

Booklet Development Based Research on the Diversity of Insects on Solanaceae as a Supplement of Biology Teaching Materials in High School

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Abstract

Booklet research-based is a teaching material which contains an important information followed by the condition of pictures around students' environment as like teaching material which is expected by curriculum 2013. This study aims at identifying insect diversity on solanaceae plants in Wirapanjuran-Kandanghaur as a supplement of biology teaching material in high school and analyzing the worthiness of booklet itself. The method of this research used a development which is adopted from ADDIE instructional model. The data were taken from a field research about insect diversity on solanaceae plants and booklet worthiness data by the experts of media and content of material, effectiveness booklet viewed from the N-gain students, and the response teacher and students. The result of this study showed that the index of insect diversity on solanaceae plants based on the equality of Shanon-Wiener was obtained 0.30 which showed low level of insect diversity. It was concluded that booklet research-based in insect diversity on solanaceae plants was worthy as a supplement of biology teaching material in high school because it obtained 93.30% which including of very valid criteria given by the experts, students' cognitive learning outcomes were seen from the N-gain score of an average of 0.68 'medium' criteria and obtained the positive response from teacher and student with score of 86.79% which including of very worthy. This research is useful for identifying insect diversity which was potentially as the resources of learning biology.

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INTRODUCTION

The standard process of elementary and secondary education has been listed in Permendikbud No.65 (2013) which hinted the necessity of learning process which is guided by the scientific approach norms (Permendikbud, 2016). Curriculum 2013 invites teachers to be creative and professional teachers by making scientific papers in which one of them should be appeared in the form of text-book as learning materials appropriated with the characteristics of social environment (Prastowo, 2015).

The appropriate learning resources can support in achieving learning objective (Pambayun & Dewi, 2015), so that the materials need to be developed which utilized a local potential which hopefully can increase the students' learning interest (Suartini et al., 2015) and motivate them in the learning process (Rumidani et al., 2014). Learning resources which oriented to the environment makes a learning more contextual and it is expected to increase students' knowledge in terms of not only theoretical, but also in practical to recognize the phenomenon in their surroundings (Elmovriana et al., 2016; Widayat et al., 2017) especially for biology in which its object is never separated from a life (Rarasandy et al., 2013).

The preliminary study which was done in one of senior high school in Kandanghaur on October-November 2017 found that: (a) Learning biology in the concept of insects has not exploited the local potential as students learning resources; (b) materials are still using handout which is available at school and the teachers have not implemented learning contextually; (c) the students have low motivation to read and understand the material by reading a lot; (d) the discussion of insects are fixated on examples of general species such as butterflies, dragonflies, flies, beetles and coconut, so that it needs to arrange research-based teaching materials as a learning resource which is more contextual by utilizing the local potential with giving an example of species varied accompanied by short explanation understandably (Louw et al., 2014; Parmin &

Peniati, 2012; Fadilah et al., 2016), to improve students' understanding and cognitive learning outcomes (Boeker et al., 2013).

Booklet can be used as an alternative of teaching materials which can help students to understand learning materials which give an effect on student learning outcomes (Zalita et al., 2017; Khotimah & Indrayati, 2016), by raising the local potential as learning resources using research-based as like it was expected by the concept of curriculum 2013 (Su'udiah et al., 2016).

This research aims at identifying insect diversity on solanaceae plants in Wirapanjunan-Kandanghaur. The research data are developed as a supplement of biology teaching materials in senior high school in the form of a booklet which is used as a tool to introduce insects around environment which can increase and improve students' knowledge and their learning outcomes.

METHODS

The method of this research used R&D using AADIE constructional design which involved five components (analysis, design, develop, implement, and evaluate), which relate one another and well-structured (Aldoobie, 2015). The school' needs analysis is conducted at SMAN 1 Kandanghaur and the identification of environmental potential was conducted in a plantation, Wirapanjunan-Kandanghaur. In this case, there are two steps in designing this research, firstly, by designing and arranging the research instrument, and secondly, by designing booklet research-based on insect diversity. In the step of developing booklet, it was validated by the experts then tested in small scale by giving a questionnaire to thirty students. The booklet which was stated valid was implemented in learning process by using research design "one group pretest-posttest." In every step of development needs an evaluation to fix up the booklet, so that it appropriates with the students' needs. Instruments and data collection techniques are presented in Table 1.

Table 1. Data Collection Techniques

No	Data	Data Collection Techniques	Data Collection Instruments
1	Identifying the diversity of insects on Solanaceae plants	Exploratory use insect net, hand sorting, and a yellow trap.	Clarification sheet and the diversity of insects analysis
2	Validating booklet	Instrument validation expert material & media	Validation sheet
3	Booklet effectiveness	Cognitive test	Pretest-Posttest sheet
4	User respond (teacher and students)	Response of teachers and students.	Questionnaire sheet

Booklet research-based was stated 'valid' if the standard score was achieved more than 62.50 % from the experts and effective if it has achieved N-gain 0.3 in the middle criteria, then the users response (teacher and student) were stated 'good' if getting minimum score 62.50 %.

RESULTS AND DISCUSSION

This research obtained qualitative and quantitative data. The qualitative data was gotten from any suggestion and feedback, while the quantitative data was obtained from measured score.

The solanaceae plant which become an observation object is eggplant species (*Solanum melongena*), tomato (*Solanum lycopersicon*), and chili (*Capsicum annumm*), the insects identification was conducted in explorative by collecting insects around solanaceae environment in Wirapanjunan.

Insect diversity on solanaseae plants

Insects identification which were conducted on eggplant (*solanum melongena*), found 36 insect species which come from 7 ordo were coleopteran, diptera, hemiptera (heteroptera and hornoptera) hymenoptera, odonatan, lepidoptera, and ortophtera with the total insects from all 2330 insect species and index of insect diversity was 0.3 (low).

It was found 21 insect species on tomato plant (*Solanum lycopersicon*), and 19 insect species found on chili plant (*Capsicum annumm*) which came from 8 ordo which are

coleoptera, diptera, hymenoptera, hemiptera (heteroptera, homoptera), thysanoptera, odonatan, lepidoptera, orthopteran with the total of 166 inects on tomato plant along with a low index of insect diversity (0.31), meanwhile, the number of insects which found on chili plant were 1474 with a low index of 0.72 diversities.

The index average of insect diversity on solanaceae plants in Wirapanjunan Village was 0.30 (H'). It means that the diversity is low, very low productivity as an indication of the heavy pressure and the ecosystems were not stable.

Wirapanjunan-Kandanghaur is one of the tropic area which is being a farmer is the majority one. In this case, farmers need a good quality of harvests and spared from pests, so that farmers routinely spray insecticides as a precaution of insects arrival in a big quantities so that they can damage the plant (Indriyanti et al., 2015), while the insects also were required surroundings as the agent of pollinators such as bees which can increase the production and quality of fruit (Indraswari et al., 2016).

The pest of insects which was found on solanaceae plants were derived from the order coleoptera (*Epilachna borealis*, *Aulachophora fovecallis*), diptera (*Bactrocera* sp., *Lyriomyza trifolii*) hemiptera (*Psydercus cingulatus*, *Leptocorisa acuta*, *Physomerus grossipes*, *Nesara viridula*, *Pseudococcus citriculus*, *Empoasca fabae*, *Bemisia tabaci*, *Frankliniella schltzei*, *Aphis* spp.); hymenoptera (*Vespa crabro*), lepidoptera (the larvae of *Helicoverpa armigera*), orthoptera (*Atractomorpha crenulata*,

Grylus mitratus), and mantodea (Mantis religiolisa).

The insects such as Aphis spp (homoptera) which were damaged were expelled the dew of soots so that it can interfere the growth (Capinera, 2008), Empoasca fabae (homoptera) that can cause “leaf burn” and abnormal growth (Indriati & Soesanthy, 2015), Bemisia tabaci (hemiptera) causes jaundice in Chili (Rahayuwati et al., 2016), fruit fly (Bactrocera sp.) and Flies leaves (Lyriomyza trifolii) that cause damage to leaves and fruit.

The insects that help the process of improving production and quality of the fruit which acts as the agent of the pollinators on solanaceae plants were observed from the order diptera (Toxomerus geminatus, Lucilia sericata,

The result of validations by the the experts which were done before at the school, this was done to minimize the occurrence of errors in terms of material at that time when it used as a supplement learning materials used in classroom activities. The assessment by the experts of the material gave a very valid criteria of booklet which was 88.75%.

Sarchopaga sp., and Aedes comunis), hymenoptera (Vespa crabro, Xylocopa virginica, Delta esuriens, Sceliphron caementarium), lepidoptera (Amata haubneri, Attacus atlas, Amblyscirtes nysa).

Insects are predators and help to reduce other pests which come from the order coleoptera (Coccinela transversalis, Paederus fuscipes, Harmonia axyridis), hymenoptera (Polyrachis frushtorferi), odonata (Orthetrum sabina), and mantodea (Mantis neligiosa).

The Validity of the Booklet based on the Experts (material and Media) assessment

The evaluation of booklet by the experts got the positive response with a percentage of 97.30% ' very valid' criteria. This showed that the booklet have been developed “valid” when it used as a supplement learning materials used in student learning.

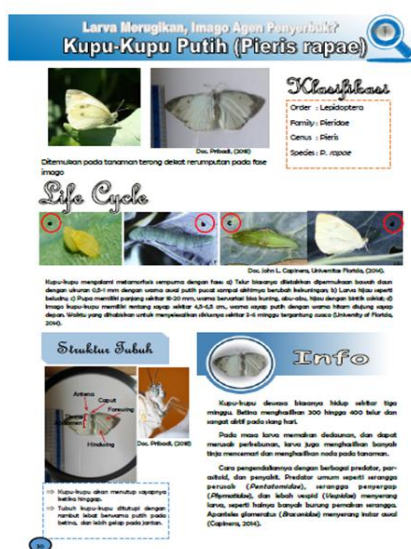


Figure 1. Display an Overview of the Contents of the Booklet

Booklet which was compiled appropriated with scientific approach emphasized in the curriculum 2013 along with the aspect of observing, questioning, experimenting, associating, and communicating (Kurniasih &

Berlin, 2014). A scientific approach is expected to provide contextual experiences involving students’ liveness which can strengthen the students’ retention memory (Daryanto, 2014).

The description of the contents of the booklet is presented in Figure 1.

Based on the validity of which refers to the standard BNSP, booklet was drawn up very valid according to experts, which has an input to pay more attention to the variation between species, density between pictures, the brightness of the image, and a description of the source image more enlarged so that the information which is presented easily is captured by the reader.

The Booklet Effectiveness Based on the Results of Students Cognitive Learning

The effectiveness of such booklets as a supplement of biology materials was assessed based on the result of students cognitive learning which were analyzed using N-gain obtained from the result of students cognitive learning as much as 66 students which are presented in Table2.

Table2. Data on Student Learning Outcomes

No.	Data	Result	<i>N-gain</i>
1	The number of students		
	Class X MIA 3 (Students)	32	0.68
	Class X MIA 4 (Students)	34	0.58
2	Pretest		
	The average value of pretest	36.06	
	The highest pretest value	50	
	Values lowest pretest	5	
3	Posttest		
	Posttest average value	75.76	
	Values highest posttest	95	
	Values lowest posttest	45	
4	Number of Students Completed	43	
5	Number of Students Not Completed	23	
6	Classical completeness (%)	65.15	

N-gain score showed the enhancement of students understanding and mastering the concepts after given the treatment. The Insect diversity of booklet research-based on solanaceae plants can enhance students learning outcomes of with the average N-gain 0.62 which included a medium criteria, and students look like very active during the learning process. The result of this research has the same trackt with the previous research conducted by Mahendrani & Sudarmin (2015). The application of insect diversity of booklet research-based on solanaceae plants also can improve the results of students learning outcomes (Rahmatih et al., 2017).

The use of supplement teaching materials in the form of booklet on the existing potential for supporting learning activities can improve

the students learning outcomes which were seen from the cognitive aspect which was evidenced by the analysis of the results of a pretest and posttest (Wulandari et al., 2016), in addition, the booklet was applied in the scientific approach to achieve learning outcomes effectively (Yani et al., 2018).

Booklet is a practical learning materials, it has an interesting look that can help to achieve the learning objectives (Segarti et al., 2016; Cherkin et al., 2014).

Teachers and Students Response toward Booklet

The response of teachers and students towards booklet insect diversity research-based was developed and presented in table 3.

Table 3. The teachers and students response toward Booklet

No.	Respondents	Score (%)	Criteria
1	Teacher	88.12	Very Valid
2	Student	85.45	Very Valid
	Average	86.78	Very Valid

Teachers and students give a positive response with an average response of 86.78% (very worthy), so that the booklet was ready to develop used for a supplement of biology teaching materials. Booklet has developed the colored pictures which can optimize student learning outcomes (Ogren et al., 2017) and motivate them to learn and enhance the result of cognitive learning (Boeker et al., 2013; Purnomo et al., 2013), and make them love to read when in learning process, the use of the booklet was used because the insects diversity were exist around them which is packed in an interesting pictures that matched with the reality.

Learning materials in the form of booklet supplements served as a proponent of learning activities (Mulyati et al., 2016; Anthony et al., 2014), and changed the process of learning to be more effective, with a teacher who did not only act as a teacher but rather act as a facilitator who accompanied students to understand the learning material (Gloria et al., 2017; Ramadaan et al., 2015). Learning materials are used as a tool to improve students understanding and learning effectiveness (Jumairi, 2016).

CONCLUSION

Insect diversity on solanaceae plants (eggplant, tomato, pepper) with an average of 0.30 (H') which means low diversity. The result of testing the validity by the experts was 93.30% which was very valid' criteria, so that in this case, the booklet was developed and used in the learning process. The effectiveness of insect diversity of booklet research-based was used as a supplement of biology materials that can enhance the result of students cognitive learning with the average N-gain 0.62 included of 'medium' criteria, and the users' response (teachers and students) toward the development

of booklet itself was very positive with an average response of 86.76% (very worthy), which stated that the booklet was developed very good, worthy and it was interested to use in learning activities.

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