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Development of LKPD Based on PBL (Problem Based Learning) To Improve Students' Learning Outcomes Motivation on Corrosion Material

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A B S T R A C T

This study aims to develop a Problem-Based Learning (PBL)-based Student Worksheet (LKPD) on corrosion material to enhance student motivation and learning outcomes. The development follows the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. Validation involved two experts, and trials were conducted with 30 students in class XII MIA 1 at SMAN 19 Gowa. Effectiveness was measured through motivation questionnaires and learning tests, while practicality was assessed through observation and response questionnaires. Results showed that the LKPD was highly valid, practical, and effective. Learning implementation was fully achieved, with positive responses from teachers and students. Student motivation and learning outcomes significantly improved, indicating that the developed LKPD is feasible as alternative teaching material.

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INTRODUCTION

Education plays an important role in forming superior and competent human resources, both in terms of knowledge, skills, and character. Law Number 1 of 2022 concerning the National Education System emphasizes that education is a conscious and planned effort to create a learning atmosphere and learning process that allows students to develop their potential optimally. In practice, current educational developments have driven a paradigm shift from teacher-centered learning to student-centered learning. This shift aims to increase active student involvement, learning independence, and critical and creative thinking skills in solving problems (Hermawanto, 2013).

However, in classroom learning, especially in chemistry subjects, conventional approaches are still often used. Chemistry as a branch of natural science presents abstract and complex concepts that require in-depth understanding. One of the challenging materials is the topic of corrosion, which includes an understanding of electrochemical processes, causative factors, and their impacts on everyday life. Based on observations at SMA Negeri 19 Gowa, chemistry learning is still dominated by the use of textbooks and modules with lecture methods. This has an impact on low learning motivation and active participation of students. The lack of active student involvement in the learning process causes learning outcomes to be less than optimal, which is reflected in the low percentage of learning completion. For example, in the previous corrosion material, out of 36 students, 16 people had not reached the Minimum Completion Criteria (KKM) standard.

To overcome these problems, innovative and interactive learning media are needed. One solution that can be applied is the use of Student Worksheets (LKPD) as a learning guide that presents structured and interesting learning activities. A well-designed LKPD is not only able to help students understand concepts, but also increase learning motivation through challenging and actively involving activities.

In this study, the learning model used in developing LKPD is Problem Based Learning (PBL). PBL is a problem-based learning approach that encourages students to think critically, work together in groups, and develop social and communication skills. This model also encourages students to learn actively and reflectively in solving real problems. Previous studies have shown that the implementation of PBL-based LKPD can significantly increase motivation and learning outcomes (Effendi, 2021; Gusyanti, 2021).

Based on this background, this study aims to develop PBL-based LKPD on corrosion material that is valid, practical, and effective for use in chemistry learning in grade XII of high school. With this development, it is expected that the learning process will be more meaningful, interesting, and able to improve students' motivation and learning outcomes.

LITERATURE REVIEW

Education and the Learning Paradigm Shift

Education plays a central role in forming superior human resources, both in terms of knowledge, skills, and attitudes. Law Number 1 of 2022 concerning the National Education System emphasizes that education is a conscious and planned effort that aims to create an atmosphere and learning process that allows students to develop their potential optimally. This includes aspects of intelligence, personality, and social skills needed in community, national, and state life. In its implementation, education no longer only relies on achieving cognitive aspects, but also emphasizes the importance of critical, creative, collaborative, and communicative thinking skills.

In line with the development of the times, there has been a paradigm shift in the learning system, from the traditional teacher-centered approach (teacher-centered learning) to the student-centered approach (student-centered learning). According to Hermawanto (2013), a learning approach that places students as the main subject in the learning process will encourage active involvement and independence in seeking, processing, and applying information. In this approach, the teacher plays a greater role as a facilitator who guides students in the process of finding knowledge, not just a transmitter of information.

Chemistry Learning and Its Problems

Chemistry is a part of natural science that studies matter, its properties, the changes that occur, and the energy that accompanies it. However, in practice, chemistry learning is often considered difficult by students. One of the challenges faced is the many abstract concepts that require in-depth understanding, such as in corrosion material. Corrosion is a complex electrochemical process, and its understanding involves the concepts of redox, metals, the environment, and their applications in everyday life. If not presented with a contextual approach, this material tends to be considered boring and difficult to understand.

Susilowati (2020) stated that one of the causes of low conceptual understanding in chemistry learning is the use of monotonous and less interactive methods. Teachers tend to use lectures or other conventional methods without actively involving students. As a result, the learning process becomes one-way and does not facilitate the diverse learning needs of students. This has an impact on low learning motivation, participation, and student learning outcomes.

The Role of Learning Media and LKPD

Learning media plays an important role in creating a fun and meaningful learning experience. Good media can bridge abstract concepts into more concrete ones and make it easier for students to understand complex materials. One form of effective learning media is the Student Worksheet (LKPD). LKPD is designed as a guide to learning activities that direct students to carry out certain activities independently or in groups.

Majid (2011) explains that LKPD is a learning tool that contains a series of tasks that must be done by students, which are systematically arranged according to basic competencies and learning objectives. LKPD that is designed in an interesting and interactive way can increase learning motivation because students feel more challenged and actively involved in the learning process. In addition, LKPD can also facilitate problem-based learning, experiments, or discussions that are relevant to real life.

Problem Based Learning (PBL)

One effective approach in designing LKPD is Problem Based Learning (PBL). PBL is a learning model that uses real problems as a starting point for building knowledge, skills, and attitudes. This model encourages students to learn actively, critically, and reflectively in solving the problems given. In PBL, teachers do not provide information directly, but rather provide problem scenarios that must be analyzed and solved by students through discussion and independent exploration.

Hmelo-Silver (2004) stated that PBL is effective in forming high-level thinking skills, such as analysis, synthesis, and evaluation. PBL also improves teamwork, communication, and learning responsibility. This is very important in the context of 21st century learning, which emphasizes mastery of the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity).

Previous studies have shown that the integration of PBL into LKPD can have a positive impact on student motivation and learning outcomes. Effendi (2021) stated that PBL-based LKPD can increase student learning engagement because they are more interested in solving real problems than just memorizing theories. Gusyanti (2021) also revealed that the application of PBL-based LKPD in chemistry subjects significantly improves student learning outcomes because it provides space for them to build concepts through direct experience.

METHODOLOGY

This research is a research and development (Research and Development) that refers to the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The research was conducted at SMA Negeri 19 Gowa in the odd semester of the 2024/2025 academic year, with the trial subjects being class XII MIA 1 consisting of 30 students.

The analysis stage is carried out through interviews, literature studies, and needs analysis to identify learning problems. The design stage includes the preparation of a PBL-based LKPD design and research instruments. At the development stage, the LKPD is prepared and validated by two experts. Furthermore, the implementation stage is carried out through limited trials in the classroom, accompanied by data collection through observation, questionnaires, and tests. Finally, the evaluation stage includes an analysis of the validity, practicality, and effectiveness of the LKPD developed.

The instruments used in this study include: LKPD validation sheets, LKPD implementation observation sheets, teacher and student response questionnaires, learning motivation questionnaires, and learning outcome tests in the form of multiple choice questions. The data obtained were analyzed descriptively quantitatively to assess the level of validity, practicality, and effectiveness of the developed products.

RESEARCH RESULT

Problem Based Learning (PBL) Based LKPD Development Process

a. Description of stage results *analysis* (Analysis)
   1) Results of student needs analysis

      Student analysis was conducted with the aim of finding out the problems often faced by students in the learning process. The results of learning observations show that in understanding the material taught, students tend to do it individually without going through discussions in small groups. Conventional learning that is more dominantly used by teachers makes students tend to be less active and less communicative during learning. LKPD that is usually used only contains practice questions that must be done by students individually.
   2) Curriculum analysis

      The curriculum applied in SMA Negeri 19 Gowa especially in class XII is the 2013 curriculum. Based on KI, KD and indicators, LKPD based on PBL will be developed. The PBL model was chosen because this model is one of the learning models recommended in the 2013 curriculum. In addition, in the PBL model, students are faced with contextual problems that are close to everyday life.

b. Description of stage results *design* (Design)
   1) Preparation of lesson plans

      The lesson plan is prepared based on the chemistry subject syllabus on corrosion material with the 2013 curriculum. Learning activities in the lesson plan are prepared according to the PBL model syntax, namely student orientation towards problems, organizing students to learn, guiding individual and group investigations, developing and presenting work results, analyzing and evaluating the problem-solving process.
   2) Preparation of Research Instruments

      The research instruments compiled are validity, practicality and effectiveness instruments. Validity instruments include RPP validation sheets, LKPD validation sheets, learning outcome test validation sheets, learning motivation questionnaire validation sheets, learning implementation observation validation sheets, teacher response questionnaire validation sheets and student responses to LKPD. Practicality instruments include learning implementation observation sheets, teacher response questionnaire sheets and student questionnaire sheets to LKPD. Effectiveness instruments include learning motivation questionnaire sheets and learning outcome test sheets.

3) LKPD product design

Product design is done by designing the cover, LKPD compilation format, and design template to be used. The LKPD cover is designed as attractively as possible using the Canva application so that it can attract the initial attention of students.

c. Description of stage results *development* (Development)

The activities carried out at this stage are expert validation and revision of validation results. This validation test was carried out by 2 validators who are experts in their fields. The following are some of the results of the validation of research instruments.

Table 1. Analysis of the Validity of PBL-Based LKPD, teaching tools and research instruments

No.	Aspect	Average Validity Value	Category
1.	Lesson Plan	3.93	Very Valid
2.	Worksheet	3.79	Very Valid
3.	Learning Outcome Test	3.83	Very Valid
4.	Learning Motivation Questionnaire	3.63	Very Valid
5.	PBL-Based LKPD Implementation Observation Sheet	3.83	Very Valid
6.	Teacher Response Questionnaire Sheet	3.83	Very Valid
7.	Student Response Questionnaire Sheet	3.83	Very Valid

d. Description of stage *results implementation* (Implementation)

This implementation stage is carried out to determine the level of practicality and effectiveness of the PBL-based LKPD that was developed.

1) Practicality test

Practicality test was conducted through observation and questionnaire responses from teachers and students. The observation results showed that the implementation of learning with LKPD was carried out entirely. The responses of teachers and students showed a practicality value above 80%, indicating that this LKPD is easy to use and effective.

Table 2. Analysis of the Practicality of PBL-Based LKPD

No.	Aspect	Mark	Category
1	Results of Observations on Learning Implementation	1.93	Completely Implemented
2	Teacher Response Perspective	95.24	Very Practical
3	Student Response Per Aspect	80.33	Very Practical

2) Effectiveness test

The effectiveness test was conducted using a learning motivation questionnaire instrument and a learning outcome test instrument. The learning motivation questionnaire was distributed at the beginning and end of the meeting, while the learning outcome test was administered at the end of the meeting.

a) Results of analysis of student learning motivation

The results of the analysis of students' chemistry learning motivation before and after participating in learning through PBL-based LKPD media as a whole were stated to have increased with an average value of 58.28 in the moderate category to 81.00 in the very high category.

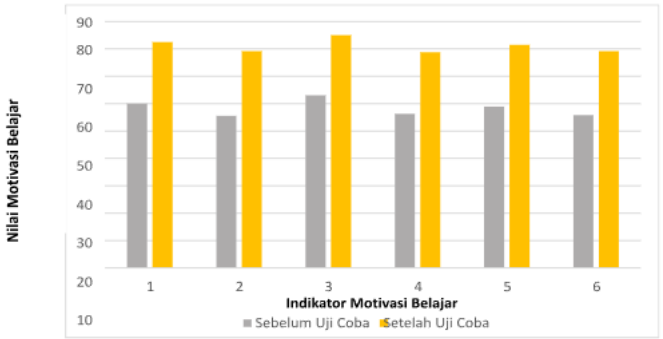

Figure 1. Percentage Diagram of the Results of the Analysis of Increasing Motivation Student Learning

Information:

1. There is a desire and will to learn.
2. There is a drive and need to learn.
3. Having hopes and dreams for the future.
4. There is appreciation in learning.
5. There are interesting activities in learning.
6. The existence of a conducive learning environment.

b) Results of learning outcome test analysis

The learning outcome test aims to determine the level of students' understanding of corrosion material after participating in learning using the PBL-based LKPD that was developed.

Table 3. Statistics of Student Learning Outcomes

No.	Variables	Statistical Values
1	Research Subject	30
2	Ideal Value	100
3	Maximum Value	95
4	Minimum Value	50
5	Average	83.53
6	Number of students who completed	26
7	Number of students who did not complete	4

Table 4. Distribution of Learning Outcome Test Completion

No	Category	Mastery Level	Frequency	Percentage
1	Completed	≥ 75	26	86.66
2	Not Completed	≤ 75	4	13.33
	Amount		30	100

Table 5. Completeness Category for Each Indicator

No	Indicator	Percentage (%)	Category
1	Explaining the meaning of corrosion	82.00	Completed
2	Mention examples of corrosion in everyday life	91.67	Completed
3	Explaining the effects of corrosion	83.30	Completed
4	Analyzing the factors that influence corrosion	80.66	Completed
5	Analyzing how to overcome corrosion	80.00	Completed
	Average Percentage (%)	83.53	Completed

The effectiveness test of LKPD in improving motivation and learning outcomes proves that the comparison of motivation scores and learning outcome tests before and after the implementation of LKPD shows a significant increase. The percentage of class completion reaches a minimum of 80%, while the motivation questionnaire shows a consistent increase in scores.

e. Description of stage results *evaluation* (Evaluation)

The evaluation stage is the final stage in research and development. Evaluation is carried out at every stage of the process from the analysis stage to implementation.

DISCUSSION

The process of developing PBL-based LKPD uses the ADDIE development model which consists of five stages, namely the analysis, design, development, implementation, and evaluation stages. This study aims to determine the quality of the PBL-based LKPD produced including validity, practicality, and effectiveness to improve student motivation and learning outcomes in the main material of corrosion.

Validity

a. Lesson plan

The validation of the lesson plan was carried out by two expert validators who are competent in their fields. The assessment aspects consist of the lesson plan format, the material (content) presented, the language and the time allocation. The results of the validation analysis of the lesson plan in Table 1 show that the average assessment from the two validators is 3.93 with a very valid category. This means that the lesson plan is very feasible to use because it is in accordance with the expected lesson plan format and the learning steps are in accordance with the PBL model.

b. PBL Based LKPD

The aspects of the assessment of the validity of LKPD consist of aspects of the curriculum, truth of content, presentation of content, multimedia presentation, process of use, language suitability, design/image display, benefits or usefulness of LKPD. Based on Table 1, the average validity value is 3.79 with a very valid category. This means that the PBL-based LKPD developed is suitable for use in the learning process. It is necessary to add introductory material related to the learning topic to be studied and more interesting images.

Research on the development of PBL-based LKPD conducted by Astuti (2018) obtained validation analysis results of 3.43 with a very valid category so that LKPD is suitable for use. Similar research was also conducted by Abdillah and Dwi (2020) stating that LKPD according to expert assessments has met the validity criteria with an average assessment of 3.6

c. Research instruments

The next validity test is the validity test of the research instrument. The results of the validation of the research instrument obtained indicate that all instruments meet the valid category and are very feasible to be used in research.

Practicality

In general, the trial results for the practicality of PBL-based LKPD were obtained from observation sheets of learning implementation, teacher and student responses.

a. Implementation of Learning through the PBL Model
   Practicality in terms of learning implementation can be met if learning takes place and is in the minimally implemented category. Data on the implementation of PBL-based LKPD media was obtained through observations by two observers, namely chemistry teachers. The results of observer observations at each meeting were then analyzed and an average value of M = 1.94 was obtained in the category ($1.5 \leq M \leq 2.0$) in table 2, which means that the implementation of learning is in the fully implemented category, so that the implementation aspect meets the criteria for practicality. The results of this study are in line with the results of Nafisah's research (2023), namely research on the implementation of the Al-Qur'an integrated PBL model which went very well with an implementation percentage of 90.3%. Another study by Mega (2016) found that the implementation of the PBL model went well and there was an increase in students' science process skills at each meeting. This means that each phase or syntax of the PBL model was implemented well.
b. Teachers' Responses to PBL-Based LKPD
   The teacher response questionnaire contains statements regarding the developed LKPD. From the results of data analysis in Table 2, the average teacher response obtained was 95.24% with a very practical category. This means that the LKPD that has been developed is practical and can be used in PBL-based chemistry learning. There are three aspects assessed in the teacher response questionnaire, namely the content of the material, appearance, and impact of PBL-based LKPD in learning.
   In addition to the assessment, there were responses conveyed by teachers who were respondents that PBL-based LKPD media were very helpful and made it easier for students to learn chemistry because of its attractive appearance and practical use. The results of this study are in line with the results of the study by Triana et al. (2021), namely that a percentage of 89% was in the very good category for use in learning activities. A similar study was conducted by Putri & Suryani (2023) which showed that both teachers and students gave very positive responses to the teaching materials, with a high percentage of agreement.
c. Student Responses to PBL-Based LKPD
   The results of the data analysis in Table 2 show that the average student response obtained was 80.33% with a very practical category. This means that the LKPD that has been developed is practical and can be used in PBL-based chemistry learning. In line with research conducted by Juniar et al. (2022), the student response questionnaire regarding the attractiveness and ease of the PBL-based LKPD developed was 88.09% with a very good category. Zai & Ulianas (2023) also obtained student response results in the very practical category with a percentage of 83%.

Effectiveness

The effectiveness of the developed media is based on the results of motivation questionnaires and student learning outcome tests.

a. Student Learning Motivation

Student learning motivation is measured through indicators of learning motivation both internally and externally, namely: (a) the desire and desire to succeed; (b) the drive and need to learn; (c) the hope and ideals for the future; (d) the appreciation in learning; (e) the existence of interesting activities in learning; and (f) the existence of a conducive learning environment that allows students to learn well (Uno, 2023). The results of the learning motivation questionnaire obtained before the learning process using PBL-based LKPD in Figure 1 were 58.28 with a moderate category, while the value after learning using PBL-based LKPD was 81.00 with a very high category. This shows that there is an increase in student learning motivation after being taught using PBL-based LKPD. The increase in students' learning motivation is due to the use of PBL-based LKPD which can attract students' attention to learn because of its attractive appearance, equipped with the presentation of problems accompanied by images that are contextual to students' daily lives so that students are motivated to solve the problems presented. In addition, the problem-solving process is carried out collaboratively so that learning is more interactive and students do not easily get bored in learning. This is in line with the research of Puspita and Dewi (2022) that the use of LKPD in learning will make students' learning activities more active, fun, interactive, and provide opportunities to practice and increase students' learning motivation. The results of the study by Artini et al. (2023) also stated that learning using LKPD media is quite effective in increasing students' learning motivation.

b. Student Learning Outcomes

The effectiveness of PBL-based LKPD can also be seen from the learning outcome test which aims to determine the level of students' understanding of corrosion material after participating in learning using PBL-based LKPD. Table 3 shows that the learning outcomes of class XII MIA 1 students of SMA Negeri 19 Gowa obtained an average score of 83.53 with the highest score of 95 and the lowest score of 50. Based on the results of the analysis in table 4, it shows that out of 30 students who took the learning outcome test, 86.66% of students completed it and 13.33% of students did not complete it. This means that class completion, which is at least 80%, has been achieved with a KKM value of 75 for individual completion. The results of the completion of each competency achievement indicator (Table 5) show that all indicators are in the complete category.

The individual and class completions obtained in this study indicate that PBL-based LKPD is effective in improving student learning outcomes. This success is due to the presentation of LKPD which is adjusted to the syntax of the PBL model which can provide meaningful learning and make it easier for students to understand the material being studied. This is supported by the presentation of introductory material in LKPD accompanied by contextual images and simple language so that students can easily understand. In addition, the presentation of problem orientation through discourse and real problems with examples that are closely related to students' daily lives. Various problems that are taken are close to students' lives which will make students understand the concept fundamentally, not just memorizing concepts in books so that it can improve students' understanding. The stages in PBL are able to provide students with learning experiences so that learning indicators can be achieved properly.

This is in line with research by Juniar et al. (2022) which states that the implementation of PBL-based LKPD is effective in improving students' cognitive learning outcomes. Lase & Lase (2020) in their research also concluded that the use of PBL-based LKPD in learning is said to be successful and effective.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research that has been conducted, the following conclusions can be drawn:

1. The PBL (Problem Based Learning) based LKPD that has been developed is in the very valid category.
2. The practical PBL (Problem Based Learning) based LKPD that has been developed is in the very practical category.
3. The PBL (Problem Based Learning) based LKPD that has been developed effectively increases the motivation and learning outcomes of students at SMAN 19 Gowa.

Based on the results obtained in this study, several suggestions are put forward as follows:

1. In implementing LKPD based on PBL (Problem Based Learning), teachers must understand the learning stages according to the syntax of the PBL (Problem Based Learning) model so that it can be implemented optimally according to the time allocation available.
2. Pay attention to the content of the problem that will be included in the orientation section.
3. There needs to be further research on the development of LKPD on learning materials and models.

ADVANCED RESEARCH

This study has limitations in the scope of the material which only covers the topic of corrosion and the implementation of the trial which is limited to one class in one school, so the results cannot be generalized. Therefore, it is recommended that further research develop PBL-based LKPD on other chemical materials by involving more schools and students, and integrating other learning approaches or media to test its effectiveness more broadly and deeply.

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