



INTERNATIONAL PAPER COMPETITION 2022
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AMBARRUKMO TOURISM INSTITUTE (STIPRAM)

YOGYAKARTA, INDONESIA

2022

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Received: day month 202x, Revised: day month 202x, Accepted: day month 202x

Published online: day month 202x

Abstract

Herbarium was one of the learning media that can be used to improve student's learning outcomes about classification and the role of plants in life. The aims of this study were determine the response and improvement of student's learning outcomes by herbarium as Biology learning media. The subjects of this study were students of class X in MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency. This study used experiment approach with descriptive method. The student's responses about herbarium utilization as Biology learning media showed high criteria with average percentage of assessment about 79.05%. On herbarium implementation as learning media, the student's average value of the pre-test was 59.00, while the student's average value of the post-test was 75.40. So, the results of this research showed that the herbarium utilization as learning media got positive response from students and was able to improve the student's learning outcomes of class X especially on plantae material.

Keywords: Biology, herbarium, learning media, learning outcome

1. Introduction

Learning in senior high school develop according to era improvement. One of them is learning activities using a scientific approach. In scientific approach learning, the roles of the teachers are facilitators and motivator while students are actors in the classroom. It promotes the students to think critically, systematically and deductively [1].

Scientific approach learning applicate in some subjects, including Biology. The application of the scientific approach learning in Biology requires some facilities to supports in the learning process. One of the supporting facilities is learning media [2]. The form of learning media in Biology subjects are student worksheets, printed books, insectariums, experimental gardens, terrariums with land animals and plants, and herbarium.

Herbarium is a collection of preserved plant or animal specimens. There are two type of herbariums, namely dry and wet herbarium. Herbarium made systematically, so it can be used as important documents related to plants [3]. Besides that, it has role in classification system [4]. The role of herbarium in classification system can be used to support some disciplines, such us taxonomy and botany. The function of the herbarium is as a basis for the study of flora and vegetation because the herbarium has a label that provides the necessary data information to facilitate the reader in digging for information. This is important and necessary to identify plants and give the correct scientific name and can be used as a data bank [5]. Therefore, herbarium often used as learning media.

Utilization herbarium as learning caused by some benefits of it. They can present new knowledge for students and motivate for students to more curious about plants [6]. Besides that, the process of

herbarium making as learning media is relatively easy and cheap [7]. The utilization herbarium as learning media as conducted by Nova et al in 2014. It was found that there was an increase in learning outcomes using the inquiry method which was supported by the use of herbarium media. It was shown by the average percentage of science learning outcomes in the learning cycle. In first cycle, there was 55.72% (medium criteria) and in the second cycle to 80.17% belonging to the high criteria. It can be seen that there was increased percentage of science learning outcomes by 165.55%. Besides that, the completeness of student learning outcomes also increased from cycle I to cycle II by 24.17%. The completeness of student learning outcomes in first and second cycle, respectively 65.51% and 96.55%, so the success criteria applied had been achieved [8]. The other research about herbarium was conducted by [9]. It was found that the effectiveness of using herbarium and insectarium as integrated science learning media was higher than learning without herbarium and insectarium media on the theme of classification of living things for class VII MTs Al-Islam Jepara. This is indicated by the presence of 97.44% of students whose learning outcomes are said to be complete and students are very active in the learning process so that a percentage of 82.05% is obtained.

Based on interviews conducted to the biology teacher on August 2021 at MA Bahrul Ulum Bojonegoro, there had been learning activities using herbarium media about ferns. Because the application herbarium only focused in ferns, so the achievement of other learning indicator in plantae material were still not optimal. Therefore, it was necessary to develop herbarium as learning media using other topic of plantae material.

This study aims to evaluate the improvement of students learning outcomes and student responses by utilization of herbarium as a medium for learning biology for class X students at MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency. From this research, we hope to presents development of learning media which effective and efficient and improving the student learning outcomes. Therefore, the learning indicator in education will be achieved.

2. Related Works/Literature Review

Research on herbarium has been done by several researchers. The research took various forms, such as introduction to herbarium, practice of making herbarium, development of herbarium media and testing its validity, and implementation of herbarium as a means of supporting the learning process (Table 1).

Table 1. Related Works

Authors & Year	Model / Technique / Method / Approach	Advantages	Disadvantages
Dahlia and M. Janiarli (2020) [3]	Quasy experiment	To know the effectiveness of using compound leaf herbarium media in Biology learning	Only focused on compound leaves
Hartono, <i>et al.</i> , (2022) [5]	Active Participatory Approach	To knowing plant taxon and increasing students' knowledge through herbarium media	Learning activities at school take quite a long time
Mualimmaturachmah, <i>et al.</i> , (2020) [10]	Research and Development (R&D) with the ADDIE model	To analyze the effectiveness of the herbarium media on student learning completeness	Using the STEM base to achieve basic competencies
Dikrullah (2017) [11]	Research and Development (R&D) with the ASSURE model	To study higher plants	Large number of research trial subjects
Syamsiyah <i>et al.</i> , (2020) [12]	Surveys, lectures, demonstrations, discussions method	To improve the ability of life skills through training activities for making herbarium	Only done by teachers who are members of the MGMP group

In study of [5], the herbarium was only used as an introduction material. In this study, herbarium was introduced as a medium or method to determine the taxon level of a plant. Therefore, in this study, the herbarium was limited as a tool to increase the knowledge of students and teachers about the existence of a media that can assist in the identification and description of plant characters. The study of [12] focused on the socialization of techniques and practices for making herbarium. Therefore, in this study, it was not known the effect of using herbarium as a learning medium in learning activities. In the study of [11], it focused on developing the herbarium book and testing its validity level. In these studies, data has not been obtained about the effect of applying herbarium in the learning process. To complete the data, this research was conducted to determine the effectiveness of herbarium as a learning medium.

In study of [3], the herbarium was tested on the respondents and tested using the pretest posttest group design method. The subjects in [3] research were 3rd semester students, while the subjects of this study were senior high school students. In addition, in this study there was no control class. In study of [10], a trial was conducted on the effectiveness of the herbarium in supporting the learning process. However, the herbarium tested was limited to pteridophyte. To determine the effectiveness of the herbarium more broadly, this study tested herbariums from various plant groups, namely spermatophyte, gymnosperms, angiosperms, dicots, and monocots.

3. Material & Methodology

The type of this research was experiment. The research used pretest-posttest design. This research was conducted from February to May 2022 at MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency. The subject of this research was students of Mathematics and Natural Sciences class X which was determined by purposive sampling technique.

There are three steps of this research. They are preparation, implementation, and evaluation. Preparatorion was conducted by preparation of herbarium as learning media. The herbariums were made by researchers. Implementation was conducted by some forms. They are pretest, utilization of herbarium in learning process, and posttest. The giving pretest was conducted to get information about the initial abilities of the students before using herbarium, while posttest was conducted to evaluate the student's learning outcome after using herbarium as learning media. Evaluation was conducted by observation and distributing response questionnaires for students about the utilization herbarium as learning media.

The data analysis of this research was qualitative descriptive. by reducing data, presenting data and drawing conclusions. In addition, the validity of the data was also checked using technical triangulation and examination by colleagues.

4. Results and Discussion

4.1. Preparation of Herbarium as Learning Media

Plantae was one of Biology topic at senior high school class X. Topic plantae consist of some sub topics as the characteristics, morphology, and the role of plants. For reached students understanding of them, it was needed certain learning media on learning process. In this research, herbarium was chosen as learning media for help students in learn of plantae material. Based on information about student's necessary and interesting of herbarium, most of students were enthusiastic. Students were interested in the use of herbarium media in learning activities. All of students agree with the existence of biology learning activities using herbarium media as a means of support in students' understanding to learn plantae material.

The first step of this research was preparation of herbarium that will be used as learning media. There were some herbariums which made by researcher. The type of herbarium was dry herbarium because it was assumed more effective for used in the classroom. The dry herbariums consist of some species of gymnosperms and angiosperms then dicots and monocots, such as *Manihot esculenta*, *Ipomoea aquatica*, *Piper betle*, *Gnetum gnemon*, *Artocarpus heterophyllus*, *Platyladus orientalis*, *Carica papaya*, *Ipomoea batatas*, *Casuarina equisetifolia*, and *Citrus maxima* (Figure 1).

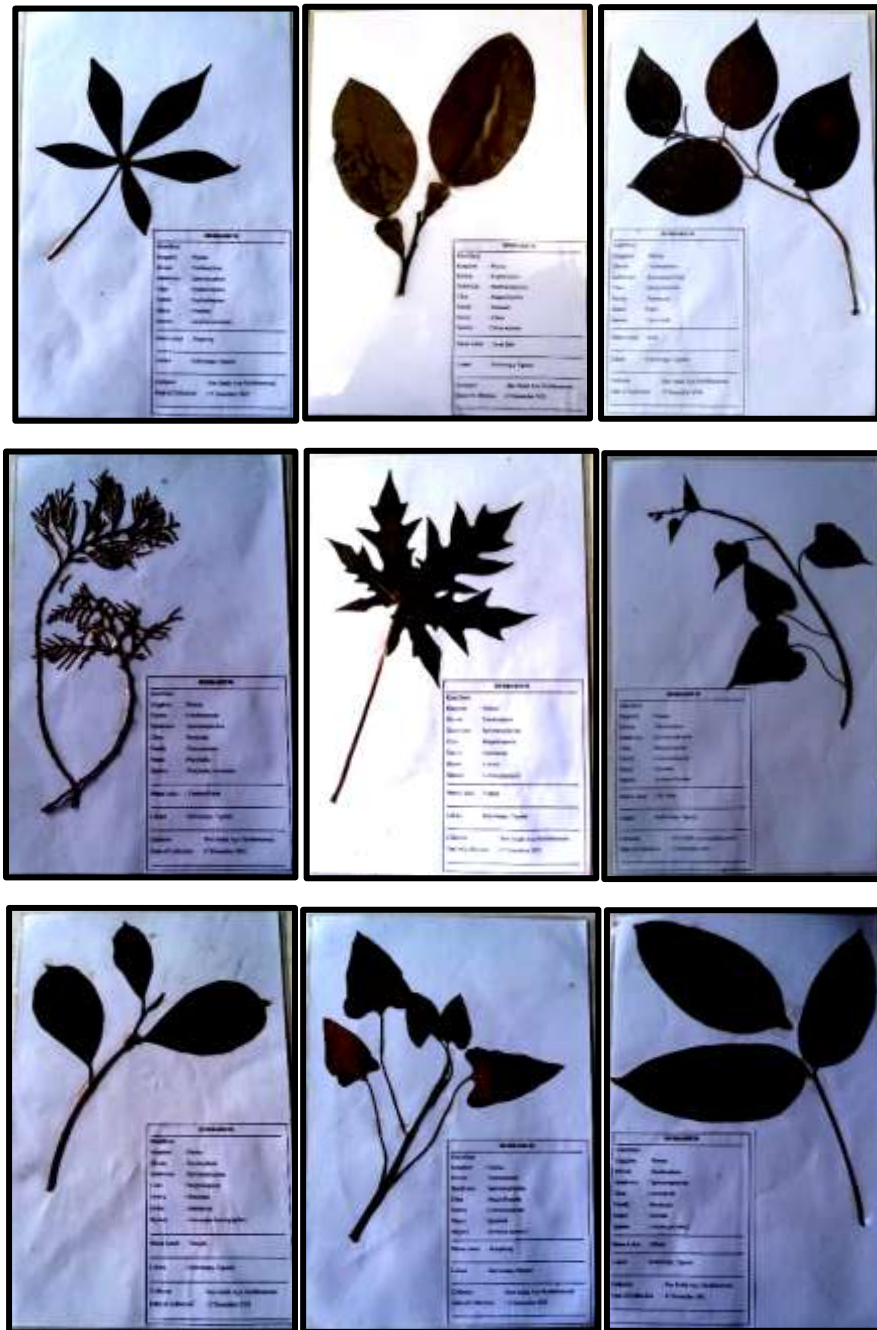


Figure 1. Herbarium learning media

4.2. Improvement of Student Learning Outcomes by Herbarium Utilization

Utilization herbarium as learning media improved the student learning outcomes in plantae material. The plantae material observed in this research was the ability of students for identification and classification in some types of plants, as spermatophyte, gymnosperms, angiosperms, and the role of each plant. The indicator learning observed were consists of classification of spermatophytes based on the available characteristics, identification characteristics of spermatophyte, identification characteristics of angiosperms, identification characteristics of gymnosperm, classification of gymnosperms based on the characteristics in the picture, identification of monocots and dicots characteristics, difference of monocots and dicots based on the morphological characteristics shown in paper sheet, difference of the order of each plant in taxonomy, role of plants based on the pictures presented. The students learning outcomes increased by utilization herbarium in learning process. The most of the indicator learning in plantae material were achieved. Percentage of true answer in posttest higher than pretest (Figure 2).

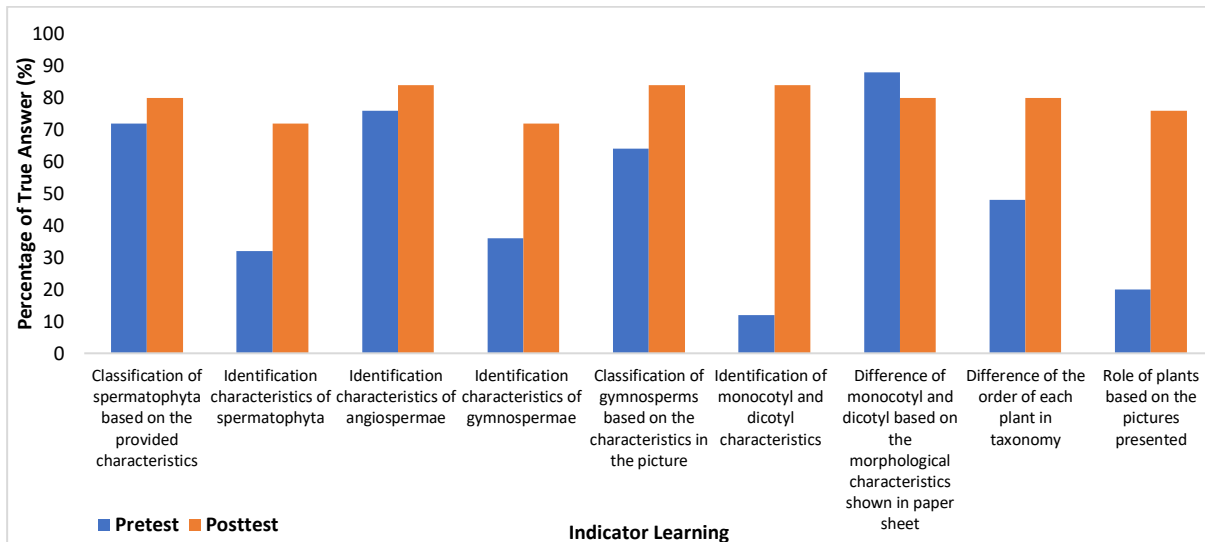


Figure 2. The result of pretest and posttest by students using herbarium as learning media

The highest improvement of indicator learning achieved in plantae material was difference of monocots and dicots based on the morphological characteristics. The percentage of student true answers in posttest was 84%, while percentage of student true answers in pretest was 12%. It showed that there was increased of learning outcome in this indicator as 72%. The enhanced percentage of student true answers in some indicator, such as identification characteristics of spermatophyte, identification characteristics of gymnosperm, and difference of the order of each plant in taxonomy about 32-40%. It showed that utilization herbarium as learning media not only help students for identify plant characteristics based on their morphology, but also promote students for capable of determine the plant position in classification system. Besides that, information in herbarium helped students for knowing the role of plants. By herbarium, student's knowledge about the role of plants was increased. The percentage of student true answers in posttest and pretest on this indicator, respectively 76% and 20%. Based on this data, the increasing of learning outcome in this indicator as 56%. While the increasing of learning outcome in classification of spermatophyte and identification characteristics of angiosperms was 8%. The increased knowledge by herbarium media had been reported by [5]. On this research was reported that herbarium increased knowledge of student at MTs Negeri 2 Gorontalo about a method to determine the plant taxon. In addition, the herbarium media supported the learning activities in school regarding the introduction and description of plants.

All of the indicator, there is an indicator that not achieved, namely difference of monocots and dicots based on the morphological characteristics. However, there was not significant differentiation the number of student true answers in posttest and pretest. The percentage of student true answers in posttest was 80%, while percentage of student true answers in pretest was 88%. The difference of student true answers percentage in posttest and pretest just 8%. Therefore, the understanding students about it was included sufficient category. That was because the lack of skills in identifying and understanding plants well. While identification material had a very high level of material complexity [13]. Therefore, in science process skills were needed cognitive skills in understanding, generating and communicating existing knowledge [14].

The results of this research showed that students able to identify the characteristics of angiosperms based on the statements presented. This is supported by the existence of herbarium media as illustration the original form of plants. Herbarium had contribution to help students for identify plants that have the same morphological characteristics [10]. In addition, students were able to identify the role of plants presented. Students can mention the presence of plants in the surrounding environment and their benefits because they often use plants as food, drinks, medicinal materials, building materials, pest control poisons, animal feed, and ornamental plants [15]. This research reported that utilization herbarium as leaning media enhanced the student's knowledge about plants, the skill of students in plant identification, the student's ability in plant classification and explanation the role of plants.

Biology learning was a learning that involves the process of science. It was an important part of knowing student abilities, especially in learning material kingdom plantae included plant morphology. It was required the cognitive or intellectual skills so the students were able to find and develop their own facts and related concepts as well as grow and develop attitudes and values.

The score of pretest and posttest were classified into some range. There were five ranges in this score group. They were 1-20, 21-40, 41-60, 61-80, and 81-100. The result of this research showed that there was increased percentage of score group between pretest and posttest. In pretest, there was students that got score in range 21-40, but nor in posttest. In contrast, there was students that got score in range 81-100 in posttest, but nor in pretest (Table 1).

Table 1. Scores obtained during the initial test (pretest) and scores at the final test (posttest)

No	Score group	Percentage (%)	
		Pretest	Posttest
1	1-20	0	0
2	21-40	8	0
3	41-60	48	16
4	61-80	44	40
5	81-100	0	44

In pretest, there were two students who got value on range 21-40. It was shown by percentage 8% in the range of this values. While in posttest, there were not students got value in this range. The percentage of value on range 41-60 and 61-80 in posttest was lower than pretest. The percentage of value on range 41-60 in posttest and pretest, respectively 16% (12 students) and 48% (6 students). This result showed that utilization herbarium as learning media can decrease percentage of students' value on this low range as 50%. In the range a value of 61-80 is obtained by a percentage of 44% on the pretest and 40% on posttest which indicates that there were 11 students and 10 students on this value range. On the highest range of value, 81-100, there were no students who were in that value range in pretest. Meanwhile there were 44% (11 students) had value in this range in posttest. This result proved that utilization herbarium as learning media can increase the percentage of students' value on this maximum range.

The average value of the students was 59.0 on pretest and 75.4 on posttest activity. Meanwhile, the minimum value based on minimum completeness criteria known as KKM was 70. Based on these data, before using herbarium in learning process, the average value of the students has not been able to achieve the value according to the KKM. However, the average value of the students according to the KKM was achieved after utilized herbarium in learning. It was shown by 18 students who get a complete score above the KKM. The achievement of student average scores above the KKM proved that the use of herbarium can improve the student biology learning outcomes. Thus, this study reported that the utilization of herbarium as a learning media promoted the improvement of student learning progress. This results according with Hasugian's research. He stated that the herbarium media can improve learning outcomes because it can facilitate the achievement of goals to understand and remember the information or goals contained in the herbarium [16].

The success of learning in students was not only influenced by the learning media used, it was also influenced by other factors, namely internal and external. The internal factors consist of physical, psychological, and fatigue factors. While external factors included family, school, and community factors [17].

4.3. Student Response of Herbarium Learning Media

Response of students about herbarium utilization as biology learning media in general showed good category. There were seven statements asked by response questionnaires for students. The contents of this statements were effect of herbarium application in learning process (Table 2).

Table 2. Responses of students about herbarium media

No	Statement	Percentage (%)
1	Herbariums was understood easily and increasing insight of students	78
2	Herbarium presents the clear information	80.5
3	Herbarium motivates the students to learn plantae material	77
4	Herbarium is interesting and help me to recognize the plants around easier	85
5	Herbarium increases my curiosity to learn plantae material	75.5
6	Learning using herbarium media makes students actively ask questions	75
7	Herbarium can support practicum activities and answer plantae material questions	80.5
The average value of student responses about utilization of herbarium as biology learning media		79.05

Based on the results of the questionnaire that has been distributed, it was found positive response from 25 students of class X MIA MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency. It was shown by average value of student responses about utilization of herbarium as biology learning media as 79.05%.

The percentage of students' response value in all of statement showed higher than 75%. The highest students' response value (85%) presented in the benefit of herbarium as interesting media and the able to help for recognize the plants around easier. The students said that in the herbarium included clear information so it can support practicum activities and answer plantae material questions. That were shown by students' response value as 80.5%. Besides that, students stated that utilization of herbarium as learning media can increase the insight because it can be understood easily which shown by students' response value as 78%. This is supported by previous research which showed that the herbarium learning media was important to be used as learning material for students. In addition, herbarium was able to used by educators as a tool to assist the process in learning activities [18].

Learning using herbarium media makes students more motivated to learn material related to plantae. This has also been proven by previous research which states that herbarium book media can improve student learning activities which promote the students to take an active role in learning activities [19].

Utilization of herbarium as learning media can hone thinking skills which can improve the development and strengthen of childrens memory. That is shown that student abilities can also be influenced by the existence of supporting facilities in learning activities. The use of learning media makes students more motivated in learning the learning materials taught by the teacher [20].

The development of herbarium as learning media was reported by [4]. This research reported that the result of validation herbarium as learning media got score 81.25 from two validators. In this research, the author stated that herbarium based on local wisdom was very suitable to be used as a learning media to study plant structure and development. Besides, the types of plants used as specimens in the developed herbarium are quite relevant because they present examples of monocot and dicot plants.

5. Conclusion and Future Works

Students of Mathematics and Natural Sciences class X at MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency needed herbarium as learning media and interested to utilize it in learning activities. The dry herbariums were provided consist of some species of gymnosperms and angiosperms then dicots and monocots. Utilization herbarium as learning media improved the student learning outcomes in plantae material in some learning indicators, such as identification and classification in some types of plants, as spermatophyte, gymnosperms, angiosperms, and the role of each plant. Utilization of herbarium in learning process improved the achievement of student average scores above the KKM. Based on it, herbarium can improve the student biology learning outcomes. In addition, the utilization of herbarium as a learning media promoted the improvement of student learning progress.

Utilization of herbarium as a learning media got positive response from students. According to student statement, application the herbarium in learning process has many benefits, such us interesting media, help for recognize the plants around easier, include clear information, support practicum activities and answer plantae material questions, and motivate to learn material related to plantae. Therefore, herbarium was recommended for used as learning media to promote the students to take an active role in learning activities.

Suggestions that can be given are expected to be more active and communicative in developing more complex herbarium media. In addition, a more in-depth literature study is needed before carrying out research.

Acknowledgement

The author would like to thank the head master of MA Bahrul Ulum, Kepohbaru District, Bojonegoro Regency for giving permission so that this research can be carried out well. The author also wants to thank the biology teacher and student Mathematics and Natural Sciences class X who as respondents in this research.

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Appendix

Appendix 1. The enhanced biology learning outcomes of students by herbarium

No.	Indicator Learning	Percentage of Student's Answer (%)				Description of True Answer	Percentage of Increasing/Decreasing (%)
		Pretest		Posttest			
		True	False	True	False		
1.	Classification of spermatophyta based on the provided characteristics	72	28	80	20	Increase	8
2.	Identification characteristics of spermatophyta	32	68	72	28	Increase	40
3.	Identification characteristics of angiospermae	76	24	84	16	Increase	8
4.	Identification characteristics of gymnospermae	36	64	72	28	Increase	36
5.	Classification of gymnosperms based on the characteristics in the picture	64	36	84	16	Increase	20
6.	Identification of monocotyl and dicotyl characteristics	12	88	84	16	Increase	72
7.	Difference of monocotyl and dicotyl based on the morphological characteristics shown in paper sheet	88	12	80	20	Decrease	8
8.	Difference of the order of each plant in taxonomy	48	52	80	20	Increase	32
9.	Role of plants based on the pictures presented	20	80	76	24	Increase	56