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Development of Student Worksheets Based on Project Based Learning Model to Improve Concept Understanding in The Biology Learning: *Respiratory System Material*

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Abstract

The demands of the 21st century extend beyond the mere mastery of knowledge; they require individuals to develop a robust set of skills, particularly in understanding complex concepts. This research focuses on creating Student Worksheets rooted in the Project Based Learning model to enhance students' comprehension in biology. To achieve this, the research employs the 4D development model, which includes four phases: Define, Design, Development, and Disseminate. Data collection involved validating the product's feasibility, gathering feedback from both teachers and students, and conducting pretests and posttests, followed by N-Gain analysis. The data analysis encompassed three main techniques: validity analysis, practical analysis, and effectiveness analysis. The findings indicated a high degree of validity, with material validation reaching 93 % (categorized as "very valid"), media validation at 99.16 % (also "very valid"), and question validation at 83.33 % ("very valid"). The practical assessment from teacher responses yielded a remarkable 97 %, classified as "very practical," while student responses reflected a score of 93.03 % in the same category. Additionally, the N-Gain results revealed an average improvement in students' concept understanding of 0.8, categorized as "very effective". In conclusion, the evidence from the validity, practical, and effectiveness assessments strongly suggests that these Student Worksheets can significantly enhance students' understanding of key biological concepts

Keywords: *Student worksheet; Project Based Learning; Respiratory System*

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INTRODUCTION

Education in the 21st century requires individuals to be more creative and innovative. According to Mufit et al., (2020) life in the 21st century also demands various skills that must be mastered by each individual. 21st century skills are skills that are very important for students to have, and aspects of 21st century skills are also known as 4C, namely critical thinking, creativity, communication, and collaboration (Trilling & Fadel, 2009). One of the abilities that students need to master in learning is the ability to understand. Concepts that are not in the form of memorization, but can be understood by students' thinking, so that students can apply these concepts in other situations. One of the goals that will be taught by the teacher is understanding, because students will be guided by the teacher in achieving understanding of the concept (Sugandi & Bernard, 2018).

Concept understanding ability means an intellectual mental process to accommodate newly received concepts and assimilate with existing knowledge to form a new cognitive structure (Triwahyuni, 2017). Although students already have high thinking skills, not necessarily students also have high concept understanding skills. High-level thinking skills can be obtained by understanding concepts in depth (Ningsih, 2022). Concept understanding can be obtained by practicing the ability to interpret, translate, conclude, find, and present problems based on concepts that have been learned (Astiti et al., 2022).

Grasping the concept of material is fundamental to effectively tackling problems (Mundy, 2000). This perspective aligns with the views of other experts in the field Andriyani & Prihandono (2017) which states that understanding the concept is needed to solve a problem related to the concept. Concept understanding allows a person to connect events in the surrounding environment with concepts that are mastered, and classify an object into certain groups based on the appropriate concept (Fakhrah et al., 2014). Grasping the foundational concepts is crucial, as mastering these ideas will significantly ease students' journey in learning biology. If a single concept remains elusive, it can create challenges in understanding subsequent material (Ramayanti et al., 2018).

The low understanding of student concepts can be caused by several interrelated factors. Learning models that are less varied and tend to be teacher-centered, as well as the lack of use of student worksheet (a.k.a LKPD) as teaching materials, and make students less actively involved in the learning process. As a result, students' interest in learning decreases and their concept understanding becomes limited (Suranti et al., 2017). This is in line with the findings of the observations made by researchers at MAN 3 Medan that 50% of students in the school have a low level of understanding of concepts in biology subjects, especially on Respiration system material and in the learning process the atmosphere in the classroom tends to still focus on the teacher as a source of knowledge (teacher centered), and in the school still does not use teaching materials such as student worksheet (LKPD). The learning only uses the package book and works on the questions in the package book, so that the teaching material has not been able to facilitate students to carry out learning activities that develop students' understanding abilities. Therefore, from these problems has a

solution one way to develop learning teaching materials such as student worksheet based on the Project Based Learning learning model.

The Project-Based Learning model has the potential to enhance learning outcomes, boost motivation, and foster creativity and independence among students. It encourages them to produce original work, offering valuable experiences that enable them to build their own knowledge. Additionally, this approach helps improve their ability to communicate their ideas and products effectively and students can connect the concepts learned with other concepts they have learned before (Nita & Irwandi, 2021). The PjBL learning model focuses on making students more active and creative in learning. This learning model also provides facilities for students to investigate, solve problems, be student-oriented, and produce a real product in the form of project results (Nurfitriyanti, 2016).

The quality of education is greatly impacted by the use of teaching materials. One of the tools that support learning is student worksheets (LKPD) (Effendi et al., 2021). According to Mutiarahman et al., (2023) student worksheet is a learning tool that has a series of questions and information created with the aim of helping students understand complex concepts and provide guidance to them in carrying out structured tasks. student worksheet (LKPD) can be developed with teacher creativity, such as creating colorful books that can invite students to imagine (Rahmi et al., 2019). LKPD that can be used in learning must invite students' activeness (Torrence et al., 2016). One of them can use LKPD with the appropriate model, namely the Project Based Learning (PjBL) Model so as to cause student activeness (Rismawati et al., 2022).

The development of LKPD Project-Based Learning for conceptual understanding has been researched. LKPD development remains focused on other subjects like mathematics, physics, and chemistry. There are still few studies on biology subjects. As conducted Nurcahyati et al., (2024) in mathematics subjects on statistical material, namely the Development student worksheet of Project Based Learning to Improve Mathematics Concept Understanding of Class VIII Students of Junior High School of SMPN 6 Seluma. Furthermore, research Barlenti et al., (2017) on chemistry subjects, namely the Development student worksheet of Project Based Learning to Improve Concept Understanding. Furthermore, in research Sakinah et al., (2023) on biology subjects, namely the Development of student worksheet Based on Mangrove Ecosystems Through Project Based Learning Models to Improve Understanding of Concepts About Ecosystems at Senior High School of SMAN 1 Lembar.

Based on the description above, this study aims to develop student worksheet of Project Based Learning model to improve students' concept understanding in biology learning. In order for teachers to use student worksheet in teaching and students comprehend concepts in the 21st century, this type of research is necessary, particularly in the field of Biology education, the findings of this study can serve as a valuable reference for teachers in selecting an effective learning model. This approach aims to enhance student engagement and foster a greater enthusiasm for participating in the learning process.

METHOD

Research Design

The researchers employed the Research and Development (R&D) method to create and refine a product while also assessing its effectiveness. In this study, the focus was on developing a PjBL-based student worksheet (LKPD) centered around the material of the Respiratory System. The research followed a structured approach utilizing the 4D (four-D) development model, which comprises four key stages: define, design, develop, and disseminate (Thiagarajan, 1974). Additionally, this model can be tailored into the 4P framework, encompassing defining, designing, developing, and disseminating.

Participants and Instruments

This research was conducted at Senior High School of Madrasah Aliyah Negeri (MAN) 3 Medan with the research subjects, namely validators, consisting of two lecturers of material and media experts and one Biology teacher to assess the results of student w orksheet (LKPD) products, and students of Second grade (class XI MIPA). In this study, researchers used nonprobability sampling techniques for sampling. The technique used was purposive sampling. This was done because the researcher chose a school that implemented the 2013 Curriculum in learning activities and the researcher had limited time, cost, or energy so it was only possible to take data from one class. The sample of students selected for study was Second grade (XI class in MIPA-5) of 29 students. The research instruments used were needs analysis in the form of interview guidelines for teachers and questionnaires for students used to collect data on learning media applied and student learning outcomes. Then, the validation test consisting of a material expert validation sheet with assessment aspects such as Suitability of Material with Core Competencies (KI) and Basic Competencies (KD), Accuracy of Material, Updating Material, Encouraging Curiosity, Presentation Techniques, Supporting Presentation, Learner Involvement, Coherence and Orderliness of Thought Flow, Contextual Nature, and media expert validation sheets with assessment aspects in the form of student worksheet **(**LKPD) Size, LKPD Cover Design, Feasibility of LKPD Content, LKPD Content Design are used to collect data on learning media reviews from validators. The criteria for validators of material experts and media experts are lecturers with minimum criteria of Masters in Education or non-education. Then the practicality test consists of a response questionnaire given to one biology teacher and 29 students, giving this questionnaire is done on validation and media trials. The response questionnaire is used to determine the assessment of the learning media made. And for the effectiveness test, a test instrument is carried out in the form of a pretest and posttest, namely by giving 10 essay questions according to the material.

Procedure

This Project Based Learning model-based student worksheet was developed by (Thiagarajan, 1974). in four stages, namely: Define stage, Design stage, Development stage, Disseminate stage. The details of the development stages are as follows:

a. The defining stage (define), helps in determining and explaining the needs and gathering information related to the things that will be developed in the product to be made. This stage includes initial-end analysis, namely researchers conducting initial observations and interviews with biology teachers regarding conditions at school, student analysis, namely researchers providing student needs questionnaires, concept analysis, namely this analysis is seen from KD and KI 3 to be used as indicators of competency achievement. This analysis is then divided into several sub-materials, namely the understanding and function of the respiration system organs, respiratory mechanisms, and respiration system disorders, task analysis, which is carried out by looking at what activities must be carried out by students in order to achieve KD and KI 4 on respiration system material, namely by conducting a simple practicum on testing the content of cigarette smoke, and this learning objective produces indicators of competency achievement on KD from KI 3 and indicators of competency achievement on KD from KI 4, resulting in learning objectives.
b. The design stage, at this stage can be done by assessing the material, namely based on the concept analysis stage, the material used to compile the student worksheet is the material of the respiration system. The next stage is the initial design, namely the form of student worksheet used related to the Project Based Learning learning method, using A4 paper. LKPD is initiated by presenting a cover, core competencies, basic competencies, indicators, instructions for use, relevant material and images, and learning syntax. The last stage of making devices is using software tools, namely Canva.
c. The development stage, the focus is on creating student worksheet products based on a project-based learning model centered around the respiratory system. The goal is to ensure that these products are valid, practical, and effective. To assess validity, three validators evaluate the materials: media, content, and questions. The practicality of the products is gauged through questionnaires distributed to both teachers and students. Finally, to determine effectiveness, students complete pretests and post-tests.
d. Disseminate stage The testing of teaching materials in small groups in the classroom has taken place at this stage, despite being ready for production in large groups, the teaching materials were only tested and distributed on a small scale in this study.

Data analysis

The research data was gathered through both qualitative and quantitative methods. Qualitative insights were derived from multiple sources, including critiques and recommendations from validators. To collect this data, a validated questionnaire was designed for evaluation by material and media experts, biology teachers, and students. On the other hand, quantitative data was obtained from assessments conducted by material experts, media experts, biology teachers, and students. The assessment results were subsequently analyzed to determine the feasibility of developing the LKPD (student worksheet). The Likert scale ranging from 1 to 4 was employed to quantify responses for each indicator on the validation sheet and to gauge student feedback.

The following are the techniques and methods applied in analyzing the data obtained from the data collection instruments:

Validity Analysis

Validation is carried out based on the results of the assessment by the validator contained in the validation questionnaire. This validation analysis is measured using the formula from (Riduwan,2016),

$$\text{Percentage}(\%) = \frac{Score\ obtained}{maximum\ score} \times 100\%$$

From the assessment obtained from the validation of LKPD by validators, the calculation is based on a Likert scale as follows,

Table 1. Validity Assessment Criteria (Sugiyono, 2018)

Percentage of Achievement	Criteria
67-100%	Very Valid
56-75%	Valid
40-55%	Fairly Valid
0-39%	Invalid

Practicality Analysis

The Learner Worksheet's practicality can be assessed through student and teacher feedback on the implementation of learning stages. Revisions or changes from the development will be completed when the feasibility value has been achieved based on the feasibility of materials and media. The feasibility of LKPD to be called feasible is if the percentage of assessment is ≥ 60 % (Riduwan, 2016). To assess the level of practicality of LKPD learning media, it can use the practicality category contained in Table 2.

Table 2. Practicality Criteria (Riduwan, 2016)

Percentage of Achievement	Criteria
81-100%	Very Practical
61-80%	Practical
41-60%	Fairly Practical
21-40%	Not Practical

Effectiveness Analysis

This study will determine its effectiveness as an LKPD by assessing through the activities of giving pretest and post test questions to students. Assessment of student learning outcomes using N-Gain. The following is the N-Gain formula according to Meltzer (2002):

$$\text{N} - \text{Gain} = \frac{Sposttest - Spretest}{Smaksimal - Spretest}$$

The division for the N-Gain Score itself is with the following predetermined categories to measure the extent of the effectiveness of the LKPD, the assessment categories see in table 3.

Table 3. Effectiveness Criteria (Nisa' et al., 2015)

Interval	Category	Criteria
g > 0,7	High	Highly Effective
0,3 < g ≤ 0,7	Medium	Effective
g ≤ 0,3	Low	Ineffective

In the N-Gain Value category table 3, Nisa' et al., (2015) describe that if the value of g> 0.7, it is considered high, which means that the LKPD that has been made is very effective in improving students' concept understanding. Conversely, if the value of g ≤ 0.3, then the effectiveness of the LKPD is considered very low and requires improvement or revision.

RESULT AND DISCUSSION

Development research (Research and Development) was the main focus of the research conducted. The developed product is the student worksheet (LKPD) Respiration System, designed to enhance students' understanding of key concepts. This study employed various research instruments, including interview sheets, material validation sheets, media validation sheets, question validation sheets, teacher response questionnaires, student response questionnaires, as well as pre-test and post-test questions, totaling 10 items. The development process followed the 4D model, which includes the stages of Define, Design, Development, and Disseminate. The author undertook the following stages:

Define Stage

Preliminary and Final Analysis

At this stage, the researcher conducted observations in the science class (XI MIPA). These observations, along with interviews, revealed several issues, particularly the suboptimal use of teaching materials. The primary resources available are traditional textbooks, and not all students have access to these books. As a result, many students struggle to grasp and master key concepts, leading to a decreased interest in learning. This finding aligns with the assertion made by Ulia & Sari (2018) that student engagement is crucial, as it significantly influences the quality of understanding that students achieve regarding concepts.

Student Analysis

At this stage, the researcher introduces a questionnaire designed to assess student needs. The findings reveal that the current learning environment remains predominantly teacher-centered, leading to a tendency for students to be passive participants in class. Furthermore, the Learning Activity worksheets (LKPD)

employed are rather simplistic, and the teacher has not fully utilized instructional materials that actively engage students in the learning process. Opportunities for hands-on learning experiences, such as practicum or project-based methods, are still infrequently incorporated. As a result, there is a pressing need for innovation in teaching methods. Among the potential solutions, project-based learning stands out due to its ability to captivate students and encourage active involvement in their education (Tascı, 2015).

Concept Analysis

At this stage the researcher identifies the main problems that must be taught and included in the LKPD and organizes them systematically. This analysis is seen from KD and KI 3 to be used as indicators of competency achievement. The material developed by researchers is the Respiration System which is then divided into several sub-materials, namely the understanding and function of the organs of the respiration system, respiratory mechanisms, and disorders of the respiration system.

Task Analysis

At this stage aims to identify the skills that will be studied by researchers by providing material and tasks for each lesson. The task is in the form of activities that students must do. At this stage the researcher gives the task by doing a simple practicum on testing the content of cigarette smoke.

Learning Objectives

At this stage, students are expected to follow and comprehend the instructions for using the LKPD effectively. Additionally, in alignment with the basic competencies outlined in the Biology syllabus, they should be able to: explain the function of the respiratory system; Identify the various tissues that comprise the respiratory organs and their respective roles; articulate the differences between the inspiratory and expiratory processes; analyze abnormalities and diseases related to the respiratory system; investigate the causes of respiratory disorders based on experiments involving cigarette smoke content; identify strategies to address these disorders; draw conclusions regarding the underlying causes of respiratory issues; and communicate their observations about these causes.

Design Stage

Material Assessment

Based on the concept analysis stage used to develop LKPDs, the Respiratory System material is for the second grade (science XI class) of senior high school. Respiratory system material consists of the definition and function of respiratory system organs, respiratory mechanisms, and respiration system disorders.

Initial Design

The LKPD format is designed in alignment with the Project-Based Learning method, utilizing A4 paper. To create the LKPD, we start with a cover page, followed by a presentation of core competencies, basic competencies, and specific learning

indicators. This is accompanied by clear instructions for use, relevant learning materials, images, and the syntax of the learning process.

Making Tools

The equipment used to make this LKPD is a software tool, namely Canva. Canva is an online application that can be used to create creative designs.

Development Stage

At this stage, our attention shifts to finalizing the product developed in the previous phase. This refinement process integrates expert feedback and suggestions, ensuring that we validate the materials, media, and questions designed to assess the product's feasibility. We also take time to evaluate the validity of the student worksheet (LKPD a.k.a called Lembar Kerja Peserta Didik) while gathering responses from both teachers and students through questionnaires to gauge its practicality. Furthermore, we administer N-Gain tests to measure the effectiveness of the LKPD.

Validity Analysis Results

Material Expert Validation

In this case, the material expert is Mrs. Dr. Rahmadina, M.Pd who is a lecturer in the Biology Tadris study program, Faculty of Tarbiyah and Keguruan Sciences, the University of Islam Negeri Sumatera Utara. The validation results obtained were carried out by filling out the validation sheet. Material validation was carried out three times. The assessment of the validation results can be seen in table 4,

Table 4. Material Expert Validation Results

Aspect	Total	Max. Quantity	Percentage (%)	Category
Suitability of Material with KI and KD	13	16	81	Very Valid
Accuracy of Material	21	24	88	Very Valid
Up-to-date material	3	4	75	Valid
Encourage Curiosity	8	8	100	Very Valid
Presentation Technique	4	4	100	Very Valid
Presentation Support	12	12	100	Very Valid
Learner Engagement	8	8	100	Very Valid
Coherence and Order of Thought	8	8	100	Very Valid
The Nature of Contextualization	16	16	100	Very Valid
Total		**93**		
Maximum Quantity		**100**		
Percentage		**93 %**		
Category		**Very Valid**		

The results of the material validation test for LKPD products based on Project-Based Learning, as illustrated in Table 4, indicate strong effectiveness across several key aspects. The alignment of materials with core competencies (KI) and basic competencies (KD) received an impressive score of 81 %, categorizing it as very valid.

The precision of the material scored even higher at 88%, also deemed very valid. Material sophistication was rated at 75 %, falling into the valid category. Remarkably, the aspect of fostering curiosity garnered a perfect score of 100%, alongside other crucial areas such as presentation techniques, supporting presentations, learner involvement, coherence and clarity of thought flow, and contextual relevance, all boasting 100% scores as well—each classified as very valid. Overall, the material validation yielded a robust score of 93 %, categorizing it as very valid. This aligns with the findings of Prastuti et al., (2018) who noted that students are more likely to retain information when it can be applied to everyday life. The use of contextual learning facilitates a greater understanding of biological concepts for students.

Media Expert Validation

In this case, the media expert is Mrs. Ummi Nur Afinni Dwi Jayanti, M.Pd who is a lecturer in the Biology Tadris study program, Faculty of Tarbiyah and Keguruan Sciences, the University of Islam Negeri Sumatera Utara. The validation results obtained were carried out by filling out the validation sheet. Media validation was carried out three times. The assessment of the validation results can be seen in the following table 5.

Table 5. Media Expert Validation Results

Aspect	Total	Maximum Quantity	Percentage (%)	Category
Size of LKPD	8	8	100	Very Valid
Cover Design of LKPD	27	28	96.42	Very Valid
Feasibility of LKPD Content	16	16	100	Very Valid
LKPD Content Design	68	68	100	Very Valid
Total		**119**		
Maximum Quantity		**120**		
Percentage		**99.16%**		
Category		**Very Valid**		

The media validation test results of the Project Based Learning-based LKPD products, presented in Table 5, reveal an impressive performance across several key aspects. The LKPD size aspect achieved a perfect score of 100 %, categorizing it as very valid. Similarly, the cover design aspect received a commendable score of 96.42 %, also deemed very valid. Furthermore, both the content feasibility and content design aspects scored 100 %, confirming their very valid status as well. Overall, the media validation commendably culminated in a score of 99.16 %, classifying it as highly valid.

According to research conducted by Febriyanti & Hakim (2023), the overall validation results reached an impressive 90 %, categorizing it as very valid. Similarly, another study by Khofifah et al., (2023) reported a validation result of 90.7%, also falling into the very valid category. Based on these findings, we can conclude that the developed product, the LKPD based on Project-Based Learning, is considered very valid. Therefore, this research is ready to progress to the practicality testing stage.

Question Expert Validation

In this instance, the material expert is Mrs. Dr. Rahmadina, M. Pd, a lecturer in the Biology Tadris study program at the Faculty of Tarbiyah and Keguruan Sciences, the University of Islam Negeri Sumatera Utara. The validation process involved completing a validation sheet and was conducted on two separate occasions. The findings from the validation assessments are presented in the table 6.

Table 6. Problem Expert Validation Results

Aspect	Total	Maximum Quantity	Percentage (%)	Category
Clarity	7	8	87,5	Very Valid
Core Appropriateness	3	4	75	Valid
Relevance	4	4	100	Very Valid
Content Validity	3	4	75	Valid
No Bias	6	8	75	Valid
Language Accuracy	7	8	87.5	Very Valid
Total		**30**		
Maximum Quantity		**36**		
Percentage		**83.33%**		
Category		**Very Valid**		

Table 6 presents the results of the question validation test, highlighting notable findings across various aspects. The clarity aspect achieved a score of 87.5 %, classified as very valid, while the core accuracy aspect received a score of 75 %, marking it as valid. Additionally, the relevance aspect garnered an impressive score of 100 %, also categorized as very valid. Both the content validity and no bias aspects scored 75 %, placing them in the valid category. Finally, the language accuracy aspect scored 87.5%, earning a very valid classification as well. Overall, the results reflect an impressive average score of 83.33 %, categorized as very valid.

Practicality Analysis Results

Teacher Response Questionnaire

In this case the biology teacher who responded to the LKPD developed was Mrs. Asmalia Septiani Zuri, S.Pd. The assessment of the validation results can be seen in the following table 7. According to Table 7, the findings from the teacher response questionnaire reveal several impressive results. The material aspect achieved a remarkable 100 % rating in the "very practical" category, while the language aspect also scored a perfect 100 %, indicating its high practicality. The presentation aspect garnered a commendable 92 %, still within the very practical category. Additionally, the aspect pertaining to adhere to project-based learning stages received an outstanding 100 % rating. Overall, the teacher response questionnaire yielded an impressive 97 %, categorizing it as very practical.

Table 7. Results of Teacher Response Questionnaire

Aspect	Total	Maximum Quantity	Percentage (%)	Category
Material	8	8	100	Very Practical
Language	12	12	100	Very Practical
Presentation	22	24	92	Very Practical
Conformity with the stages of Project Based Learning	20	20	100	Very Practical
Total		**62**		
Maximum Quantity		**64**		
Percentage		**97%**		
Category		**Very Practical**		

Student Response Questionnaire

The results of the student responses were gathered from a questionnaire completed by 29 students from the XI MIPA-5 class. The findings from the questionnaire assessment are presented in the table 8.

Table 8. Student Response Questionnaire Results

Aspek	Total	Maximum Quantity	Percentage (%)	Category
Material	743	812	92	Very Practical
Language	219	232	94.39	Very Practical
Interest	333	348	96	Very Practical
Total		**1295**		
Maximum Quantity		**1392**		
Percentage		**93,03%**		
Category		**Very Practical**		

According to Table 8, the student response questionnaire revealed notable findings across various aspects. The material aspect received an impressive score of 92%, classified as very practical. Similarly, the language aspect garnered a remarkable 94. 39%, also falling into the very practical category. The interesting aspect achieved the highest score at 96%, confirming its classification as very practical. Overall, the student response questionnaire recorded an average score of 93.03 %, reflecting a strong endorsement of its practicality.

According to Audin et al., (2023) a learning device is deemed practical if its practical value is 80 % or higher, or if the level of response achievement in learning falls within the good category. For instance, research conducted by Tarigan (2024) on the practicality of LKPD yielded an average percentage of 88 %, classifying it as practical. Similarly, a study by Sari et al., (2020) reported a practicality score of 88.9 %, placing it in the very practical category. Therefore, it can be concluded that the LKPD based on the Project-Based Learning model for respiration system material is categorized as very practical.

Effectiveness Analysis Results

In the effectiveness test, a pretest was administered prior to the learning activities to assess the students' understanding of concepts related to the respiratory system. Following the pretest, the LKPD was evaluated by a group of 29 students. After this assessment, a posttest was conducted to gauge the effectiveness of the project-based learning approach employed in the LKPD.

Table 9. N-Gain Test Results

Number of Students	Pretest	Posttest	N-Gain	Category
29	46.4	93.8	0.8	High

The results of the N-Gain test presented in Table 9 reveal insights into students' conceptual understanding after employing the Project-Based Learning approach with the LKPD. The N-Gain score falls within a high range of 0.8, indicating very effective outcomes. Students achieved an average pretest score of 46.4, which rose significantly to an average posttest score of 93.8. This reflects an impressive improvement of 47. 4 points from the pretest to the posttest.According to the findings of the research Selian et al., (2023) Results for the effectiveness test were obtained by conducting a pretest and posttest 0.72 with an N-Gain classification of "high" and "memorable" lighting. This is in accordance with the opinion of Nugraha et al., (2022) that increasing concept understanding in students can be seen from the average posttest results which are higher than the average pretest results.

Disseminate Stage

The goal of this stage is to distribute the products that have been developed. In this study, the dissemination of the LKPD took place at MAN 3 Medan, specifically in the second grade (XI MIPA-5 class), which comprises 29 students. The results of the assessment indicate that the developed LKPD is classified as highly practical and effective for use as teaching materials, greatly aiding teachers in their instructional activities. In accordance with Sugiyono (2013) opinion that the developed device can be said to be practical, if the teacher can use the LKPD to carry out learning logically and continuously, without many problems. Thus, the LKPD that has been developed can be used as an example in other schools that need it.

CONCLUSION

The research focused on the development of student worksheets (LKPD) based on the Project Based Learning model yielded promising results. The validity tests showed that material validation achieved a score of 93 %, categorizing it as "very valid" Media validation scored an impressive 99.16 %, also categorizing as "very valid," while the question validation test resulted in 83.33 %, which falls under the same "very valid" classification. In terms of practicality, the teacher response questionnaire resulted in a score of 97 %, indicating it is "very practical," while the student response questionnaire yielded 93.03 %, also classified as "very practical. " Furthermore, the N-Gain results

reflecting the improvement in students' understanding of concepts averaged 0. 8, categorized as "very effective". These findings suggest that the student worksheets (LKPD) developed using the Project Based Learning model significantly meets the criteria of validity, practicality, and effectiveness in enhancing students' conceptual understanding.

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