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THE INFLUENCE OF THE NATURAL PRODUCT PRACTICUM ON DECISION MAKING SKILLS

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Abstrak

Studi tentang metabolit sekunder adalah inti dari Kimia Bahan Alam. Proses isolasi metabolit sekunder dari tumbuhan Sasambo yang merupakan tumbuhan obat yang dimanfaatkan oleh suku asli di Provinsi Nusa Tenggara Barat, Indonesia berpotensi untuk diintegrasikan ke dalam Laboratorium Kimia Bahan Alam. Mahasiswa mempelajari cara mengekstrak, memfraksinasi, memurnikan, dan mengidentifikasi struktur metabolit sekunder melalui kegiatan Laboratorium Kimia Bahan Alam. Dengan berbagai tindakan alternatif yang terkait dengan proses isolasi metabolit sekunder, latihan laboratorium ini dapat dimanfaatkan untuk membantu mahasiswa meningkatkan keterampilan pengambilan keputusan mereka. Penelitian ini bertujuan untuk mengetahui pengaruh Praktikum Kimia Bahan Alam Berbasis Tanaman Obat Sasambo atau *Natural Product Practicum Based on Medicinal Plants Sasambo* (NPP-MPS) terhadap keterampilan pengambilan keputusan mahasiswa. Ini adalah penelitian eksperimen semu dengan desain penelitian *nonequivalent control group pretest-posttest*. Pesertanya adalah 63 mahasiswa mahasiswa semester 6 jurusan pendidikan kimia salah satu perguruan tinggi negeri di Nusa Tenggara Barat, Indonesia, untuk tahun ajaran 2019/2020, yang terbagi menjadi kelas eksperimen dan kelas kontrol. Temuan menunjukkan bahwa *NPP-MPS* berpengaruh positif terhadap keterampilan pengambilan keputusan siswa.

Kata kunci: keterampilan pengambilan keputusan, praktikum kimia bahan alam, metabolit sekunder

Abstract

The study of secondary metabolites is the core of Natural Product Chemistry. The process of isolating secondary metabolites from Sasambo plants, which are medicinal plants used by indigenous tribes in West Nusa Tenggara province, Indonesia, has the potential to be integrated into the Natural Product Chemistry Practicum. Students learn how to extract, fractionate, purify, and identify the structure of secondary metabolites through Natural Product Chemistry Practicum. With various alternative actions related to the process of isolating secondary metabolites, these laboratory exercises can be utilized to help students improve their decision-making skills. This study aims to investigate the impact of Natural Product Chemistry Practicum Based on Medicinal Plants Sasambo (NPP-MPS) on students' decision-making skills. This is quasi-experimental research with nonequivalent control group pretest-posttest research design. The participants are 63 students who enrolled in 6th semester students of the chemistry education department at one of the state universities in West Nusa Tenggara, Indonesia, for the 2019/2020 academic year, which were divided into experimental and the control classes. The findings show that the NPP-MPS does positively influences students' decision-making skills.

Key words: *Decision Making Skills, Natural Product Chemistry Practicum, Secondary Metabolites*

INTRODUCTION

Natural Product Chemistry analyses secondary metabolites of an organism [1]. Analysis, isolation, and purification of secondary metabolite compounds are key principles in Natural Product Chemistry. The objects of isolation in Natural Product Chemistry are plants, especially medicinal plants [2]. Steroids, alkaloids, terpenoids, phenolics, flavonoids, polyketides, and saponins are examples of secondary metabolites that each have their own set of benefits [3].

Indonesia provides a wide range of biological natural resources that have been employed in traditional medicine since ancient times [4]. Various regions in Indonesia, including West Nusa Tenggara, own traditional medicinal herbs in large quantities. West Nusa Tenggara's population are divided into three tribes: Sasak, Samawa, and Mbojo, also known as Sasambo. Each tribe has its own set of traditional medicinal plants. In the Sasak tribe, traditional medicinal plants are neatly written in lontar manuscripts left by their ancestors, with roughly 163 plants that can be utilized as remedies [5]. The Samawa tribe also has a variety of medicinal plants on their land. There are forty medicinal plants that have been identified and are widely used by the locals [6]. In addition, the Mbojo tribe possesses traditional medicinal herbs, which include 45 different species of plants that have been used by the Mbojo Tribe for generations [7].

Traditional medicinal plants utilized by the Sasambo tribal people are based on ancestral beliefs that have been passed down from generation to generation. Locals, on the other hand, are unaware of the chemical components of traditional medicines that have been utilized so far. It is feasible to determine the secondary metabolite compounds contained in these medicinal plants and their properties by conducting a Natural Product Chemistry *Practicum* that includes extraction, fractionation, purification, and identification of secondary metabolite compounds [7].

The most prevalent type of laboratory teaching is expository, which is oriented on the teacher. The undergraduate students are required to follow the series of set directions from the manual book [8]. Traditional laboratories only provide scientific language, ideas, and facts, as well as thorough protocols and descriptions of what students would see throughout experiments. In this style, they are simply concerned with following the lab manual's instructions. As a result, they are unable to acquire higher-order cognitive skills [9] including decision making. Since the procedure is fixed and the result is planned, and the students do not have a chance to make any decision. In addition, a decision-making skill pretest on students enrolled in Natural Product Chemistry course at one of the state universities in West Nusa Tenggara, Indonesia, for the 2019/2020 academic year, showed relatively low scores reflecting their lack decision-making skill.

In Indonesia, natural product chemistry courses are more effective when students participate in mini project laboratory activities [10]. These activities can develop students' higher-order thinking skills. In addition, students might be guided via laboratory activities to carry out thinking and decision-making processes. According to Gutierrez [11], students need to be involved in the processes of comprehending and characterizing the situation, proposing viable solutions based on relevant data, and assessing alternative solutions in order to enhance decision making skill. Mini project laboratory is a form of learning carried out in a particular place, where students play an active role in solving problems by using certain tools, materials, and methods. Through mini project laboratory activities, students will acquire hands-on experience to improve their mastery of concepts, problem-solving abilities, and scientific skills, as well as build an understanding of how science and scientists work, foster interest, and train thinking skills. During this experience, they have spent a lot of time presenting and communicating their decisions throughout the experiments which eventually have a positive influence on students' decision-making skill.

Universities in Indonesia generally use laboratory activities that require students to follow the procedures that have been provided without allowing students to design their laboratory activities. Designing laboratory activities in the form of a project will enable students to develop cognitive skills and ways of thinking as well as make decisions when solving problems in the laboratory [12]. According to Suryanti [13], decision making is a process that involves writing questions, making choices, gathering information, creating a list of pros and cons, and finally making the decision.

This study developed a Natural Product Chemistry Practicum based on Project Based Learning which will present a medicinal plant of Sasambo. This laboratory is expected to provide opportunities for students to design their project for the isolation of secondary metabolites in medicinal plants of the Sasambo from the preparation process to the implementation of the laboratory activity that can improve students' decision-making skills.

RESEARCH METHOD

This study used a quasi-experimental method with nonequivalent control group pretest-posttest research design. In this design, the experimental class (A) and the control class (B) were given pretest and posttest [14]. The experimental class used the *NPP-MPS*, while the control class used the conventional practicum. In conventional practicum, students follow explicit instructions to obtain a planned conclusion, and the effectiveness of the activity is measured by how closely the students' results match the established data. Students' progress is monitored by laboratory assistants, and queries from students are foreseeable [15]. Meanwhile, in *NPP-MPS*, the structure of the laboratory activities consists of introduction, laboratory activities training, orientation problem, designing laboratory activities, presenting laboratory activities proposal, implementation of laboratory activities, results reporting and presentation, evaluation of the laboratory activities, and analysis of the complex concepts, consecutively, as described in our previous work [10]. The participants are 63 students who enrolled in Natural Product Chemistry course at one of the state universities in West Nusa Tenggara, Indonesia, for the 2019/2020 academic year. The experimental samples were A class, while the control samples were B class. A decision-making skill test instrument and a non-test instrument in a learning observation sheet for the Natural Product Chemistry Practicum were used in this study. In the decision-making skill test instrument, 28 item description questions were constructed by referring to the decision-making indicators developed by Tawil & Liliasari [16].

In this study, qualitative and quantitative data were collected. The qualitative data was described, while the quantitative data from the test results was analysed using two different test statistics, with the average gain score being normalized. To get a normalized gain score, the formula developed by Hake [17] was as follows:

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} x100\%$$

Categories: height: g > 70; medium: 30 ≤ g ≥ 70; and low: g < 30.

RESULT AND DISCUSSION

The *NPP-MPS* uses materials of laboratory activity derived from medicinal plants from the indigenous tribes of the province of West Nusa Tenggara, Sasak, Samawa, Mbojo, or called Sasambo. In addition, the application of this laboratory activity will also link the cultural phenomena of the Sasambo community with sciences, especially Natural Product Chemistry. Students are interested in learning more about medicinal plants that grow near them, as well as the isolation of compounds from these plants. The laboratory activity is centred on the students, not the lecturers or researchers. This activity helps to create a more engaging learning atmosphere.

The effect of *NPP-MPS* in the cognitive domain can be seen from the increase in the value of the initial test (pretest) to the final test (posttest). Twelve meetings were carried out to implement the *NPP-MPS*, which included pretest-posttest activities. The initial data obtained A and

B class homogeneity test results, with $F_{count} < F_{table}$ (1.24 < 1.71), so the control and experimental groups could be considered homogeneous. The normality test in this study was performed using the chi square method. The experimental class's pretest value ($\chi 2$ count) was 6.01, whereas the control class's pretest value was 9.39, according to the calculations. The value ($\chi 2$ count) was then compared to the price ($\chi 2$ table) at a significant level of 5%, namely 11.07 with dk = 5 so that $2_{count} < 2_{table}$, indicating that the data from the pretest results in both classes are normally distributed. In the posttest, the experimental class had a value ($\chi 2$ count) of 2.85 while the control class had a value of 11.86. Then, at a significant level of 5%, the value ($\chi 2$ count) was consulted with the price ($\chi 2$ table) which was 12.59 with dk = 6, resulting in $2_{count} < 2_{table}$. It means that the data from the posttest results in both classes are normally distributed (Sugiyono, 2014). In this study, the F-test formula was used for the homogeneity of variance test. Based on calculations using posttest value data, the F_{count} value is 1.29. The price of F_{count} was consulted on F_{table} with a significant level of 5% which was 1.69. Therefore, $F_{count} < F_{table}$ (1.29 < 1.69), indicating that the variance of the two data was homogeneous.

To thrive in life, student needs higher order thinking skills (HOTS) [18]. HOTS can be measured through an instrument [19]. One way to increase HOTS is the Innovative Chemistry Laboratory [20]. The cognitive result data of decision-making skills were processed using the n-gain. Based on the results, the value of t_{count} (3.10) > t_{table} (1.67) at a significant level of 5%. This demonstrates that the application of *NPP-MPS* statistically has a positive effect on students' decision-making skills.

Student decision-making skills were measured before and after lectures with nine essay test items. Furthermore, the data were analysed by calculating the normalized test gain to determine the average and percentage changes in student decision-making skills scores. The research data related to the average score and the percentage change in the pretest-posttest scores of students' decision-making skills in each class are shown in Figure 1.

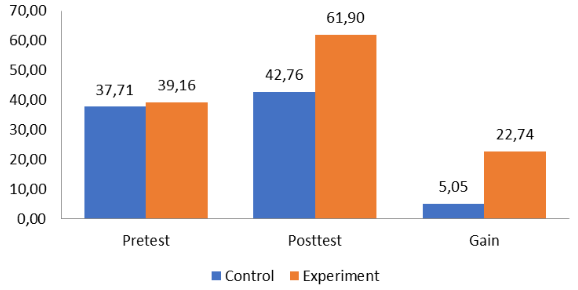

Figure 1. Graph of The Difference in The Average Value of The Decision-Making Skill Test Between The Experimental Class and The Control Class

Figure 1 showed that the increase in the average value of the decision-making skill test in the experimental class was classified as high and the control class was classified as low. This average value was determined using the average score for all items on the decision-making ability indicators, namely: 1) analysing the causes of the problem from various factors, (2) identifying the impact of the problem, (3) identifying alternative decisions to solve the problem, (4) making decisions to solve problems, (5) giving reasons for choosing decision-making, (6) predicting the impact of decision-making actions in a real context, and (7) providing an assessment of the advantages and disadvantages of the resulting decisions [21].

Table 1 showed the results of the quantitative descriptive analysis in the form of the average pretest and posttest scores, standard deviation (SD), and the average N-gain in percent (%) for each indicator of decision-making skills. According to the findings, the experimental class students who received the *NPP-MPS* learning showed a significant difference from the control class. This showed that *NPP-MPS* could improve decision-making skills. The experimental class has a higher average N-gain for each indicator of decision-making skills than the control class. In both the experimental and control classes, the average N-gain for each indicator was still in the medium category.

Table 1. Average Score, Standard Deviation, and N-gain on Decision-Making Skills Indicators

No.	**Decision Making Skills Indicator**	**Experiment** Pretest		Posttest		N-Gain (%)	**Control** Pretest		Posttest		N-Gain (%)
		Avg	SD	Avg	SD		Avg	SD	Avg	SD	
1.	Analyze the cause of the problem from various factors	69.7	6.7	116.7	12.3	47.00	56.33	2.10	57.67	8.20	1.33
2.	Identify the impact of the problem	64.3	3.1	107.7	4.2	43.33	54.33	10.24	57.00	12.67	2.67
3.	Identify alternative decisions to solve problems	61.3	6.8	101.0	11.8	39.67	54.00	5.91	62.33	7.70	8.33
4.	Make decisions to solve problems	62.7	4.8	104.0	8.9	41.33	51.67	7.10	63.00	10.91	11.33
5.	Give reasons for making decisions	64.7	2.5	108.0	3.7	43.33	55.67	11.03	69.00	8.62	13.33
6.	Predict the impact of decision-making actions in a real context	62.3	6.5	103.0	9.4	40.67	61.33	7.37	75.00	16.37	13.67
7.	Provide an assessment of the advantages and disadvantages of the resulting decisions	67.3	4.2	110.7	5.2	43.33	62.67	9.28	65.00	3.76	2.33

According to Robinson [22], The analytical procedure, which includes exploring the material, selecting a technique, obtaining and processing samples, selecting a calibration method, and presenting findings, takes several weeks to a full semester in many laboratory projects. In this research, the pre-laboratory stage and the orientation of the plant sample are the first stages of the *NPP-MPS*. This stage entails directing and posing important questions to students about plants found in the surrounding environment that Sasambo people use as drugs. This was done to pique students' interest and motivate them to set their own learning objectives [23]. The subsequent stage requires students to create a project implementation plan and schedule. This activity trains students to pick the theme, purpose of the experiment, relevant information, tools and materials needed, experimental procedures, and division of tasks among group members. In the last stage, students present the results of their laboratory activity in front of the class. Students exchange information and opinions about the results of their laboratory during the discussion in presentation process, to see if they are consistent with the material and discourse provided by the researcher. All students were actively involved in the group. During the presentation, the researcher used observation sheets to conduct an assessment process with the help of several observers. This observation sheet contained indicators of decision-making skills that were assessed through attitudes in conducting presentation activities. This observation sheet supports research data to evaluate students' decision-making skills.

Students in the control class learn through conventional laboratory activities, in which they simply follow the steps of the experimental activity as instructed by the lecturer. During this study, the control class participants followed the instructions correctly and obtain the expected conclusion successfully. However, Ural [24] stated that This recipe book type laboratory does not assist students in translating scientific findings into meaningful knowledge acquisition, and hence is insufficient for fulfilling the laboratory's development goals. Conventional laboratory does not facilitate the development of student decision-making skills in determining goals, making activity plans, and determining task completion strategies. Students can complete assignments, but their decision-making skills are not trained because they are not involved in the planning process of the laboratory activities. In the experimental class, each student can speak and argue with all of their abilities in comprehending the information presented and elevate the topic of laboratory activity by relating medicinal plants to the Sasambo community, so that their learning outcomes increase, and decision-making skills improve. According to Hakim et al., [8], the Natural Product Chemistry Laboratory, when combined with traditional medicinal plants, was able to offer students with a stimulus to help them make the best decisions possible. In this laboratory activity, students determine their materials and methods of compound isolation from scientific articles. Since Parker and Fischhoff [25] argued that poor decision making on typical laboratory tasks is linked to real-world antecedents and effects, a transformation from conventional recipe book style laboratory into mini project laboratory in natural product chemistry is strongly suggested.

CONCLUSIONS

The results obtained indicate that the *NPP-MPS* positively influences the decision-making skills of 6th semester students of the chemistry education department at one of the state universities in West Nusa Tenggara, Indonesia, for the 2019/2020 academic year.

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