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Application of Project-Based Worksheets for Making Conditioner from Aloe Vera (*Aloe vera L.*) to Develop Students' Scientific Performance

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ABSTRACT

This research aims to describe student activities, analyze student scientific performance at each learning stage, and analyze the characteristics of conditioners made from aloe vera (Aloe vera L.) by applying a project-based worksheet. The research method used was pre-experimental with a One-Shot Case Study design. The subjects of this research were students of class XI MIA MA Al-Jawami Cileunyi. The instruments used are learning descriptions, observation sheets, student worksheets (LKS), student scientific performance sheets and product assessment sheets. Data was obtained from observations of learning activities, filling out scientific performance sheets and product assessment sheets. The research results showed that overall student activity reached 94.8% with very good interpretation. The average value of student performance at all stages of learning by implementing project-based learning is 88.4 with good interpretation. The average value of students' scientific performance ability is 94.4 with very good interpretation. The average value of the characteristics of conditioners made from aloe vera as a whole is 98.4 with a very good interpretation. Thus, the application of project-based worksheets for making conditioner from aloe vera (Aloe vera L.) can develop students' scientific performance.

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1. INTRODUCTION

Chemistry is a logical science with many interesting concepts and various applications. In chemistry there are two things that are interrelated, namely chemistry as a product including facts, concepts, theories and principles and chemistry as an aspect including scientific performance developed through practical methods (Andromeda *et al*., 2018). Practicums in chemistry learning are useful for increasing activity and interest in chemistry. In practicum, tools or media are usually used in the form of worksheets (LK). The worksheet used in the practicum must be designed taking into account its characteristics and in accordance with the learning material so that the practicum activities run well (Rahmatullah & Fadilah, 2017).

The worksheet is a medium designed to help students play an active role in project-based learning (PjBL). Chemistry learning can be done through PjBL, which includes scientific process skills (Sumarti *et al*., 2018). PjBL is good learning to develop students' thinking and communication skills (Barlenti *et al*., 2017). Based on research by Apipah *et al*. (2019), project-based worksheets can help students explore a subject by developing projects related to that subject, which will increase their interest in the learning process. Many questions in the project-based worksheet are based on the PjBL stages that lead to the creation of the final product.

PjBL is a learning method that involves students in real projects that require problem-solving, for example in colloidal materials. In colloid material, students are required to explain colloid systems, their characteristics, and their applications in everyday life. Students must also create and analyze various colloid systems with the surrounding materials following colloid competency standards and basic competencies. Students are expected to develop a deeper understanding of colloids and their relationship to the real world. This method allows them to actively participate in exploration, research, and problem-solving related to colloids (Kumalasari *et al*., 2017). Based on research from Bahriah *et al*. (2017), PjBL on colloidal materials can improve students' understanding, increase their motivation to learn and increase their interest in learning.

One application of colloidal material is making conditioner. Hair care using shampoo and conditioner aims to maintain cleanliness and health of the scalp. Hair care is an ongoing process to avoid wavy, dry, dull, or damaged hair (Sari, 2021). Sometimes using shampoo alone is not enough to care for hair, conditioner is needed as additional care to provide the best possible hair care (Batubara *et al*., 2019). Based on research results, Sri (2019) stated that making conditioner with several variations in the concentration of hibiscus leaf mucus (*Hibiscus rosa-sinensis L.*) produces a product that is stable and has a soft texture that can soften hair after shampooing, protect hair, and make hair look shinier.

Aloe vera contains several important compounds including aloin, emodin, gum, and essential oils. In addition, aloe vera contains lectins, saponins, minerals, vitamins, and fibrous amino acids which all help in maintaining healthy hair (Rusli & Sinala, 2018). Based on research results from Masyitoh *et al*. (2019), traditionally aloe vera is used to treat hair loss. Using alternative hair treatments with aloe vera can repair dry hair, strengthen hair roots, and reduce hair loss.

Based on the background that has been explained, this research aims to: a) describe student activities in a worksheet based on the project of making aloe vera (*Aloe vera L.*) to develop students' scientific performance; b) analyzing students' scientific performance in the application of project-based worksheet on making aloe vera conditioner; c) describe the characteristics of conditioner made from aloe vera.

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2. THEORY

2.1. Project based worksheet

Worksheets help students in learning activities by finding and exploring information, applying concepts and developing the concepts they have learned (Wahyuni *et al*., 2017). Worksheets also help students in the learning process by increasing student activity and making learning material easier to understand (Muslimah *et al*., 2021). Project-based worksheets are a learning model that helps students acquire basic skills, such as decision-making skills and problem-solving skills (Sahtoni *et al*., 2017). Project-based worksheets can be understood as worksheets that are focused on students creating final products based on lesson principles.

PjBL is a learning approach that is student-centered and involves students in meaningful learning. In the PjBL approach, students' learning experiences and concepts are built through products (Afriana *et al*., 2016). This approach can produce results in the form of project design, planning, and implementation as well as results that can be published. By using active questions that are relevant to actual conditions, PjBL can improve student performance (Rajabi *et al*., 2015).

The project-based worksheet has six stages, namely 1) analyzing the problem, 2) creating a design, 3) carrying out research, 4) preparing a product draft/prototype, 5) measuring, assessing, and improving the product, and 6) finalizing and publishing the product (Apipah *et al*., 2019).

2.2. Student Scientific Performance

Scientific performance is a series of actions taken by researchers to solve problems using a scientific approach. The development of facts, ideas, perspectives, and values as well as the ability to process data or new things are part of the scientific performance skills that students need. Some examples of scientific work skills include formulating problems, conducting experiments, communicating data, and making conclusions (Suryana *et al*., 2015).

Scientific performance is the ability to plan, conduct, and communicate research. The only way to measure students' scientific performance is to measure how well they master process skills. Developing students' abilities to process useful information such as facts, ideas, and developing perspectives and values (Khanafiyah, 2010). Detailed indicator is shown in **Table 1**.

Table 1. Indicators of scientific performance capability.

No	Scientific Performance Indicators	Information
1	Observe	a. Observe a discourse that has been given b. Create a problem formulation based on discourse
2	Formulate a hypothesis	Create a hypothesis from the problem that has been created
3	Designing experiments	Ability to create experimental procedures and determine tools and materials
4	Doing experiments	Ability to carry out experiments based on procedures that have been created
5	Collecting data	Ability to test products, compare products
6	Communicate	Present the results of worksheets and products that have been carried out

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Teachers must provide opportunities for students to understand, design, solve problems, analyze, see, evaluate, and develop understanding of concepts to train students' scientific performance skills (Khanafiyah, 2010). A learning model is needed to teach scientific work skills to students. The PjBL model is one model used to do this.

2.3. Applications of colloid concepts

Colloidal systems are often found in everyday life, such as nature (soil, water and air), industry, medicine, agriculture and food. Due to their unique properties, colloids can be used to mix unstable materials for large-scale production. In this research, the colloid application studied was a conditioner made from aloe vera.

Conditioner is a cosmetic product that functions as a hair protector after shampoo. Consumers use conditioners to care for their hair. Shampoo alone is not enough to care for hair, so conditioner must be used with shampoo to support care. Conditioner softens hair after shampooing, protects hair, and makes hair look softer and shinier (Sri, 2019).

The components for making conditioner are the following:

(i) Cetyl alcohol. The emulsifying properties of cetyl alcohol cream are used to increase stability, improve texture, and improve the consistency of cream preparations.
(ii) Triethanolamine. Triethanolamine is widely used in making topical preparations, especially to make emulsions. Triethanolamine acts as an emulsifier which reduces the surface tension of two surfactant phases, and helps stabilize pH levels.
(iii) Stearic acid. It is a shiny crystalline solid and is white or slightly yellow in color, almost insoluble in water and functions as an emulsifier.
(iv) Dimethicone. Dimethicone is a clear, colorless liquid available in a variety of viscosities. Dimethicone functions as an antifoaming, softening, and water-repellent agent.
(v) Aquadest. Pure water produced through the distillation process is called distilled water. Widely used in preparations containing water, unless intended to be given parentally.

Conditioner quality standards are the following:

(i) Organoleptic examination. Visually, observations are made by observing the color, aroma and texture of the conditioner.
(ii) Homogeneity test. To test homogeneity, conditioner is applied to a glass slide and then covered with another glass slide. The base must be ensured to be homogeneous, have a smooth surface, and no hard granules.
(iii) Test pH. The purpose of the pH check is to ensure that the pH of the conditioner is still acceptable for hair conditioner preparations, namely between 3.5 and 6.5. In other words, the preparation will be stable if used on the scalp with a pH between 4.5 and 6.5.
(iv) Spreadability test. The spreadability test aims to determine how easily the cream spreads on the skin. Cream preparations are expected to be easy to use after being applied to the skin, the requirement for good spreadability is 4-7 cm.

Test Cream type. This cream type test aims to determine the desired type of cream, namely oil in water (o/w). Emulsion-type testing is carried out using the dilution method, namely by diluting with water. If water is dispersed quickly in cream, then the result follows the type of cream to be made, namely oil in water (o/w) (Sri, 2019).

3. METHOD

This research uses a pre-experimental approach, with design One Shot Case Study with a sample of one class as the research subject. The subjects in this research were class XI MIA MA Al-Jawami Cileunyi with research instruments: learning descriptions, student activity

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observation sheets, student worksheets, student scientific performance sheets and product assessment sheets.

Data collection was carried out in observing student activities to determine the implementation of student activities during learning, student worksheets to determine student performance in working on the worksheet. as well as scientific performance sheet and product assessment sheet to determine the development of scientific performance.

4. RESULTS AND DISCUSSION

4.1. Description of student activities in project-based learning

In this research, project-based learning consists of six stages, namely analyzing the problem, creating a design, carrying out research, compiling a product *draft/prototype,* measure, judge and improving the product, and finalizing and publishing the product. This stage has been modified from Rahman (2015) with the aim of adjusting the learning conditions at the school. The following is a description of student activities during learning:

4.1.1. Phase analyzing the problem

At the problem analysis stage, students are given a project-based worksheet which contains a discourse on the problem of using conditioner and the solution to this problem, namely the concept of making conditioner using aloe vera which functions as an active ingredient. Students read the discourse carefully with their group friends. After that, students are assigned to look for the main idea of the discourse contained in the worksheet. The aim is to make it easier for students to create or compile problem formulations.

Next, students create two problem formulations according to the main ideas created previously. Then students create two hypotheses according to the problem formulation. From the results of observations of activities carried out during the learning process, students were very enthusiastic in creating main ideas, problem formulations and hypotheses. However, there were some students who were still confused in determining the main idea so they were helped by researchers.

4.1.2. Project design stage

At this stage students design a conditioner making project including selecting the tools and materials to be used and experimental procedures. The aim is to make it easier for students to carry out the conditioner making project. The design plan can be made based on discourse in the worksheet or others.

During the process of designing a project, students use discourse on worksheets, pictures of a series of procedures that have been presented and guidance from researchers due to limited electronic media such as smartphones and laptops because students are not allowed to bring electronic media such as smartphones and laptops. However, even if they only use the discourse on the worksheet and guidance from researchers, students can carry out this stage well.

4.1.3. Stage of carrying out research

At this stage students carry out practicums in making conditioners based on the experimental procedures created in the flowchart prepared at the design stage. Students homogenize the oil phase and water phase in a bath to a temperature of 70 ℃ ℃, then mix the oil phase and water phase using *a hand mixer* until a white mass form at a temperature

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below 40 °C, add the aloe vera liquid and stir until homogeneous. Then, it is put into a container and a physical evaluation is carried out on the formulation.

4.1.4. Stage of preparing a product *draft/prototype*

Next, students create a conditioner testing procedure based on SNI. This testing procedure is used to obtain products produced based on SNI. At this stage students make reports and discuss things that happened during the practicum. Overall, all group members participated in making this report. However, there are some students who do not participate and rely on their group friends.

4.1.5. Stage of Measuring, Assessing and Improving Products

At this stage students assess and improve the product by working on appropriate questions on the worksheet. Students in each group compare data from observations of making conditioner with SNI. At this stage, product improvement activities are carried out during learning with the help of researchers. The group whose product was still not successful was given advice by researchers to pay more attention to the procedure for making conditioner properly. Because if there is a procedure that is not carried out properly it will result in failure in making the conditioner.

4.1.6. Product publication and finalization stage

The product finalization and publication stage are the final stage in the project-based learning process. Students publish the results of making conditioner by presenting the results in front of other group friends. The other students pay close attention to the explanation from each group.

The product publication activities carried out by the students went well, the students not only explained their success but also explained the failure of the conditioner making which was caused by several factors. In the presentation activities, some students looked active, but there were also some students who only paid attention to the presentations made by each group without providing comments or suggestions.

There is a recapitulation of student activities in learning by implementing worksheets based on a conditioner making project presented in **Table 2**.

Table 2. Percentage of student activities at each learning stage.

No	Activity	Implementability (%)	Note
1	Introduction	100	Very good
2	Analyzing Problems	81.5	Very good
3	Creating Designs	100	Very good
4	Carrying out Research	100	Very good
5	Prepare product *drafts/prototypes*	77.8	Very good
6	Measuring, Assessing and Improving Products	100	Very good
7	Product Finalization and Publication	100	Very good
8	Closing	100	Very good
Average		**94.8**	**Very good**

Based on **Table 2**, the implementation of learning activities at the stages of analyzing problems, creating designs, carrying out research, compiling product *drafts/prototypes,* assessing and improving products and product publication is going very well. In the activity of preparing product *drafts/prototypes,* the presentation was lower, namely 77.8 %, this was because at the stage of preparing product *drafts/prototypes,* not all students were not active

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in discussions to determine conditioner testing procedures. Overall, the implementation of learning by applying worksheet based on the conditioner making project had a percentage of 94.8 % with very good interpretation.

4.2. Analysis of Students' Scientific Performance in Doing Project-Based Worksheet

Here, scientific performance in learning is measured based on their ability to complete project-based worksheets in groups. The following is a recapitulation of the average student scores at each stage of the worksheet (**Table 3**).

Table 3. Recapitulation of the relationship between learning stages and the ability to complete worksheets with students' scientific performance.

PjBL stage	Scientific Performance Indicators	Average
1	Observe	100
2	Designing Experiments	100
3	Conducting Experiments	93.2
4	Collecting data	100
5		
6	Communicate	100
	Average	**94.4**

Information:
1: Analyzing the Problem
2: Make a Design
3: Carrying out Research
4: Make a Trial Report
5: Assess and Improve Products
6: Finalization and Publication of Products

Based on **Table 3**, the average student score for all stages is 94.4 with a very good interpretation. The highest score with a score of 95.8 was obtained by group two while the other two groups obtained the lowest score with a score of 93.8 but were still included in the very good category. Developing students' scientific performance can provide experiences for students in the cognitive, affective, and psychomotor domains. In the cognitive domain, students gain an understanding of the material being taught, and in the affective domain, students are trained in scientific attitudes in practical activities, and in the psychomotor domain, they gain an understanding of how to use practical tools and materials. Apart from that, practicum activities help students achieve the expected competencies (Dijaya *et al*., 2018).

4.3. Description of Conditioner Characteristics

The following are the characteristics of making conditioner made from aloe vera. The characteristic criteria values can be presented in **Table 4**.

Conditioner characteristic analysis data comes from the implementation of a project-based worksheet with three groups, based on **Table 4** with the very good category, the average product data is 98.4. Organoleptic testing of aloe vera conditioner based on observations of the color and aroma produced meets SNI requirements. For the texture in one of the resulting groups there are granules, whereas in the homogeneity test it must have a smooth surface and no hard granules. The pH obtained meets the SNI requirements, namely 4.5 - 6.5 because

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it has a normal pH value like skin. Testing the type of cream produced by oil in water (o/w) meets SNI requirements because water is quickly dispersed in the cream (Sri, 2019). The resulting spreading power is 5.5 cm, this meets the SNI requirements which range from 4-7 cm.

Table 4. Characteristics of Aloe vera conditioner.

No.	Observed Aspects	Average	Interpretation
1	Color	100	Very good
2	Smell/aroma	100	Very good
3	Texture	88.9	Very good
4	pH value	100	Very good
5	Cream type	100	Very good
6	Spread Power	100	Very good
7	Homogeneity	100	Very good
Average		**98.4**	**Very good**

5. CONCLUSION

Based on the research that has been carried out, it can be concluded that student activities in the learning process by implementing the project-based worksheet for making aloe vera conditioner overall went very well with an average percentage of 94.8%. Then the students' scientific performance in working on worksheets showed very good results with an average score of 94.4. Furthermore, the characteristics of aloe vera conditioner show very good results with an average of 98.4.

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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