013. The curriculum of 2013 is activity-based learning with characteristics including (1) interactive and inspirational, (2) fun, challenging, and motivating learners to participate actively, (3) contextually and collaboratively, (4) providing sufficient space for the initiative, creativity, and independence of learners, (5) according to the talents, interests, abilities and physical and psychological development of learners. The curriculum of 2013 emphasizes the

modern pedagogic dimension of learning, which uses a scientific approach consisting of five activities: observing, questioning, collecting data, associating and communicating.

Natural science essentially includes four main elements: (1) attitudes of curiosity about something, natural phenomena, living things, and causal relationships that create new problems that can be solved through the correct procedures; (2) the process of problem-solving procedures through scientific methods that include the preparation of hypotheses, experimental or experimental design, evaluation, measurement, and drawing conclusions; (3) products including facts, principles, theories, and laws; (4) application including the application of scientific methods and concepts in everyday life. These four main elements of natural science should appear in the natural science lesson. In natural scientific subjects, there are still some students who have not reached the established Minimum Mastery Criteria (MMC). As shown in Table 1.

Table 1. The Average Scores of Daily Test of Natural Science of Students of Class VIII1 in Semester 2 in MTsN Subang Anak, Year of 2016.

Class	Mastery		Non-mastery		MMC
	Number	%	Number	%	
VIII1	6	38.00	10	62.00	75
VIII2	7	44.00	9	52.00	75
VIII3	8	50.00	8	50.00	75
Average Scores	7	44.00	9	56.00	

Data Table 1 shows that there is no class reaching the Minimum Mastery Criteria (MMC). This shows that the competency of knowledge of the learners should be improved again. It can also be concluded that there is conformity with the results of questionnaire analysis of learners about creative thinking skills that are in the realm of knowledge. The results of the questionnaire can be seen in Figure 1.

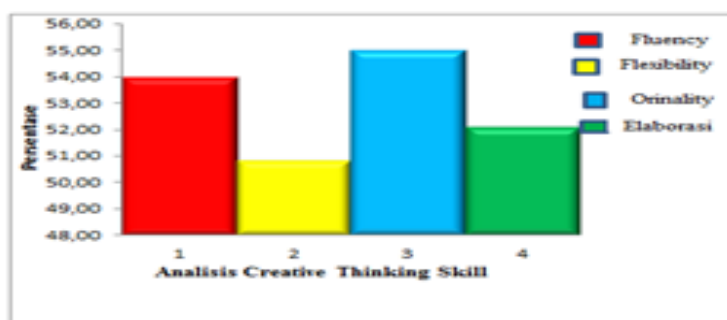


Figure 1. Results of questionnaire analysis about learners' creative thinking skills

Results of the analysis of learners on the indicator of creative thinking skills show an average of 52.96% which means that creative thinking skills of learners should be improved again. Based on the analysis of indicators of creative thinking skills, 54% of learners are able to think fluently in learning (fluency), 50.83% are able to think flexibly (flexibility), 55% are able to develop their own thinking (originality), and 52.08% are able to think in detail. Overall, it seems that creative thinking skills learners are still low.

There are many factors that affect the competency of learners, one of which is the willingness of learners to engage in learning is still weak so that learners have not fully understood subject matters in natural science, and have not fully achieved their learning objectives. Therefore, it is seen that the results of learning and creative thinking skills learners are still low. For that, supporting materials to develop the thinking ability of learners so that they can overcome the problems in learning natural science are needed.

Teaching materials are external factor which strengthens internal factors in learning process. Observations had been conducted on teaching materials in the field found that the creativity of teachers in developing materials is still less. Observations had also done to the teaching materials existing in the field, namely modules. Judging from the completeness of the modules components, it was found that they have not been equipped with learning objectives for each meeting. The modules have not shown scientific activities to invite learners to observe, ask, try, process, and communicate data, whereas this stage is able to encourage the activities of learners. The teachers assume that the current modules are sufficient as learning resources. This problem shows that there is a need for completed teaching materials to support learning activities on natural science subjects. Module should be a teaching material that is able to increase the motivation and creativity of learners by paying attention to its characteristics are, among others, designed for self-learning system, having a complete and systematic program, containing objectives, materials or evaluation activities, communicative, using focused and measurable language and emphasizing on user's activities[7].

From the above problems, in addition to the lack of natural science modules which are in accordance with the characteristics of learners, there are also other factors that will affect the achievement of learning objectives, especially on the competency of learners. This factor is an application of learning models that can foster motivation, interest and thinking ability of the learners themselves. Learning model in question is a model of learning which is in accordance with the demands of the curriculum of 2013. One of the appropriate learning models to overcome the above problems is the model of Problem-Based Learning (PBL).

PBL is a series of learning activities that emphasize on the process of solving problems scientifically[10]. By applying PBL model, learners will not only master a number of subject matters, but also how they can develop ideas through verbal language that is one of abilities to think and can develop their self-reliance and self-confidence[2]. The syntax of the PBL model is as follows: learners' orientation to the problems faced, organizing the learners to learn, guiding individual/group experiences, developing and presenting works, analyzing and evaluating problem-solving processes[6]. Based on this description, PBL Model-based natural science modules to increase learners' creative thinking skills should be developed. The purpose of this research is to produce valid, practical and effective PBL model-based natural science modules to improve learners' creative thinking skills.

Method

This research was a kind of R & D (Research and Development) researches. The products developed are valid, practical, and effective PBL model-based modules to enhance creative thinking skills of learners. This development model of PBL-based natural science modules used Four-D (4D) model as proposed by Thiagarajan. Thiagarajan stated that this development model consisted of four stages, namely defining, designing, developing and disseminating stages. The subjects of the module test were students of class VIII1 totaling 20 people in the academic year 2016/2017 in MTsN Subang Anak for the chapter of Pressure. For dissemination activities, different classes were selected at the same school.

The type of data taken in this study were data from the validation of Lesson Plans, modules and assessment by validators, data of the practicality of teachers and learners, as well as data effectiveness taken from the observation and assessment to the learners.

1. Initial Analysis

At this stage, curriculum analysis, learner analysis and material analysis were performed. These analyses were used to determine the initial problem that needs a development.

2. Analysis of Validity

Validity analysis was based on Likert scale values. Validators' assessment of each statement were analyzed using Aiken's V[1] formula. A module would be considered valid if it has reached within the interval of ≥ 0.61 .

3. Analysis of Practicality

Analysis of practicality is collecting information relating to that the product is practical in learning. All questionnaires of practicability in this study were validated first through the valuation sheets of instruments of practicality. Assessment of the instruments of practicality is essential, so that the data resulted in about the practicality are valid. Practicality analysis was based on Likert scale values. Modules would be said to be practical if they get score of $\geq 6\%$ and in the practical and very practical categories.

4. Analysis of Effectiveness

Effectiveness analysis could be done by seeing improvement of creative thinking skills of learners. The effectiveness instrument consists of a competency test for creative thinking skills.

5. Analysis of Knowledge Competency

Analysis of learners' knowledge competency is categorized completely if the learners reach MMC. Knowledge competency is seen from results of essay analysis. To categorize the learners' mastery, classification as in Table 2 was used.

Table 2. Learners Minimum Mastery Criteria

No	Score	Criteria
1	≥ 75	Master
2	< 75	Non-master

The PBL model-based modules for improving creative thinking skills were categorized as effective when creative thinking skills on the knowledge aspect are $\geq 75\%$ in a classical manner with a minimum value of predicate B in the categories of Good and Very Good.

Analysis of Attitudinal Competency

Attitudinal competency analysis was obtained through observation to the learners during the learning process.

Table 3. Category of learner's attitudinal competency

Score of attitudinal mastery (Predicate)	Criteria
Very Good (VG)	76 -100
Good (G)	51-75
Less Good (LG)	26-50
Bad (B)	0-25

Analysis of Skill Competency

Analysis of skill competency was obtained through observation to learners' activities within the learning process. Table 4. Category of learner's skill competency

Analysis of Creative Thinking Skills

Learners' Creative thinking skills were analyzed by conducting pre-test in each meeting. The results of pre-test of a meeting were compared to the results of pre-test done in the next meeting, and it was applied in each meeting. To see the score of completeness, the following criteria were used (Table 5).

Table 5. Classification of Creative Thinking Skills

Interval	Criteria
$0 \leq N \leq 39$	Not creative
$40 \leq N \leq 55$	Less creative
$56 \leq N \leq 65$	Creative enough
$66 \leq N \leq 100$	Creative
$80 \leq N \leq 100$	Very creative

The designed Lesson Plan components consisted of subject identity, core competencies, basic competencies, competency achievement indicators, learning objectives, teaching materials, time allocation, learning methods and learning steps according to the PBL steps, the learning sources with full of assessment. The results of this draft were submitted to experts to be validated.

PBL-base Module Draft

The designed module consisted of several sections: general instructions that contain KI, KD, indicators, and guidance of problem-oriented PBL module, as well as teaching materials, learner's worksheet, formative tests, and bibliography. The module was also validated by the same validators in the Lesson Plan.

Assessment Design

At the stage of assessment design, the assessment of knowledge used a written test consisting of 5 items of descriptions to be done by the learners at each meeting. This assessment was used to measure their creative thinking skills. Furthermore, this assessment was also validated by the same validators.

Results of develop phase

1. Practicality

Questionnaire of teacher response was useful to know teacher's response to the Lesson Plan, module and assessment of result of development. Questionnaire consisted of Lesson Plan practicality sheets, modules and assessments.

2. Effectiveness

The assessment of creative thinking skills used description or essay tests. In addition, the assessment was taking into account group assessment when learners were working on LKPD, because LKPD raised the indicators of creative thinking skills at each meeting. For more details, the average increase in creative thinking skills learners can be seen in Figure 3.

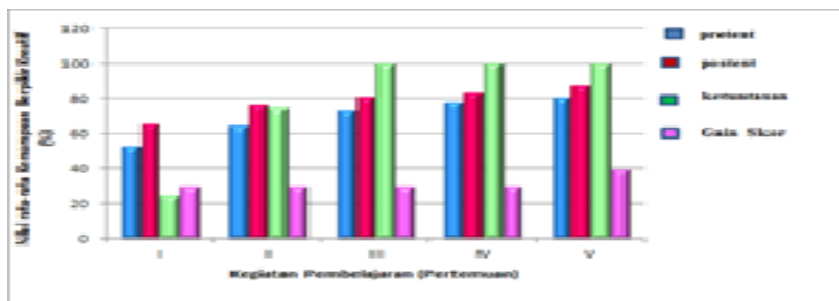


Figure G 3. Graph of the Average of Learners' creative thinking skills

The increase of creative thinking skills was analyzed through the answer of the students about creative thinking skills. Then the data was converted with gain score equation. The gain score results can be seen in Table 6.

Table 6. Results of Gain Score of Creative Thinking Skills

Meeting	Gain Score	Category
First	0.30	Medium
Second	0.30	Medium
Third	0.30	Medium
Fourth	0.30	Medium
Fifth	0.40	Medium

This means that the Problem based learning model-based natural science modules can improve the creative thinking skills of the learners, although the improvement of creative thinking skills in the medium category. Thus, the modules used were effective in improving creative thinking skills. Furthermore, the results of attitude assessment was obtained from the observation to learners' attitude during the learning process.

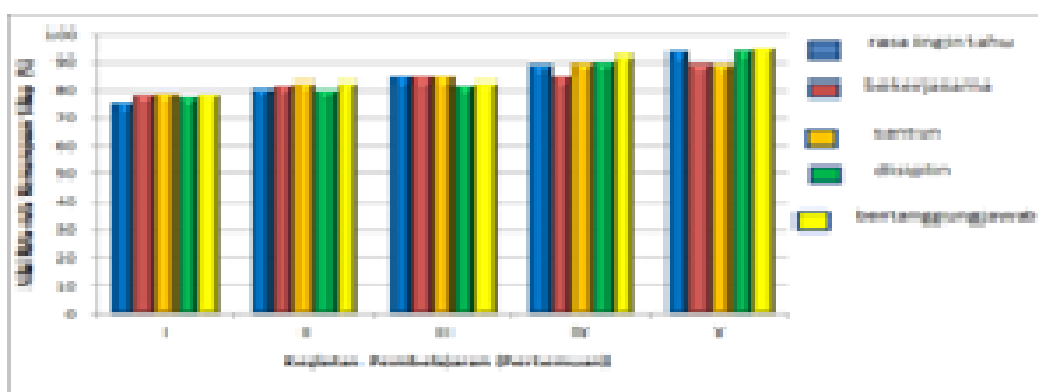


Figure 4. Results of Attitudinal Competency Assessment Analysis

Based on Figure 4, it was found that learners' attitudes were improving at each meeting. At each meeting shows, the average percentage of learners' attitudes have been in good and very good category. Assessment of the skills of learners was done at each meeting. The results of the skills competence assessment of the learners are presented in Table 7.

Table 7. Results of Skill Competency Analysis

Indikator	Pertemuan									
	Pertama		Kedua		Ketiga		Keempat		Kelima	
	Rata-rata	K	Rata-rata	K	Rata-rata	K	Rata-rata	K	Rata-rata	K
Merangkai alat	76,25	SB	78,75	SB	81,87	SB	85,62	SB	81,87	SB
Partisipasi	80,62	SB	83,12	SB	83,75	SB	88,75	SB	85,00	SB
Ketepatan menggunakan alat	75,00	B	78,12	SB	78,12	SB	80,62	SB	85,00	SB
Menganalisis data	75,00	B	79,37	SB	80,00	SB	82,50	SB	81,87	SB
Mencatat kesimpulan	84,37	SB	83,75	SB	85,62	SB	88,75	SB	91,25	SB
Memperhatikan laporan	83,75	SB	83,75	SB	85,12	SB	88,75	SB	88,12	SB
Rata-Rata	79,37		81,25		82,00		85,83		85,52	
Rata-rata nilai keterampilan peserta didik										
	82,73									

Table 7 shows that all indicators of skill competency assessment of learners were categorized very well. In addition, the average scores of skill competency assessments of learners were increased every meeting.

Discussion

Module is a printed material containing a general summary of the materials. It is equipped with guidance on the execution of learning tasks for learners both theoretically and practically. Activities in the module are in accordance with the basic competency indicators that must be achieved by learners. Module development follows the 4-D model development procedure. This model consists of

4 stages of define, design develop, and disseminate phases. The objective is to produce a valid, practical and effective module.

1. Define phase

In the define stage, some analyses, namely curriculum analysis, material analysis, characteristics of learners, and teacher needs analysis. The teacher needs analysis is addressed to the educators, the instrument used is in the form of a questionnaire, a questionnaire developed based on indicators from the study of theories. The next process is analysis of the characteristics of learners including interest, motivation, self-preparation, learning styles and creative thinking skills learners. There is conformity with the results of analysis that interest and motivation of learners still have to be improved again. This means there is a desire or willingness of learners to be active in learning. For that, supporting materials to stimulate learners are needed. The teaching materials should be integrated with the application of the learning model according to the problem. Furthermore, creative thinking skills consisting of several indicators, namely curiosity, fluency, flexibility, originality, and elaboration are observed low are categorized and very need to be improved again. Material analysis is done by assessing and adapting the material to the curriculum requirements. Materials are grouped according to facts, concepts, principles and procedures. Each group must be clearly visible so that the natural science materials will be a unified whole. Based on some analyses done, the results are used to minimize problems in field. Hence, development of PBL model-based natural science modules to improve learners' creative thinking skills is done.

2. Design Phase

In the design stage, IPL-based modules are designed to enhance creative thinking skills. In addition to the modules, teaching materials supporting the Lesson Plan as a guide in the implementation of learning and assessment as an evaluation tool are developed. All products are validated first. In the validation stage, information on shortcomings and errors in Lesson Plan, modules and assessment are obtained. For that purpose, repeated revisions are made to refine the products based on suggestions from the validators.

3. Develop Phase

After the design phase is done, the field test is done as well. This test was conducted in class VIII1 which is amounted to 20 learners. Prior to the research, the modules were distributed first to the learners. Through field test, it is known that the practical levels of the developed Lesson Plan, module and assessment. Practicality is the level of usage of products developed by teachers and learners. Based on the results of practicality analysis, it is concluded that the PBL model-based modules to improve the creative thinking skills of learners is very practical to be used in learning according to the learners' responses. In this develop phase, in addition to practicality, the effectiveness of the modules will also be assessed. The effectiveness seen is a special enhancement of creative thinking skills of learners. If creative thinking skills of learners have been good, then the attitudes and skills of learners that are formed will also be good. Improving creative thinking skills of learners is the impact of the use of PBL model-based modules. PBL is a teaching system in the form of solving the problem and communicating the benefits so as to foster learning independence, critical skills, being creative and having good communication [3]. The technique of analysis is with the equation of gain test score through pre-test and post-test.

Overall, the increase through the gain test score analysis of the first meeting pre-test value compared to the fifth meeting post-test was obtaining medium criterion. In the study, the trials were conducted for five meetings only and resulting medium increasing. Based on the results obtained, the modules developed are effective to improve the creative thinking skills of learners, although the increase is medium. In addition to finding the improving of the creative thinking skills of learners, data analysis for learners' attitude competency shows improvement at each meeting. Data were obtained from the observation to the attitude of learners during the learning process. The results say that by using problem based model based modules are effective to improve the attitude of learners.

Skill assessment is done through the observation to the works when practicum is done by learners. The assessed skill indicators include tools assembly, participation in experimental steps, tools accuracy, experimental data analysis, experimental conclusions record, and group reports presentation. Overall, the results of the analyses showed that there is improvement of the learners' skills in each meeting in the chapter of pressure. This suggests that the PBL model-based natural science modules can effectively improve the skills of learners. Thus it can be concluded that PBL model-based natural science modules in the chapter of pressure can improve learners' creative thinking skills and can be said to be practical and effective to use in learning process.

Conclusions

The development of PBL model-based natural science modules to improve learners' creative thinking skills, in general, has met the valid, practical and effective criteria. The results of the assessment stage indicate that the product meets the criteria effectively because the data obtained showed an increased competency of knowledge, attitude and skills as well as creative thinking skills. The average scores of knowledge competency, attitude competency, and skill competence are 84.00, 84.65, and 83.40, respectively. The improvement of creative thinking skills is obtained on average in every meeting. So the modules are valid, practical, and effective.

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