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Development of Plantae Taxonomy Garden as a Contextual Learning Resource of Plantae Subject in High School Biology

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Abstract

Learning at SMA N 1 Wonotunggal, Batang Regency on the Plantae subject has not used learning resources in the form of taxonomy garden to observe plant characteristics directly. This study aims to analyze the validity, measure the effectiveness, and describe the practicality of plantae taxonomy garden as a contextual learning resource of plant subject. This study was designed using Research and Development approach and ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model which was tested on 30 students. The results showed (1) the validity of the plantae taxonomy garden is valid with an average score of 77.22%; (2) cognitive learning outcomes based on the N-Gain index of 0.76 which is in the high category and means very good in students' science process skills training with an average assessment score of 86.33%; (3) the response to the use of plantae taxonomy garden by students was 92.13% and teachers 93.18%. These results indicate that the plantae taxonomy garden is a valid resource of contextual learning, effectively improves learning outcomes, able to train students' science process skills, and practically used in learning.

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INTRODUCTION

Plants subject is implemented to achieve basic competence number 3.8 and 4.8. Competency number 3.8 aims to apply classification principle in classifying plants into divisions based on observations and plants metagenesis and relating their role in the life continuity on earth. In this regard, there is 4.8th which aims to present the observations results data, phenetic and phylogenetic analyzes and plants role in life sustainability on earth (Kemendikbud, 2017).

Ideally, biology learning allows students to carry out a series of science process skills which help students to construct biological concepts (Sudarisman, 2015). This is in accordance with the basic competencies target which require students to make direct observations related to plant subject because science process skills also train students to make an observation.

In the preliminary study with Biology teacher of SMA N 1 Wonotunggal showed that biology learning especially plants subject was still carried out by the lecture method. Learning media is limited to learning modules, presentation slides, and student worksheets. Therefore, students are not used to doing science process skills activities and their learning outcomes are not optimal.

SMA N 1 Wonotunggal is located in a rural and has a large area, but it has not been created as a garden yet. This condition is an opportunity in the learning resources development, especially biology related to plants subjects. This learning resource can be thematic garden such as vertical garden, pot scaping, or other forms. Taxonomy garden development was chosen because themes can be made according to basic competencies achieving target. The taxonomy garden was designed to represent the plantae kingdom members.

Based on the background, this study will develop taxonomy garden to facilitate contextual learning. This product is expected to support the contextual learning process. A well-designed garden could make students learn natural phenomena directly and get more meaningful learning process (Ramadhani, 2016). Learning activities through park observation could improve scientific concepts understanding, skills, provide direct experience and increase environmental awareness (Morgan et al., 2009).

This study aims to analyze the validity, measure the effectiveness, and describe the practicality of plantae taxonomy garden as a plant subject contextual learning resource. The benefits are facillitate contextual learning, train students' science process skills, inspire teachers to develop new learning resources, and improve the quality of learning in schools.

METHOD

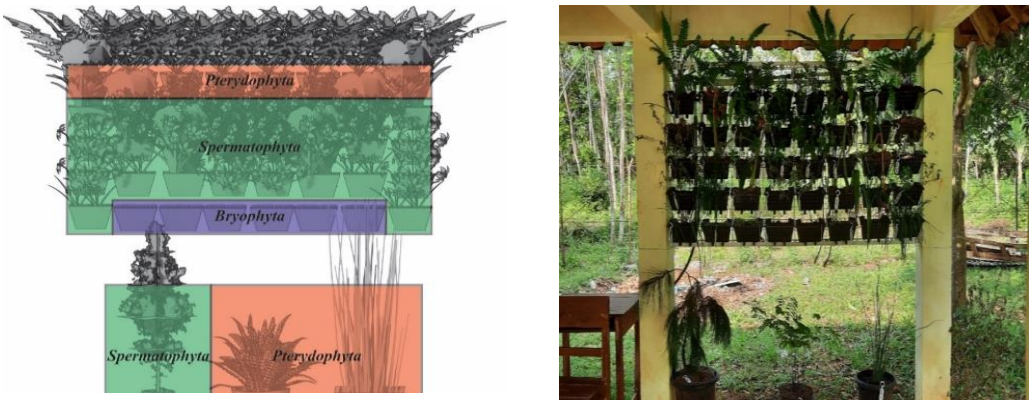
This study was designed using Research and Development approach. Development study is used to obtain products and verify the product effectiveness. The products are taxonomy garden. The product was designed in the vertical garden form and adopt living wall system. It contains Bryophyta, Pteridophyta, and Spermatophyta representatives. This study uses the ADDIE model Analysis, Design, Development, Implementation, and Evaluation). The ADDIE model was chosen because it is effective, dynamic and supports the program performance itself (Warsita, 2011).

The research subjects were 10th grade students of SMA N 1 Wonotunggal Batang, Central Java, which consisted of 30 students. The product validity test includes material and media assessment which is carried out using a questionnaire instrument. Product effectiveness is evaluated based on cognitive learning outcomes and science process skills assessment. Cognitive learning outcomes tests using One Group Pretest-Posttest Design. This study was carried out with three steps, 1) giving a pretest, 2) giving experimental treatment to the subjects (applying ecosystem modules based on scientific literacy), and 3) giving posttest. Student and teacher responses were collected using a questionnaire instrument for product practicality analysis.

RESULT AND DISCUSSION

Plantae Taxonomy Garden

The plantae taxonomy garden is made by using the school corridor poles as a support. The dimensions of the taxonomy garden are 1.8 meters wide and 0.9 meters high and can accommodate 40 stick pots and 3 bucket pots.



(a) (b)

Figure 1. Plantae taxonomy garden: (a) plans; (b) actual

Plantae taxonomy garden collection consisting of division Bryophyta, Pterydophyta, and Spermatophyta. The Bryophyta division is represented by Polytricum sp, and Marchantia polymorpha. The Pterydophyta division is represented by Osmunda claytoniana, Nephrolepis hirsutula, Deplaria petersenii, Adiantum raddianum, and Equisetum debile. The Spermatophyta division is represented by Cataranthus roseus, Amaryllis sp., Turnera subulata, Zephyrantes minuta, and Pinus merkusii.

Validity of Plantae Taxonomy Garden as Learning Resources

Plantae taxonomy garden is made based on biology contextual learning resources need which are effective and practical to use. Lack of learning resources is an opportunity for the development of a taxonomy garden. As a learning resource, the taxonomy garden was made with certain procedures and requirements to be used in learning. Several schools also stated that gardens could be used as an innovative educational tool (Rye et al., 2012).

Plantae taxonomy garden validation was carried out as procedure in learning media feasibility assessment. The validity achievement of the taxonomy garden shows that the product can be used in learning. The validation results are presented in table 1.

Table 1. Taxonomy garden validation result

Validator	Assessment Indicators	Score	Avera-ge (%)	Crite-ria
Media Expert	Graphic	75	75.00	Valid
	Language	75		
Course Expert	Content	75	79.44	Valid
	Presentation	83		
	Contextual	80		
Validity average			77.22	Valid

Validation is carried out by media and course experts. Media assessment obtained score of 75% and course assesment obtained score of 79.44% with an average of 77.22% that classified as valid criteria. The validity fulfillment shows that taxonomy garden has met good learning resource criteria, so that it can be used in learning. Good learning resources can support the process and learning goals achievement, motivate student learning, can be observed, solve learning problems and convey messages (Prastowo, 2012).

Media assessment score of 75% was obtained through an assessment of the graphic and linguistic aspects. Media experts gave a very positive response to the suitability of garden types with location related to the graphic aspects. In addition, media

experts provide corrections on the plant name tags. According to media experts, plant names are unclear because plastic labels use with handwritten letters. Improvements were made by changing the plant label to a larger size by consider garden aesthetics. According to the statement by Arifin (2006) that garden design is carried out by selecting and arranging the elements in detail to obtain functional and aesthetic garden.

Validation by course experts is related to the feasibility of content, presentation, and contextual. The appropriateness of content relates to core and basic competencies suitability, accuracy, up-to-dateness, and ability to encourage curiosity. Valid statement from the validator proves that the product meets the learning requirements. Garden can be used as teaching facilities and enrich the learning curriculum (Passy, et al., 2010).

The developed taxonomy garden is in accordance with basic competency, so learning objectives can be achieved. Sukaesih, et al. (2017) stated that relevant learning resources selection can improve learning competencies achievement. Therefore, the achievement of basic competencies is a plant with morphological characteristics of each division, so that students can classify plants into divisions through observation.

In the presentation feasibility aspect, the indicators with maximum value are plant samples in learning activities. Students will understand a complex and abstract concept easily if the learning process is accompanied by concrete examples (Ambarsari, et al., 2013). Therefore, plants were selected based on representatives of each division and were taken from the surrounding school environment. Thus, the plants provided correspond to the real world around students.

Contextual aspect assessment in the relationship between the course and the real situation around students also gets the maximum value from the validator. The assessment indicates that taxonomy garden is eligible to facilitate contextual learning. Contextual learning is designed to help students to connect known course with new things they want to learn, by building new knowledge based on analysis and synthesis of the learning process (Hudson & Whisler, 2015).

Students analyze the different characteristics of each plant then divide them into divisions. Through this activity, students build their knowledge by linking to existing literature. Associated subject with real conditions could make more meaningful learning and encourage students to make connections between their knowledge and its real application (Purwanto et al., 2015). By linking what students learn and how knowledge is used in understanding academic concepts, of course very useful for their life (Afriani, 2018).

Plantae Taxonomy Garden Effectivenes

The effectiveness of plantae taxonomy garden usage focuses on cognitive learning outcomes and students' science process skills.

Cognitive Learning Outcomes

Cognitive learning outcomes are measured by N-Gain index. The N-Gain calculation is carried out to measure the improvement in learning outcomes based on the pre-test and post-test scores. The increase in cognitive learning outcomes shows the function of the taxonomy garden which can support the learning needs of plants subject. The results of the N-Gain calculation are presented in table 2.

Table 2. Pre-test and post-test result

Test	Score (%)			N-Gain	Criteria
	Min.	Max.	Average		
Pre-test	12	88	54.4	0.76	High
Post-test	64	100	89.2		

The N-Gain value was 0.76 which is classified as high criteria. This shows an increase in student cognitive learning outcomes between before and after learning using plantae taxonomy garden as contextual learning resource. Supported by the statement of Ruiz-Gallardo, et al. (2013), garden usage in learning could significantly increase academic results. Botanical gardens usage in learning affect student cognitive achievement and could be used as an effective learning environment (Sellmann & Bogner, 2012).

The increase in learning outcomes occurs because students do not only get theories from the plants subject, but also observe plants directly. Students could classify various types of plants based on each plant division morphological characteristics. Thus, it is easier for students to

remember the material because it interacts directly with the object being studied. Learning by links the biology concept with real life will be more meaningful and not just rote learning (Widyaningrum et al., 2013). Therefore, a taxonomy garden is effectively used in learning.

Science Process Skills

Science process skills assessment was carried out by observer through observation during learning process. Learning process is carried out with teacher assistance who directs the method of using the taxonomy garden. Students observe main morphological feature in each division representatives. Student worksheets are used as a tool to report observations. The observation results of science process skills are presented in table 3.

Table 3. Science process skills observation result

Num.	Science Process Skills Aspect	Score (%)
1	Observe	95.00
2	Clasify	94.17
3	Prediction	84.17
4	Conclude	77.50
5	Communicate	80.83
Average		86.33
Criteria		Very good

Students' science process skills assessment obtained an average score of 86.33%. This value means very good criteria. It shows that taxonomy gardens use as a contextual learning resource is effective in students' scientific process skills training. In accordance with Marnita (2013) that contextual learning could improve students' science process skills.

The highest score indicator is observing aspect obtainind a value of 95%. Observing skills are skills to collect information through the senses (Usman, 2017). The lowest score indicator is the conclusion aspect obtained a value of 77.5%. The same thing was also expressed by Gasila et al. (2019), that science process skills indicator with the highest score is observing obtain a value of 90% and the lowest score is concluding that obtaining a value of 77%.

The observing activity obtained very good result because all students made observations.

This shows that observing activities are the basic skills of all process skills, so observing skills must be mastered first before mastering other process skills. In line with this statement, Rezba (2007) stated that observing activities are an important stage in carrying out the steps of the scientific method. The observations results are used as a formulating problems basis and developing other scientific process skills.

Classifying indicators get a score of 94.17% means very good category. This high result is because students are trained to do separation, grouping based on the characteristics of similarities and differences. Science process skills on classification indicators are obtained when students are able to interpret experiences related to the surrounding environment (Rifqiawati et al., 2017).

The indicator predicts getting a value of 84.17% means good category. The high result of predicting indicators is because students are trained to find knowledge independently through practicum and group discussions. Students are able to predict well because they get concept understanding from the practicum (Salosso & Kusumawardani, 2018). In learning process, students are taught to find their own knowledge through discussion activities, so predictive indicators get high score result (Nelyza et al., 2015).

Good communication skills are the skills to convey something verbally, in writing or through pictures (Agustina & Saputra, 2016). During learning, students are trained to communicate the results of observations and discussions through presentations and making reports. During learning, students are trained communicating the observations results and discussions through presentations and preparing reports. Yusefni & Sriyati (2016) state that communication is not only done verbally, communication can also be done in writing. Students' written communication skills can assist students in transferring, presenting knowledge consistently and correctly so that students are not mistaken in abstracting the information obtained.

The indicator of getting the lowest score is concluding skill. It is known that only 3 students get maximum scores in conveying conclusions in writing and orally, while other students only delivered conclusions in writing. This is in line with Subali's (2011) statement that concluding skills are the most difficult skills among process skills.

Concluding means students are able to make conclusions about an object or phenomenon after collecting, interpreting data and information.

Taxonomy Garden Practically

Information on product practicality is known from student and teacher response data. A student and teacher responses result is presented in table 4.

Table 4. Product practically response

Numb	Respondents	Score (%)	Criteria
1	Teacher	93.18	Very practical
2	Students	92.13	Very practical

The student response shows a score of 92.13% and the teacher's response shows a score of 93.18%. The response is in the very high category which indicates that the taxonomy garden is very practical and able to meet the the research location needs. The highest score indicator is given by students in the statement of taxonomy garden gives students opportunity to observe plants morphological features of directly. This means that the product has met the basic competencies that require students to make direct observations. Learning activities carried out in the garden are more meaningful and real also provide pleasant experiences that have a positive impact on students (Block et al., 2012).

The statement that students can make a report on the results of their taxonomy garden observations gets the lowest score. This is consistent with Subali's (2011) statement that the most difficult skills in investigative skills are reporting investigations and making investigations. Even, overall student responses gave very positive results.

The teacher gives a positive response to the taxonomy garden because it can deliver lessons in accordance with the demands of learning competencies to make direct observations. Contextual learning is an alternative learning that can reduce verbalism and theory (Kadir, 2013). Lessons are easier to teach because they can show the real morphological differences of each division in the school environment.

CONCLUSION

Based on the results of the study, it can be concluded that the plantae taxonomy garden can be used as a valid contextual learning resource with an average score of 77.22%. The taxonomy garden is effectively applied to learning because it can improve students 'cognitive learning outcomes with the N-Gain score of 0.76 which means high category and able to train students' science process skills with an average score of 86.33% which means very good criteria. The plantae taxonomy garden is also practically used because it gets positive responses from students and teachers. Students give a score of 92.13% and a teacher of 93.18% with very practical criteria.

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