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### The Arthropoda Diversity Booklet as a Learning Resource for Biodiversity Materials

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#### Abstract

The development of science and technology has a great influence in the world of education. Educators are required to be able to increase innovation in the learning process, one of which is the use and selection of effective and efficient media. Based on an interview with a Biology teacher at Pangudi Luhur Santo Yosef High School Surakarta, learning during the pandemic has not been able to run optimally due to various obstacles such as the mindset of students towards material concepts and independence for learning. This study aims to analyze the validity, response, and readability of the Arthropod Diversity booklet product of the Bengawan Solo River in the Sukoharjo Regency. The collection of arthropod specimens from the Bengawan Solo River was carried out in Sukoharjo Regency using purposive sampling technique. The booklet is made based on the results of species collection using the Research and Development (RnD) method. Data collection techniques were carried out using interviews, questionnaires, and tests in the form of a gap test. The data analysis technique used is descriptive statistics with quantitative and qualitative data. The results showed that the arthropod diversity booklet on biodiversity material was very feasible to use with a percentage of 93.75% in the validity test by media experts and 83.33% by material experts. The Bengawan Solo River arthropod diversity booklet was also considered very well to use with a percentage of 88.12% in the response test by teachers and 88.389% by students. In addition, based on the readability test conducted by the students, it showed that 75% of the students had very good understanding of the contents of the booklet and 85.71% of the students were independent readers who could understand the contents of the booklet without any educational interaction. Based on the results above, it can be concluded that the Bengawan Solo River arthropod diversity booklet is valid and can be used in learning on biodiversity material as a companion book or learning supplement.

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## INTRODUCTION

The development of science and technology today has an influence in various sectors, one of which is the education sector. Currently, educators are required to be able to use various kinds of technology in accordance with the times. This is in accordance with Arsyad's (2015) statement which states that the use of various kinds of learning media in the current era can affect the desire and willingness of students to learn and can increase and stimulate learning activities which will have a psychological effect on students.

The use and selection of various kinds of learning media effectively and efficiently has the aim of making it easier for educators to convey the material presented and making it easier for students to receive information. According to Rindiantika (2018), learning media can arbitrarily be categorized into five categories, including: audio media, visual media, audio-visual media, tactile, and virtual media.

The use of media in the teaching and learning process must at least consider various aspects with structured planning. The selection of learning media must be adjusted to the characteristics of the selected material. The learning media developed in this research is print media in the form of booklets. Booklet is a print media that has a function to convey various kinds of information with the material presented in a very concise, light, and supported by attractive images and visuals. With an interesting booklet, it is hoped that it can improve the quality, interest, and learning outcomes of students.

Based on the results of observations and interviews conducted by Biology teachers at Pangudi Luhur Santo Yosef High School Surakarta, it was found that the learning resources used included e-modules and mind maps with explanations via the youtube channel. The teacher considers that conventional learning resources, especially on biodiversity material owned by students, are considered less contextual because the examples and pictures presented are far from the students' environment with less up-to-date information. These various shortcomings are allegedly causing students to lack examples that are more diverse, contextual, and close to the student's environment so that they are considered less than optimal in their learning.

Media booklets at least have various advantages, including the use of simple language with attractive visuals so that it can increase students' interest in learning. In addition, the use of booklets developed from research results is expected to be a contextual learning resource so that it can motivate students to be able to use the surrounding environment as a learning resource. This is reinforced by research developed by Yani (2018) which states that the use of booklets effectively improves student learning outcomes with cognitive learning outcomes that are superior to classes that do not use booklet media. In addition, according to Pralisaputri (2016), it is stated that the use of booklets can improve student learning outcomes and be more active in solving environmental problems and are better able to relate material concepts to events in everyday life.

Regarding the problem of media development and the contextuality of learning media, a solution can be found regarding the development of learning media in this case is a booklet developed from the results of research on diversity in the Bengawan Solo River. The purpose of this study was to analyze the response and legibility of the booklet developed from the results of previous studies.

## RESEARCH METHOD

The first study was conducted by collecting terrestrial arthropod specimens at two locations, namely location A in the Palur Asri Housing area and location B in the Rejosari Village area, Sukoharjo Regency, which was carried out using purposive sampling method. Specimen collection was carried out using several techniques, including: pitfall trap, yellow sticky trap, hand collecting, and beat sampling. Species discovery data were then identified and made into a booklet as a study supplement.

The booklet was made using the Research and Development (RnD) method developed by Sugiyono (2015). The booklets that have been created are then tested by validators who have competence in their fields. The results of the booklet that have undergone a validation process are then revised and ready for small-scale product testing.

Small-scale product testing is carried out by students to measure the response and readability of the booklet. This research was conducted in high school in the even semester of the 2021/2022 academic year. The sample used in this study were students of X Science 2 class at SMA Pangudi Luhur Santo Yosef Surakarta. The sample was selected using purposive sampling technique. The collected data was then analyzed using descriptive statistical techniques with quantitative data and qualitative data. Quantitative data was obtained from the results of the questionnaire assessment, while qualitative data was obtained from responses and suggestions from validators, teachers, and students.

**RESULT AND DISCUSSION**

**Arthropod Species Collection Results on The Bengawan Solo River**

The results of the study on the collection of arthropods at locations A and B, both exposed and sheltered, showed that a total of 282 individuals were collected which were divided into 18 genera, 18 species and 16 families (Table 2). Land arthropods were collected using four techniques, namely pitfall trap, yellow sticky trap, hand collecting, and beat sampling. The pitfall trap technique was carried out to obtain arthropods that were active on the ground, the yellow sticky trap was carried out to obtain arthropods that were active in the air, hand collecting and beat sampling were carried out to obtain arthropods associated with plants. The arthropod species found in this study can be found in various locations as listed in Table 1.

**Table 1** Presence of Arthropod Species at Each Location on the Bengawan Solo River

No	Species Name	Finding Location	No	Species Name	Finding Location
1	<i>Gryllus assimilis</i>	LATn, LATd, LBTn, LBTd	10	<i>Chrysomya megacephala</i>	LATd dan LBTd
2	<i>Dissosteira carolina</i>	LATn, LATd, LBTn, LBTd	11	<i>Melanitis leda</i>	LATd
3	<i>Blatella germanica</i>	LATn, LATd, LBTn, LBTd	12	<i>Pisaurina mira</i>	LATd
4	<i>Thricops diaphanus</i>	LATn, LATd, LBTd	13	<i>Palystes superciliosus</i>	LATd
5	<i>Musca domestica</i>	LATd dan LBTd	14	<i>Vespa affinis</i>	LATd
6	<i>Solenopsis sp.</i>	LATn, LATd, LBTn, LBTd	15	<i>Scolopendra sp.</i>	LATd
7	<i>Pachycondyla sp.</i>	LATn, LATd, LBTd	16	<i>Diacrothrica fasciola</i>	LATd
8	<i>Orthomorpha coarctata</i>	LATd dan LBTd	17	<i>Chikunia nigra</i>	LATd
9	<i>Triatoma sp.</i>	LATn dan LATd	18	<i>Orthetrum sabina</i>	LATd dan LBTd

Description: LATn = Lokasi A Ternaung (Sheltered Location on Location A), LATd = Lokasi A Terdedah (Exposed Location on Location A), LBTn = Lokasi B Ternaung (Sheltered Location on Location B), LBTd = Lokasi B Terdedah (Exposed Location on Location B).

**Table 2** Number of Species, Individuals, Families, Diversity Index, and Evenness Index of Arthropod Species in Bengawan Solo River

Code	Value				Total
	LATn (St.1)	LATd (St.2)	LBTn (St.3)	LBTd (St.4)	
S	7	18*	4	10	18
F	6	16*	4	8	16
N	45	150*	27	60	282
H'	1,65	2,51*	1,27	2,13	2,40
E	0,85	0,86	0,91	0,92*	0,42

Description: LATn = Lokasi A Ternaung (1<sup>st</sup> Station), LATd = Lokasi A Terdedah (2<sup>nd</sup> station), LBTn = Lokasi B Ternaung (3<sup>rd</sup> station), LBTd = Lokasi B Terdedah (4<sup>th</sup> station), S = Number of Species, F = Number of Families, N = Number of Individuals, H' = Diversity Index, E = Evenness Index, \* = The Highest Score.

Based on the results of the analysis of the data contained in Table 2, it was found that the diversity of arthropod species in the Bengawan Solo River in total was in a relatively moderate condition with a value of 2.40. This situation refers to the Shannon-Wiener index which defines that  $H' > 3$  will indicate abundant diversity,  $1 < H' < 3$  indicates moderate diversity, and  $H' < 1$  indicates low diversity. The value of the diversity of arthropods at each location was classified as moderate with values ranging from 1.27 to 2.51.

The results of the analysis of the evenness index (E) in the Bengawan Solo River in total show a value of 0.426111. Based on this value, it can be indicated that the even distribution of individuals of one species in the Bengawan Solo River is moderate. This is based on the criteria that in the range of values 0.4 – 0.6 indicates that the evenness of the species is moderate, E 0.4 is low, and E 0.6 is high (Kurniawari, 2018). The evenness index at each location is classified as high with a value range of 0.85 – 0.92. The evenness index has a function to determine the distribution of individual arthropods as measured by the uniformity value.

The presence of arthropods in the Bengawan Solo River is inseparable from the various existing environmental conditions. Based on the research, data obtained that the research location is close to housing locations, chicken and pig farms, bush areas, and rice fields. For example, the discovery of the species *Solenopsis* sp. which has a habitat in rice fields (Abdullah, 2020) which acts as a predator of pests (Kurniawan, 2017). In addition, species such as *Musca domestica* are found which are commonly found in home area and farms that act as cosmopolitan pests (Tan, 2017).

### Preliminary Research Results

Before testing the validity, response, and readability of the Bengawan Solo River arthropod diversity booklet, it is necessary to analyze the problems and potentials that underlie the development of this booklet. The data generated in the form of descriptive data obtained from interviews with biology teachers class X science.

Based on the results of the interviews, it was found that learning uses a collaborative learning model by combining various kinds of subjects into a single unit. Thus, not all subjects can be conveyed in their entirety to students. The teacher also thinks that the biggest challenge in teaching is changing the mindset of students that biology is not a rote material. In addition, the COVID-19 pandemic has had a major impact on interactions and learning strategies. Distance learning has a tendency that students are required to be able to learn and explore their knowledge independently. This has an impact on the lack of student activity and weak optimization of learning. One way to increase the motivation and mindset of students in learning is the use of innovative learning media. This is in line with the opinion of Tjiptany (2016) which says that the success of learning does not only depend on the learning method, but also depends on the various learning tools used. The various obstacles and problems above can be used as a reference for developing a Bengawan Solo River arthropod diversity booklet based on learning from the students' immediate environment.

### The Results of The Validity Test by Media and Material Experts

The booklet product that has been developed in accordance with Research and Development procedures is then validated by competent media and material experts. The results of the validity tests carried out by media experts are presented in Table 3 below.

**Table 3** The Results of the Validity Test by Media Experts

No	Assessment Indicators	Score	Max Score	Percentage (%)
1	Aspect of Graphic Eligibility	48	48	100
2	Aspect of Language Eligibility	14	16	87,5
<b>Average score</b>				93,75
<b>Criteria</b>				Very Good

Based on the analysis of data from the validation test by media experts in Table 3, it shows that the arthropod diversity booklet developed is considered very good and valid for use by students with an average score or percentage of 93.75%. The feasibility aspect of the graph is considered very good because it has met the criteria for learning media contained in the BSNP (National Education Standards Agency). However, the language eligibility aspect gets the lowest score when compared to the graphic eligibility aspect. Media experts revealed that the shortcoming lies in the consistency of the use of the common name and the local name of the species. This is because not all species have commonly known local names. Changes were made by uniforming the use of other species names by using the common name so that it could look more consistent. According to Pribadi (2017), the consistency of the language contained in the learning media needs to be considered. This is intended as a continuity in the use of the term so that it can be more easily understood by the reader.

In addition to being analyzed using the total score, the feasibility of the booklet was also analyzed using the formula and the feasibility table developed by Widiastuti (2014). From the results of the assessment carried out by media experts, this booklet got a total score of 62. Based on calculations using the formula, this total score is included in the appropriate category because it is in the range of  $32 \leq S \leq 64$ . The results of the calculation and criteria can be seen in Table 4 below .

**Table 4** Media Eligibility Results Criteria by Media Experts

No	Category	Score	Result
1	Eligible	$(S_{\min} + p) \leq S \leq S_{\max}$	$32 \leq S \leq 64$
2	Not Eligible	$S_{\min} \leq S \leq (S_{\min} + p - 1)$	$16 \leq S \leq 31$

Description: S = Respondent Score, p = Interval Class Length,  $S_{\min}$  = Minimum Score,  $S_{\max}$  = Maximum Score.

The validity of the Bengawan Solo River arthropod diversity booklet was also measured by material experts. The results of the validity test by material experts are presented in Table 5 below.

**Table 5** The Results of the Validity Test by Material Experts

No	Assessment Indicators	Score	Max Score	Percentage (%)
1	Aspect of Content Eligibility	13	16	81,25
2	Aspect of Language Eligibility	15	16	93,75
3	Aspect of Presentation Eligibility	12	16	75
<b>Average Score</b>				83,33
<b>Criteria</b>				Very Good

Based on data analysis from the results of the validity test by material experts as contained in Table 5 above, it can be concluded that the Bengawan Solo River arthropod diversity booklet is very good and valid for use with a percentage score of 83.33%. All aspects of the assessment are stated to be very good, but the presentation component aspect has a lower score when compared to other aspects. The low score on the aspect of the presentation component is due to deficiencies in the glossary section and errors in the use of other terms that make the score in this aspect less than perfect. In the aspect of content feasibility, there is also a revision in the material accuracy section. According to media experts, it is necessary to add to the arthropod diversity indicator section on environmental factors that affect the presence of arthropods at the sampling site. This is done to add to the contextual value of the booklet taken from the research results. This statement is in line with the opinion of Sunaryo (2020) which states that learning Biology does not only depend on the ability to master knowledge, principles, and concepts, but is also based on the discovery process that can be adopted to strengthen concepts.

Data from the results of the material validity test were also processed using the formula developed by Widiastuti (2014). Based on the assessment of material experts, the total score shows a value of 46. Based on calculations using the formula, this score is in the proper category because it is in the range of  $28 \leq S \leq 56$ . The results of processing the validity test data by media experts are presented in Table 6 below.

**Table 6** Media Eligibility Results Criteria by Material Experts

No	Category	Score	Result
1	Eligible	$(S_{\min} + p) \leq S \leq S_{\max}$	$28 \leq S \leq 56$
2	Not Eligible	$S_{\min} \leq S \leq (S_{\min} + p - 1)$	$14 \leq S \leq 27$

Description:  $S$  = Respondent Score,  $p$  = Interval Class Length,  $S_{\min}$  = Minimum Score,  $S_{\max}$  = Maximum Score

**Booklet Response Results by Teacher and Students**

After the Bengawan Solo River arthropod diversity booklet has been validated by media experts and material experts, then the response of the product is tested by teachers and students. Respondents or teachers who filled out the response instrument were teachers of SMA Pangudi Luhur Santo Yosef Surakarta who taught Biology in class X Science. The students who were used as respondents were 28 children, all of them were students of class X Science 2 who had studied or received material on biodiversity before. Sampling was done by using purposive sampling technique. The following are the results of the response test conducted by the teacher which is presented in Table 7 and the students in Table 9.

**Table 7** The Results of the Teacher Response to the Booklet

No	Assessment Indicators	Score	Max Score	Score (%)
1	Aspect of Graphic Eligibility	40	40	100
2	Aspect of Content Eligibility	21	24	87,5
3	Aspect of Presentation Eligibility	6	8	75
4	Aspect of Language Eligibility	18	20	90
<b>Average Score</b>				88,12
<b>Criteria</b>				Very Good

Based on the data presented in Table 7, it shows that the Bengawan Solo River arthropod diversity booklet is included in the very good criteria with a percentage score of 88.12%. According to the teacher's assessment, the booklet is classified as very good because it fulfills several aspects of the graphic element, the content of the material is in accordance with the basic competencies and core competencies, the systematic presentation is good, and the use of language is in accordance with the applicable language rules. In addition to using the total score, the feasibility of the booklet is also measured using the calculation developed by Widiastuti (2014) which is presented in Table 8. Based on the calculation, the total score collected from the questionnaire is 85 so that it is in the range of  $46 \leq S \leq 92$  as listed in the table 8. Thus, this booklet is categorized as feasible and very well to be used in learning as a learning supplement.

**Table 8** Media Eligibility Results Criteria by Teacher

No	Category	Score	Result
1	Eligible	$(S_{\min} + p) \leq S \leq S_{\max}$	$46 \leq S \leq 92$
2	Not Eligible	$S_{\min} \leq S \leq (S_{\min} + p - 1)$	$23 \leq S \leq 45$

Description :  $S$  = Respondent Score,  $p$  = Interval Class Length,  $S_{\min}$  = Minimum Score,  $S_{\max}$  = Maximal Score

In addition to the teacher, students also filled out the Bengawan Solo River arthropod diversity booklet response instrument. Based on the data presented in Table 9, it shows that the Bengawan Solo River arthropod diversity booklet is included in the very good criteria with a percentage score of 88.389%. According to the assessment of students, the booklet is classified as very good because it meets several criteria such as interest in graphic elements, presentation of material content, ease of use of language that is easy to understand, ease of use of booklets, and usefulness values.

**Table 9** The Results of the Students Response to the Booklet

No	Assessment Indicators	Score	Max Score	Percentage (%)
1	Aspect of Interest Eligibility	384	448	85,71
2	Aspect of Content Eligibility	770	896	85,93
3	Aspect of Language Eligibility	299	336	88,98
4	Aspect of Ease of Use Eligibility	507	560	90,53
5	Aspect of Benefit Eligibility	305	336	90,77
<b>Average Score</b>				88,38
<b>Criteria</b>				Very Well

In addition to using the total score, the results of the booklet responses were also measured using the calculations presented in Table 10. Based on the calculation, the total score collected from the questionnaire is 2256 which is the total score of 28 students so that it is in the range  $X > 1937.75$ . Thus, this booklet is considered by students to be very well to be used as a learning supplement in supporting learning on biodiversity material.

**Table 10** Media Eligibility Results Criteria by Students

No	Category	Score	Result
1	Strongly Agree	$X \geq M + 1.5 SD$	$X > 74,75$
2	Moderately Agree	$M \leq X \leq M + 1.5 SD$	$57,5 \leq X \leq 74,75$
3	Moderately Disagree	$M - 1.5 SD \leq X < M$	$40,35 \leq X < 57,5$
4	Strongly Disagree	$X < M - 1.5 SD$	$X < 40,25$

Description: X = Respondent Score, M = Ideal Score Average, SD = Ideal Standard Deviation.

In summary, teachers and students assess that the Bengawan Solo River arthropod diversity booklet is packaged using attractive visuals and the use of illustrations that support the discussion. This is in accordance with Russel's (2011) statement which states that the use of attractive booklets with the value of consistency in each visual element can make it easier for students to capture information and prevent students' confusion in using booklets. In the opinion of Paramita et al (2019), the use of booklets can help students understand the concept of material provided by educators with more interesting learning nuances. In addition, Prastowo (2011) states that the use of illustrations or pictures has the power to increase students' motivation in reading instructional media.

The linguistic aspect was assessed by teachers and students as very good in accordance with linguistic rules with language that is easy to understand. This is in line with Wahyono's (2016) statement which states that language is an important component in delivering information or messages. Thus the information to be conveyed must be discussed properly so that the meaning contained can be understood. Furthermore, the teacher and students assessed that the presentation components contained in the booklet were very good. This booklet is equipped with a Quick Response Code (QR Code) which contains various videos as a complement to the material so that it adds to the interactive value and usefulness of this booklet. This is in accordance with Nafisah's statement (2020) which states that the use of QR Codes in learning media can support the independence of students to learn. Thus, students can be more assisted and motivated to learn because the learning resources utilize technology that is easy to access.

### Students Readability Results

The readability test was carried out using a cloze test or a gap test. According to Hittleman in Haryadi (2014) it is stated that the gap test is a technique to eliminate words contained in a discourse and the reader is asked to fill in the appropriate words. Readers in this case are students who are asked to read and understand the discourse in the booklet and then do a test by filling in the 25 words that are missing. This test contains at least several topics of discussion, ranging from the topic of biodiversity, activities that affect biodiversity, the distribution of biodiversity in Indonesia, and arthropods. This test has the aim of

analyzing the level of understanding of students towards the contents of the booklet. The following is the result of the students' understanding ability data contained in table 11.

**Table 11** Results of Students' Understanding Ability Data on Booklets

No	Score (%)	Frequency	Percentage (%)	Criteria
1	80 – 100	21	75	Very Good
2	66 – 79	3	10,71	Good
3	56 – 65	3	10,71	Good Enough
4	46 – 55	0	0	Not Good
5	0 – 45	1	3,57	Fail

Based on Table 11, the results show that as many as 21 students (75%) have very good comprehension skills, 3 students (10.71%) are classified as having good reading skills, 3 students (10.71%) are classified as having sufficient reading skills, while 1 (3.57%) of students belong to the failed reading ability. This reading ability is intended to see the ability of students to read arthropod diversity booklets using a close test.

After knowing the level of students' understanding of the content of the discourse, data analysis was carried out regarding the categories of students' reading abilities. The division of this category is also based on the results of the gap test to determine whether students are classified as independent, instructional, or frustrated readers. This activity has the aim of knowing whether the booklets made can be used independently by students or not. The results of the analysis regarding the category of students' reading abilities are contained in Table 12.

**Table 12** The Level of Students' Understanding of the Discourse Contents in the Booklet

No	Reading Ability Category	Total	Percentage (%)
1	Independent	24	85,71
2	Instructional	4	14,28
3	Frustrated / Failed	0	0
Jumlah		28	100

Based on Table 12, it was found that as many as 24 students (85.71%) belonged to independent readers, while 4 students (14.28%) belonged to instructional readers. Independent or independent readers are readers who can understand the contents of the booklet independently without instructions or directions from the teacher. While the instructional reader is a reader who must be guided first by the teacher in understanding a reading in the booklet.

There are two kinds of factors that can affect the level of readability of students, namely internal and external factors. Internal factors are factors that influence students' interest in reading, both emotionally within students or the factor of the textbook being tested. Meanwhile, external factors are external factors that affect the level of readability of students, including the use of existing language in reading, writing, text structure, reading conditions, and other factors. These two factors have a big role in influencing the level of readability of students. This is also expressed by Zainani (2016) which states that various kinds of linguistic features in reading materials can affect students' reading abilities. The reading materials contained in the learning resources must at least meet several requirements, one of which is that the reading materials must be at the level of instructional or independent understanding. Thus, the Bengawan Solo River arthropod diversity booklet can be used as a learning supplement for students.

## CONCLUSION

Based on the data analysis and discussion above, it can be concluded that the Bengawan Solo River arthropod diversity booklet on biodiversity material is valid and very well to use as a learning supplement according to the assessments of media experts, material experts, teachers, and students. In addition, this booklet can be used independently according to the results of the cloze test conducted by students.



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