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Exploration and Identification of Seed Plants (Spermatophytes) in Wana Wisata Penggaron to Develop Learning Module of Biology

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Abstract

Species richness of seed plants (Spermatophytes) at Wana Wisata Penggaron has the potential to be developed as a learning resource of biology. This study aims to develop teaching materials through exploration and identification of seed plants (Spermatophytes) in Wana Wisata Penggaron to the form of modules and knowing the validity, effectiveness of modules developed based on learning outcomes and user responses. The research method used is R & D. The results of exploration and identification of seed plants (Spermatophytes) found 64 species consisting of 3 species of Gymnosperms and 61 species of Angiosperms. Species richness of of seed plants in Wana Wisata Penggaron has represented members of the Spermatophytes division, so it can be developed as a source of learning biology. The results of the material and media expert validation were 98.44%, indicating that the modules included in the criteria were very feasible, which then the module was used in learning. The results of the module effectiveness test show that the module effectively used in learning is shown by 80% classical completeness. Affective and psychomotor learning outcomes show all students get the criteria of "Very Good". The teacher's response to module development is 94.79%, included in the criteria very feasible. Student responses were 86.8%, included in the criteria very feasible.

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INTRODUCTION

Wana Wisata Penggaron is one of the forest park in Semarang district which is still a natural forest. This area is dominated by several stands of Pinus, Teak, Randu alas, Mahoni, and Puspa trees. Under the stands of these trees there are many understorey plants, most of which are also members of the Spermatophytes division. Seed plants (Spermatophytes) is one of the materials studied at the Senior High School.

Seed plants (Spermatophytes) are included in Kingdom Plantae material. This material is covered in KD 3.8, is applying classification to classify plants into the divisio based on morphological and metagenetic observations of plants and linking their role in the survival of life on earth and 4.8, is presenting data on the results of phenetic and phylogenetic analysis of plants and the role of plants in survival on earth.

Observations in several Senior High Schools in Semarang and Demak, are MA Futuhiyyah Kudu, MA Infarul Ghoy, and MA Futuhiyyah 2 Demak show that plantae material is classified as difficult material. This is marked by the number of learning outcomes of students who have not reached minimal completeness criteria (KKM). 50% of MA Futuhiyyah Kudu students have not yet reached minimal completeness criteria, 30% of MA Infarul Ghoy students have not yet reached minimal completeness criteria, and 25% of MA Futuhiyyah 2 Demak students have not yet reached minimal completeness criteria. The results of interviews with several class X students, most of the students had difficulty in plantae material. According to students, plantae has extensive studies and the number of classifications that must be memorized. Students said that there were not many plants in the environment and there were still difficulties in classifying these plants including monocot plants or dicotyledonous plants.

Observations of teaching materials used by teachers and students of class X, especially seed plants, the contents of teaching materials did not display phenetic and phylogenetic analysis material, the picture does not represent the full sample of members of the Spermatophytes. The images displayed in the teaching material are few, small in size, and some images are colorless. The limitations of giving pictures to teaching materials can make students less interested and difficult to learn about the morphological characteristics of plants. One step that can be a solution to help students understand seed plants material is through the use of additional teaching materials that display material concepts more detailed and interesting material concepts along with clear and colorful images.

The development of teaching materials by utilizing the environment will create contextual learning. The environment can be used as a learning resource because it can help students associate the material learned with real conditions, thus encouraging students to make connections between the knowledge they have and their application in life (Ardan et al., 2015; Rizqiana et al., 2017). The environment used in science learning will provide a more meaningful experience for students (Winaryati et al., 2015).

Preliminary observations, using roaming methods for tree habitus and quadratic plot methods for understorey plants (shrubs, herbs and lianas) located in the main door area of Wana Wisata Penggaron, found 25 species belonging to the Spermatophytes division. The 25 species consisted of 19 plants with understorey plants and 6 plants with tree stature. The results of follow-up research will be packaged in modules which will then be connected with Kingdom Plantae material on Spermatophytes sub topics, namely KD 3.8 and 4.8 Curriculum 2013 in Class X.

METHODS

This research is an R & D study with research procedures referring to Sugiyono (2013). The research begins with analyzing the potential and problems that exist in biology learning in several Senior High School in Semarang City and Demak dictrict. Furthermore, it explores and identifies seed plants (Spermatophytes) at Wana Wisata Penggaron to collect module development materials for the richness of seed plants. The next activity is product design,

material and media expert validation, product revision based on validator suggestions, small scale tests, and large scale tests.

Module trials were carried out in 3 schools, are MA Futuhiyyah Kudu, MA Infarul Ghoy, and MA Futuhiyyah 2 Demak on seed plants (Spermatophytes) material. Small-scale trials were conducted by giving a questionnaire to 10 studens of MA Futuhiyyah 2 Demak to determine the readability and practicality of the module. Large-scale tests are used to determine the effectiveness of using modules in learning. Large-scale tests were conducted on 76 students, consisting of 19 studens of MA Futuhiyyah Kudu, 21 students of MA Infarul Ghoy, and 36 students of MA Futuhiyyah 2 Demak. Implementation of modules in large-scale tests using the One-shot case study design.

Student completeness in a classical manner is used to measure the effectiveness of the module richness of seed plants (Spermatophytes) at Wana Wisata Penggaron. The percentage of students' classical completeness was calculated by the number of students who completed learning divided by the total number of students. The module developed is said to be effective if ≥75% of students have completed (Purwanto, 2008). Data collection techniques are presented in Table 1.

Table 1. Data Collection Techniques

Data type	Data collection techniques	Instrument for data collection
Richness spesies of seed plant (*Spermatophytes*)	Roam method	Observation sheet and identification book
Validity of module in modul stage 1 and 2	Question validation for material and media experts, users	Validation sheet
Cognitive learning outcomes	Test	Test sheet
Affective learning outcomes	Non test	Questionnaire sheet assesment between friends
Psychomotor learning outcomes	Non test	Studens worksheet

RESULTS AND DISCUSSION

The results of the study consisted of several types of data, including data on the species richness of seed plants (Spermatophytes) at Wana Wisata Penggaron, results of module validation, student learning outcomes, and user responses (teachers and students).

Species Richness of Seed Plants (Spermatophytes) in Wana Wisata Penggaron to Develop of Module

Exploration and identification of seed plants (Spermatophytes) in Wana Wisata Penggaron found 64 species, 32 families, 55 genera consisting of 3 species of Gymnosperms and 61 species of Angiosperms consisting of 16 species of monocotyledonous plants and 45 dicotyledonous plants. Identification data of seed plant species found at Wana Wisata Penggaron presented in Table 2.

Members of the Orchidaceae family are not found in Wana Wisata Penggaron because the habitat for growing orchids is not suitable with the Wana Wisata Penggaron conditions that are classified as lowland forests (Baskoro et al., 2018). Puspitaningtyas (2005) states that a plateau with a height of 500 – 1500 m is a suitable place for orchids because the diversity of orchid species is more than in the lowlands. Research conducted by Farokhah et al. (2018); Agustini et al. (2016) and Wijaya et al. (2018) show that the abundance of orchids is high at high regional heights.

The Liliaceae family has been represented by Crinum asiaticum L from the order Liliales. Anwar et al. (2015) stated that the Papilionaceae family is closely related to Fabaceae /

Leguminoceae. Based on the species found, species of Fabaceae were found in one species, namely Vigna radiata, so it was considered to be represented. Rosaceae members are not found in Wana Wisata Penggaron, although it is said that Rosaceae members are plants that can grow in cold or hot areas and are very tolerant of environmental conditions (Siregar et al., 2005).

Table 2. Seed plants (Spermatophytes) and the availability of families in the Wana Wisata Penggaron and Textbook

No	Species of Seed Plants in Wana Wisata Penggaron	Family	Availabiliy of families	
			Textbook	Wana Wisata Penggaron
1	Zamia (*Zamioculcas zamifolia*)	Zamiaceae	√	√
2	Pinus *(Pinus merkusii)* Cemara *(Cupressus sempervirens)*	Pinaceae	√	√
3	Palem raja *(Roystonea regia)* Palem kuning *(Chrysalidocarpus lutescens)*	Arecaceae/ Palmae	√	√
4	Keladi red star *(Caladium bicolor)* Daun talas *(Colocasia esculanta)* Bunga bahagia *(Dieffenbachia oerstedii)* Bunga bahagia *(Dieffenbachia seguine)*	Araceae	√	√
5	Bunga bakung *(Crinum asiaticum L)*	Amaryllidaceae	≠	√
6	Andong merah *(Cordyline fruticosa L)*	Asparagaceae	≠	√
7	Adam hawa *(Tradescantia spathacea)* Tapak burung *(Murdannia nudiflora)*	Commelinaceae	≠	√
8	Jukut pendul putih *(Kyllinga nemoralis)* Jukut pendul hijau *(Kyllinga brevifolia)* Bambu *(Bambusa* sp*)*	Graminae/ Poaceae	√	√
9	Iris kuning *(Trimezia martinensis)*	Iridaceae	≠	√
10	-	Liliaceae	√	≠
11	Pisang *(Musa paradisiaca)*	Musaceae	√	√
12	Kunyit *(Curcuma longa)*	Zingiberaceae	√	√
13	Pletesan *(Ruellia tuberosa)*	Acanthaceae	≠	√
14	Bunga kancing *(Gomphrena celosioides)* Bunga kancing *(Alternanthera philoxeroides)*	Amaranthaceae	≠	√
15	Glodogan *(Poliyalthia longifolia* Sonn*)*	Annonaceae	≠	√

No	Species of Seed Plants in Wana Wisata Penggaron	Family	Availabiliy of families	
			Textbook	Wana Wisata Penggaron
16	Pegagan *(Centella asiatica)* Pegagan embun *(Hidrocotyle sibthorpioides)*	Apiaceae	≠	√
17	Bunga tusuk konde *(Wedelia trilobita)* Seruni *(Wedelia biflora)* Temu wiyang *(Emilia sonchifolia)* Ajeran (*Bidens alba*) Ajeran *(Bidens pilosa)* Gletang *(Tridax procumbens)* Tapak liman *(Elephantopus scaber)* Buyung *(Vernonia cinerea)* Jotang kuda *(Synedrella nodiflora)* Babandotan *(Ageratum conyzoides)*	Asteracea	≠	√
18	Injeh-injehan *(Ipomoea obscura)*	Convulvulaceae	≠	√
19	Pare *(Momordica charantia* L*)*	Cucurbitaceae	≠	√
20	Katuk *(Sauropus androgynus)* Meniran *(Phyllanthus urinaria)* Singkong (*Manihot esculanta)* Teh-tehan *(Acalypha siamensis)*	Euphorbiaceae	√	√
21	Bunga telang *(Centrosema pubescens)* Daun opo-opo *(Phyllodium pulchellum)* Kacang hijau *(Vigna radiata)* Bunga kupu-kupu *(Bauhinia purpurea)*	Fabaceae	≠	√
22	Jati *(Tectona grandis)*	Lamiaceae	≠	√
23	Kembang sepatu *(Hibiscus rosa-sinensis)*	Malvaceae	√	√
24	Harendong bulu *(Clidemia hirta)*	Melastomaceae	≠	√
25	Sukun *(Artocarpus altilis)*	Moraceae	√	√
26	Putri malu *(Mimosa pudica)* Putri malu besar *(Mimosa diplotricha)*	Mimosaceae	√	√
27	Bunga bugenfil *(Bougenville glabra)*	Nyctaginaceae	≠	√
28	-	Orchidaceae	√	≠
29	Calincing *(Oxalis barrelieri)* Calincing *(Oxalis corniculata)* Krambilan *(Biophytum sensitivum)*	Oxalidaceae	≠	√

No	Species of Seed Plants in Wana Wisata Penggaron	Family	Availabiliy of families	
			Textbook	Wana Wisata Penggaron
30	-	Papilionaceae	√	≠
31	Suruhan *(Peperomia pellucia)* Daun karuk *(Piper sarmentosum)*	Piperaceae	√	√
32	Rumput mutiara *(Hedyotis corymbosa)* Bunga soka *(Ixora javanica)*	Rubiaceae	√	√
33	-	Rosaceae	√	≠
34	Bunga browalia *(Browallia americana* L*)*	Solanaceae	√	√
35	Katumpangan *(Pilea microphylla)*	Urtiaceae	≠	√
36	Bunga tembelekan *(Lantana camara)* Bunga tembelekan *(Lantana trifolia)* Bunga pagoda *(Clerodendrum paniculatum)*	Verbenaceae	√	√

Activities carried out after obtaining data on the speciess richness of seed plants (Spermatophytes) in Wana Wisata Penggaron is design the modules. Module design developed using a Correl draw for covers and Microsoft Publisher 2010 for module contents, the font specifications selected are the cambria and then printed in A4 size. Photos in modules Species richness of seed plants is the result of direct documentation of seed plants that grow on Wana Wisata Penggaron. Plant parts taken include stature, roots (if plant stature is herbaceous and if possible removed), stems, leaves, flowers (if not flowering, will be supplemented from other sources or similar plants elsewhere). The truth of the scientific name of each species is confirmed by matching species photos with the Picture This and Pl@nt Net applications. The classification truth is confirmed by entering the species scientific name at itis.gov.

Modules developed are systematically packaged, consisting of several parts, are preface, table of contents, module usage instructions, basic competencies and learning objectives, material chart, learning activities (classification of seed plants, Gymnosperms plants, Angiosperms plants, stature plant, phenetic and phylogenetic analysis), a glimpse of the speciess richness of seed plants (Spermatophtes) in Wana Wisata Penggaron, worksheets, summaries, formative tests, answer keys, feedback, glossaries, and bibliography.

The learning module developed has a different character from the textbook, which is a module that displays images from personal documentation. Well-designed and equipped learning resources will attract students' interest and stimulate students to learn independently so learning objectives will be achieved (Setyowati et al., 2013; Shabiralyani et al., 2015). The module displays LKS containing seed plants species found at Wana Wisata Penggaron. LKS consists of many species, thus giving students the opportunity to practice more. Learning to use LKS has a better effect than conventional models. LKS is also able to improve student learning outcomes both cognitive, affective, and psychomotor (Mustofa et al., 2013; Deviani et al., 2016).

The module contains material on phenetic and phylogenetic analysis, where in the textbooks currently used for learning do not display the material. Phenetic and phylogenetic analysis material is included in the coverage of KD 4.8.

Rahmayani et al. (2015) argued that one of the objectives of developing teaching materials is to supplement existing teaching materials but still lack. Development of teaching materials that are well adapted to student characteristics, learning material, and environmental conditions of students (Ardan et al., 2015; Kamaludin et al., 2018; Setiawan et al., 2016).

Validity of Module Species Richness of Seed Plants (Spermatophytes) in Wana Wisata Penggaron

Module validation is done by a validator consisting of material expert validators and media experts. Validation aims to provide a feasibility assessment based on material aspects, presentation, and language suitability in the module so that later the modules developed are in accordance with the needs of students and can be an additional learning resource for biology learning, especially seed plants (Spermatophytes) (Fidiastuti et al., 2016). Based on the validity criteria of BSNP (2006), the results of the validation of material experts and media experts scored 98,44%. The results of expert validation indicate that the modules developed are included in the "very feasible" category.

Suggestions given by material and media experts, including image replacement which lacks contrast with the background, for example on Mimosa pudica leaves and unclear leaf reinforcement images, providing a dendogram column on phenetic and phylogenetic analysis material. Provision of columns makes it easier for students to work on and shorten the time so that the assignments are completed more quickly. Based on expert advice, the phenetic and phylogenetic analysis material should be accompanied by the answer signs displayed on the final page of the module. Developed module display presented in Figure 1.

Figure 1. Display of cover and LKS contains species of seed plants (Spermatophytes)

The effectiveness of Module of Species Richness of Seed Plants (Spermatophytes) in Wana Wisata Penggaron

The effectiveness of the module is measured using classical completeness based on minimal completeness criteria (Fatonah et al., 2017). Minimal completeness criteria of Biology subjects at MA Futuhiyyah Kudu 68, while MA Infarul Ghoy and MA Futuhiyyah 2 Demak are 75. Cognitive learning outcomes were measured using a test consisting of 25 items. Classical completeness obtained in learning using the module Speciess richness of seed plants (Spermatophytes) is presented in Figure 2.

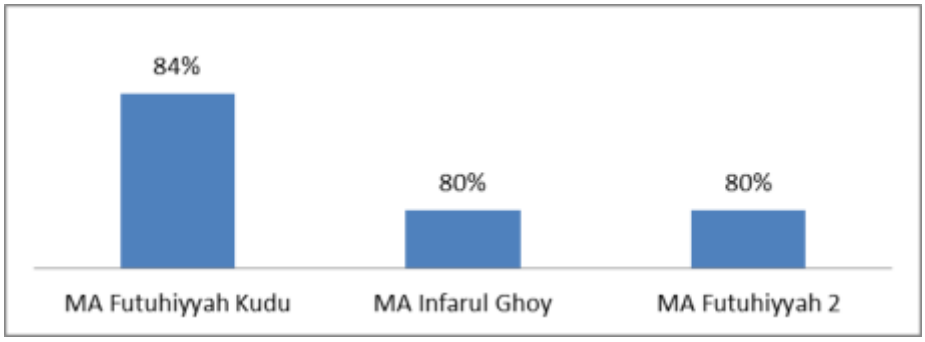

Figure 2. Classical completeness of MA Futuhiyyah Kudu, MA Infarul Ghoy, and MA Futuhiyyah

The classical completeness of each school is different, this is because the KKM determined from each school is different. Overall classical completeness is 81%, included in the very high category. The large number of students who complete learning shows that the modules developed make it easier for students to understand seed plants material (Spermatophytes). The module of seed plants (Spermatophytes) at Wana Wisata Penggaron Tourism contains systematic material. The material displayed starts from introductory material for seed plants that are general to seed plants in particular, that is seed plants found at Wana Wisata Penggaron. The material display aims to enable students to apply the basic concepts derived from introductory material to specific material. The module contains LKS consisting of many seeded plant species from various families, thus providing opportunities for students to practice and recognize more seed plants. The way to fill in the LKS and examples of completed LKS is also displayed in the module, this will make it easier for students to complete the LKS.

Affective learning outcomes were measured using assessment questionnaires between friends. Evaluation data between friends is obtained by giving an assessment questionnaire between friends. Friends who give ratings are friends in a discussion group. Muntasyir et al. (2014) stated that peer assessment was the same as the assessment carried out by the teacher. Peer assessment can improve the quality of learning, student participation, and empower students (Zhi, 2013). Questionnaire assessments between friends measure honesty, responsibility, cooperation, dare to express opinions, and respect the opinions of others. Affective learning results showed that the affective learning outcomes obtained were 90.67%, included in criterion A.

The application of seed plants (Spermatophytes) module at Wana Wisata Penggaron consists of 2 tasks, that are individual tasks and group assignments. Individual tasks help develop themselves, for example self-responsibility, honesty, confidence, giving students the opportunity to learn according to their abilities, and allowing students to master the material in full. The group's assignment gives students the opportunity to get to know more seed plants (Spermatophytes). The task of the group can train students to interact with other students who later can foster a sense of cooperation, train students not to prioritize self-ego which later can foster an attitude of respect for the opinions of others. Group assignments also provide opportunities for students to exchange ideas between students who do not master the material with students who have more mastery and train students to express opinions. Nurinda et al. (2018) states that the ability to express good opinions can help students obtain optimal learning outcomes.

Psychomotor learning outcomes were measured using a psychomotor assessment sheet. Psychomotor learning outcomes are obtained from reports on student observations / worksheets given during learning. Psychomotor assessment sheets include assessment of the skills of classifying seed plants, writing species of seed plants, and the skill of observing the morphological characteristics of plants which

include habitus / stature, roots, stems, leaves, and flowers. Psychomotor learning outcomes obtained are good, including criteria A with a percentage of 82.33%. Good psychomotor learning results indicate that students are able to complete the LKS well, this is because in the module developed there is a guide to filling in worksheets, examples of completed worksheets, and answers to dendograms of seed plants.

The success of using the module species richness of seed plants (Spermatophytes) at Wana Wisata Penggaron because the module makes it easier for students to understand seed plants material, this can be seen from the many students who complete learning. The module contains seed plants material from general to specific material, namely seed plants in Wana Wisata Penggaron, there are many seed plants species from various families so that it provides opportunities for students to practice and get to know more seed plants, modules equipped with colored images so that students are more interested in learning it. The results of this study are in accordance with the research conducted by Widyaningrum et al. (2013) and Nugroho et al. (2017), which states that the application of modules in learning can realize learning activities that are better planned, independent, complete, and with clear results and can improve students' thinking skills.

User Response to the Development Module Species Richness of seed plants (Spermatophytes) at Wana Wisata Penggaron

User response consists of teacher and student responses. The response from users is used as a basis for improving the modules developed so that they will be suitable for use in learning. The teacher who gave a response to the module speciess richness of seed plants (Spermatophytes) as many as 3 teachers, each came from MA Futuhiyyah Kudu, MA Infarul Ghoy, and MA Futuhiyyah 2. The response given by the teacher as a whole is 94.89%, the module developed is included in the criteria that is very feasible. Teacher response to module species richness of seed plants (Spermatophytes) at Wana Wisata Penggaron are presented in Figure 3.

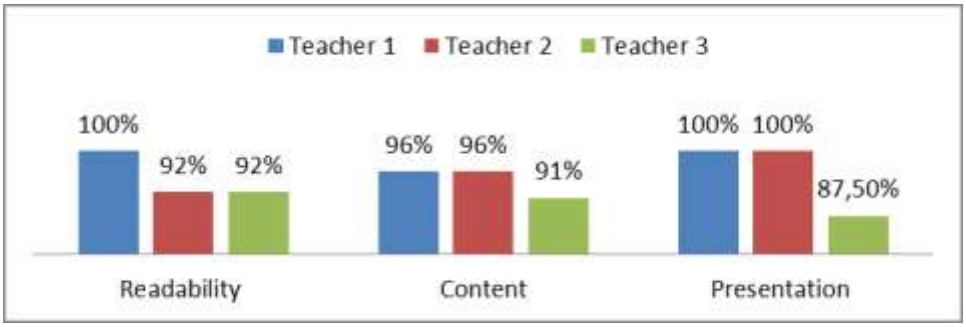

Figure 3. Recapitulation of Teacher's Response to Modules

Student responses were obtained from class X MA Futuhiyyah Kudu, MA Infarul Ghoy, and MA Futuhiyyah 2 Demak. Student response data was taken using student response questionnaires consisting of 10 items. Small-scale trials were conducted on 10 students of class X MA Futuhiyyah 2 Demak. The results of small-scale trials show that the modules developed are included in the very feasible category with a score of 86%. After conducting a small-scale trial, then a large-scale trial was conducted with a number of respondents taken as many as 76 students.

Before data collection, students were first given learning of seed plants (Spermatophytes) by using a module of species richness seed plants (Spermatophytes) at Wana Wisata Penggaron 2 times. Based on the results of student responses to the development of modules it is known that the modules developed are included in the very feasible category with persentasse 86.8%. Items in the response questionnaire of students who have

high scores include interesting module covers, clear font size in the module, and attractive module design.

CONCLUSION

Species richness of seed plants (Spermatophytes) in Wana Wisata Penggaron, found 64 species, 32 families, 55 genera consisting of 3 species of gymnosperms and 61 species of angiosperms consisting of 16 species of monocotyledonous plants and 45 dicotyledonous plants. The results of expert validation and user responses show that the module developed is very feasible. Module species richness of seed plants (Spermatophytes) in Wana Wisata Penggaron is effectively used as a source of learning in seed plants, cognitive learning outcomes above minimal completeness criteria, affective and psychomotor learning outcomes are very good.

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