Vocational High School Students’ Creativity in Food Additives with Problem Based Learning Approach

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Abstract. The aim of this study is to verify the creativity of vocational students through Problem Based Learning approach in the food additives. The method which used quasi-experiment with one group posttest design. The research subjects were 32 students in grade XII of a vocational high school students courses chemical analysis in Bandung city. Instrument of creativity were essay, Student Worksheet, and observation sheets. Creativity measured include creative thinking skills and creative act skills. The results showed creative thinking skills and creative act skills are good. Research showed that the problem based learning approach can be applied to develop creativity of vocational students in the food additives well, because the students are given the opportunity to determine their own experiment procedure that will be used. It is recommended to often implement Problem Based Learning approach in other chemical concepts so that students' creativity is sustainable.

1. Introduction

According to the Regulation of the Minister of Health No. 392 / Menkes / Per / XII / 76, Additives are the added and mixed ingredients during food processing to improve quality, while additives are banned for foodstuffs regulated by the government in Permenkes RI 722 / Menkes / PER / IX / 88 and No. 1168 / Menkes / PER / X / 1999. In vocational curriculum, The food additives is a concept in daily life (contextually) and often become social issues, with the characteristic, the learning approaches that can be used is Problem Based Learning (PBL).

Excessive Use of additives generated a lot of negative impact. The additives can cause various allergies and trigger hyperactivity in children's attitudes [1]. Researched on the application of PBL approach to measure creativity in general show positive results. The class with Problem Based Learning model has values of flexibility, originality and elaboration higher compared with classes didn’t use the PBL. PBL model means gives a positive effect on students' creative thinking skills [2]. Learning by PBL can improve several skills, including communication skills, and the organization through team work [3]. The PBL as a learning approach can encourage creative thinking skills during the learning process for the emergence of creative ideas and there are additional techniques useful to cultivate ideas, then grew into a productive concept or solution of a problem. Reveals that creativity is includes several creative skills necessary to change the concept or perception or find alternative solutions [4].
This research is expected to produce a useful alternative learning approaches to develop creativity vocational high school students on the food additives.

2. Material Content

Dyes
Food coloring agents are substances that are often used to give the color effect on the food so that the food looks more attractive, and getting people interested in tasting [5]. Dyes are divided into 2 parts, natural and synthetic dyes. Natural dyes include carotenoids, chlorophyll, anthocyanin, antoxantin, and tannins, while synthetic dyes include tartrazine and sunset yellow.

![Tartrazine and Erythrosine](image1)

Preservatives / Antioxidants
The purpose of adding preservatives in processed foods are to prevent oxidation and inhibit bacterial growth. Both functions are important for the preservation, transport, storage and stability of nutrients in the supply of human foodstuffs [6]. Some examples of artificial preservatives are Sodium Benzoate and Butylated hydroxyanisole (BHA).

![Sodium Benzoate and Butylated hydroxyanisole - BHA](image2)

Sweetener
Low calorie sweeteners are sugar replacements that have zero calories and do not blood glucose level through eating them, which makes them a preferable choice for diabetic people over sugar [7]. Some examples of artificial sweeteners are Saccharin and aspartame.

![Saccharin and aspartame](image3)

Increased use of additives in food, raises scientific data linking the influence of additive food with various physical and mental disorders, especially with child hyperactivity and hypersensitivity [1,5]. By knowing several types of additives and the negative effects that may be expected the students are able to identify the additives contained in the food ingredients as well as more careful in choosing food for consumption.
3. Experimental Method
The method used in this research was quasi experiment with one group posttest design. The subjects were 32 students in grade XII of vocational high school in the city of Bandung, West Java. Instruments used in the form of 5 items essay, student worksheets, and observation sheet. During the lessons the students are divided into small groups consisting of 4 people, then before doing the experiment in the laboratory fill out the student worksheet first, and write the experiment procedures in accordance with the literature that they each earn. During experiment in the laboratory, the teacher acts as a facilitator and assesses student performance through the observation sheets, and after completing the experiment, the students are given a written test and make a report of experiment they have been work.

4. Result and Discussion

4.1 Creative thinking skills
Creativity measured include creative thinking skills and creative action skills. Creative thinking skills post-test be measured by five items description based on three indicators: fluently thinking skills, flexible thinking skills, and original thinking skills. Elaborative thinking skills measured by student worksheets. The next step was to calculated the percentage obtained from every creative aspect then interpreted the criteria according to Arikunto’s theory [8], the detailed results are presented in Table 1 below:

Table 1. Distribution of the creative aspect, learning indicators, numbers matter, the maximum score and the mean value of creative thinking skills on food additives vocational high school student

| Creativity Aspect | Indicator                      | Item of Issues                                                                 | Question Number | Maximum Score | Mean  |
|-------------------|--------------------------------|--------------------------------------------------------------------------------|-----------------|---------------|-------|
| **Fluency**       | Smoothly express their ideas to identify of dyes, artificial sweeteners and preservatives | Give ideas to identify the type of synthetic dyes in food | 1               | 20            | 9.84  |
| **Flexibility**   | More thinking about use of additives food | Do you think, is it good to use synthetic additives? | 2               | 20            | 16.25 |
|                   | Applying of concept about dyes, sweeteners and preservatives to solve problems in daily life | snack is very delicious if eaten with sauces. But the sauces undurable if stored at room temperature. If you want the sauces can be durable in a few months, what should you do? Give examples of additives that can be used! | 3               | 20            | 14.52 |
|                   | Applying of concept about dyes, sweeteners and preservatives to solve problems in daily life | | | | |
Table 1. Cont.

| Originality | Percentage | Criteria of capabilities |
|-------------|------------|--------------------------|
| Think of a different ideas with their friends What is your ideas about additives food circulation in daily life | 4 | 20 | 16.88 |
| Write the experimental procedures accordance with literature | | | |
| Write the experimental procedures based on the literature that you get to analyze dyes, synthetic sweeteners and preservatives! | 5 | 20 | 10.47 |

Table 1 shows the distribution of the creative aspect, learning indicators, numbers matter, the maximum score and the mean value of creative thinking skills on food additives vocational high school students. The mean of flexibility was 14.52 highest of fluency (9.84) and the mean of elaborative was 30.

The next step was to calculated the percentage obtained from every creative aspect then interpreted the criteria based on Arikunto’s theory [8]. Distribution of the creative aspect, the percentage of acquired skills and skills criteria can be seen in Table 2 below:

Table 2. Distribution of the creative aspect, the percentage of acquired skills and capabilities criteria

| Indicators of creative thinking skills | Percentage | Criteria of capabilities |
|--------------------------------------|------------|--------------------------|
| Fluently Thinking Skill (fluency)     | 49.22      | Enough                   |
| Flexibly Thinking Skill (flexibility) | 74.61      | Good                     |
| Originally Thinking Skill (originality) | 68.36     | Good                     |
| Detailing Skills (elaboration)        | 100        | Very good                |

Table 2 explained the fluency was 49.22 (enough), flexibility was 74.61 (good), originality was 68.36 (good) and elaboration was 100 (very good). The average value of creative thinking skills for vocational students in the food additives concept with PBL approach was 73.05% (Good). The result of this research as the result of the results that has been done by Awang and Ramly. They said, PBL as an instructional model that could encourage the creative thinking skills during the learning process, creative ideas and create concepts and made solution of a problem [4]. The PBL approach given more positive effects for students’ creative thinking skills [2].

Fluency showed that students’ ability to provide ideas to identify food additives has not reached the maximum value, this is caused by the students generally only provide one or two methods, while the expected answer using three methods. The three methods are organoleptic, color reaction (test wool) and paper chromatography. It’s may be caused by only two methods to do the experiment, organoleptic and wool test, while the paper chromatography was not done. Therefore the students conveyed something what they remembered.

Flexibly thinking skills (flexibility) obtained at 74.61 with good categories, the findings suggest that students are able to give consideration of various viewpoints related to the use of food additives. Students are able to provide consideration in terms of economic, health and law, besides flexibility measured also by the question of how to preserve food, students are generally able to provide answers that preserve food could naturally that is the process of storing at low temperatures or by using preservatives both natural and synthetic preservatives specifically for the correct amount of food allowed. This is in line with the results of research by Tosun and Taskesenligil, They said that PBL
has a positive contribution to the critical thinking skills, scientific process skills, ability to work in
groups, communication skills, and problem solving skills [9].

Originally thinking skills (original) was 68.36 with good category, this finding suggests that
students have different opinions regarding the use of synthetic additives on the market, most of the
students found the use of additives is not allowed, but some argue that the use additive synthesis is
allowed during the usage rules set by the government, they issued an opinion along with logical
reasons. In addition, the originally thinking skills measured through the command to write an
experimental procedure in accordance with the literature obtained, most students were able to answer
it, this is caused by these commands related to syntax PBL stage 2, so that students have ever been to
implement and still remembered well, because PBL fit into cognitive theory and constructivism,
linking new information with pre-existing, elaboration and cooperative information in building
knowledge [10].

Elaborative thinking skills obtaining the value of 100 with excellent category, these findings
indicate that the students were able to completely write data and observations in detail, they have to
write every change of every steps of the experiments. These things happen because they work in
groups, so they can complement each other. This finding is consistent with the opinion of William,
that in PBL increased several skills, including communication skills, and team work [3].

From the above it can be concluded that PBL is able to generate creative thinking skills well,
because students were studying and thinking, not just memorizing. So when given a test of creative
thinking skills, they are generally able to answer well.

4.2 Creative acting skills
Skills of creative act is a product of creative thinking skills. Creativity is includes several creative
skills necessary to change the concept or perception or find alternative solutions [4]. Creative acting
skills in this study was measured by two indicators creative acting skills, there are original act and
detailing skills, by using observation sheet. Score, percentages and criteria can be seen in Table 3
below:

| Table 3. Distribution of mean and creative acting skills criteria |
|---------------------------|-----------------|----------------|
|                            | Score | %     | Criteria |
| Originally Act Skills      | 1.5   | 54.25 | Enough   |
| Elaborative Act Skills     | 2.75  | 91.75 | Very good |

From Table 3, obtained that elaborative acting skills have the greatest value of 91.75% with a very
good category, while the original thinking skills reached 54.25% with sufficient criteria. Elaborative
acting skills obtained by observing when the students write down complete observations supported by
analyzing the trial report that they set. It was found that all the students have been able to write data
and observations in detail, they write down any changes that occur at every step of the experiment.
Skills detailing (elaborative) reached 91.75% in the category of "very good". This approach can
optimize all the potential that exists in students to learn, because during the presentation involve
students actively both mentally and physically [11]. In this learning process the student's responsibility
to learn more, because students work more than just listen to the information.

Original acting skills acquired when students conduct experiments in a laboratory in the group.
Researchers conducted observations when the implementation process of trial qualitative analysis of
additives, and held discussions with students. Assessment is done when students were able to try
adding a reagent to obtain a clear observation. The results obtained for the acting skills of authenticity
(original) is 54.25% (category enough). This shows that there are still some students who attempted to
follow existing procedures without performing tests on the addition of reagent volume.
The conclusions that can be drawn from the above description is a creative act of skills acquired based on two indicators creative acting skills is 73% means that the approach to Problem Based Learning is able to explore a creative acting skills of students in the additive materials.

5. Conclusion
The results showed that the Problem Based Learning can be applied to develop creativity well. Suggested PBL is often be used so that the creativity of students getting trained.

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