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Development of Student's Worksheet using Project-Based Learning (PjBL) on Ecosystem Concept for Class X SMA

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ABSTRAK

Minat belajar siswa perlu didorong dengan keberadaan bahan ajar interaktif, menyenangkan, dan membantu siswa untuk mencapai hasil belajar dan proses belajar yang baik. Karena itu, peneliti berinovasi mengembangkan Lembar Kerja Peserta Didik (LKPD) berbasis project based learning (PjBL). Tujuan penelitian untuk mengetahui kelayakan LKPD berbasis PjBL berdasarkan penilaian para ahli (materi, media, bahasa) dan respon peserta didik. Jenis penelitian yang digunakan adalah R&D dengan 10 langkah kerjanya. Adapun hasil penilaian ahli materi pada LKPD berbasis PjBL memperoleh nilai 82,03% "Sangat Layak", ahli media 86,5% "Sangat Layak", dan ahli bahasa 83% "Sangat Layak", serta respon peserta didik 53% "cukup positif". Maka dapat disimpulkan bahwa pengembangan LKPD berbasis proyek mendorong siswa secara aktif dalam belajar pelajaran Biologi, terkhusus pada materi Ekosistem.

Kata kunci: Ekosistem; LKPD; Penelitian dan Pengembangan; Project-Based Learning (PjBL).

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ABSTRACT

The student's interest in learning needs to be encouraged through the presence of interactive, enjoyable teaching materials that help students achieve good learning outcomes and processes. Therefore, it will be very important to develop Student Worksheets (LKPD) based on project- based learning (PjBL). The research aims to determine the feasibility of PjBL-based LKPD based on the assessment of experts (content, media, language) and student responses. The type of research used is Research and Development (R&D) with its ten working steps. The results of the expert assessment on the content of PjBL-based LKPD obtained a score of 82.03% "Strongly Feasible," media experts 86.5% "Strongly Feasible," and language experts 83% "Strongly Feasible," as well as student responses of 53% "moderately positive." It can be concluded that the development of project-based LKPD encourages students to learn biology actively,especially the ecosystem concept.

***Keywords**: Ecosystem; LKPD; Project-Based Learning; Research and Development.*

INTRODUCTION

Interactive and communicative learning in the 21st century is an undeniable phenomenon. This is supported by previous studies that state that basic characteristics shape internal motivation to learn in students, a concept that is often mentioned in contemporary conversations about smart education and self-directed learning (Peng & Liu, 2022). To bridge this, learning media is needed that can encourage the optimization of student learning independently. Learning materials according to Udo (2006) refer to materials that can be used to enhance or improve educational programs and advance the teaching and learning process. Furthermore, education is a process of building individual character to optimize their potential and abilities, as summarized in Law Number 20 of 2003. Teaching materials are one of the supporting elements in the educational process, which is defined as a collection of material arranged systematically, both written and unwritten (Sadikin & Yelianti, 2021). Student Worksheets (Lembar Kerja Peserta Didik or LKPD) are an example of one of the written teaching materials that can be used in learning (Kosasih, 2021). Teaching materials are designed to assist students in understanding the content of the material in accordance with the curriculum used (Magdalena et al., 2020).

Biology learning materials have a tendency to always develop and experience innovation (Kamuihkar et al., 2023). To support the biology learning process, it is necessary to develop teaching materials that are integrated with student thinking through project-based learning activities. The development of teaching materials in the form of LKPD for biology learning aims to provide interactive, fun learning, and help students achieve optimal learning outcomes. Furthermore, the results and discussion of this study will describe the R&D work steps, namely potential and problems, data collection, product design, design validation, design revision, and student response.

Furthermore, LKPD need to be made by taking into account the needs of students who want to learn independently. These worksheets focus on developing active learning as part of learning autonomy. Being autonomous involves influencing at a deeper level than just managing the surface aspects of a task. Providing control without forcing learners to take control can potentially foster a sense of autonomy, as proposed by Deci and Ryan in 1985. Using the LKPD, students are also required to think critically to respond to each learning activity by learning about authentic ecosystems. Authentic learning experiences can be classified into ten design components, including relevance to the real world, vague problems, prolonged inquiry, diverse viewpoints, collaboration, reflective practice, interdisciplinary perspectives, thorough assessment, polished end products, and multiple interpretations (Lombardi, 2007). With this needs analysis, the application of LKPD on ecosystem concept is important to be applied in the classroom.

Student Worksheets (LKPD) have a role as one of the teaching materials used in the learning process. LKPD is a printed material that contains material, summaries, and instructions for implementing learning tasks (Andriyani et al., 2018). The use of LKPD that is arranged in an interactive and fun way can motivate students to actively

participate in learning (Nata & Manuaba, 2022). However, in practice there are still LKPD that lack attractive color combinations and diverse designs (Lestari & Rahayu, 2020). This is also supported by the results of observations that the LKPD used by teachers is not very attractive, still simple in appearance and content only contains questions, no explanation of the material provided, lacks attractive color combinations, lacks a variety of learning activities, and does not provide learning experiences that encourage students to experiment and explore their potential.

Observation result found that students paid less attention when the teacher explained the material using the blackboard, power point, and textbooks. This indicates that students feel bored. Based on the results of a student needs survey conducted through Google Form, students want to get ecosystem concept that encourages them to actively participate in learning independently and collaborating with peers in the classroom. If not resolved, the problems that have been described will have a negative impact on student learning outcomes (Nata & Manuaba, 2022). Therefore, it is necessary to develop LKPD teaching materials that are attractive to students as a solution to overcome these problems. Interestingly, the solution that can be taken is the project learning model which has the characteristics of authentic material based on knowledge and empirical. Students face challenges that guide them to complete a specific project by investigating information from various sources, planning and researching plans to complete the project, receiving input from peers and teachers for assessment and revision. This process aims to foster and refine their creative thinking skills (Aisah et al., 2023).The LKPD that will be developed is based on Project Based Learning.

The learning model that focuses on students to collect, apply ideas and solve problems independently is called Project Based Learning (PjBL), in this case student activities focus on making real products. Outputs that can be produced in this learning process such as posters, videos, workshops, and others. This method can also provide a better experience for students (Ismail, 2018).

PjBL-based LKPD can be applied to biology learning, including ecosystem concept. One of the best ways to start learning about ecosystems is through going directly to the field (Setiawan et al, 2020). This is because the objects that students will learn in ecosystem concept are real and can be found. From the description of the problems above, this is important to conduct research and development entitled “Development of Worksheet based on Project-Based Learning (PjBL) on Ecosystem Concept in Class X SMA 42 Jakarta.”

METHOD

The research design used is development or R&D (Research and Development Research and development or research and development is a research method used to produce certain products and test the effectiveness of these products (Sugiyono, 2011, p. 407). (Ugiyono, 2019) presents 10 work steps in this research, namely analysis of potential and problems, data collection, product design, design validation, design revision, product trials, product revision, field trials, product revision, and

mass production. To explain the development of LKPD, this research used a storyboard to make it easier to visualize the process of implementing LKPD in the classroom. A storyboard is a series of images or illustrations arranged in sequence to detail the important parts of a story or presentation. In the context of student worksheets, storyboards can be used as a tool to explain the steps or process that student must follow. Furthermore, the research period took place from February to May 2023, and the research site was at SMA Negeri 42 Jakarta. The research sample was class X students as many as 34 people. The place and sample of the research were used to analyze the needs of teaching materials and how students respond to these teaching materials.

Data collection techniques through interviews and student response questionnaires. Interviews were used to explore students' perceptions and direct experiences in using the LKPD. Interview data was taken from students' experiences when using the LKPD and then transcribed to be filtered to get concrete data; this was done to explain the questionnaire data to get robust data. Not only that, Biology teachers were interviewed directly as teachers who have practical and classroom experience. Many well-known interview procedures involve the task of “practice narration,” in which participants are asked to talk about neutral or positive events in response to open-ended questions before discussing more significant topics (Roberts et al., 2011).

Data analysis was done descriptively qualitative and quantitative. Qualitative data includes suggestions and criticisms of experts (material, media, language) on LKPD. Interview data was dissected descriptively. The purpose of qualitative research should prioritize social justice where participants are more diverse (Denzin & Lincoln, 2005). While quantitative data is obtained from scores through a questionnaire and then validated and analyzed by project-based LKPD material experts. As the old saying goes, “a picture is worth a thousand words,” and this is very applicable to quantitative research (Connolly, 2007). Material analysis was also applied in this study by referring to the aspects of Graduate Competency Standards, Core Competencies, and Basic Competencies. This study used a Likert scale measurement tool to see students' interest in using the LKPD as shown in Table 1.

Table 1. Likert Scale

No	Statement	Score
1	Strongly Agree (SS)	5
2	Agree (S)	4
3	Quite disagree (KS)	3
4	Disagree (TS)	2
5	Strongly Disagree (STS)	1

The questionnaire for students' responses to project-based LKPD is as follows:

Figure 1. The questionnaire for students' responses

The results of data acquisition are analyzed with qualitative descriptive analysis, for quantitative type data in the form of numbers, the calculation results can be processed by calculating the overall value using the equation:

$$\text{Percent of feasibility } kelayakan\ (\%) = \frac{\text{Observation score}}{\text{Expected score}} \times 100\%$$

The data were tabulated using table 2 below to determine the criteria for the feasibility of the LKPD.

Table 2. Category of Feasibility

No	Percentage (%)	Category
1	81-100	Strongly feasible
2	61-80	Feasible
3	41-60	Feasible enough
4	21-40	Unfeasible
5	0-20	Strongly unfeasible

The equation below is to calculate the percentage of student response data.

$$P = \frac{F}{N} \times 100$$

Notes:
P = Percentage
F = Frequency
N = Number of respondent

The next step is to determine the criteria that can be adjusted in Table 3

Table 3. Criteria of student's response

No	Percentage (%)	Criteria
1	81-100	Strongly Positive
2	61-80	Positive
3	41-60	Moderately Positive
4	21-40	Less Postive
5	0-20	Very Less Positive

RESULTS AND DISCUSSION

To develop project-based LKPD material on Ecosystem concept in Biology class, a needs analysis are conducted through observations and distribution of questionnaires. With the R&D research design, this research present learning activities that encourage student autonomy to explore Ecosystem concept both independently and collaboratively.

Scope: Starting from looking for information related to the current state of education in Indonesia where there is a renewal of regulations related to the curriculum by the Minister of Education and Culture listed in Law No. 56 of 2022, namely the independent curriculum and several schools have now implemented it according to the readiness of each school. One of the learning characteristics in the independent curriculum is project-based. This research then made observations in the field by following the practicum activities using LKPD and teaching and learning activities in the classroom. Based on observations, it found that the LKPDs used were less attractive both in terms of appearance, content and activities carried out.

Following this, interview to the biology teacher was conducted. The purpose of the interview was to obtain information related to the curriculum, facilities and infrastructure, and materials used. The results of the teacher interview showed that SMAN 42 Jakarta has used the independent curriculum, which means that the school will use project-based learning and one of them has used teaching materials in the form of LKPD. To find out the needs of students, this research conducted a survey using Google form. From the answers, it was concluded that students agreed to the development of teaching materials in the form of interesting LKPD, so that the learning process did not feel monotonous. From the steps that have been taken, the potential for developing PJBL-based LKPD products can later help reduce the problem of LKPD, which is felt to be less interesting by students.

Data Collection: At this stage a needs analysis was conducted as a guide to develop project-based LKPD. It establish communication with Biology teachers to develop guidelines by collecting information about student needs, observations, interview biology teachers and survey student needs through questionnaires. Observations made were objective through learning observation in the classroom and observation of the school environment. The flow of learning and materials used by Biology teachers in Ecosystem concept was observed and recorded. Communication to Biology teachers was conducted about the need for students to be encouraged independently, both individually and in groups to carry out learning activities. Finally, Project Based Learning (PjBL) was choosen to accommodates this. This model is then formulated with Student Worksheets that prioritize cooperation between students in working on Ecosystem tasks. Observation also performed to the school environment with the aim of obtaining ideas or innovations for project activities carried out by students.

The results of the discussion became a reference for teachers in the science learning process, especially ecosystem concept and the results of the student needs survey showed that students agreed on the development of LKPD teaching materials

that were not only limited in the classroom, but could also be carried out outside the classroom. Thus, students have the opportunity to discuss together and can repeat what they have learned at home. Thus, the results of interviews and surveys support the development of more interesting and interactive teaching materials.

Product Design: In the next stage, Worksheet was devided into several parts, namely the introduction, cover sheet, preface, table of contents, identity, learning outcomes, learning objectives, instructions for using LKPD and Project Based-Learning (PjBL) syntax. On the cover sheet designed using the Canva application, there is a UKI logo, institution, LKPD title, education level, class, author's name, supervisor's name, and an identity box containing the names of group members and classes. In the preface, the author expresses gratitude to God Almighty and also expresses gratitude to the supervisor and validators who have helped in completing this LKPD. While the table of contents contains pages to make it easier for readers to find the topic of the page that has been designed. The identity of the LKPD consists of material to be studied, class/semester of students, phase, time allocation, and school year. Learning outcomes and learning objectives are designed to help students understand what is expected after using the Student Worksheet (LKPD). Instructions are intended to make it easier for students to use the LKPD, while the stages/syntax of the LKPD make it easier for teachers to assign LKPD projects.

Figure 2. Example of Worksheet page

In the content section of the LKPD, there are material descriptions of learning activities I and learning activities II that have been adapted to the PjBL syntax. The description includes the presentation of problems, planning, scheduling, monitoring project development, conducting assessments, evaluating, and summarizing. Meanwhile, the closing part of the LKPD includes two things, namely the bibliography and the author's bio. The bibliography contains references used in preparing the LKPD, including journals, books, internet sources, and other relevant studies. The

author's bio contains information about the author, such as name, place and date of birth, gender, institution, and email address.

The result of Design Validation: The validation process was assessed by 2 experts (material, media, language). Material Expert: The aspects to be assessed by material experts include content feasibility, presentation feasibility, and contextual assessment. The validation results can be seen in Table 4.

Table 4. Summary of Material Expert Validation Results

No	Indicator	Validator score		Max Score	$\frac{Validator\ Score}{Maximum\ Score} x\ 100\ \%$
		1	2		
Eligibility Aspects of Content					
1	Material compatibility to learning outcome	11	12	30	76,7 % (Feasible)
2	Material Accuracy	12	12	30	80 % (Feasible)
3	Material update	6	9	20	75 % (Feasible)
4	Encourage curiosity	8	9	20	85 % (Strongly Feasible)
Aspects of Eligibility for Presentation					
1	Presentation Technique	24	24	60	80 % (Feasible)
2	Presentation Support	20	24	50	88 % (Strongly Feasible)
3	Presentation of Learning	4	5	10	90 % (Strongly Feasible)
Aspects of Contextual Assessment					
1	Contextual Essence	8	8	20	80 % (Feasible)
Average					**82,03 %**

Based on the data listed in Table 4, it is known that the LKPD that has been developed is rated as “strongly feasible” by material experts, with an average percentage value reaching 82.03%. Here, the material expert assesses the suitability of the material with SKL. KI, and KD as well as the instructions and materials presented for students to learn are very good.

Media Expert: Consists of 3 indicators and 12 assessment items. To find out the overall results of media expert validation 1 and 2, see Table 5.

Tabel 5. Summary of Media Expert Validation Results

No	Indicator	Validator score		Max Score	$\frac{Validator\ Score}{Maximum\ Score} x\ 100\ \%$
		1	2		
1	Size	**4**	**5**	**10**	90 % (Feasible)
2	Cover Design	**12**	**13**	**30**	83,3 % (Feasible)
3	Conten Design	**32**	**37**	**80**	86, 2 % (Feasible)
Average					**86,5 %**

Based on the data listed in Table 5, the average value of the assessment from media experts as a whole reached 86.5% “strongly feasible”. This is in line with the

results of previous research by (Al Azka et al, 2019) stating that the percentage of media expert assessment reached 86.25% “very good”. Thus, the LKPD learning media proved to be suitable for use by students. This indicates that the LKPD designed with Project Based Learning (PBL) is in line with the Basic Competencies (KD) and or Core Competencies (KI), and is explained with Scaffolding in the form of a clear Storyboard so that it is easy for students to understand and follow the flow. Guiding students through the learning process is very important, and the use of teaching aids plays a significant role (Van de Pol et al., 2010).

Language Expert: There are 5 indicators and 10 assessment items. To find out the overall results can be seen in Table 6.

Tabel 6. Summary of Language Expert Validation Results

No	Indicator	Validator score		Max Score	$\frac{Validator\ Score}{Maximum\ Score} x\ 100\ \%$
		1	2		
1	Businesslike	12	12	30	80 % (Feasible)
2	Communicative	8	10	20	90 % (Strongly Feasible)
3	Dialogical and Interactive	4	4	10	80 % (Feasible)
4	Suitability to Student Development	8	8	20	80 % (Feasible)
5	Conformity to Language Rules	8	9	20	85 % (Strongly Feasible)
Average					**83 %**

Table 6 shows that the average value of language expert, which is 83% overall, is classified as “Strongly Feasible”. This is in line with research (Koriaty & Agustani, 2016) saying that the percentage value is categorized as “Strongly Feasible” if it gets a percentage of 83%. The design of materials and instructions is developed in such a way as to produce more dialogic and interactive learning. Therefore, learning seems more independent and sustainable. So that the development of LKPD is declared to be used as teaching material.

Design Revision

After assessment from the validators, LKPD was revised based on the input that has been given.

Material Expert: input by material expert 1 that the material on LKPD is less in-depth, spelling or language that is less standardized and improve the sentence “Describe the project design that you have designed!” replaced with, Describe the project design that has been designed with the group! While the input by validator 2 is that it is necessary to improve the LKPD in the identity section of the LKPD because SMAN 42 Jakarta has used the independent curriculum with learning outcomes and there are no Basic Competencies in the independent curriculum and on page 5 of the LKPD in the picture of the fish pond and mini forest there needs to be improved work instructions.

Media Expert: Media expert 1 gave an assessment with the conclusion that the LKPD could be used without revision. In media expert 2, there are two suggestions or

criticisms, namely the ecosystem image as an illustration of the LKPD cover is too dominant and there is more than one image, and the placement of decorations or illustrations as a background for writing pages is less interesting.

Language Expert: In the validation of language expert 1, there were criticisms and suggestions, namely the terms Latin and local language should be italicized and use standard language instead of spoken language. Meanwhile, the validation by language expert 2 concluded that the LKPD could be used without revision.

Student's responses

After obtaining the percentage value of product feasibility and making improvements according to input from experts, this PjBL-based LKPD is ready to be tested. The PjBL-based LKPD trial involved 34 grade X students through distributing questionnaires to assess indicators of interest, material, and language.

Table 7. Student's responses to LKPD

No	Indicator	Percentage	Predicate
1	Interest	45,2 %	Moderately Positive
2	Material	55,6 %	Moderately Positive
3	Language	58,1 %	Moderately Positive
	Average	**53,0 %**	Moderately Positive

In table 7, it is revealed that the average result of students' responses to this PjBL-based LKPD is 53.0% with the predicate "Moderately Positive". The interest assessment indicator obtained a percentage score of 45.2% with the predicate "Moderately Positive", the material assessment indicator obtained a percentage score of 55% with the predicate "Moderately Positive", and the language assessment indicator obtained a percentage score of 58.1% with the predicate "Moderately Positive". This indicates that the Ecosystem concept with LKPD encourages students to be active and collaborate with peers; this is supported by the observation process that they actively exchange opinions and work according to directions through one of them is a storyboard so that students know the flow of work. The results of the assessment of each indicator are listed in Figure 3.

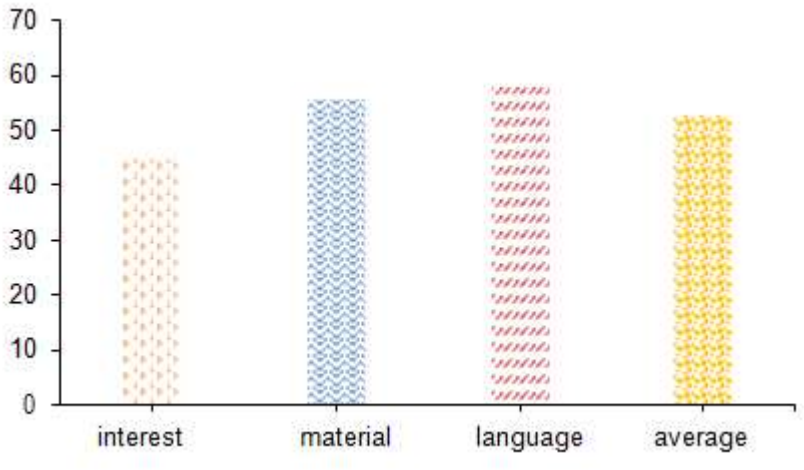

Figure 3. Diagram of Student's Responses

The trial results showed that students were quite interested in using this LKPD. However, in order to get more satisfactory results, the LKPD will be revised again as said by Purnama, (2013) in his research if the LKPD developed shows better response results than previous research then the LKPD can be used without revision, but if the results of the students' response do not reach the expected level (55%) then the LKPD teaching materials need to be improved. Due to time constraints, the trial can only be carried out at one meeting, so that in a short time students only review LKPD products in this case making students less than optimal when questioning student responses (Nasution & Oktaviani, 2020) therefore it is concluded that the development of PjBL-based LKPD gets a “Moderately Positive” learner responses with a percentage result of 53%, LKPD can be used with revision.

CONCLUSION AND RECOMMENDATION

Based on the results of the study, the total score of material experts was 82.03% “Strongly Feasible”, media experts 86.5% “Strongly Feasible”, language experts 83% “Strongly Feasible”, student responses to PjBL-based LKPD received a score of 53.0% in the “moderately positive” category. These results indicate that PjBL-based LKPD is feasible and relevant to be used in learning biology, especially on ecosystem concept. Furthermore, the development of Project Based Learning (PBL) based LKPD with Ecosystem concept makes it easier for students to carry out learning autonomy with the guidance of the storyboard as a teaching scaffold. This certainly contributes conceptually and theoretically to this study making it easier for Biology teachers to apply it in the classroom. The project-based model is incorporated into the design of the LKPD which becomes a teaching concept by Biology teachers; this can later be incorporated into teaching materials in the school curriculum. Input from experts for the improvement of project-based LKPDs became the focus of future LKPD development. Furthermore, for the next similar development research are advised to examine ecosystem concept in more detail, in order to increase and expand the knowledge of high school students.

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