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The Influence of Herbarium-STEM on Students' Interest of Becoming the Plant Taxonomists

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Abstrak: Kajian taksonomi di Indonesia masih menjadi perhatian karena metode pembelajaran yang tidak inovatif yang menyebabkan mahasiswa tidak tertarik untuk belajar dan melakukan penelitian tentangnya. Akibatnya, dipengaruhi oleh kurangnya Ahli Taksonomi Tanaman Indonesia. Penelitian ini bertujuan untuk mengetahui pengaruh Herbarium-STEM terhadap minat siswa untuk menjadi Ahli taksonomi tanaman. Penelitian ini merupakan penelitian kuasi-eksperimental menggunakan desain pre-test dan post-test satu kelompok. Sampel adalah 35 mahasiswa yang dipilih dengan menggunakan teknik *purposive* sampling. Data dikumpulkan dengan menggunakan teknik pre-test dan post-test distribusi kuesioner. Analisis data dilakukan dengan SPSS dengan (1) analisis kuantitatif deskriptif terhadap minat; (2) analisis peningkatan minat menggunakan uji N-Gain; (3) analisis hipotesis menggunakan uji-t dan R2. Hasil diperoleh : (1) nilai rata-rata pre-test adalah 40,14 (kategori rendah) sedangkan post-test adalah 80,71 (kategori tinggi); (2) nilai rata-rata uji N-Gain pada peningkatan bunga adalah 0,70 (kategori tinggi); (3) hasil uji-t adalah 0,00 < 0,05 dan hasil uji R^2 adalah 0,614. Dengan demikian, Herbarium-STEM memengaruhi minat siswa untuk menjadi ahli taksonomi tumbuhan, dengan tingkat pengaruh yang tinggi sebesar 61,4%.
Kata kunci: Herbarium-STEM; Minat; Ahli taksonomi tanaman.

Abstract: Taxonomy study in Indonesia is still a concern due to non-innovative learning methods that cause students not interested in learning and conducting research on it. Consequently, it was impacted by the lack of Indonesian Plant Taxonomists. This research aimed to determine the influence of Herbarium-STEM on students' interest in becoming The Plant Taxonomist. It was quasi-experimental research using one group pre-test and post-test design. The sample was 35 college students chosen by using a purposive sampling technique. The data was gathered using pre-test and post-test techniques of questionnaire distribution. Data analysis was carried out with SPSS by (1) descriptive quantitative analysis on interest; (2) analysis of increasing interest using the N-Gain test; (3) hypothesis analysis using t-test and R2. The results were obtained: (1) the average value of the pre-test on interest was 40,14 (low category) while the post-test was

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80,71 (high category); (2) the average value of the N-Gain test on increasing interest was 0,70 (high category); (3) the result of t-test was 0,00 < 0,05 and the result of R^2 test was 0,614. Thus, Herbarium-STEM influences students' interest in becoming plant taxonomists, with a high level of influence at 61,4%.
Keywords: Herbarium-STEM; Interest; The Plant Taxonomists.

1. Introduction

The diversity of plants in Indonesia has not been fully documented and utilized due to limited scientific knowledge and expertise [1]. It is bad because biodiversity wealth is an important asset for economic growth, food security, and national competitiveness [2]. Indonesia is home to approximately 31.750 species of plants [1];[3];[5], the seventh largest country in the world of flowering plants (20.000 species), and 40% of them are endemic [6]. However, Indonesia is also the country with the highest biodiversity decline and the highest level of endangered and extinct species of plants in the world. [3];[6].

Under such conditions, The Plant Taxonomists have an essential role in saving and utilizing the wealth of Indonesian plants. Currently, there are a few or limited Taxonomists in Indonesia. In the last 60-70 years, the number of new species had been described very low, which was an indictment of the low Taxonomist and impacted the conservation science because most of the species became extinct before being described [2];[7]. Worse, the Taxonomist crisis was also occurring globally [8] along with the extinction of species caused by: the habits of underestimating taxonomy; inappropriate research focus which only pursued publication; the excessive target on technological innovation; the shifting forest's function as a natural museum; and weak f government regulation [9]. As a result, the science of taxonomy faces many challenges currently. An important question was raised by Michael: "How can you name a species before it becomes extinct, while Taxonomists are also an endangered profession"? It indicates that currently there is a global degradation of Taxonomists [10].

To respond to this problem, universities play an important role in producing graduates to fill the gap between Indonesian and even world Plant Taxonomists. However, a complex case that occurs in the learning of plant

taxonomy in Indonesia currently needs to be addressed. Only a few students were interested in conducting research related to plant taxonomy because it was considered a boring science and useless [11]. In addition, taxonomy is also considered as the way to memorize Latin names and to know the structure of their classification which has an impact on the low interest in taxonomy learning [12];[13]. These misunderstandings resulted in the loss of many opportunities to harness biodiversity in Indonesia [14].

The students of the Biology Education Department at Universitas Abulyatama also experienced the same thing without any exception. The compulsory course in Plant Taxonomy was not popular with them. Instead of hoping the graduates produced would be able to solve the problems of Indonesian taxonomy, students' interest in the subject was too low and they were even reluctant to become The Plant Taxonomists. Besides students' misperception toward the benefits and opportunities of taxonomy, students also had difficulties learning it because it was considered difficult although various methods had been implemented. So, the students refused to conduct the research and pursue the science of taxonomy. The same problem was also experienced by Biology Education students at STKIP Bima [12] and Biology Education students at USK Banda Aceh [15]. Even Morocco also experienced it, students had difficulty in learning taxonomy, lacked motivation, and many of them had misconceptions [16];[17].

To overcome these issues, learning methods were needed such as innovative, modern, active, and integrating various fields of knowledge to improve various competencies and oriented to 21stcentury learning, so the graduates can thrive in real life and build the nation [18]. Moreover, the graduates of Biology Education also have other competencies besides being teachers, considering the opportunity to become a teacher is very small currently due to the high number of graduates. It also aims to minimize the unemployment generated by universities [19].

The learning approach offered to solve such critical problems above is through an innovative, modern, active, and student-centered learning model,

namely the STEM Approach. STEM is an interdisciplinary learning approach to studying academic concepts and then connecting them to real life with the principles of science, mathematics, engineering, and technology [20];[21]. STEM has proved effective in the shortage of scientist's crisis as it was done in the United States, Japan, Finland, Australia, and Singapore [22];[23].

An innovative product that can be combined with the STEM approach to increase students' interest is The Plant Taxonomists in the Plant Taxonomy Course, namely Herbarium (Herbarium-STEM). Herbarium as a learning media can support material understanding [24], and increase learning effectiveness [25]. It can be created based on STEM also it can be used as the teaching materials [26]. The researcher's previous research also provided information that learning media such as smartphone microscopes combined with the STEM approach are powerfully effective in improving various competencies such as learning outcomes, scientific attitudes, and students' psychomotor skills [27];[28].

Previous research by Mualimaturrochmah stated that the Herbarium could be combined with the STEM approach [27]. However, the study was limited which only improved students' learning outcomes and Herbarium-STEM was applied only to one Phylum of plant, Pteridophyta. So this research was attempted in a broader context and applied at the university level in the Plant Taxonomy Course to increase students' interest in becoming Plant Taxonomists. Previous research that had been conducted did not use the STEM approach, but rather the contextual models (15) and field trip method [12]. In addition to the research by Mualimaturrochmah [27], other researchers had never combined Herbarium with the STEM approach, but rather Conventional Herbarium, Herbarium Book and Scientific Herbarium [30];[31];[32].

Based on these issues, specifically, this research aimed to determine whether there was an influence and how much influence Herbarium-STEM had on students' interest in becoming Plant Taxonomists. Furthermore, this research is expected to produce young scientists who are experts in plant taxonomy in Indonesia and even internationally. It also creates a new learning model to overcome the problems already described.

2. Research Method

a. Research Type and Design

The type of this research is a quasi-experiment with a quantitative approach. The design used one group pre-test post-test as in Figure 1.

O_1	X	O_2

Figure 1. One-group pretest-posttest design [29].

Where:
O_1 : pre-test (test of early interest)
X : treatment (implementation of Herbarium-STEM)
O_2 : post-test (test of final interest)

b. Location, Population, and Sample of Research

This research was conducted in two places, at Universitas Abulyatama (Herbarium creation and learning process) and Taman Hutan Raya (Tahura) Pocut Meurah Intan, Aceh Besar (identification of plant and Herbarium sampling). Tahura was chosen as the appropriate location because it is a conservation forest with high plant diversity.

The research population was all students of the Biology Education Department at Universitas Abulyatama with totaling of 85 students. The sample was students who had low interest in becoming Plant Taxonomists and did not pass the Plant Taxonomy Course during the learning process, consisted of 35 students and was chosen by using a purposive sampling technique.

c. Data Collection Technique and Instrument

The data collection technique uses pre-test (test of early interest) and post-test (test of final interest). The instrument used was a Likert scale questionnaire of positive statements with the indicators which were determined by Slameto and Safari: happiness feelings, interest, attention, motivation, and involvement [30] which was adopted from Knekta [31]. The questionnaire answer options can be seen in Table 1.

Table 1. Guidelines for Selecting Answers to the Likert Scale Questionnaire [32]

Value	Category
1	Strongly Disagree
2	Disagree
3	Agree
4	Strongly Agree

d. Data Analysis Technique

The data analysis techniques of this research included several steps as follow.

1) Interest Analysis

The analysis of students' interest in becoming Plant Taxonomists was carried out using a descriptive quantitative approach as follows.

$$\text{Percentage} = \frac{\text{Score obtained}}{\text{Maximum score}} \text{ x } 100 \text{ [33]}$$

The analytical data obtained were then used to decide the level of interest as shown in Table 2.

Table 2. Interest Assessment Criteria [34]

Value	Category
76-100%	High
50-75%	Medium
<50%	Low

2) Increasing Interest Analysis

Analysis of increasing students' interest in becoming Plant Taxonomists using the N-Gain test with the following formula.

$$\text{N-Gain} = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Possible\ Score - Pretest\ Score} x\ 100 \text{ [35]}$$

The gain value obtained was then used to decide the level of interest as formulated in Table 3.

Table 3. N-Gain Assessment Criteria [35]

Gain Score Value	Criteria
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

3) Hypothesis

The hypothesis testing procedure was done by a normality test as a pre-requirement using the Shapiro-Wilk Test to determine the level of data normality. Then, if the data is normal, it would continue the hypothesis testing with a t-test (paired sample t-test) by using SPSS with the following decision-making criteria:

a. If sig > 0, 05 then H_0 is accepted: there is no effect of Herbarium-STEM on interest to become The Plant Taxonomists among Biology Education Students of Universitas Abulyatama.
b. If sig < 0, 05 then H_α is accepted: there is an influence of Herbarium-STEM on the interest to become Plant Taxonomists among Biology Education Students of Universitas Abulyatama.

Furthermore, to find out the magnitude of influence, the Determination Coefficient Test (R^2) was continued with the decision rate if the value of R^2 obtained was 0 (zero) then the variable of Herbarium-STEM had no effect at all on the interest, but if the value of R^2 obtained was closer to 1 (one), then it had a strong influence on the criteria according to Table 4.

Table 4. Guidelines for Correlation Level [36]

Interval Coefficient	Correlation Level
0,00 – 0,20	Very Weak
0,21 – 0,40	Weak
0,41 – 0,60	Moderate/medium
0,61 – 0,80	Strong
0,81 – 0,100	Very Strong

3. Results and Discussion

The results which were obtained from this research as follows.

a. Interest Description

The results of the statistical description analysis on interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama in learning using the Herbarium-STEM were presented in Table 5.

Table 5. Statistical Description of Interest

	Pre-test	Post-test
N	35	35
Minimum	29	57
Maximum	51	98
Mean	40,14	80,71
Standard Deviation	5,981	8,053
Median	39	80
Variance	35,77	64,85

The data from Table 5 with the sample (N) of 35 students showed that the pre-test obtained minimum score was 29, the maximum score was 51, the mean score was 40,14, the standard deviation was 5,981, the median was 39, and the variance was 35,77. Meanwhile, in the post-test, the minimum score was 57, the maximum score was 98, the mean score was 80, 71, the standard deviation was 8,053, the median was 80 and the variance was 64, 85.

b. Increased Interest

The results of the N-Gain test on increasing interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama in learning by implementing Herbarium-STEM were presented in Table 6.

Table 6. The Data of N-Gain Score

N	Lowest Score	Highest Score	Average	Category
35	0,33	0,97	0,70	High

The data from Table 6 above showed the lowest score of the N-Gain test was 0,33 and the highest score was 0,97. Meanwhile, the average score of N-Gain was 0, 70 with a high category. These results indicated that using Herbarium-STEM on the Plant Taxonomy Course effectively increased interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama. Moreover, a comparison of the average pre-test and post-test scores to see the increased interest was displayed in Figure 2.

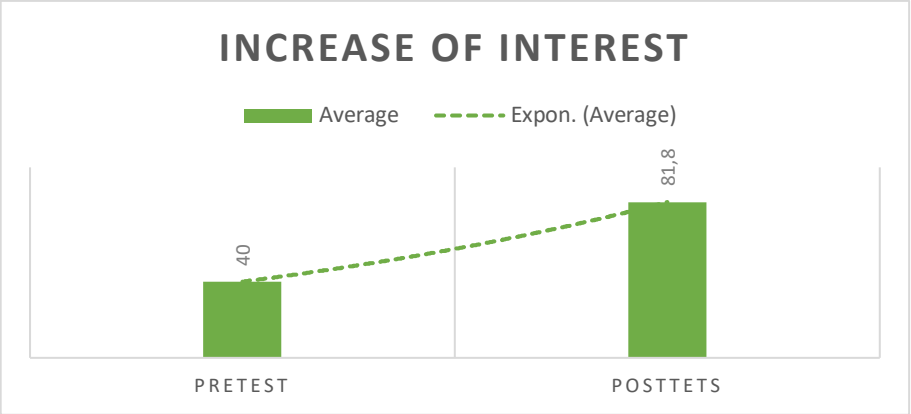

Figure 2. Comparison of Average Pre-test and Post-test

The data in Figure 2 showed an increase in interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama, where the average score obtained before treatment (pre-test) was 40 then increased to 81,8 (post-test) after learning using Herbarium-STEM.

c. Hypothesis Testing

The result of the hypothesis test is presented in Table 7. It also displayed the prerequisite result, namely the normality test using the Shapiro-Wilk Test.

Table 7. Result of Normality and Hypothesis Test

	Normality	t	R^2
Pre-test	0,72	0,00	0,614
Post-test	0,26		

The data in Table 7 above showed that the normality score obtained as a pre-requisite test was 0, 72 for the pre-test and 0, 26 for the post-test data. This value exceeded the sig value of 0, 05 (0, 72 > 0, 05 and 0, 26 > 0,005) so that both data were normal. Meanwhile, the result of paired sample t-test (t) was obtained with a value of 0, 00. This value was smaller than the sig value of 0, 05 (0, 00 < 0, 05) so it meant that Hα hypothesis was accepted in this research. It indicates that Herbarium-STEM influences the interest in becoming Plant Taxonomists among students of the Biology Education Department, Universitas Abulyatama.

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Furthermore, the result of the determination coefficient test (R2) gained a value of 0,614 with a strong correlation level (as shown in Table 4). The value indicated that the influence level of Herbarium-STEM toward students' interest in becoming Plant Taxonomists at Biology Education of Universitas Abulyatama was 61,4%, while its remaining 38,6% (100% - 61,4%) which was influenced by other factors that were not controlled in this research.

The results reveal that the Herbarium-STEM was one of the effective learning media for increasing students' interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama. It is based on the average N-Gain value shown in Tabel 6 with a high increasing category. It also could be seen from the increase of interest before and after treatment shown in Figure 2, where the average value of pre-tests gained before treatment indicated a low category (40). In contrast, the average value of the post-test obtained after treatment indicates a high category (81, 8). It proved a significant improvement.

The improvement occurred because, in the learning process of plant taxonomy, the students carried out project-based learning and started identifying plants in the conservation forest (Tahura). The plants that were successfully identified were then taken to be used as the Herbarium samples. Next, the students made the Herbarium using the STEM technique. Through this approach, the students created the Herbarium by combining multidisciplinary insights such as science, technology, engineering, and mathematics. The students also carried out an in-depth literature analysis of the plants that were used as Herbarium to determine the levels of its taxa.

In addition, the Herbarium-STEM also had a strong influence on students' interest in becoming Plant Taxonomists with the R2 value obtained as 61,4% (Table 7). Looking at these results, showed that to foster students' interest in becoming Plant Taxonomists, the Herbarium-STEM was an innovative learning media which appropriate to be implemented. It is known that the Herbarium was a nature-based learning media of biology that could foster students' interest and learning enthusiasm [37].

Moreover, the learning process using Herbarium media was combined with a STEM approach, where STEM was one of the effective approaches in enhancing interest. It was because, in the learning, this approach treated students as being directly involved in completing projects, namely Herbarium-STEM. It was in line with Rustaman's finding which revealed that through the STEM approach, the students were not only included in theory-based learning but also project-based learning, so the students directly experienced the learning process [38]. STEM integrates engineering concepts into the science and mathematics curriculum through an interesting practical application that helps students enhance their learning interest by making the lessons learned in the classroom connected to real life [39].

The results of this research were in alignment with the findings of Mualimaturrochmah, which also discovered that the developed of Herbarium-STEM was valid and appropriate to be implemented for the learning process of Biology and it could increase the effectiveness, especially on Pteridophyta Phylum [27].

4. Conclusion

Based on the results of this research, it could be concluded that the Herbarium-STEM as an innovative learning model had a strong influence on students' interest in becoming Plant Taxonomists among students of the Biology Education Department at Universitas Abulyatama. In addition, the Herbarium-STEM was also effective in increasing interest in becoming Plant Taxonomists among Biology Education Students at Universitas Abulyatama.

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