



Development of Student Worksheets for Chemistry Experiments Based on Socio-scientific Issues

Disa Putri Anggianti^{1*}; Abdullah²; Herdini³

^{1,2,3}Departemen of Chemistry Education, Universitas Riau, Indonesia

^{1*}Corresponding Email: disaputrianggianti@gmail.com

Article History:

Received: Jun 20, 2025

Revised: Aug 17, 2025

Accepted: Dec 12, 2025

Online First: Jan 05, 2026

Keywords:

Chemical Experiment,
Socio-scientific Issue,
The Student Experiment
Worksheet.

Kata Kunci:

Eksperimen Kimia,
Lembar Kerja Peserta Didik
Eksperimen,
Socio Scientific Issue.

How to cite:

Anggianti, D. P., Abdullah, A., & Herdini, H. (2026). Android-Based Media for Enhancing Critical Thinking in Elementary Science: A Systematic Review. *Edunesia : Jurnal Ilmiah Pendidikan*, 7(1), 216-231.

This is an open-access article under the CC-BY-NC-ND license



Abstract: Learning plays an essential role in shaping students' understanding, but many teachers still use conventional methods that are less varied, leading to less enjoyable and unmotivating learning, especially in chemistry subjects. The observations indicate a lack of teaching materials and chemical experiments that could improve students' understanding and motivation. This study aims to develop a valid Chemistry Experiment Student Worksheet for Grade XI that addresses socio-scientific issues and to examine user responses to the worksheet. The research model used is a 4-D model consisting of 4 stages: define, design, develop, and disseminate. The results of this study are in accordance with the assessments of 2 material expert validators and one media expert validator, namely the Chemistry Experiment Student Worksheet Based on Socio-Scientific Issue, which obtained percentages of 98.4375% and 100%, respectively, and were categorized as valid. This means that the Experiment Student Worksheet developed is suitable for use. The Student Worksheet for Chemistry Experiments Based on Socio-scientific Issue also received a positive response from users, with 92.96% and 87.91% of teacher and student responses, respectively, in the good category.

Abstrak: Pembelajaran berperan penting dalam membentuk pemahaman peserta didik, namun banyak guru masih menggunakan metode konvensional yang kurang bervariasi, mengarah pada pembelajaran yang kurang menarik dan tidak memotivasi, terutama dalam mata pelajaran kimia. Hasil observasi menunjukkan kurangnya bahan ajar dan eksperimen kimia yang dapat meningkatkan pemahaman dan motivasi peserta didik. Penelitian ini bertujuan untuk mengembangkan Lembar Kerja Peserta Didik Eksperimen Kimia Kelas XI Berbasis *Socio Scientific Issue* yang valid serta mengkaji respon pengguna terhadap Lembar Kerja Peserta Didik Eksperimen Kimia Kelas XI Berbasis *Socio Scientific Issue*. Model penelitian yang digunakan adalah pengembangan model 4-D yang terdiri dari 4 tahap yaitu; define (pendefinisian), design (perancangan), develop (pengembangan), dan disseminate (penyebarluasan). Hasil penelitian ini sesuai dengan penilaian 2 orang validator ahli materi dan 1 orang validator ahli media yaitu Lembar Kerja Peserta Didik Eksperimen Kimia Berbasis *Socio Scientific Issue* secara berturut-turut mendapatkan persentase sebesar 98,4375% dan 100 % dikategorikan valid. Artinya Lembar Kerja Peserta Didik Eksperimen yang dikembangkan layak digunakan. Lembar Kerja Peserta Didik Eksperimen Kimia Berbasis *Socio Scientific Issue* juga mendapat respon positif dari pengguna dengan persentase respon guru dan peserta didik secara berturut-turut sebesar 92,96% dan 87,91% dengan kategori baik.

A. Introduction

Learning plays a crucial role in shaping students' understanding. However, in practice, many teachers still use conventional learning methods that tend to be monotonous and teacher-centred. This approach often emphasizes theoretical instruction without providing students with opportunities to apply concepts in real-world contexts. Based on a preliminary survey conducted by researchers of chemistry teachers at several high schools in Pekanbaru, approximately 75% of teachers reported still using the lecture method as their primary teaching method, and only 15% routinely incorporate experiments into their teaching.

Ideally, chemistry learning should not only focus on conceptual understanding but also require students to apply scientific concepts to solve real-world problems they encounter. However, in reality, classroom chemistry learning still seems theoretical and lacks relevance to students' real-world situations. This leaves students feeling detached from meaningful learning contexts and tending to view chemistry as a problematic and uninteresting subject. Chemistry experiments have the potential to serve as a bridge to make learning more contextual, but their implementation remains very limited. Experiments are often not carried out due to limited teaching materials, tools, and teachers' skills in designing relevant and engaging practical activities.

The results of observations and interviews conducted by researchers with chemistry teachers in grade XI of SMA Negeri 6 Pekanbaru and SMA Negeri 9 Pekanbaru revealed a lack of chemistry teaching materials. Therefore, students have difficulty learning independently, which reduces the development of their ability to construct knowledge independently. Teachers also stated that student motivation for learning remains low, partly due to the lack of student-led chemistry experiments. In one semester, no experiments were conducted during the teaching, even though experiments are an effective way to increase students' understanding and motivation. However, teachers also struggle to design engaging, relevant experimental activities related to the material being taught. In addition, educators also stated that limited tools and materials for conducting experiments are a significant challenge. The lack of alignment of practical activities with chemical ideas and students' passive participation in the learning process, which places the teacher at the centre of learning, leads students to receive only concepts from the teacher's teaching materials. Based on analysis of daily test scores from both schools, 65% of students have not met the learning objectives for acid-base material taught using conventional methods without experiments or other supporting media. This shows that a learning approach that lacks interaction and exploration not only reduces interest in learning but also significantly affects student learning outcomes, characterized by weak conceptual understanding, difficulty applying knowledge in authentic contexts, and a lack of critical thinking and problem-solving skills.

The teaching materials currently available still emphasize content rather than attitude and context, so learning remains limited to textual content. Learning that remains textual will make it difficult for students to link scientific knowledge to real problems

around them. Therefore, many researchers are developing innovative teaching materials, such as Student Worksheets.

Student Worksheets (LKPD) are a type of printed teaching material often used by teachers in the learning process (Dermawati, 2019). According to the Kemendikbud (2013), student worksheets are sheets containing tasks for students to complete. Activity sheets are usually in the form of instructions or steps to complete a task. Student worksheets (LKPD) are one means of facilitating teaching and learning, enabling effective student interactions and increasing student engagement to improve learning achievement. Student worksheets are one of the learning resources that educators can develop as facilitators in learning activities. The LKPD can be designed and developed based on the conditions and situations encountered during the learning activities (Umbaryati, 2016).

Student Worksheets (LKPD) help students understand the material and measure their understanding. LKPD facilitates active, independent learning through teacher-given questions or assignments. Through LKPD, students are trained to think critically, analytically, and creatively, while teachers can assess students' understanding in a structured manner. LKPD is often applied in experiment-based learning to create an in-depth learning experience.

LKPD consists of several types, according to Dewi (2020). There are two types of LKPD in the teaching and learning process: experimental and non-experimental. Experimental LKPD contains practical instructions. The sections of this LKPD are: title, introduction, objectives, tools and materials, work steps, observation tables, and questions. At the same time, non-experimental LKPD contains materials that guide discussions. This type of LKPD is called DART (DirectDirect Activity to Relate to the Test Book), which consists of several activities related to the continuity of concepts in the form of discourse or text.

LKPD can be developed into an experimental LKPD by adding more specific elements, such as experimental steps, data collection procedures, and analysis of results. Experimental LKPD aims to provide students with opportunities to further explore scientific concepts through direct experience in designing and conducting experiments, thereby honing their practical and critical thinking skills. The use of this experimental LKPD is essential, especially in chemistry experiments.

Chemistry experiments will be more interesting and significant if they are connected to students' real-world problems. This allows students to get the material directly rather than just listening to the teacher explain the theory. Thus, chemistry experiments are needed to encourage students' interest and enthusiasm in learning chemistry. Therefore, the experimental LKPD must be relevant to everyday life; this aims to make it easier for students to understand the subject matter. Experimental LKPD related to everyday life is an experimental LKPD based on a Socio-Scientific Issue.

The student-oriented learning approach emphasizes students' dominance during learning activities, with teachers serving only as facilitators, mediators, guides, and leaders. Its characteristics are student-oriented, with diverse learning and the use of various

resources, methods, media, and strategies alternately, so that during the learning process, students actively participate both individually and in groups (Sanjaya, 2016). One approach that is oriented towards students is socio-scientific issues.

The SSI approach can make students more interested, motivated, active, and more understanding during classroom teaching and learning activities (Khasanah, 2022). SSI is an approach to delivering science content on social issues that incorporates ethical and moral principles. SSI contextual learning enables students to analyze and investigate social problems related to science (Kartika, 2019).

Socio-scientific Issues (SSI) refers to problems, issues, and information in the community that stimulate students to solve them. Learning with the SSI approach connects science content to students' real-life context, making it easier for them to discuss science in relation to real problems.

SSI-based learning is a learning approach that studies phenomena or controversial issues related to science and problem-solving activities whose solutions are relatively or perhaps uncertain. In SSI-based learning, complex thinking is needed to widely and openly disseminate scientific concepts (Amalia, 2021).

The SSI-based learning approach creates opportunities for each student to think critically and discuss science material. SSI-based learning is an instructional strategy that examines facts, phenomena, or events related to social issues in students' lives. Using the SSI approach allows students to think critically across different views (Sismawarni, 2020).

Student Worksheet Experiment based on a Socio-Scientific Issue is designed to improve students' understanding through scientific, social, and integrative approaches that connect scientific concepts with everyday life. This aims to develop critical, collaborative, and reflective skills in the experimental learning process.

Tukan (2020) research on "Development of Environmentally Based Chemistry Practical Worksheets on Reaction Rate Material" indicates that this worksheet is worth testing, with strong endorsements from material and media experts and positive student responses. Arif (2020) research on "Development of Green Chemistry-Based Chemistry Practical Guidelines for Grade XII IPA SMA" shows that chemistry practicals can be improved by using environmentally friendly materials, thereby increasing learning motivation and making learning more meaningful. Moreover, Khasanah (2022) research on "Implementation of the Socio-scientific Issues Approach Assisted by E-LKPD on Additive Material" shows that this approach can improve students' scientific literacy, as evidenced by increases in pretest and posttest scores and by paired t-tests.

Therefore, the novelty of this research lies in the development of an experimental Student Worksheet (LKPD) for chemistry learning that is explicitly based on the Socio-scientific Issues (SSI) approach. Unlike conventional LKPDs that emphasize procedures, this LKPD is designed to combine practical laboratory work with socio-scientific analysis. It enables students to explore scientific concepts through experiments while simultaneously addressing socially relevant problems, thereby fostering critical thinking, collaboration, and ethical reflection. This innovation is expected to address the dual problems of monotonous

teaching methods and the lack of contextual teaching materials in chemistry learning, ultimately enhancing students' understanding, motivation, and scientific literacy.

This study is guided by the following research questions: (1) What are the needs of teachers and students for chemistry experiment worksheets that are relevant to real-life socio-scientific contexts? (2) How can a Socio-scientific Issues (SSI)-based chemistry experiment student worksheet (LKPD) be designed and developed to encourage students' critical thinking and active participation in learning? (3) To what extent is the developed SSI-based chemistry experiment worksheet valid in terms of content, media, and pedagogical aspects? and (4) How practical is the developed worksheet based on teachers' and students' responses during a limited trial?. Accordingly, this research generally aims to develop a SSI-based chemistry experiment student worksheet that is valid, practical, and effective as a contextual teaching material to support chemistry learning in Grade XI of senior high school or its equivalent. Specifically, this study aims to analyze teachers' and students' needs for contextual teaching materials, design and develop a SSI-based chemistry experiment worksheet that fosters critical thinking and active engagement, examine its validity through expert judgment in content, media, and pedagogy, evaluate its practicality based on teacher and student responses, and assess its effectiveness in enhancing students' conceptual understanding and scientific literacy.

B. Method

The research used is development research, designed using the 4-D model of Research and Development (R&D). The 4-D development model is a learning device development model. This model was developed by Thiagarajan et al (1974). The 4-D development model consists of 4 main stages: Define, Design, Develop, and Disseminate. Researchers chose to use the 4-D (Define, Design, Develop, Disseminate) development model because it is specifically designed for developing learning tools such as LKPD. Compared to other models such as ADDIE or Borg & Gall, the 4-D model is more straightforward, more focused, and more efficient. Its stages start from needs analysis to validated product development, making it suitable for creating contextual and innovative teaching materials. This model also enables systematic product evaluation and revision, ensuring that the final results are more relevant to students' needs and classroom learning. The complete stages are shown in Figure 1.

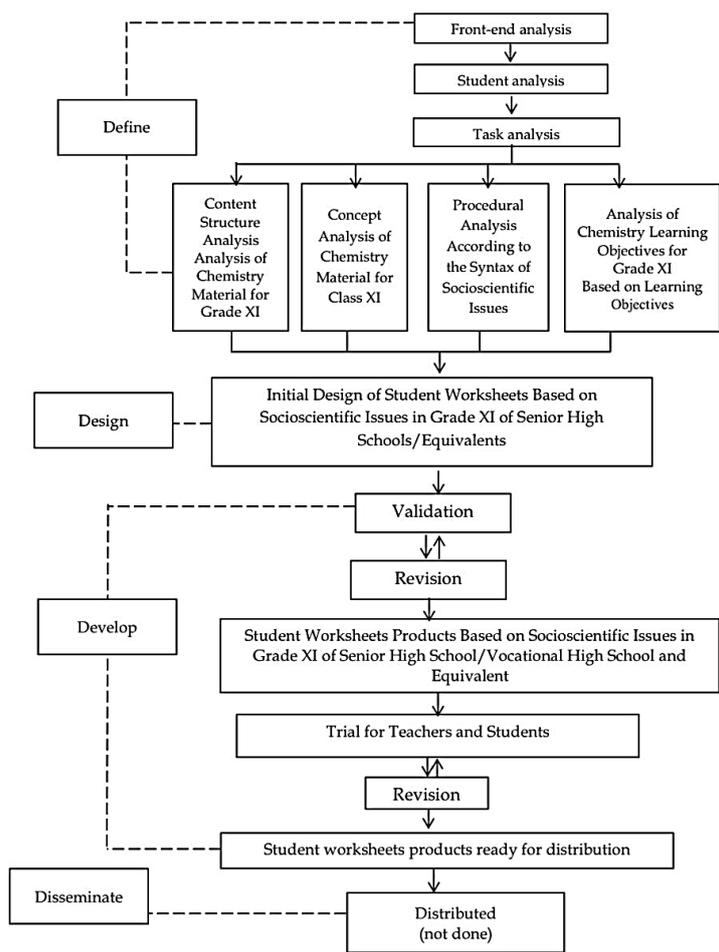


Figure 1. Complete 4-D Stages

The sample in this study consisted of 20 grade XI students from SMA/MA or equivalent. The data collection techniques used were interviews, validation sheet data, teacher response data, and student response data. The data analysis techniques used were validation and user response tests.

C. Result

Define Stage

The front-end analysis conducted yielded interview data with chemistry teachers at SMA Negeri 9 Pekanbaru and SMA Negeri 6 Pekanbaru, as shown in the appendix. The information obtained covers various aspects of the learning process, including the implementation of practicums, assessment of learning outcomes, the learning resources used, the availability of facilities, and the obstacles encountered.

Based on the pre-study results, students still demonstrated limited understanding of the material, as evidenced by their difficulties following lessons and completing assigned tasks. In addition, the lack of involvement in chemical experiments prevented students from gaining direct experience that could strengthen their understanding of concepts in real

terms. The learning process was still minimal because it relied solely on textbooks as its teaching materials, without any variation in media or an interactive approach. As a result of these various obstacles, only about 50% of students achieved grades in line with the KTTP. The analysis of students, conducted in an unstructured manner based on observations and interviews, showed that the users of the SSI-based Chemistry Experiment Student Worksheet were high school students aged 16-18. According to Piaget's Theory, this age range enters the formal operational stage. At this stage, students begin to think about experiences more abstractly, idealistically, and logically, and can solve verbal problems (Hafiz, 2023).

Task Analysis consists of a content structure analysis of the Chemistry Experiment LKPD, produced in accordance with the independent curriculum syllabus, resulting in Learning Achievements (CP), Learning Objectives (TP), Experiment Objectives, and Learning Objective Achievement Indicators (IKTP) related to the material developed. The Chemistry Experiment LKPD developed is designed based on the sequence of material that is suitable for class XI material; concept analysis contains identification of the main concepts produced from concept analysis in accordance with the introductory chemistry independent curriculum for class XI SMA/MA and arranges them systematically and links the concepts to produce a concept map; The results of the procedural analysis obtained based on the Socio Scientific Issue approach which has four stages, namely the Scientific Background stage; Evaluation of Information; Local, National, and Global Dimension; and Decision Making; The results of the objective analysis are to formulate the experimental objectives to be achieved based on Learning Achievements (CP), Learning Objectives (TP), Experiment Objectives, and Learning Objective Achievement Indicators (IKTP) in the content structure analysis.

Design Stage

The design stage produced an initial design of the Chemistry Experiment Student Worksheet, validation sheet, and user response questionnaire.

The preparation of the initial design of the Chemistry Experiment Student Worksheet based on SSI in Grade XI resulted in a draft of the Chemistry Experiment Student Worksheet containing the title of the LKPD, Learning Achievements, Learning Objectives, Experiment Objectives, and Student Activities in the LKPD.

Experiment LKPD Title:

Table 1. Activity titles in LKPD

Title of Student Worksheet	SSI-Based Chemistry Experiment Student Worksheet
LKPD 1	Determination of River Water Properties Using Acid-Base Indicators
LKPD 2	Determination of Soil Properties Using Young Oil Palm Fruit Flesh Extract Indicator
LKPD 3	Determination of Excess Base Levels in Detergents

Learning Outcomes, Learning Objectives, and Experimental Objectives.
Student Activities in LKPD:

Table 2. Stages of Student Worksheets for SSI-based Chemistry Experiments

Stage	Contents
Scientific Background	In the Student Experiment Worksheet, the Scientific Background stage includes issues related to the Experiment to be carried out.
Evaluation of Information	In the Experiment Student Worksheet, the Evaluation of Information stage provides details on the tools, materials, and methods for the Experiment.
Local, National, and Global Dimension	The Student Worksheet for the Local, National, and Global Dimension Experiment contains information about the impacts that will result from the Experiment.
Decision Making	In the Student Experiment Worksheet, the Decision Making stage contains the conclusions that can be drawn from the experiments.

Before being validated against the SSI-based Chemistry Student Worksheet validator, the researcher tested all experiments in the laboratory. After validating it against the validator, the researcher conducted a teacher response test and tested it with students.

The validation sheet is used as a data collection instrument to assess the validity of the LKPD, which consists of validation sheets from material and media experts. The assessment aspects in the material expert validation sheet include material, construction, language, graphics, practicality, and didactic aspects. In contrast, the media expert validation sheet includes display feasibility.

The user response questionnaire consists of a teacher response questionnaire and a student response questionnaire, each composed of several aspects with statements designed to elicit responses from teachers and students regarding the use of the Experimental LKPD.

Development Stage

The results of the development stage are valid SSI-based Chemistry Experiment Student Worksheets for Grade XI of SMA/MA and equivalent schools. The following is a description of the results of the development stage.

LKPD Validation

Material Expert Validation:

Table 3. Recapitulation of Expert Material Assessment Data

Number	Assessment Aspects	Validation Score Percentage (%)	Category
1	Material Aspects	100	Valid
2	Construction Aspects	100	Valid
3	Language Aspects	100	Valid
4	Graphic Aspects	90,625	Valid
5	Practical Aspects	100	Valid
6	Didactic Aspects	100	Valid

Number	Assessment Aspects	Validation Score Percentage (%)	Category
	Average Percentage Score	98,4375	Valid

To obtain optimal final validation results, the researcher made several revisions to the developed chemistry experiment worksheets (LKPD). These revisions included adding more detailed information to the scientific background section, including the number of tools and materials used, relevant images, and appropriate chemical elements. For the Experiment involving the extract of young oil palm fruit flesh, the extract was prepared in advance to improve time efficiency during implementation. Additionally, typographical errors were corrected, foreign terms were italicized, and the cover design was adjusted to better align with the experimental content. The worksheets were also systematically numbered in the order of the material: LKPD I, LKPD II, and LKPD III. A summary of the material was added to the scientific background section to strengthen students' conceptual understanding prior to the Experiment. These revisions were made based on feedback from validators to enhance the quality and feasibility of the LKPD before classroom use.

The average percentage score on the aspects of material, construction, language, graphics, practicality, and didactics after revision is 100%; 100%; 100%; 90.625%; 100%; and 100%, respectively, with valid criteria.

Media Expert Validation

Table 4. Recapitulation of Media Expert Assessment Data

Number	Assessment Aspects	Validation Score Percentage (%)	Category
1	Display Eligibility Aspect	100 %	Valid
	Average Percentage Score	100%	Valid

To obtain the final validation results, the researcher made the following revisions: aligning the cover with the LKPD content, standardizing the LKPD template, and adding the institutional identity. The institutional identity has already been included in the LKPD.

The average percentage score for the appearance feasibility aspect after revision was 100%, meeting the validity criteria.

Teacher Response Test

The teacher response test was conducted by two chemistry teachers, including one at SMA N 9 Pekanbaru and one at SMAN 6 Pekanbaru.

Table 5. Recapitulation of Teacher Response Test Data

Assessment Aspects	Average Score of Teacher Responses (%)	Criteria
Content Eligibility	100	Very good
Effectiveness	96,875	Very good
Practicality	87,5	Very good
Attraction	87,5	Very good

Assessment Aspects	Average Score of Teacher Responses (%)	Criteria
Average percentage of total score	92,96 %	Very good

The average assessment score was 92.96%, placing it in the excellent category. Based on this assessment, the SSI-based Chemistry Experiment Student Worksheet has been made well.

Small Group Trials

Small-group trials were conducted with 20 students, namely 10 from SMAN 9 Pekanbaru and 10 from SMAN 6 Pekanbaru. The identities of the small-group trial students are listed in the appendix. The respondents selected for the trial were grade XI students of SMA/MA or equivalent.

Table 6. Recapitulation of Small Group Trial Data

Assessment Aspects	Average Score of Student Responses (%)	Criteria
Attraction	89,58	Very good
Effectiveness	85,41	Very good
Practicality	88,75	Very good
Average percentage of total score	87,91%	Very good

The student response assessment had an average score of 87.91%, placing it in the excellent category. The average percentage of the total score is the final result of the small group trial.

D. Discussion

The product resulting from this development research is the Chemistry Experiment Student Worksheet based on Socio-Scientific Issues in Grade XI of SMA/MA Equivalent, which has been validated. The assessment was carried out twice for each validator, and the data used were the results of the last validation, as each aspect was analyzed separately. The following is a description of the validation discussion by material experts and media experts.

The material aspect of the Experimental LKPD based on SSI obtained a validation result of 78.125% in the valid category, but the validator still provided suggestions for improvement. The validator suggested adding more detailed information to the scientific background section to give students a broader picture. The more reading sources provided, the more insight and knowledge students can gain. This aligns with Samsinar (2019) statement that learning resources will increase learning productivity for both educators and students, as well as motivation and interest in learning. After being revised, the material aspect obtained a second validation percentage of 100% in the valid category.

The first validation result for the construction aspect showed a 77.08% valid category, but there was room for improvement. The validator suggested adding the number of tools and materials used to clarify the information presented in the Experimental LKPD and make it easier for students to conduct experiments. This is in accordance with Jayantri

(2017) statement that one of the important requirements in compiling LKPD is the construction requirement for language mastery, sentence structure, vocabulary, level of difficulty, and clarity. After the improvements were made, the percentage obtained in the second validation was 100% with a very valid category. In addition, LKPD's usefulness in the learning process is to make it easier for students and teachers to carry out teaching and learning activities (Nurlian, 2023).

The language assessment in the first validation obtained a 75% score in the reasonably valid category. The validator suggested fixing typos and italicizing words in foreign languages contained in the Experimental LKPD. After improvements, the final validation results for the language aspect showed a 100% validity rate, with a very high validity category. Based on the validity value of the language aspect, it shows that the LKPD has used the correct and proper Indonesian language rules; the words or sentences used are in accordance with the level of students' abilities; and the spelling of the words used is in accordance with EYD, making it easier for students to learn (Rahman, 2019).

The first validation of the graphic aspect yielded a score of 68.75%, indicating a reasonably valid category. However, the validator provided several improvements, namely adding images and appropriate chemical elements to the Experimental LKPD and adjusting the cover to the material to be carried out in the Experiment, so that students were more interested in the display. After making improvements and conducting the second validation, the final percentage obtained was 100% with a very valid category. This shows that the Experimental LKPD already has attractive images and aligns with the material presented. The use of attractive images/illustrations can help students understand, interpret, and facilitate the material being studied (Muhibbullah, 2022).

The first validation of the practicality aspect yielded a 82.5% value in the valid category. However, the validator suggested improvements, namely that the LKPD should be assigned a number sorted by material. In the LKPD whose Experiment uses oil palm fruit flesh extract, the extract should be provided to shorten the LKPD processing time. The preparation of the work steps for the Experimental Student Worksheet is carried out concisely to shorten the processing time. In addition, the LKPD presentation is structured: it is systematically arranged according to the learning sequence or the logical flow of the material. To make it easy for students to understand, this aligns with Prastowo's statement in Rosmana (2024). One of the functions of LKPD is as a concise teaching material; its presentation is structured so that students can understand the subject matter. After the revision, the practicality aspect achieved 100% validity.

The didactic aspect received a first validation percentage of 75% in the reasonably valid category, but there were some areas for improvement. The validator suggested adding a brief overview of the material as an initial introduction before starting the Experiment, which was added to the scientific background section. Providing an initial overview before learning or conducting an experiment is very important because it can help students build a foundation of knowledge. With this initial knowledge, students will be better prepared cognitively to receive new information, understand concepts, and carry out learning

activities more effectively. This also makes it easier for students to connect theory with practice, so that the implementation of the Experiment becomes more meaningful and focused. In learning, students' initial knowledge has a significant role. As an implication, educators need to understand and accommodate this in the form and design of appropriate learning. Initial knowledge is important because it makes it easier for students to learn (Hasanuddin, 2020).

The feasibility aspect of the display in the first validation obtained a 83.3% valid category. However, the validator suggested improvements, namely aligning the LKPD cover with its contents, standardizing the LKPD template, and adding agency identity to the LKPD cover. After the improvements were made, the second validation returned 100% validity. This proves that each element of the LKPD must be clear. In accordance with Sihafudin (2020) statement, the linguistic aspect is essential in LKPD because language serves as the primary means for students to understand the existing information. Jayantri (2017) opinion states that one of the important requirements in compiling LKPD is the construction requirement for language mastery, sentence structure, vocabulary, level of difficulty, and clarity. Moreover, the use of interesting images/illustrations can help students understand, interpret, and simplify the material being studied (Muhibbullah, 2022).

Two chemistry teachers conducted the teacher response test: one at SMA N 9 Pekanbaru and one at SMAN 6 Pekanbaru. The Chemistry Experiment Student Worksheet that had been given was then observed and assessed by the chemistry teacher using the provided response questionnaire. The teacher response test was conducted directly. The teacher's response contained 11 questions, including aspects of content feasibility, effectiveness, practicality, and attractiveness. The overall results of the teacher response test were excellent, with 92.96% in the excellent category. According to the chemistry teacher, the SSI-based Chemistry Experiment Student Worksheet, which was developed, motivated students to learn, as it linked to everyday life. This aligns with Sismawarni (2020), who states that SSI-based learning is an instructional strategy that examines facts, phenomena, or events related to social issues in students' lives. Using the SSI approach allows students to think critically and consider different views.

Small-group trials were conducted with 20 students: 10 from SMA N 9 Pekanbaru and 10 from SMAN 6 Pekanbaru. Student responses have three aspects: interest, effectiveness, and practicality. The overall student responses were very positive, with 87.91% in the excellent category. User responses to the SSI-based Chemistry Experiment Student Worksheet showed a high average percentage, indicating that it is highly feasible and practical as a teaching material in Class XI.

Testing the validity of the SSI-based Chemistry Experiment Student Worksheet is an important step before assessing its effectiveness. This study was limited to the trial stage in small groups, in accordance with the primary objective, namely to develop and evaluate user responses to the SSI-based Chemistry Experiment Student Worksheet in Grade XI of

SMA/MA. The final product of this development has the potential to be applied on a broader scale through further research.

However, the researcher encountered several difficulties during this study. The first challenge was finding a suitable lecturer validator who was willing to provide constructive feedback on the developed product. The second difficulty involved designing experiments that effectively connect the experimental activities with everyday life contexts, making the material more relevant and easier for students to understand. This challenge required creativity and careful consideration to ensure that the experiments were not only theoretical but also practical and applicable to students' real-life experiences.

E. Implication

The development of an SSI-based chemical experiment, LKPD, can improve students' critical thinking skills, scientific literacy, and social and environmental awareness. Students are invited to analyze real-world issues, evaluate evidence, and make responsible scientific decisions. The implementation of this LKPD has the potential to foster more meaningful, contextually relevant learning experiences, especially when applied consistently across diverse educational settings. However, this approach also requires active student participation and appropriate teacher guidance to be effective. Teachers play a crucial role not only in facilitating learning but also in providing constructive feedback to support the continuous improvement of the LKPD. In the long term, the consistent use of SSI-based LKPD can support the development of scientifically literate individuals who are socially responsible and environmentally conscious, provided that educators receive sufficient training and institutional support.

F. Limitation and Suggestion for Further Research

Research on the development of the Chemistry Experiment Student Worksheet (LKPD) based on Socio-Scientific Issues (SSI) for Grade XI SMA/MA equivalent was conducted only through validation and limited trial stages. Therefore, the researcher recommends that this study proceed to the large-group trial and dissemination stages to evaluate the effectiveness of the developed LKPD more comprehensively. Potential challenges that may arise in further stages – such as differences in school conditions, limited facilities, and teacher readiness – should be carefully considered in future research. To enhance the quality and long-term impact of the LKPD, future studies should expand the sample size, include schools with diverse backgrounds, and assess the sustained effects of implementing SSI-based LKPD across various learning contexts.

G. Conclusion

Based on the research results, it can be concluded that the SSI-based Chemistry Experiment Student Worksheet for Grade XI at SMA/MA has been developed using a 4-D development model. The Chemistry Experiment Student Worksheet that was developed has

been declared valid by the material expert validator across the material, construction, language, graphic, practicality, and didactic aspects, with an average material validation score of 98.4375%. Validation by the media expert yielded an average score of 100% and a valid category based on display feasibility. The SSI-based Chemistry Experiment Student Worksheet in Grade XI of SMA/MA received a positive response from users. Teachers gave positive responses regarding content feasibility, effectiveness, practicality, and attractiveness, with an average score of 92.96% and a good category. This is supported by students' responses, which indicate that the Chemistry Experiment Student Worksheet was rated very good (87.91%) and was rated good across attractiveness, effectiveness, and practicality.

References

- Amalia, A. D., & Lestyanto, L. M. (2021). LKS Berbasis Saintifik Berbantuan Live Worksheets untuk Memahami Konsep Matematis pada Aritmetika Sosial. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(3), 2911–2933. <https://doi.org/10.31004/cendekia.v5i3.822>
- Arif, K. (2020). Pengembangan Penuntun Praktikum Kimia Berbasis Green Chemistry untuk Semester Ganjil Kelas XII IPA SMA. *Semesta Journal of Science Education and Teaching*, 3(1), 59–64. <https://semesta.pj.unp.ac.id/index.php/semesta/article/view/96>
- Dermawati, N., Suprpta, & Muzakkir. (2019). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Lingkungan. *Jurnal Pendidikan Fisika*, 7(1), 74–78. <https://doi.org/10.24252/jpf.v7i1.3143>
- Dewi, W. A. F. (2020). Dampak Covid-19 Terhadap Implementasi Pembelajaran Daring di Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 2(1), 55–61. <https://doi.org/10.31004/edukatif.v2i1.89>
- Hafiz, A., Romdaniah, L., Ahmad Nizar, R., Mauliza, S., Nata, A., & Mu'ti, A. (2023). Teori Pendidikan Ibn Sina dan Jean Piaget: Perbandingan Antara Perkembangan Kognitif dan Pertumbuhan Usia Peserta Didik. *Rayah Al-Islam*, 7(3), 1268–1285. <https://doi.org/10.37274/rais.v7i3.819>
- Hasanuddin, M. I. (2020). Pengetahuan Awal (Prior Knowledge): Konsep dan Implikasi dalam Pembelajaran. *EDISI: Jurnal Edukasi dan Sains*, 2(2), 217–232. <https://ejournal.stitpn.ac.id/index.php/edisi/article/view/860>
- Jayantri, Y., Jaya, M. T. B. S., & Surbakti, A. (2017). Pengembangan Lembar Kegiatan Siswa Berbasis Tematik Terintegrasi Berorientasi Problem Based Learning. *Jurnal Pendidikan Dasar*, 5(13), 1–14. <http://jurnal.fkip.unila.ac.id/index.php/jpd/article/view/13462>
- Kartika, I., Kurniasih, S., & Pursitasari, I. D. (2019). Pengembangan Bahan Ajar Berbasis Socio-Scientific Issues pada Materi Bioteknologi untuk Meningkatkan Literasi Sains Siswa. *Journal of Science Education and Practice*, 3(1), 1–12. <https://doi.org/10.33751/jsep.v3i1.1375>

- Kemendikbud. (2013). *Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 81A Tahun 2013 tentang Implementasi Kurikulum*. Kementerian Pendidikan dan Kebudayaan.
- Khasanah, S. U., & Setiawan, B. (2022). Penerapan Pendekatan Socio-Scientific Issues Berbantuan E-LKPD pada Materi Zat Aditif untuk Meningkatkan Literasi Sains Siswa. *Pensa E-Jurnal: Pendidikan Sains*, 10(2), 313-319. <https://ejournal.unesa.ac.id/index.php/pensa/article/view/46497>
- Muhibbullah, M., & Zamhari, M. (2022). Pengembangan Cacing Kimia Sebagai Media Pembelajaran Kimia Berbasis Android pada Materi Larutan Penyangga. *Jurnal Inovasi Pendidikan Kimia*, 16(1), 37-40. <https://doi.org/10.15294/jipk.v16i1.29921>
- Nurlian, N., Maysara, S., & Saefuddin, M. (2023). Pengembangan LKPD Mata Pelajaran Kimia Berbasis Discovery Learning pada Pokok Bahasan Termokimia Kelas XI. *Jurnal Pendidikan Kimia FKIP Universitas Halu Oleo*, 8(2), 133-146. <http://ojs.uho.ac.id/index.php/jpkim/article/view/7>
- Rahman, A., Heryanti, L. M., & Ekanara, B. (2019). Pengembangan Modul Berbasis Education for Sustainable Development pada Konsep Ekologi untuk Siswa Kelas X SMA. *Jurnal Eksakta Pendidikan (JEP)*, 3(1), 1-8. <https://doi.org/10.24036/jep/vol3-iss1/273>
- Rosmana, P. S., Ruswan, A., Lesmana, A. R. D., Andini, I. F., Yuliani, I. P., Ramanda, N., Nurfitriana, R., & Citra, W. R. (2024). Penerapan LKPD terhadap Efektivitas Pembelajaran Peserta Didik di Sekolah Dasar. *Jurnal Pendidikan Tambusai*, 8(1), 3082-3088. <https://doi.org/10.31004/jptam.v8i1.12851>
- Samsinar, S. (2019). Urgensi Learning Resources (Sumber Belajar) dalam Meningkatkan Kualitas Pembelajaran. *Didaktika: Jurnal Kependidikan*, 13(2), 194-205. <https://doi.org/10.30863/didaktika.v13i2.959>
- Sanjaya, W. (2016). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Kencana Prenadamedia Group.
- Sihafudin, A., & Trimulyono, G. (2020). Validitas dan Keefektifan LKPD Pembuatan Virgin Coconut Oil Secara Enzimatis Berbasis PBL untuk Melatih Keterampilan Proses Sains pada Materi Bioteknologi. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, 9(1), 22-28. <https://ejournal.unesa.ac.id/index.php/bioedu/article/view/35508>
- Sismawarni, W. U. D., Usman, U., Hamid, N., & Kusumaningtyas, P. (2020). Pengaruh Penggunaan Isu Sosiosaintifik dalam Model Pembelajaran Berbasis Masalah terhadap Keterampilan Berpikir Tingkat Tinggi Siswa. *Jambura Journal of Educational Chemistry*, 2(1), 10-17. <https://doi.org/10.34312/jjec.v2i1.4265>
- Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. Center for Innovation on Teaching the Handicapped.

Tukan, M. B., Komisia, F., Leba, M. A. U., & Amtonis, J. S. (2020). Pengembangan Lembar Kerja Peserta Didik (LKPD) Praktikum Kimia Berbasis Lingkungan pada Materi Laju Reaksi. *Jurnal Koulutus: Jurnal Pendidikan Kahuripan*, 3(1), 108–117. <https://ejournal.kahuripan.ac.id/index.php/koulutus/article/view/324>

Umbaryati, U. (2016). Pentingnya LKPD pada Pendekatan Scientific Pembelajaran Matematika. *PRISMA, Prosiding Seminar Nasional Matematika*, 217–225.

Author's Biography

	<p>Disa Putri Anggianti, S.Pd    Was born in Tanjung Balai Karimun on September 20, 2003. She is an undergraduate student in Chemistry Education at the Faculty of Teacher Training and Education, Universitas Riau, admitted through SBMPTN in 2021. Her academic activities include KUKERTA, PLP MBKM at SMAN 9 Pekanbaru, participation in HIMAPROSTPEK, and serving as a Chemistry Olympiad question writer (2023–2025). Email: disaputrianggianti@gmail.com</p>
	<p>Abdullah, S. Si, M. Si    Was born on June 13, 1970. He is a permanent lecturer in the Chemistry Education Study Program at Universitas Riau. He holds a Bachelor's degree in Chemistry and a Master's degree in Analytical Chemistry. His research interests include educational models, measurement instruments, and learning evaluation. Email: abdullah@lecturer.unri.ac.id</p>
	<p>Dra. Herdini, M. Si    Was born on May 27, 1962. She is a permanent lecturer in the Chemistry Education Study Program at Universitas Riau. She holds a Bachelor's degree in Chemistry Education and a Master's degree in Organic Chemistry. Her research interests focus on educational media development and learning evaluation. Email: herdini@lecturer.unri.ac.id</p>