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Application of Project Based Learning Model on Basic Chemical Colloidal Materials to Improve Science Process Skills and Student Learning Outcomes

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Abstract

The old view, learning as a process of interaction between lecturers and students in the context of knowledge transfer. Along with the times with the era of sophisticated technology and globalization, the concept is no longer appropriate. In this era of technology and globalization, the challenges of life are increasingly complex. Student centered learning must be interactive, fun, challenging, motivate students to participate actively, and provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students. From the various existing learning models, innovation can choose project-based learning model. Students constructively carry out deepening learning with a research-based approach to weighty, real, and relevant problems and questions. Science process skills are important skills to be used in the science learning process such as in studying chemistry. In addition, science process skills also reflect the behavior of scientists in classifying science, but the current science process skills of students are still low. The purpose of this study is to analyze application of project-based learning model on basic chemical colloidal materials to improve science process skills and student learning outcomes. The research area was carried out in the Chemical Education Study Program, PMIPAFKIP, Universitas Jambi in the odd semester 2021/2022. The population in the study were all students who contracted Basic Chemistry II in the odd semester of the 2021/2022 academic year. The sample was taken in one class. This research is a quantitative study using a pre-experimental design type one group pretest-posttest (single group initial-test-posttest). The results showed that project-based learning model can be applied to basic chemical colloidal materials. Students' science process skills in learning colloidal materials by applying project-based learning model are very good. Student learning outcomes in learning basic chemical colloidal materials by applying project-based learning model are very good.

Keywords
project based learning model; science process skills; learning outcomes

I. Introduction

The old view, learning as a process of interaction between lecturers and students in the context of knowledge transfer. Along with the times with the era of sophisticated technology and globalization, the concept is no longer appropriate. In this era of technology and globalization, the challenges of life are increasingly complex. So that learning must be interpreted as a process of student interaction with lecturers and learning

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resources in the learning environment. This learning environment is very broad, starting from the problems around it to world problems.

Student centered learning must be interactive, fun, challenging, motivate students to participate actively, and provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students. From the various existing learning models, innovation can choose project-based learning model.

Project based learning model is a teaching approach that is built on learning activities and real tasks that provide challenges for students related to everyday life to be solved in groups (Goodman and Stivers, 2010). Grant (2002) defines project-based learning model as a learner centered learning model to conduct an indepth investigation of a topic. Students constructively carry out deepening learning with a research-based approach to weighty, real, and relevant problems and questions.

The basic chemistry course is a compulsory subject for chemistry education study students, colloids are one of the subjects. The sub topics of colloids are the concept of colloids, the properties of colloids, the manufacture of colloids and colloids in everyday life. So far (about 28 years) the author as a lecturer in basic chemistry only explains the material and gives examples in everyday life assisted by power points. The material in this colloid is very close to everyday life. In addition, by applying some of the properties of colloids, it can produce products such as making tofu, purifying water, making agar and jelly. According to Rais (2010), project-based learning model is suitable for materials that can produce a product and are related to real problems or everyday life.

Based on the results of telephone interviews with several students who have passed basic chemistry courses and who have graduated, most of them do not remember the colloid materials anymore. They also did not think of applying colloid science as a business. It means that the learning that has been done previously is less meaningful. In the interview the author explains project-based learning model, after that the author asks "what if colloid materials is taught with project based learning model?". Almost all of them strongly agree, especially those who have taught school.

Science process skills is one of the important process skills to be possessed by students. Science process skills can be used to solve chemical problems experienced by students in everyday life (Zeidan and Jayosi, 2015). Science process skills are important skills to be used in the science learning process such as in studying chemistry. In addition, science process skills also reflect the behavior of scientists in classifying science, but the current science process skills of students are still low.

According to Fakhan (2017), science process skills components are observing, grouping, interpreting observations, predicting, asking questions, hypothesizing, planning experiments/research, using tools/materials, applying concepts, and communicating. Furthermore, Fakhan (2017) stated that of the 10 science process skills there are what are called basic science process skills, namely; observing, communicating, classifying, and predicting.

Learning outcomes are the result of the learning process. According to Sudjana (2009) learning outcomes are essentially changes in behavior as a result of learning in a broader sense covering the cognitive, affective, and psychomotor domains. Dimyati and Mudjiono (2006) also mention that learning outcomes are the result of an interaction between learning and teaching actions. From the teacher's side, the act of teaching ends with the process of evaluating learning outcomes. From the student's perspective, learning outcomes are the end of teaching from the peak of the learning process. The cognitive domain (C) is remembering (C1), understanding (C2), applying (C3), analyzing

(C4), assessing (C5), and creating (C6). From the data of basic chemistry lecturers for the last 3 years, students' scores on this colloidal material are low, the average is 62.5. Students have difficulty answering analytical questions (C4) and assessing (C5).

II. Research Method

Research area means a location within a licensed research section used for the cultivation, planting, growth, handling, harvesting, conditioning, storage, distribution, transporting, or processing of industrial hemp plants, plant parts, grain, or seeds (Asyraini et al., 2022; Octiva et al., 2021; Pandia et al., 2018 ; Pandiangan et al., 2018). The research area was carried out in the Chemical Education Study Program, PMIPAFKIP, Universitas Jambi in the odd semester 2021/2022.

The population is a group of people, events or things that have certain characteristics (Pandiangan, 2015; Pandiangan, 2022). The population in the study were all students who contracted Basic Chemistry II in the odd semester of the 2021/2022 academic year. The sample is a small part of the population itself which is taken as an object in an observation or research because it is considered capable of representing the population (Octiva, 2018; Pandiangan, 2018; Pandiangan et al., 2021). The sample was taken in one class.

This research is a quantitative study using a pre-experimental design type one group pretest-posttest (single group initial-test-posttest). This one group pretest-posttest design consists of one predetermined group. In this design, a test is conducted twice, namely before being given treatment it is called pretest and after treatment is called posttest. The research pattern of the one group pretest-posttest design method according to Sugiyono (2013) is as follows:

O1XO2	O1= Pretest Value (Before Treatment) O2= Posttest Value (After Treatment) X= Project Based Learning Model

Figure 1. *Research Patterns One Group Pretest-Post Test Design Method*

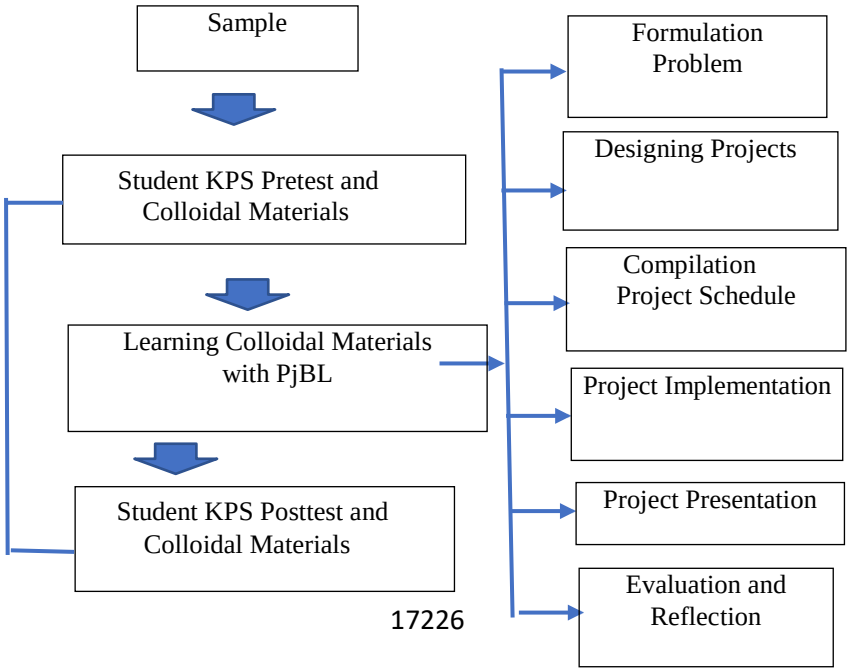

Figure 2. *Project Based Learning Model Implementation Flow*

This research consists of several stages, namely:

1. Analyzing colloidal materials, determining the problems that will be made into the project.
2. Make semester lesson plan.
3. The first meeting (3x50 minutes) via zoom:
   a. Pretest colloidal materials.
   b. Explain the learning system.
   c. Explain colloidal materials with powerpoint.
   d. Discussed the formulation of the problem that will be used as a project, in colloidal materials there are many problems that can be used as projects, in this study students were divided into 3 groups.
4. Outside the class, each group formulates different problems and projects through group discussions and videos of the discussions.
5. Second meeting (3x50 minutes) via zoom:
   a. Each group conveys the project they will be doing and receives input from their friends and input from the lecturer.
6. Outside of class hours for one week, each group works on their own project, which is documented by video. And prepare ppt to present the results of the project.
7. Third meeting (3x50 minutes) via zoom:
   a. Each group presents the results of their project.
   b. Lecturer leads class discussion.
   c. Posttest colloid materials.

Instruments in research there are 2 types, namely:

1. Observation sheets to observe the implementation of project based learning model (PjBL) and observation sheets are arranged based on the stages of implementing PjBL (Figure 2) and student science process skills (KPS) (Figure 2).
2. Essay test to measure student learning outcomes in the form of a test essay compiled based on colloidal materials for components C4-C6 of Anderson's taxonomy. The essay questions are validated (content) by asking for comments from 2 lecturers of chemistry education who are considered to have more abilities.

Data is a collection of information or facts made with words, sentences,symbols,numbers, and others (Octiva et al., 2018; Pandiangan et al., 2022; Tobing et al., 2018). There are two kinds of data in this study, namely:

1. Qualitative data, namely data on the implementation of learning with PjBL on colloidal materials and student KPS data on learning with PjBL on colloidal materials. This qualitative data was taken from videos of student activities and project presentation times.
2. Quantitative data, namely data on student learning outcomes C4, C5, and C6 for colloidal materials taught with the PjBL model.

Data processing is as follows:

a. Qualitative data is presented in the form of descriptive text, narrated towards conclusions.
b. Quantitative data in the form of pretest and posttest were searched for the average then seen the increase from pretest to posttest to draw conclusions.

III. Result and Discussion

3.1 Project Based Learning Model Implementation

Colloid materials learning with project-based learning model is carried out online (zoom and WA), zoom activities are recorded to evaluate the implementation of learning. The assessment team was given learning recordings and learning implementation assessment sheets. The assessment sheet for the implementation of project-based learning model refers to Rais' opinion in Lestari (2015) of the 20 assessment items, only 6 items scored 4, the rest scored 5, so the percentage was 94% (very good). However, the appraiser's suggestions/comments are generally "the role of the lecturer is somewhat reduced". Indeed, sometimes the weakness of lecturers is not patiently waiting for student answers/comments.

The concept of colloid is very much found in everyday life. According to Rais (2010), project-based learning model is compatible with materials that can produce a product and are related to real problems or everyday life.

There are 3 projects made by students on these colloidal materials, and they are published on YouTube, namely:

1. 1Making tofu with pineapple juice, youtube link:
   https://www.youtube.com/watch?v=MSdkas7ZgXM.
   Until December 9, 2021 at 11.00 it has been played 260 times and has been liked by 160 people.
2. Jelly candy from dragon fruit skin, youtube link:
   https://www.youtube.com/watch?v=Q0oAYquzvOI.
   Until December 9, 2021 at 11.00 it has been played 303 times and has been liked by 171 people.
3. Water purification with Moringa seeds, youtube link:
   https://www.youtube.com/watch?v=MDSD93w64Rc.

   Until December 9, 2021 at 11.00 it was played 219 times and has been liked by 137 people.

The following are pictures of colloidal lecture atmosphere with project-based learning mode and project performances for each group.

Figure 3. *Lecture Atmosphere*

Figure 4. *Appearance of Group* 1

Figure 5. *Appearance of Group 1*

Figure 6. *Appearance of Group 2*

Figure 7. *Appearance of Group 3*

Figure 8. *Appearance of Group 3*

3.2 Student Science Process Skills

Student science process skills (KPS) were assessed using the KPS assessment sheet which refers to the opinion of (Rustaman, 2003). The assessors are given learning videos and videos of students working on projects, then asked to rate based on the assessment sheet provided. The number of KPS assessment items is 16. The average student score is 4.25 or 85% (very good).

Student KPS which were rather low were:

1.Asking what, how and why an average score of 3.4.

2.Defending their ideas/opinions an average score of 3.6.

Observing, grouping observations, interpreting observations is high. This is in accordance with what was conveyed by Semiawan (1992) that science process skills are skills that are able to find and develop facts and concepts as well as the growth and development of attitudes and values.

Science is developing rapidly, so assessors convey that it is very important for students to develop science process skills thing. This is in accordance with what was

stated by Semiawan (1992) that one of the reasons it is necessary to develop student KPS is "The development of science and technology is accelerating so that it is no longer possible for educators to teach all concepts and facts to students". If students' KPS are students, they can learn on their own and their creativity will increase.

3.3 Student Learning Outcomes

Student learning outcomes were obtained from 5 essay questions, at C4, C5, and C5 the cognitive domain of Bloom's taxonomy. Cognitive domains C4, C5, and C6 are included in higher order thinking. The following Table 1 presents the pretest and posttest scores for colloid materials and the posttest scores for the last two years:

Table 1. Average Student Pretest and Posttest Results

School Year	Pretest	Posttest	Learning Model
2019/2020		63	Direct Instructional
2020/2021		60	Direct Instructional
2021/2022	38	86	Project Based Learning

The posttest scores for the academic year 2019/2020 and 2020/2021 are shown to be compared with the posttest scores for learning using project-based learning model. Obviously, the difference from the 60's, to the 80's. When compared with the pretest (38), the posttest score (86) is clearly different. What's more interesting is that the posttest score range is very close, with a high of 98 and a low of 76.

IV. Conclusion

The results showed that project-based learning model can be applied to basic chemical colloidal materials. Students' science process skills in learning colloidal materials by applying project-based learning model are very good. Student learning outcomes in learning basic chemical colloidal materials by applying project-based learning model are very good.

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