Understanding natural coloring substances using a web-based application

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Abstract. This study describes chemical learning in junior high school through Project Based Learning (PjBL). Learning through Project Based Learning (PjBL) can help students reduce learning difficulties, both in academic performance, motivation (self-efficacy and task value in terms of environmental studies) and group work (acceptance in groups and involvement in the learning process). In order to be able to attend learning well, students must have cognitive abilities, because it is one aspect of child development that must be stimulated by their abilities early. Therefore, this study aims to develop students' cognitive abilities through the design of Project Based Learning (PjBL) on the topic of natural dyes. The researcher used the Greivemeijer & Cobb Design-Based Research (DBR) research method consisting of 3 phases namely Preliminary Design, Design Experiment and Retrospective Analysis. Participants in this study were 25 class VIII students, science teachers and 3 observers who understood the PjBL design. Based on the results of the study, the PjBL design can improve students' cognitive abilities. Understanding (C2) obtaining an average of 59.59% (sufficient category), applying (C3) obtained an average of 66.66% (good category), analysed (C4) obtained an average of 58.58% (sufficient category). The highest cognitive ability of students is in the ability to remember, while the lowest is in the ability to analyse.

1. Introduction
A teacher can teach students in class by giving knowledge to their students, and then evaluating the results of their knowledge transfer. Teachers teach and assess students so that they can learn a subject matter and remember it for so long or it is also called retention. Retention and transfer are categories that exist in the cognitive process. Through cognitive transfer processes can produce meaningful learning. One that is included in the cognitive transfer process is creating with the categories of generating, planning, and producing [1]. This shows that one way to increase student creativity is by directing students to create, plan, and produce through the design of PjBL learning.

Learning through Project Based Learning (PjBL) can help students reduce learning difficulties, both in academic performance, motivation (self-efficacy and task value in terms of environmental studies) and group work (acceptance in groups and involvement in the learning process). The students also prefer to learn based on experience in learning. In the context of student-centred learning, learning through Project Based Learning (PjBL) has become increasingly prominent as a response from schools to the challenges of the 21st century. Project Based Learning (PjBL) involves the study / research of topics in depth where students' ideas, questions, predictions and interests form life experiences and work / activities carried out. A key characteristic of PjBL is examining questions that have been submitted by
students and collaborating with classroom teachers and can be further refined during the study program [2].

Research related to creativity and cognitive abilities of students has indeed been done a lot. Did in learning through Problem Based Learning (PBL). The research that has been done is on water purification material. Because creativity is very important, I tried to do more research on creativity by applying different learning and topics. One of the lessons that can be applied to increase creativity is PjBL, so I will apply PjBL in learning the topic of Additive Substances. Increasing student creativity can be done by applying learning with Project Based Learning (PjBL).

Based on learning characteristics to encourage the ability of students to produce contextual work, both individually and in groups, it is strongly recommended to use a learning approach that produces problem-based work with a project (project based learning) [3]. The characteristics of PjBL are students can choose activities and work carried out during learning, they can be communicative, creative and develop practical thinking when they are involved in active investigations/discoveries, exploration and decision making; knowledge is based on experiences and experiments in real/authentic life; Project Based Learning (PjBL) connects manual and intellectual work.

One topic that fits PjBL is food additives, because it is closely related to real life and can guide communicative and creative students. In accordance with KI.3 in the 2013 curriculum, namely Understanding and applying knowledge (factual, conceptual, and procedural) based on the curiosity about science, technology, art, culture related to phenomena and events that appear to the eye. In everyday life we often use additives, either colouring or preservatives, some are made from natural ingredients that are safe for the health of the body or made from chemicals that are harmful to the health of our bodies. Based on BPOM test results conducted in 18 provinces in 2008 including Jakarta, Surabaya, Semarang, Bandar Lampung, Denpasar, and Padang for 861 food samples showed that 39.95% (344 samples) did not meet food safety requirements. Of the total sample, 10.45% contained prohibited dyes, namely Rhodamin B, methanil yellow and amaranth [4-6]. Students can develop creativity in making natural additives that are safer for our bodies.

Based on the background and several opinions above, the author tries to conduct a study entitled "Project Based Learning (PjBL) Design to Develop Cognitive and Creativity Abilities of Class VIII Middle School Students on Topics of Natural Dyes".

2. Method
This research was conducted at one of the private junior high schools in Cirebon Regency, with the subject of research being class VIII students. This study uses the Design Based Research (DBR) model Greivemeijer and Cobb with the following stages: (1) Preparing for the experiment / Preparation and design phase, by analysing the learning objectives to be achieved based on curriculum in junior high school determines and determines the initial conditions of the study by interviewing science subject teachers, discussing conjectures from local instructional theories that will be developed with science subject teachers, determining class characteristics and teacher roles from the results of interviews with teachers and students, and setting theoretical goals to be achieved through research; (2) Stage Design experiment, covers the learning process that occurs in the classroom with the design of Project Based Learning (PjBL) to develop students' cognitive abilities on the topic of natural dyes; (3) Retrospective Analysis Phase, analyses the data that has been obtained from the video recording of the learning process and the results of interviews with students and teachers, student work sheet results, field notes and video and audio recordings that contain the research process from the beginning.

3. Results and discussion
3.1. Implementation of the PjBL model to improve students' cognitive abilities

From this study, to see the feasibility of the PjBL design to improve the cognitive abilities of students using the N-gain the following data were generated:

### Table 1. Implementation of PjBL with N-Gain.

| The number of student | Score | Interpretation |
|-----------------------|-------|----------------|
| 25                    | 0.31  | average        |

As for the categories we can use the Gain index interpretation Normalized (g) according to the modified Hake:

### Table 2. Interpretation N-Gain calculation.

| N-Gain       | Category     |
|--------------|--------------|
| -1,00 < g < 0,00 | Decrease     |
| g = 0,00     | Stable       |
| 0,00 < g < 0,30 | Low          |
| 0,30 < g < 0,70 | average     |
| 0,70 < g < 1,00 | high        |

3.2. Student cognitive abilities based on the results of the pre-test and post-test

Based on the results of student answers, it can be classified according to the cognitive abilities of students as follows: considering (C1) obtained an average of 74.74% (good category), understanding (C2) obtaining an average of 59.59% (sufficient category), applying (C3) obtained an average of 66.66% (good category), analysed (C4) obtained an average of 58.58% (sufficient category). The highest cognitive ability of students is in the ability to remember, while the lowest is in the ability to analyse.

Questions made for pre-test and post-test include questions that can measure students' cognitive abilities. Pre-test is done before students make a project in making natural dyes, while post-test is done after the student has done a project to make natural dyes. Based on the results of student answers, most students can answer questions correctly. The average score of students from the post-test results is greater than the results of the pre-test.

**Figure 1.** Examples of questions based on cognitive abilities.
With students' cognitive abilities in memory and good categories, the students' memories are good and they understand the material of natural dyes. Whereas in the elderly it is quite good, some of them understand the material of natural dyes, some of them do not understand, as well as the analysis of the material.

4. Conclusion
Based on the research that has been done, the results show that the PjBL design can improve the cognitive abilities of students, especially the ability to remember students, which is equal to 74.74%, and the implementation of the PjBL design is also an average category.

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