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Development of Pretest-Posttest Assessment Based on Coffee Peel Utilization Project to Measure Students Creative Thinking Skills

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Abstract: This study aims to develop a project-based pretest-posttest assessment of the use of coffee husks. This study used the research and development method of the ADDIE model until the development stage. At the analysis stage, a literature study and a preliminary study were conducted. At the design stage, planning and preparation of an initial draft in the form of a pretest-posttest assessment were carried out. In the development stage, two science education experts validated the suitability of the content and construction of the pretest-posttest assessment with Torrance's creative thinking skills indicator framework. The product of the validation results was then responded to the suitability of the content and construction aspects of creative thinking skills indicators by the three science teachers. The results of expert validation and teacher responses indicated that the pretest-posttest assessment instrument product is very suitable to be used to measure students' creative thinking skills in integrated learning based on coffee peel utilization projects.

Keywords: pretest-posttest assessment, coffee peel utilization projects, creative thinking.

Abstrak: *Penelitian ini bertujuan untuk mengukur keterampilan berpikir kreatif menggunakan asesmen pretes-postes berbasis proyek pemanfaatan kulit kopi. Penelitian ini menggunakan metode penelitian dan pengembangan model ADDIE.Pada tahap analysis dilakukan studi literatur dan studi pendahuluan. Pada tahap desain, dilakukan perencanaan dan penyusunan draft awal dalam bentuk asesmen pretes-postes. Pada tahap develop, dua pakar pendidikan IPA memvalidasi kesesuaian isi dan konstruksi asesmen pretes-postes dengan kerangka indikator keterampilan berpikir kreatif Torrance. Pada tahap implementasi, asesmen diterapkan ke 31 siswa di SMP Al-Qur'an Miftahul Ulum Bukit Kemuning. Implementasi produk kemudian digunakan untuk mengukur keterampilan berpikir kreatif siswa,dan hasil menunjukkan bahwa produk instrumen asesmen pretes-postes sangat cocok digunakan untuk mengukur keterampilan berpikir kreatif siswa dalam pembelajaran terpadu berbasis proyek pemanfaatan kulit kopi.*

Kata kunci: *asesmen pretes-postes, proyek kulit kopi, berpikir kreatif.*

▪ INTRODUCTION

Rapidly improving science and technology has become a major influence on various aspects of life. One of these impacts is the emergence of complex and competitive life problems. Preparing qualified human resources with excellent life skills to compete to encounter this challenge. There are so many skills that every individual must have, but one of the skills needed in problem solving is the ability to think creatively. Improving the quality of human resources is indicated by the establishment of creative human beings. Ruseffendi (2010), mentioned that one of the indicators of improving the quality of human resources is the establishment of creative human

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beings. A creative characteristic can be developed by practice and behave from the beginning to create a habit to explore, inquiry, discover, and solve problems.

According to Suherman (2003), creative thinking skills could encourage people in mastering the skill of problem-solving. Someone who can think creatively must have multiple ideas in solving problems and will choose solutions using methods that are relevant to the problem, for example, based on the time, cost, and energy required to implement the idea. Creative thinking is defined as a mental activity that is used by a person to build new ideas or thoughts. Thus, creative thinking can be interpreted as a person's ability to generate a new idea, thought, or answer to a problem (Hariman, 2014). Creative thinking skills as a learning outcome to assist students to become successful, confident individuals, and responsible citizens, therefore it is important to develop this skill in various subjects to support students to develop their creativity in solving problems (Cachia, 2010). One of the efforts that can be done to improve creative thinking skills is through education (Wulandari, 2017).

The Indonesian government has integrated creative thinking skills into the education curriculum. This has been formulated in Law Number 20 of 2003 article 3 concerning the National Education System. However, the fact is that the creative thinking ability of students in Indonesia is still relatively low. This statement is shown from Indonesia's creativity ranking based on the 2015 Global Creativity Index that Indonesia is ranked 115 (Florida, 2015). This problem is suspected to happen because education in Indonesia only emphasizes memorizing and finding the correct answer from the question, therefore high-level thinking processes, including creative thinking, are rarely trained (Munandar, 2009). In recent years, many studies have been developed to emphasize activity-based learning and students' creative thinking skills. Creative thinking skills can be applied by the active learning model which is student-centered and based on constructivism (Diawati, 2020). Project-based learning is curriculum-based contextual learning by challenging real questions or problems, involving students in selecting the topic, considering approaches, designing, solving problems, making decisions, providing opportunities to work independently for a long time, and producing real products related to problems (Diawati, 2017). Project-based learning allows students to use their knowledge to solve real problems in projects (Bilgin, 2015).

The characteristics of this project-based learning are by the characteristics of the Immersed integrated model. The Immersed integrated model is designed to assist each individual to combine all data from each field of science according to his field of interest. In this learning type, students are screening all concepts that had been learned by themselves to accomplish the project. Teachers encourage student interest through challenging problems, then students will find and combine all related information to solve the problem (Fogarty, 2009).

Project-based learning can be performed by utilizing various items or any objects that are available around the residential environment. Each region in Indonesia has different regional potentials. For example, in Bukit Kemuning, North Lampung Regency, which has potential in the plantation sector, one of which is coffee. When the coffee harvest arrives, people will dry the coffee in their yards. However, during the milling process to produce coffee beans, there is coffee peel waste that is not utilized. Even though, in coffee peel waste there is still a nutrient content which if processed properly will become a useful new product.

On the other side, this problem can be used as a learning resource in integrated science learning. Integrated science materials related to solving the problem about the

waste of coffee peel as study materials of environmental pollution, and biotechnology. Both of these materials can be applied in the immersed integrated learning model. Students are challenged to creatively solve the problem related to coffee peel utilization.

In an integrated science learning project based on the use of coffee husks, students' creative thinking skills are assessed in various ways; one of them is by pretest-posttest. In this article, the product of the pretest-posttest assessment development is based on real-life problems such as the coffee husk utilization project, this is a novelty in this research. In addition to changing the learning model and environment, to train creative thinking skills, it is necessary to develop a pretest-posttest assessment to improve students' creative thinking skills. Based on a literature review, the development of a pretest-posttest assessment of creative thinking skills is still very limited.

▪ METHOD

The sample of this study was 31 9th grade students at Miftahul Ulum Al-Qur'an Middle School.The method in this research is research and development using the ADDIE model. This model consists of five stages, namely analysis, design, development, implementation, and evaluation (Fadiawati & Fauzi, 2018). At the analysis stage, literature studies and preliminary studies are carried out according to the assessment used in learning activities. Furthermore, at the design stage, planning and preparation of the initial draft of the pretest-posttest assessment instrument were carried out. At the development stage, validation is carried out by two science education experts.Validity and Practicality test using questionnaire instrument in research as well as for testing effectiveness of using One Group pretest - Posttest Design (Fraenkel; Wallen & Hyun, 2006).

Data collection techniques in this study were through the provision of questionnaires, interviews, tests, and performance assessments. The questionnaire was given at the analysis science learning program integrated according to students and teachers. Questionnaires were also given at the development, namely expert validation questionnaires and teacher response questionnaires on the suitability of the content and construction of the developed learning tools. The test of creative thinking skills is carried out at the implementation.Then, the data is calculated using a formula:

$$\text{n} - \text{gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{score max} - \text{pretest score}}$$ (Hake, 1999).

The result of the n-gain calculations is then categorized using the classification stated by Hake which is if $g \geq 0,7$ categorized as high, if $0,4 \leq g < 0,7$ is medium, and if $g \leq 0,3$ categorized as low.

▪ RESULT AND DISCUSSION

Development was carried out using the model ADDIE through five stages development of pretest-posttest assessment, namely: analysis, design, development, implementation, and evaluation.

1. Analysis

The analysis phase is carried out in two stages, namely performance analysis and needs analysis. In the performance analysis, it is obtained an overview of the learning model used by the teacher in the learning process, especially in the matter of environmental pollution and biotechnology and what skills are trained by the teacher, an overview of the integrationmodel and project-based learning model, as well as a description of the teacher's knowledge of creative thinking skills. The analysis will produce an overview of facts, expectations, and alternative problem solving, thus making it easier to determine the initial steps in the development of an integrated science learning program. At this stage, a questionnaire was given to 122 grade 9^{th} junior high school students from two junior high schools located in the Bukit Kemuning district and also conducted by interviewing five junior high school science teachers.

Needs analysis is carried out by examining the theory of *Immersed* learning and project-based learning, as well as indicators of creative thinking skills. The real problem that occurs in the Bukit Kemuning area is the amount of coffee husk waste that is not used by local farmers. After knowing the theory of *Immersed* learning and project-based learning, then an analysis of the basic science competencies of SMP is carried out which is suitable to be taught in this integrated learning.

Integrated science learning *Immersed* project based on the use of coffee peel, the basic competencies are 3.8 for class VII (Analyzing the occurrence of environmental pollution and its impact on the ecosystem), and for class IX is basic competence 3.7 (Applying the concept of biotechnology and its role in human life), and basic competence 3.10 (Analyzing processes and products of environmentally friendly technologies for the sustainability of life). These three basic competencies can be combined based on environmental pollution problems that exist in the Bukit Kemuning environment and produce basic integrated competencies, namely, "Applying the concept of biotechnology and environmentally friendly products to creatively solve the problem of coffee peel utilization."

Then, an analysis of indicators of creative thinking skills were carried out which is appropriate to measure students' creative thinking skills. The indicators made refer to the indicators of creative thinking skills according to Torrance which are adapted to the stages of project-based learning. The results of the needs analysis and performance analysis that have been carried out were used as a reference in the development of the *Immersed* based on the coffee husk utilization project to improve the creative thinking skills of junior high school students.

Furthermore, performance analysis was carried out by collecting data through interviews with five science teachers and filling out questionnaires by students from two public and private junior high schools in Bukit Kemuning District. The schools that were used as objects of analysis at this stage were Public Junior High School 3 Bukit Kemuning, and Al-Qur'an Miftahul Ulum Junior High School Bukit Kemuning. Based on the results of interviews with five junior high school science teachers, it can be seen that all teacher respondents do not use integrated learning in science learning activities.

All teacher respondents have never applied the integrated model to science learning.integrated model *Immersed*. The remaining 40% of teachers do not know this integrated model.integrated model *Immersed* have never attended training on this model, so teachers have never applied it in science learning activities. The learning models that are usually used by teachers are *Discovery Learning, Project Based Learning, Problem Based Learning, Jigsaw,* and *Snowball models.* The teacher only gives assignments to students to do a project, such as a project from used goods.

Project-based learning applied by teachers is not based on existing problems. Meanwhile, the problem that occurs in the Bukit Kemuning environment is the amount of coffee skin waste. This is supported in Ni'mah's research; Saptorini; & Pamelasari (2013) that project-based learning is applied only by giving assignments to students without problem-solving, so students become passive and the material provided has not been able to apply knowledge to solve problems in real life.

All teacher respondents stated that creative thinking skills need to be measured. All teacher respondents also know about creative thinking skills. The teacher states that students are said to be thinking creatively if students can complete the given task or experiment with new ideas, create something, and think creatively in making a design from the task given by the teacher. The indicators understood by the teacher respondents are not indicators of creative thinking skills that will be measured in this study. Indicators of creative thinking according to Al-Sulaeman (2009), namely *fluency* (identifying some problems based on the problems presented), *flexibility* (writing some ideas about the importance of the coffee skin utilization project), *originality* (writing ideas about variations in the composition of different materials in the leather coffee peel utilization project), and *elaboration* (initiating the details of the tools and materials of the coffee peel utilization project).

Teacher respondents who have applied the creative thinking skills measurement test, as many as 80% of teacher respondents obtained the results that students' creative thinking skills were not following the expected creative thinking skills. Based on the results of filling out questionnaires by students, it was found that all student respondents had done project-based learning on environmental pollution materials by utilizing used goods around the school environment. Students who carry out project-based learning usually used plastic waste to be used as project materials. However, all teachers have never given and conducted learning in the form of projects involving regional potential, such as the use of coffee peel. Meanwhile, the problem that often arises in Bukit Kemuning District is related to coffee peel utilization from plantation products owned by residents. Mardhiyana & Sejati (2018) argued that through activities in project-based learning involving regional conditions, students can find new thoughts and generate valuable ideas, which are very useful for finding new solutions to a problem. These solutions can be in the form of new thoughts and ideas that are part of creative thinking skills.integrated science learning tool *Immersed* based on the use of coffee peel utilization to improve creative thinking skills of junior high school students.

2. Design

The design of the development of this learning program started from determining the basic competencies of integration and learning objectives, then designing teaching and learning activities that were oriented towards project-based learning, designing learning media that were used by students, designing a pretest-posttest assessment consisting of questions compiled based on indicators of creative thinking skills.integrated science learning *Immersed* project based on the use of coffee peelwas to measure the creative thinking skills of junior high school students. The indicators for developing creative thinking skills were formulated based on the project-based learning stage. While teaching and learning activities in the development of this learning program used project-based learning stages that were arranged in a lesson plan.

The learning media used in the *Immersed* project based on the use of coffee peel was student worksheets. The worksheets in this study contained teaching and learning

activities that students go through while implementing the *Immersed*. Assessment of creative thinking skills consists of test questions and performance assessment of creative thinking skills. The test questions were in the form of pretest-posttest questions that function to measure students' creative thinking skills before and after the learning process. The test questions used to consist of five questions arranged based on creative thinking indicators.

Pretest-posttest instrument for questions number one which was made referring to the indicator of fluency, namely identifying some problems based on the discourse presented. In question number one, a picture and problem discourse is also given that aims to attract students' interest so that students will maximize themselves in answering questions. After being given a real problem, students are asked questions, "*identification three problems that exist in the discourse above!*". Question number two was made referring to the indicator of fluency, namely writing down some ideas about projects that will be carried out to solve the problem of coffee peel. The question is "*if you live in a coffee-producing area in North Lampung, make at least two projects that you will do to solve the problem*". Fluency indicator questions that have been made, in line with Csikzentmihalyi (1988), that some cognitive dimensions is a suitable option in advancing toward a construct definition of creativity. Almeida & Prieto (2007) present some topics in order reach a better definition of creativity as a cognitive characteristic, one of which is that can be more characterized by problem-finding.

Instrument for question number three which was made referringto the flexibility thinking indicator, namely writing down some ideas about the project's objectives for utilizing coffee peel. The question is "*if you are asked to do one of the coffee peel waste projects by applying the concept of biotechnology, write down at least three goals for the project!*". This question in line with Meissner (2006), in order to reach a creative teaching, it requires that the individuals, whose personal and social abilities are specified, should express themselves efficiently, and be able to find the similarities or differences of the problems they face, and carry out multi-faceted classification.

In question number four, it was made referring to the elaboration thinking indicator, namely to initiate the details of the tools and materials for the coffee peel waste utilization project and to write down the idea of describing the procedure for the coffee peel utilization project in detail. While question number five was made referring to the indicator of originality thinking, namely to propose details of tools and materials that are different from the project for utilizing coffee peel waste in general, as well as writing down the idea of describing procedures that are different from the project of utilizing coffee waste in general.

In question number 1, students are presented with problems that must be identified. The score for assessing student answers uses a gradation of values from the highest with 4 points if students can write 3 correct answers, get 3 points if they write 2 correct answers, get 2 points if they write 1 correct answer, and get 1 point if they write the answer but the concept is not correct. Each answer to the question is given a score with a gradation of values like the question in number 1.

3. Development

At the developmentintegrated science learning program was carried out in the Immersed form of lesson plans, LKPD, and pretest-posttest assessments, which are then validated by science learning expert validators. Learning activities were arranged in

lesson plans using anImmersed project-based while the selection of media was done to optimize the project-based integrated science learning program Immersed developed.

The pretest-posttest test instrument was arranged based on the specification of learning objectives, to measure the creative thinking skills of junior high school students before and after the implementation of the Immersed based on the use of coffee peel waste. The test indicators developed to include the ability to generate many ideas or questions related to the problem (fluency), the ability to provide various interpretations of a problem and can take alternative solutions to a problem (flexibility), the ability to generate new ideas or ideas (originality), and the ability to develop or refine ideas or specify strengths or weaknesses (elaboration).

Indicators of pretest-posttest questions were prepared concerning indicators ofcreative thinking skills according to Torrance in Al-Sulaeman (2009), which include thinking skills fluency (to spark many ideas or questions related to problems), flexibility (providing various interpretations of problems and can take alternative solutions to solve a problem), originality (the ability to generate new ideas or ideas), andelaboration (the ability to develop or refine ideas or detail advantages ordisadvantages). At the development stage, five questions of creative thinking skills were produced, wherein question number 1 contains indicators of *fluency*. Question number 2 contains indicators of *fluency*. Question number 3 contains indicators of *flexibility*. Questions number 4 and 5 contain indicators of *originality* and *elaboration*.

4. Implementation

After producing the Immersed integrated science learning program based on a valid and reliable coffee rind utilization project, the product was implemented. The implementation of the product was carried out at the Miftahul Ulum Al-Qur'an Middle School. The class that was the subject of the research was given an Immersed integrated science learning treatment based on a coffee peel utilization project using a developed learning tool.

The stages of Immersed integrated science learning based on the use of coffee peel refers to the project-based learning stages contained in the LKPD. These learning stages consist of 5 learning stages, namely the orientation stage, identifying and determining the project, planning the project, implementing the project, documenting the project, and reporting the project.

5. Evaluation

Students' creative thinking skills were measured at the evaluation stage, after the *Immersed* based on the coffee peel utilization project, by determining the n-gain value. The class that was used as the research sample was class IX-A. Before applying the learning process, a pretest of creative thinking skills was conducted.integrated science learning was implemented *Immersed* based on the coffee peel utilization project. After the learning was applied, a posttest of creative thinking skills was carried out. The pretest and posttest value data obtained were used to calculate the n-gain. The results of the pretest-posttest score indicators for students' creative thinking skills can be seen in the following graph.

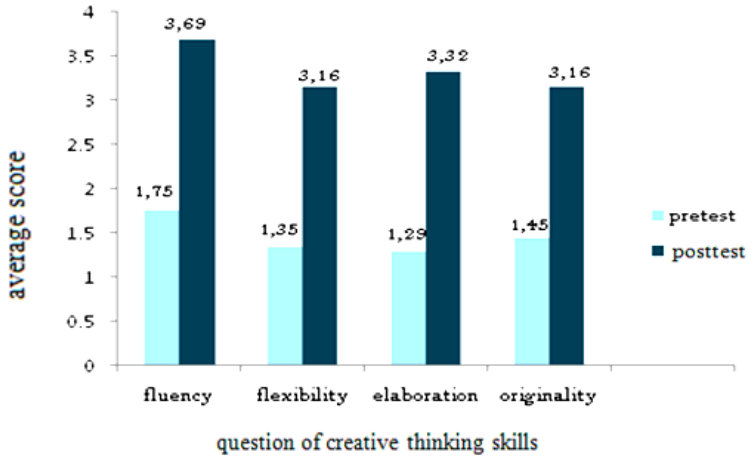

Figure 2. The average pretest-posttest score of creative thinking

Based on Figure 2, the average pretest score of students on the *fluency* is 1,75, while the average posttest score of students on the fluency indicator is 3,69. On the flexibility indicator, the average pretest score of students is 1.35 and the average post-test score obtained by students is 3,16. On the elaboration indicator, the average pretest score of students is 1,29 and the average posttest score obtained by students is 3,32. While on the originality indicator the average pretest score of students is 1,45 and the average posttest score obtained by students is 3,16. In this study, it was shown that the highest percentage of creative thinking skill indicators at the pretest was *fluency* at the first level, the second was *flexibility*, *elaboration* at the third level, and the last was *originality*. Meanwhile, the highest percentage of creative thinking skills indicator achievement at the time of the post-test was *fluency* at the first level, the second was *elaboration*, and the last was *flexibility* and *originality*. These results indicate that on average students are better able to answer problems quickly and smoothly, and more than expected than the ability to answer by expressing new ways because the old way is no longer efficient for existing problems. Furthermore, the ability of students to answer questions relevantly and students to answer questions by thinking original or answering uniquely and differently than what had existed before. Most students can achieve the elaboration indicator, where students can enrich ideas in detail and detail in answering questions. This is supported by research by Djupanda & Darmadi (2014) that problem solving systematically, sequentially, in more detail, and full of explanations is the tendency of someone who has good elaboration thinking skills. The average results of the pretest, posttest and n-gain values of creative thinking skills are shown in the table below.

Table 1. Average scores of pretest, posttest, and n-gain of students' creative thinking skills

Question number	Average of pretest	Average of posttest	Average ofn-gain	Criteria of n-gain
1	1,74	3,51	0,78	High
2	1,77	3,87	0,94	High
3	1,35	3,16	0,68	Medium
4	1,29	3,32	0,74	High

5	1,45	3,16	0,67	Medium
Average	1,53	3,38	0,71	High

The table above shows that there is an increase in the pretest value to the posttest value in the class that is the research sample. Of the 31 research samples, the average pretest score on question number one was 1.74 while the average post-test score of students was 3.51 with an average n-gain of 0.78 high criteria. In question number two the average pretest score is 1.77 while the average post-test score of students is 3.87. The average n-gain on question number two is 0.94 with high criteria, this means that questions on numbers one and two that are made can improve students' fluency thinking skills. This is supported by research by Eragamreddy (2013) that creativity aims for an effective balance of searching (to find old ideas) and imagining (to invent new ideas) so we can combine the best of old and new ideas. In question number three the average pretest score is 1.35 while the average post-test score of students is 3.16, the average n-gain is 0.68 with moderate criteria. In question number three, there is an increase in flexibility thinking skills in the medium category. In line with this, Guilford (1954) stated that stimuli in the forms of conditions/situations may change learners' behaviors. Guilford further stated that creative actions are an example of the outcomes of a learning process that shows changes in behaviors resulting from stimulation and responses.

In question number four the average pretest score is 1.29 while the average posttest score of students is 3.32, and the average n-gain is 0.74 with high criteria. In question number four, there is an increase in originality thinking skills with a high category. This is supported by research by Eragamreddy (2013), that students can use purposeful strategies to channel their thoughts in new directions. In question number five the average pretest score is 1.45 while the average post-test score of students is 3.16 and the average n-gain is 0.67 with moderate criteria. The strength of the increase from pretest to posttest was measured using the n-gain value with an overall average of 0.71 with high criteria. The improvement of creative thinking skills occurs because the learning stages used are project-based learning stages which consist of 5 learning stages, namely the orientation stage, identifying and determining projects, planning projects, implementing projects, and documenting projects and reporting projects. This is supported by research by Sari, Hidayat & Kusairi (2018) that after experiencing a project-based learning process, students gain more scientific knowledge so that students can develop their creative thinking skills to solve problems. In addition, several supporting studies are Mihardi et al. (2013); Zhou (2012); Marlinda (2012); Luthvitasari (2012); Wurdinger & Qureshi (2014). They found that project-based learning was effective in improving creative thinking skills. In addition, the improvement of students' creative thinking skills is also due to the provision of pretest-posttest instruments in which each item is made based on creative thinking skills according to Torrance. In line with Pada (2018), the creative thinking skills instrument brings a heavy emphasis on the practice of thinking and reasoning, developing creative activities, problem-solving skills, and communicating ideas.

▪ CONCLUSION

Based on the results of data analysis and discussion research that has been carried out by researchers, can be concluded that this development produces pretest-posttest assessment valid to measure creative thinking skills of the student because this

assessment has been tested for validity, teachers, and students. This development of a pretest-posttest assessment is based on basic competencies, learning objectives, and creative thinking indicators. Suggestions for other prospective researchers should pay attention to the availability of books, journal and other supporting sources because this learning requires students to seek information from various sources. Next for prospective researchers should be able to take advantage of all the potential possessed by each region to be used as learning material.

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