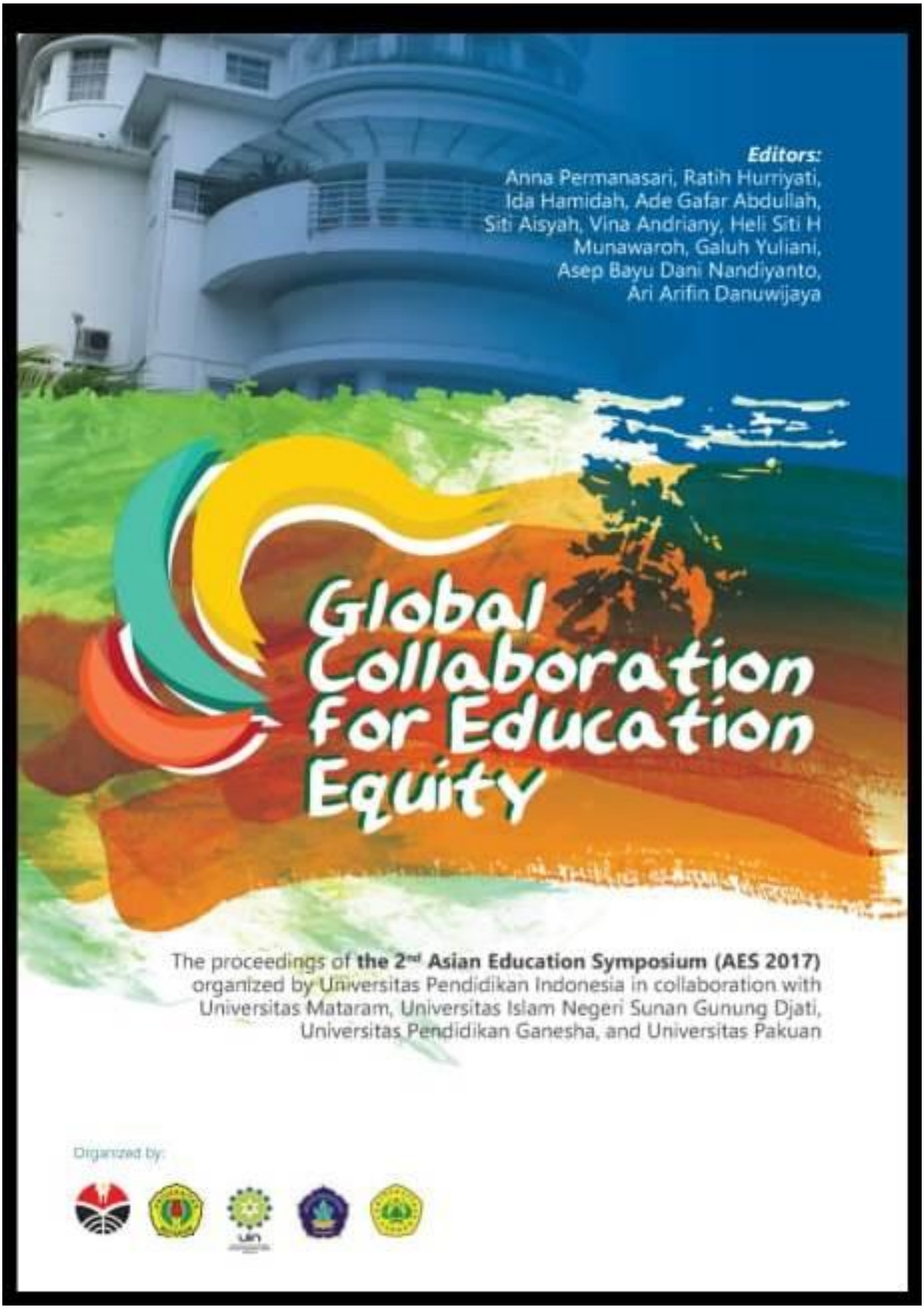
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Global Collaboration for Education Equity
The proceedings of the 2nd Asian Education Symposium (AES 2017)
organized by Universitas Pendidikan Indonesia in collaboration with
Universitas Mataram, Universitas Islam Negeri Sunan Gunung Djati,
Universitas Pendidikan Ganesha, and Universitas Pakuan
Organized by:

Introducing Phytochemical Testing of *Sandoricum koetjape* Merr. Through Inquiry-Based Learning

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Keywords: Inquiry, Phytochemical, *Sandoricum koetjape* Merr.

Abstract: Phytochemical testing of natural products is one of the interesting topics in the chemistry research. So, it’s necessary to introduce for Senior High School students. Currently the phytochemical testing laboratory (lab) manual of *Sandoricum koetjape* Merr, has been successfully performed, focussed on the secondary metabolites findings of flavonoids and alkaloids. The experiment method of the verified-lab manual can be implemented in a practicum-based inquiry learning. Experiment of lab activities increased students understanding and knowledge about phytochemical test of secondary metabolites of *Sandoricum koetjape* Merr., which were confirmed by all students/groups achieved hypothesis successfully, a highest post-lab assignment score and students ability to conclude their experiment.

1 INTRODUCTION

The Curriculum 2013 state that knowledge cannot be transferred from teacher to student directly. Students are subjects who have the ability to actively seek, process, construct and use knowledge. The learning approach that is applied to the application of learning curriculum of 2013 is a scientific approach. Scientific approach is an approach commonly used by scientists (Dass and Rushton, 2015).

Simply, the scientific approach can be interpreted as a means or mechanism of acquiring knowledge in accordance with procedures based on a scientific method. The scientific method can also be interpreted as a series of process management of information of properties, an explanation of what is observed, experimental procedure that being carried out and the delivery of information from observations obtained (conclusion) (Indonesian Ministry of Education and Culture, 2016).

In the curriculum 2013, the scientific method is specifically plotted in grade X (ten), especially in the Basic Competence 3.1, “comprehends scientific methods, the essence of chemistry, chemical safety and security in the laboratory, and the role of chemistry in life’, and Basic Competence 4.1, “presents the results of the design and results of scientific experiments. However, in actual fact, this scientific method is integrated in all the basic competencies of knowledge (Indonesian Ministry of Education and Culture, 2016).

The typical learning model of the scientific method is inquiry. Inquiry learning model is a learning model that involves students in the process of data collection and hypothesis testing. In practice, the learning model is done through lab activities, with the guidance of a teacher (called a guided inquiry) (Cheung, 2011; Arteche and Aznar, 2016).

There are about 250.000 species of high plants in the world, and more than 60% of these are tropical. 30.000 plants are found, approximately, in tropical rainforests, and about 1.260 species are known to be effective as a medicine. However, only about 180 species that have been used for various industrial purposes and herbal medicine, and only few species that have been cultivated intensively (Atun, 2010).

The process of exploration of natural materials through the discovery of primary or secondary metabolites is very important for various fields (e.g. food fields, medical fields and pharmaceutical fields). Primary metabolites include starch, cellulose, chitin, while secondary metabolites such as terpenoids, steroids, flavonoids, etc. Secondary metabolites are isolated by extraction, fractionation, purification and structural elucidation of plants.

Heliawati, L., Ardianto, D. and Ndruru, S.
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In 2nd Asian Education Symposium (AES 2017), pages 395-398
ISBN: 978-989-758-331-5

These metabolites can be utilized as components for pharmaceuticals (pharmaceuticals), construction materials, food material and so on (Kosela et al., 1995; Tan and Luo, 2011).

It is necessary to introduce the basic techniques of the metabolite discovery process through the chemical constituents called Phytochemical Test. Phytochemical test is the initial test method (screening) in an effort to determine the content of active compound contained in the plant (Hakim, et al., 2015).

In the process of inquiry through lab activities, it needs a lab manual which is developed by the teacher. Development of lab manual is to minimize the role of the teacher, make students more active and acquire meaningful knowledge, making the students acquire creative thinking and hard skill, facilitate teacher to implement teaching in the laboratory (Raydo, 2014).

This research aimed to introduce phytochemical testing of *Sandoricum koetjape* Merr. experiment, in order to increase students understanding and to gain experiences performing by participating in laboratory activities.

2 METHODOLOGY

Teachers prepared the laboratory manual prior the experiment for a guidance. The manual consists of:

2.1 Title Experiment

Phytochemical Test for secondary metabolites (flavonoids and alkaloids) from Santol Fruit Leather (Sandoricum koetjape Merr.).

2.2 Experiment goals

Experiment goals is to identify secondary metabolites (active compounds) alkaloids and flavonoids on the skin of Kecapi fruit through phytochemical test.

2.3 Basic theory which

Basic theory which is providing early knowledge for doing phytochemical test experiment. Includes the usage of phytochemical testing. Phytochemical tests for medicinal plants are indispensable, usually phytochemical tests are used to refer to secondary metabolite compounds found in special or particular-needed plants. Secondary metabolites are produced by plants as the defend against unfavorable environmental conditions such as temperature, climate, pests and plant diseases.

2.4 Procedures

Procedures (Silaban, 2009; Rizki and Nugroho, 2016; Rohyani et al., 2015), in the form of steps undertaken by learners to conduct experiments. Here, the phytochemical test of the Kecapi rind is limited to the discovery of flavonoids and alkaloids.

2.4.1 Flavonoid test

A total of 0.5 g of simplicial powder was added 10 mL hot water, boiled for 10 min and filtered in hot, into 5 mL filtrate added 0.1 g of Mg powder and 1 mL of concentrated HCl and 2 ml of amyl alcohol, shake and let it separate. Flavonoids are positive in the presence of red, yellow-orange in the amyl alcohol layer.

2.4.2 Alkaloid test

Powder weighed as much as 0.5 g crude drug was then added 1 mL of 2 N HCl and 9 ml of distilled water heated over water bath for 2 minutes. Cooled and filtered. Filtrates of 3 drops plus 2 drops of reagent solution Dragendorff, will form the orange sediment deposits.

2.5 Assignments

Assignments, aim to asses' students learning outcomes of phytochemical test. There are two kinds of assignments: pre-lab assignment and post-lab assignment.

Before the lab, students must answer pre-lab assignment. After that, students work in their group, and ask to prepare their lab book journal. There were 32 students, divided in to six (6) groups, consist of 5-6 students per group. Groups must do the experiment based on teacher-prepared lab manual of phytochemical testing.

3 RESULTS AND DISCUSSION

Before doing an experiment, students had a problem to identify secondary metabolites from the plants. But after completing experiment, most students increased their understanding how to identify secondary metabolites. They knew reagents which were needed to test.

By the groups, students reached the hypothesis, these are:

Alkaloids : (+)
Flavonoids : (+)
(+) : contains secondary metabolite
(-) : does not contain secondary metabolite.

In Table 1, it can be seen that all groups were able to reach hypothesis which was expected in experiment.

Table 1: Groups achievement to Hyphotesis.

Group	Phytochemical test		Hypothesis	
	Alkaloids	Flavonoid	Reached	unreached
1	(+)	(+)	V	
2	(+)	(+)	V	
3	(+)	(+)	V	
4	(+)	(+)	V	
5	(+)	(+)	V	
6	(+)	(+)	V	

All of students through their group were able to reach hypothesis based on experiment goals. Each group observed that when sample was treated by flavonoids test formed yellow-orange in the amyl reagent solution which confirmed a positive test to flavonoids, while when it was treated by Dragendorff reagent, formed the orange precipitation spot, which confirmed a positive test to alkaloids. According to this observation and results, it is shown that students had succeed to do their experiment.

The students' understanding increased after they get inquiry-based experiment. This results described in detail in Table 2.

Table 2: Comparison pre/post – lab assignment score.

Indicator	Score assignment (%)		Comparison
	Pre-lab	Post-lab	
Definition of secondary metabolites	68.75	100	Increaced
Kinds of secondary metabolites	37.50	87.50	Increased
Structure of alkaloids and flavonoids	31.25	87.50	Increased
Reagents for phytochemical test of alkaloid and flavonoids	25.00	100	Increased
How to identify secondary metabolites through phytochemical test of alkaloids and flavonoids	18.75	100	Increased
Average	36.25	95	Increased

The average students score on the pre-lab assignment score was 36.25% compared with average post-lab assignment score of 95% (32 total students completed this experiment).

Pre-lab assignment score average was very low because students had not experiences and knowledge yet about topic. This condition was specially confirmed how a lowest score in item question about how to identify secondary metabolites through phytochemical test of alkaloids and flavonoids.

A post-lab assignment score increasing of 95% approved that through experiment in laboratory using lab manual impact significantly for student's knowledge and understanding about this topic.

From their report, students were also able to draw conclusions to determine an effective strategy to identify secondary metabolites from the plants samples. This indicated that students increased their understanding about phytochemical test of secondary metabolites from the samples.

The laboratory activities had many benefits from a student perspective, such as able to explain the concept and principle of identification secondary metabolites through introducing phytochemical test of *Sandoricum koetjape* Merr., have good skill in performing phytochemical test techniques.

4 CONCLUSIONS

This experiment by lab activities had increased students understanding and knowledge about phytochemical test of secondary metabolites of *Sandoricum koetjape* Merr. All students reached hyphotesis of experiment, those are a positive (+) test to alkaloids and a positive (+) test to flavonoids. Post-lab assignment score (95%) increased compare with pre-lab assignment score (36.25%). Finally, students were able to conclude how to identify secondary metabolites of *Sandoricum koetjape* Merr. and its results.

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