

Development of student worksheet for basic introduction of Angiosperms classification in the environment of 3 Bantul senior high school as a plant classification learning media

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Abstract. This research aims to determine 1) the species of Angiosperms in the environment of 3 Bantul Senior High School, 2) the potential diversity of Angiosperms morphological as a learning resource that can be used to develop a student worksheet for basic introduction of Angiosperms classification, and 3) the feasibility of student worksheet as a plant classification learning media. This research, which took from February to May, was divided into 3 phases, namely biological research (identifying morphological characteristics of Angiosperms), the adoption of biological research results as a learning resource, and development of student worksheets using the ADDIE model but limited to the development stage. Student worksheet then tested on 30 students and 2 Biology teachers. The collected data then analyzed using the formula for the percentage of occurrences of each value. A total of 55 species with diverse morphological characteristics have been identified. The diversity of morphological features has the potential to be used in determining the basis of classification which can be used as a learning resource arranged to student worksheet. Based on the assessment of the Biology teacher and student responses it can be said that this student worksheet worthy of use as a plant classification learning media.

1. Introduction

Ministerial Decree of Education and Cultural No. 22 year 2016 describes learning objectives from the curriculum 2013, which includes the development of attitudes, knowledge, and skills, and emphasizes contextual learning with student-centered and scientific approaches. One important component in determining the successful implementation of learning is the learning resource. According to [4], the learning resources are formulated as everything that can provide students with facilities to obtain a number of information, knowledge, experience, and skills in the learning process, so that learning resources can be all things that exist both human beings, materials, tools, messages, techniques, and environment that can be used as a place to uncover a learning experience and provide facilities in obtaining information, knowledge, experience, and skills in order to improve knowledge, understanding, skills and better attitudes.

The local potential of a school environment can be a learning resource of biology that is cheap, affordable, and contextual [5]. The environment around the school that can be in the form of rice fields, school gardens, parks, fields in the form of grasslands, and others can provide support to student learning activities. In the process of learning biology, the environment around the school can be used as a learning resource or media in learning Biology [6]. The surrounding environment as the source and medium of biological learning for students can be optimized in the learning process to enrich the material and make the teaching process more varied. The utilization of the surrounding environment in the learning process of biology will be more meaningful because students are faced with the actual and natural events that can be accounted for the truth [12].

The environment of 3 Bantul Senior High School there are many plants, especially Angiosperms (covered-seed plants). The existence of these plants can be used as a learning resource for students. A high diversity of living creatures in the plant is often difficult to learn. To facilitate the study of the diverse plants, it is necessary to simplify the study object by classifying the plants that exist in certain units (taxon). This activity is referred to as classification. Characteristic similarities are used as the basis of classification [10]. One of the characters that can be used as the basic criteria of plant classification is a morphological character. Grouping with morphological characters is expected to distinguish an individual with another individual more easily and objectively [2].

The plant classification material is listed in Basic Competency 3.8 that is classifying plants into divisions based on common characteristics and associating roles in life and 4.8 that is presenting reports of both phenetic and phylogenetic observations and analyses Plants and roles in life. To reach this Basic Competency, students can do a direct observation of the objects that they have learned. The basic introduction of classification is important for students to know how to do classifying or grouping. Classifying becomes an important skill because it is one aspect of the scientific approach. Observation skills are the primary capital for students to be able to classify.

The existence of observation activities needs to be done to practice activities in the field. Therefore, it takes a learning media that can be used as a guideline to conduct observations of plant morphology in the field. The student worksheet is one of the learning media that serves to improve student engagement and activity in the learning process. Student worksheet can be used to optimize student learning outcomes [8]. The student worksheet is practical to use for learning activities, creating student-centered learning and can develop process skills, scientific attitudes, and student's interest in the environment [3].

Plants in the environment of 3 Bantul Senior High School has not fully utilized, especially in the activity of classifying plants. Besides, the available student worksheet has not facilitated the observation activity or exploration to classify the plants in the school environment so that the student worksheet needs to be developed following with the demands of the curriculum and school conditions. Based on the explanation, the author intends to develop a student worksheet for the basic introduction of Angiosperms classification in the environment of 3 Bantul Senior High School as a plant classification learning media.

Based on this, the purpose of this research is to determine the species of Angiosperms in the environment of 3 Bantul Senior High School, knowing the potential diversity of the morphological characteristic of Angiosperms in the environment of 3 Bantul Senior High School as a learning resource that can be used to develop a student worksheet for basic introduction of Angiosperms classification, and know the feasibility of student worksheet for basic introduction of Angiosperms classification in the environment of 3 Bantul Senior High School as plant classification learning media.

2. Research methods

The study was conducted through 3 phases. First, biological research that is identifying morphological characteristics of Angiosperms in the environment of 3 Bantul Senior High School. Second, the adoption of biological research results as a learning resource. Third, student worksheet development based on biological research results.

2.1. Research type/design

In biological research, the research type used is exploratory descriptive. Then, for student worksheet development research based on biological research results using the research design of R&D (Research and Development) with ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation) [7]. However, this research is limited to the Development stage only.

2.2. Time and place of research

Research on identifying the morphological characteristics of the Angiosperms plant was conducted in February 2019, while the development of the student worksheet was conducted in February-May 2019. Both are implemented at 3 Bantul Senior High School.

2.3. Research subject and object

The subjects in this research were 30 students of 10th grade from science class and 2 biology teachers at 3 Bantul Senior High School. Then the research object is the student worksheet for the basic introduction of Angiosperms classification in the environment 3 Bantul Senior High School.

2.4. Procedure

This research was divided into 3 phases, namely biological research (identifying morphological characteristics of Angiosperms), the adoption of biological research results as a learning resource, and development of student worksheets using the ADDIE model but limited to the development stage.

2.4.1. Biological research. At the stage of biological research (identifying the morphological characteristic of Angiosperms), the research procedure that is 1) prepare the tools and materials to be used in the research, 2) observe the types of plants in the area 3 Bantul Senior High School, 3) Document the type of plant that have been found, 4) records the characteristics of plants on the worksheet, and 5) identify the species of plant that have been found.

2.4.2. The adoption of biological research results as a learning resource. At the stage of adoption of the biological research result as a learning resource, the procedure is 1) identify the process and research products, 2) perform the selection and modification of the research result as a biological learning resource, and 3) The application of research results into instructional organizations.

2.4.3. Development of learning media in the form of student worksheets based on the research results. At the stage of development of learning media in the form of student worksheets based on the results of the research, the stage is conducted 1) stage analysis (analysis). At this stage, the activities undertaken are analyzing the student needs, competency, and instructional. 2) Planning phase (design). At this stage, the activities undertaken are determining the physical characteristics of student worksheets and to develop the student worksheet systematics. 3) the development phase. At this stage the activities performed are pre-writing, draft writing, 1st editing, 1st revision, 2nd editing, and 2nd revision.

2.5. Data, instruments, and data collection techniques

The data obtained from biological research is the data morphological characteristic of Angiosperms. Data collection characteristic of Angiosperms morphology is carried out by observing directly in the environment of 3 Bantul Senior High School. I also conducted literature and documentation studies to complement the data result of observation. Then, the data obtained from the development of student worksheet research is the form of student worksheet quality assessment data by material experts, media experts, biology teachers, and students. Data obtained using the Likert scale poll with 4 (four) alternative answers are very good, good, bad, and very bad.

2.6. Data analysis techniques

The Data of biological research in the form of the morphological characteristic of the Angiosperms is analysed descriptively which will be shown in the form of images and descriptions. Furthermore, the process of identification of the plant is done by observing morphological characteristics which are then conducted grouping based on the similarities and differences in morphological characteristics of Angiosperms. Also, researchers have also compared the observations of morphological traits with the identification books (Plants in Tropical Cities) to determine the species name.

After that, data on the results of the student worksheet development that form qualitative data are criticism and advice from experts, biology teachers, and students analyzed descriptively and subsequently used as inputs to revise the product. Then the quantitative data obtained through the assessment poll will be calculated the percentage of occurrences of each assessment with the following formula.

$$\text{Percentage of each value} = \frac{\text{The frequency of each assessment}}{\text{Number of frequencies of all values}} \times 100\%$$

Based on the calculations with the formula will be obtained percentage for each assessment is very good, good, bad, and very bad in the number of percent according to the assessment of respondents. Ratings that have the most frequency of occurrence (mode) or the greatest percentage will be the conclusion of this student worksheet quality. This student worksheet will be feasible when it has a minimum good scoring mode. The data percentage of each assessment will be presented in table form [9].

3. Results and discussion

3.1. Types of Angiosperms plants and their potential as a learning resource

Based on the results of an exploratory descriptive study with the free-roaming method in the 3 Bantul Senior High School, 55 species of Angiosperms that are identified. These species are *Adenium obesum*, *Tabernaemontana divaricata*, *Adonidia merrillii*, *Pritchardia pacifica*, *Cyrtostachys renda*, *Dypsis lutescens*, *Phoenix* sp., *Rhapis humilis*, *Agave desmettiana* 'Jacobi', *Sansevieria trifasciata*, *Chlorophytum amaniense* 'Fire Flash', *Chlorophytum bichetii*, *Aglaonema commutatum*, *Aglaonema* sp. (*Aglaonema* 'Donna Carmen'), *Aglaonema modestum*, *Alocasia amazonica*, *Anthurium plowmanii*, *Caladium bicolor*, *Dieffenbachia amoena* 'Tropic snow', *Epipremnum aureum*, *Philodendron bipinnatifidum*, *Zamioculcas zamifolia*, *Aloe vera*, *Alpinia* sp., *Axonopus compressus*, *Basella alba*, *Bryophyllum pinnatum*, *Calathea ornate*, *Canna* sp., *Capsicum annuum*, *Cinnamomum* sp., *Cissus verticillate*, *Citrus sinensis*, *Evodia suaveolens*, *Euphorbia milii*, *Codiaeum variegatum*, *Excoecaria cochinchinensis* 'Firestorm', *Jatropha multifida*, *Dimocarpus longan*, *Echinodorus palaefolius*, *Ficus benjamina*, *Graptophyllum pictum*, *Ixora coccinea*, *Mangifera indica*, *Manilkara zapota*, *Piper sarmentosum*, *Polyalthia longifolia*, *Polyscias fruticosa* 'Elegans', *Schefflera arboricola*, *Syzygium oleana*, *Syzygium malaccense*, *Terminalia catappa*, *Tradescantia zebrina*, *Tradescantia spathacea*, and *Vernonia amygdalina*.

Based on the results of the identification of the plant morphological characteristics of Angiosperms in 3 Bantul Senior High School, it appears that the Angiosperms there have diverse morphological characteristics. Classification is an activity grouping based on similarities and characteristic differences. The existence of morphological characteristics is very good to be used as a learning resource of plant classification because with the diversity of characteristics, plants in the environment 3 Bantul Senior High School can be classified based on similarities and characteristic differences.

Based on the morphological characteristics owned by Angiosperms in 3 Bantul Senior High School, there are 19 basic classifications that can be used as the basis of grouping plants to be 55 species of Angiosperms. The basic grouping used in this research are the completeness of the leaves,

the number of leaf blade (*lamina*) in a stalk (*petioles*), the composition of the leaflets (*foliolum*) on the stem mother (*petiolus communis*), the leaf blade shape (*circumscriptio*), the *apex folii*, the *basis folii*, the leaf branch bones (*nervus lateralis*) growth direction, the leaf bone arrangement (*nervatio*), the leaf margin (*margo folii*), the leaf flesh (*intervenium*), the leaf colour, the *phyllotaxis*, the appearance of the stem, the direction growth of the stem, the stem fork, the number of flowers in one stalk, the type of inflorescence (for plants with inflorescence), flower symmetry, and petals colour.

The results of biological research can be appointed as a learning resource when there is conformity with the material in the applicable curriculum. As [1] has revealed, the assessment of the results of this research can be done if the results of the study meet the requirements as a learning resource, such as potential availability of objects and issues raised, conformity with the learning goals, the material goals and the designation, the information to be disclosed, the exploration and acquisition guidelines to be achieved [8]. As previously spelled out, biological research results in the identification of the morphological characteristics of Angiosperms in the environment of 3 Bantul Senior High School are eligible to be appointed as a learning resource. Then, a research result, if it will be appointed as a learning resource, must go through the stages of identification process and product research, selection and modification of processes and products as learning resources, and the application of research results as learning resources into the instructional organization [8].

3.1.1. Identification of the research process and product. At the stage of identification of the research process and product, the activity is reviewing the process and product of the research that is relevant to biological problems in schools. In terms of the process can be described the scientific measures in the order of the identification and formulation of problems, the formulation of research objectives, the formulation of hypotheses, the preparation of research procedures, implementation of activities, collection and analysis of data, discussion of research results, and withdrawal of conclusions. Then in terms of research products, the fact of the research results was generalized into concept [8].

3.1.2. Selection and modification stages of the process and product as a learning resource. At the selection and modification stages of the process and product as a learning resource, the first step that must be considered is the research work procedures (processes) that must be adjusted to the learning activities. From the results of the assessment of research that has been done, the steps of the scientific process that can be done by students are observing the learning object (morphological characteristics of Angiosperms plants), identifying similarities and differences between Angiosperms plants found, determining the basis of grouping, interpreting work data, summarizing the work, and communicating the work in a discussion forum. The second step, namely the research product in the form of facts and concepts must be adjusted to the applicable curriculum.

3.1.3. Applying research results as a learning resource into instructional organizations. At the stage of applying research results as a learning resource into instructional organizations, what is done is the application of research results realized in the design of learning activities with components consisting of concepts and sub-concepts, core competencies, basic competencies, learning outcomes, indicators, description of material, objectives, types of activities, learning strategies, facilities and infrastructure, forms of learning, system interactions, and evaluation tools.

3.2. Development of Angiosperms classification basic introduction from biological research results
In the utilization of the environment as a source of learning media presence has a significant significance because in the activity the obscurity of the submitted materials can be assisted by presenting the media as an intermediary message distributor to achieve learning goals [12]. Development of student worksheet for basic introduction of Angiosperms classification used ADDIE development model (Analysis, Design, Development, Implementation, Evaluation). However, the research is limited to the Development phase.

3.2.1 Analysis stage. At the analysis stage, it is necessary to analyse the needs of students, competencies, and instructional. Based on the results of the student's need analysis, the student worksheet that already used by students during the study only contained a summary of the materials and exercises in which the student worksheet has not been able to explore the potential in the school environment. This relates to the interview with a biology teacher stating that students are also rarely invited to learn the object of learning directly when the concepts of the Plantae material will be more easily accepted by the students when the students can interact directly with learning objects. The next is conducting a competency analysis. Based on the results of the research, it is noted that plants in the environment of 3 Bantul Senior High School are included in the Angiosperms division. Angiosperms or covered-seed plants have a special characteristic of having a seed that is always covered by a body derived from the leaves of fruit called *ovary* [11]. Another characteristic of Angiosperms is that it has the roots, stems, and true leaves where the organs can be observed and differentiated. It is known that the morphological characteristic of Angiosperms in the environment of 3 Bantul Senior High School is diverse. The diversity of morphological character can be used as the basic grouping of each plant. Thus, Angiosperms that exist there can be used as a learning resource to achieve the basic competencies of 3.8 and 4.8 but only limited to the Angiosperms division and the characteristics of the plant that can later be used to study the classification of plant materials, especially Angiosperms. Then, the instructional analysis The thing that is done is to describe the Core Competence and Basic Competence into the learning goals that previously described in advance the indicators of its competency achievement.

3.2.2. Design stage. At the design stage, what is done is to determine the physical characteristics of the student worksheet and to develop the student worksheet layout systematics. The layout systematics of student worksheet for basic introduction of Angiosperms classification in the environment of 3 Bantul Senior High School includes cover, cover page, group identity, preface, table of contents, instructions the usage of student worksheet, competence, introduction, learning activities (each learning activity contains the titles of activity, the topic of activity, the purpose of activity, tools and materials, work steps, observation result, discussions, conclusions, appendix guidelines), and the references.

3.2.3. Development stage. At the development stage, the activities are pre-writing, draft writing, 1st editing, 1st revision, 2nd editing, 2nd revision. At the pre-writing stage, the authors collect references both the image and the text obtained from the book or the internet as a guideline in drafting the student worksheet. Besides, the author also conducts direct observation of plants in the environment of 3 Bantul Senior High School. At the draft writing stage, the author performs the framework of student worksheets to compose material or graphic drafts. The result of this draft writing is consulted by the guidance lecturer to get advice and input as reference for the improvement of student worksheet At the stage of 1st editing, it is the assessment phase of student worksheet quality by material and media experts.

Table 1. The results of student worksheet quality assessment by material experts

Assessment Aspect	Very Good	Good	Bad	Very Bad
Truth and expanse of concept	57%	43%	0%	0%
Student learning activities	55%	44%	0%	0%
Content presentation	61%	39%	0%	0%
Average percentage	58%	42%	0%	0%

Based on the quality assessment of student worksheets by the material experts from the three aspects of assessment above obtained the average percentage of the highest assessment of 58% with very good criteria. It is indicated that the student worksheet for the basic introduction of Angiosperms

classification is feasible to be tested with some improvements based on advice and feedback from material experts.

Table 2. The results of student worksheet quality assessment by media experts

Assessment Aspect	Very Good	Good	Bad	Very Bad
Linguistic	17%	83%	0%	0%
Layout	66%	34%	0%	0%
Book Anatomy	67%	16,5%	16,5%	0%
Code of conduct and copyright	0%	100%	0%	0%
Content presentation	12,5%	87,5%	0%	0%
Usage of student worksheet	14,3%	85,7%	0%	0%
Average Percentage	41%	58%	1%	0%

Based on the quality assessment of student worksheets by the media experts from the six aspects of assessment above obtained the average percentage of the highest assessment of 58% with good criteria. However, the assessment of the media experts seems to get an average percentage of 1% with bad criteria of the assessment in the anatomy aspect of the book. This is because writing a list of references in the form of URL still does not match the rules of reference writing. Therefore, to improve the development of this student worksheet, the writing of the reference of the URL is corrected again by adjusting the writing following the rules applicable so that it can be said that the student worksheet for basic introduction of Angiosperms classification is worth testing after the revision.

Furthermore, in the 1st revision student worksheets are improved based on the advice and feedback from material and media experts so that student worksheets can meet the criteria to become a worth media that will be tested in the school. Then, at the stage of 2nd editing, conducted through limited trial activities. Limited trials are conducted to obtain the biological teacher's assessment data and student's response to the student worksheet for basic introduction of Angiosperms classification in 3 Bantul Senior High School to determine the eligibility of student worksheet.

3.3. The eligibility of student worksheet for basic introduction of Angiosperms classification

The eligibility of this student worksheet is determined based on the assessment of biological teachers and students by requesting student's responses to the student worksheet. Before the student worksheet was tested in school to be asked for the assessment of the biology teacher and asked for the response from the students, the product in the form of a student worksheet has been reviewed by the reviewer, namely the material and media experts so it is worth to be tested.

Table 3. The results of student worksheet quality assessment by biology teacher

Assessment Aspect	Very Good	Good	Bad	Very Bad
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Truth and expanse of concept	75%	17%	8%	0%
Student learning activities	94%	6%	0%	0%
Content presentation	94%	6%	0%	0%
Linguistic	70%	30%	0%	0%
Layout	90%	10%	0%	0%
Book anatomy	100%	0%	0%	0%
Code of conduct and copyright	100%	0%	0%	0%
Usage of student worksheet	79%	14%	7%	0%
Average percentage	87%	11%	2%	0%

The results of student worksheet assessment by biological teachers get a very good judgment into the scoring mode with an average percentage of 87%. However, the assessment of biological teachers appears to be gaining an average percentage of 2% with bad criteria in the truth and expanse concepts and the usage of student worksheet aspects. Biology teachers gave bad judgment because the teacher assesses that the material presented is too broad. Then, the teacher assessed that with the material presented is too broad, it takes a longer time to do the learning activities on the student worksheet. Besides, the teacher also gave an advices and feedback that is related to the consistency of page tagging in the working step, affirmation in the use of punctuation marks, table rendering, and the extent of materials.

Based on the criticism from the biology teacher, the extensive material on the student worksheet is only to provide additional knowledge to the students where the characteristics include the overall characteristics of Angiosperms in the environment of 3 Bantul Senior High School. For the observation activity, students only observe four Angiosperms (not observing all Angiosperms in the environment of 3 Bantul Senior High School) so that students do not need to record all morphological characteristics of the plant to detail. Then for the learning time, if the practice goes in order and the students can be disciplined in time, the learning activities of this student will not take too long. However, if time is insufficient, activities can be done outside of lesson hours or conducting learning activities in the form of field studies. Furthermore, the advice and feedback from biological teachers are related to the consistency of page-tagging in the working step, affirmations in the use of punctuation marks, table rendering, and the extent of the material have been followed up to improve the quality of this student worksheet. Based on the results of the assessment of student worksheet by biology teachers, student worksheet for basic introduction of Angiosperms classification in the environment 3 Bantul Senior High School which has been prepared to be used as a learning media by making improvements in advance.

Table 4. Student responses to student worksheet quality

Assessment Aspect	Highly Agree	Agree	Disagree	Strongly Disagree
The expanse of concept	39%	60%	1%	0%
Content presentation	24%	76%	0%	0%
Linguistic	37%	63%	0%	0%
Layout	53%	47%	0%	0%
Usage of student worksheet	47.8%	51.7%	0.5%	0%
Code of conduct and copyright	47%	53%	0%	0%
Average Percentage	43.7%	55%	0.3%	0%

The results of the student worksheet quality assessment by students show good scoring mode with an average percentage of 55% with agree criteria. However, the response from this student appears to

be getting an average percentage of the responses to disagree by 0.3%, which is in the aspect of the concept and on the aspect of the usage of the student worksheets. Students gave disagreement because the students did not understand a few questions about the discussion. Also, students are less familiar with the available work steps. Based on the student's response, before conducting the learning activities at the student worksheet, the teacher directs how the activities will include the work step explanation and the meaning of the answers that students need to give from discussion. That way, students are expected to have no confusion in their learning activities and here are the opportunities for students to discuss with their group mates or inquire directly with the teacher. Overall, the student worksheet for the basic introduction of Angiosperms classification is worth to use as a learning media. Students also make comments that mostly show interest and ease in the use of student worksheets.

4. Conclusion and suggestion

4.1. Conclusion

Based on the research on identification of the morphological characteristics of Angiosperms in the environment of 3 Bantul Senior High School was found 55 species consisting of 30 families with diverse morphological characteristics. The diversity of morphological characteristics of Angiosperms in 3 Bantul Senior High School has the potential to be used in determining the basic classification that can be used as a learning resource arranged in the form of the student worksheet. Then, based on the results of student worksheet quality assessment obtained the results that the student worksheet for the basic introduction of Angiosperms classification in the environment 3 Bantul Senior High School worthy to be used as a learning media for classification material based on the assessment of biological teachers and student responses.

4.2. Suggestion

Advice for the next researcher in the development phase of student worksheet for basic introduction of Angiosperms classification in the environment of 3 Bantul Senior High School should be continued until the evaluation stage (evaluation) to be obtained products that are completely ready to use the student worksheet for the learning process. Furthermore, subsequent research should be in addition to measure the feasibility of student worksheet also calculate its effectiveness. Furthermore, morphological features that were observed must be more specific especially for the morphology of stems and flowers. Also, morphological features used as the basis for classification can be supplemented by the morphological characteristics of the fruit and roots to be more specific.

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