

Inquiry Learning Worksheet to Strengthen Science Process Skills in Elementary Students

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Abstract: Science instruction should facilitate the development of science process skills. Therefore, innovative teaching tools are needed; one of them is meaningful worksheets. This study aims to develop LiveWorksheets based on the inquiry learning model to facilitate the development of science process skills in fourth-grade elementary school students. This study uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. Data were collected through observation, interviews, and questionnaires to assess the validity and practicality of the product and were analyzed descriptively, qualitatively, and quantitatively. The results of the needs analysis indicate that teachers and students need different, challenging worksheets. After a series of stages, the product was successfully designed and developed by integrating inquiry-based learning. These Liveworksheets present a variety of contextual, inquiry-based experiments, thus being useful for facilitating students' science process skills. Validity tests conducted by subject-matter and media experts indicate a highly valid category, while practicality tests conducted by teachers and students indicate a highly practical category. This research provides an important contribution to the development of technology-based science learning in elementary schools, particularly in facilitating students' science process skills through interactive worksheets.

Keywords: Inquiry learning; liveworksheet; science learning; science process skills

INTRODUCTION

Science is one of the compulsory subjects that educators must teach at the elementary school level. Besides introducing science concepts, science learning is expected to facilitate various experiences with natural phenomena, such as direct observation, experimentation, and simple research (Akerson & Bartels, 2023; Jeong et al., 2023). Thus, science learning not only builds students' knowledge but also develops students' skills in dealing with nature (Greenspan, 2016). One skill that supports this is the science process skills. Science process skills are a set of skills derived from the components of the science method and involve various aspects of students' abilities to acquire knowledge through observation of phenomena (Gizaw & Sota, 2023). These skills include the ability to observe, group, interpret, predict, ask questions, form hypotheses, design experiments, use tools and materials, apply concepts, communicate, and carry out experiments systematically (Fatimah Millenia Fauziah, 2022; Harlen, 2010). Science process skills are oriented toward developing solutions and strategies to create contextual learning, such as solving everyday problems. Science process skills are important in science learning because they help students build a scientific mindset and understand concepts in depth (Jirout & Zimmerman, 2015; Lehrer & Schauble, 2015; Zimmerman & Klahr, 2018). Thus, the development of science process skills is an important domain that must be developed in science learning in elementary schools (Widyaningsih et al., 2020).

Experts have published various alternative strategies for developing and enhancing science process skills, including the use of appropriate and relevant worksheets (Arifullah et al., 2020; Mumtaza & Zulfiani, 2023; Mutlu, 2020). The digital era has enabled easy access to information and learning resources, thereby positively impacting education worldwide. In their role as motivators, facilitators, and inspirers, teachers are required to use technology to develop teaching materials tailored to students' needs. One innovation is to package worksheets in digital form, such as electronic or live worksheets, so that students can access them at any time without time limits. Liveworksheets is a web-based platform that enables educators to create or use interactive digital worksheets (Putri & Raharjo, 2024). Researchers have also developed various live worksheets as an innovation in developing students' science process skills (Felitasari & Rusmini, 2022; Mayasari et al., 2023; Mualidiyah et al., 2025; Sa'adah et al., 2023). However, based on previous research, there are still limited studies that develop digital worksheets using specific platforms that structure and content based on relevant learning models to improve science process skills. This gap research needs to be supplemented with further research to complete it.

One effective way to develop science process skills is through the inquiry-based learning model (Athuman, 2017; Biswal & Behera, 2023; Chengere et al., 2025; Negerie et al., 2026). The Inquiry-Based Learning model aligns stages with science process skill indicators and provides students with an active role in the scientific process. This model also encourages students to think critically and develop their knowledge through direct experience (Biswal & Behera, 2023; Mutiara et al., 2025).

Although various studies have shown that the use of digital worksheets and Liveworksheets can support the development of students' science process skills, most previous research has focused on the use of digital media in general. It has not integrated these platforms with learning models specifically designed to train science process skills. Furthermore, previous research has been limited to the development of interactive features, without emphasizing alignment with systematic scientific stages. In fact, the inquiry-based learning model aligns with science process skill indicators because it encourages students to actively observe, investigate, analyze, and draw conclusions through direct experience. Therefore, there is a research gap related to the development of Liveworksheets specifically integrated with the inquiry-based learning model for elementary school students. The novelty of this research lies in the development of inquiry-based Liveworksheets that are systematically designed according to the inquiry stages to facilitate the science process skills of fourth-grade elementary school students, while producing digital products that are interactive, practical, and appropriate to the needs of 21st-century learning.

Therefore, it is important to conduct research aimed at developing Liveworksheets based on the inquiry learning model to facilitate the development of science process skills in fourth-grade elementary school students. In addition to addressing the current literature and research gaps, it can provide a practical alternative for teachers in conducting science instruction, especially in facilitating the development of elementary school students' science process skills. Based on this

description, it is necessary to develop a worksheet in Liveworksheets based on the inquiry learning model to facilitate the development of science process skills in fourth-grade elementary school students. This worksheet is expected to provide a more interactive, engaging, and tailored learning experience to meet students' needs. This study aims to answer three research questions: first, how to develop Liveworksheets based on the inquiry learning model to facilitate the development of science process skills? Second, what are the product characteristics? Third, how is the validity and practicality of the product?.

METHOD

To achieve this research's objectives, the development research method is considered relevant. This method is used to develop a product and test its feasibility before wider use (Richey & Klein, 2014). The development model used is ADDIE (Analysis, Design, Development, Implementation, Evaluation) (Branch, 2009; Peterson, 2003). This development model was chosen because of its systematic and flexible structure. This research is limited to the Development stage to produce valid and practical products.

This research was conducted at SDN 43 Parepare, South Sulawesi, Indonesia, involving fourth-grade students and homeroom teachers who served as test subjects. The location selection was based on initial observations that showed that the worksheets used were limited to practice questions and did not integrate the stages of science learning. This resulted in low student science process skills and limited use of interactive digital teaching tools by teachers and students. Data collection techniques are a crucial stage in any research. The method used must be appropriate and consistent with the research approach, so that the data obtained align with the objectives or hypotheses formulated. In this study, data were collected through interviews, observations, and questionnaires.

A research instrument is a tool used to collect data and information in a study, which is then processed and analyzed to draw a conclusion. The instruments used in this study included interview guidelines, observation guidelines, a student needs analysis questionnaire, a validation sheet, and a practicality test sheet. The outline of the instruments used is presented in Tables 1, 2, and 3.

Table 1. Instrument Grid for Subject Matter
Expert Validation Questionnaire

Aspect	Indicator
Inquiry Learning Learning Model	Liveworksheets can help students clearly observe objects and illustrations as an initial learning stimulus.
	Liveworksheets guide students to formulate relevant questions based on observations.
	Liveworksheets direct students to make temporary, logical, & appropriate assumptions (hypotheses) about the problem being asked.
	Liveworksheets provide activities that enable students to collect, observe, and classify data to answer questions.
	Liveworksheets facilitate students in comparing their guesses with the data obtained and clearly conveying the

	results.
	Liveworksheets encourage students to draw conclusions based on learning outcomes through scientific thinking processes.
Content Eligibility Compo-nents	Liveworksheets activities with learning outcomes, objective flow and student development stages in the Style material Suitability to student needs Benefits of increasing students' knowledge related to the material on Force Compliance with learning activities related to the material on Style
Modification from Haryati et al. (2024)	

Table 2. Instrument Grid for Media
Expert Validation

Rated aspect	Indicator
Coloring	Rising color combination The suitability of the presentation of images & material discussed
Use of Words and Language	Using Indonesian in accordance with the enhanced spelling Suitability of language to students' level of thinking Politeness in the use of language Suitability of dialogue/text to story/material
Liveworksheets view	The image design creates a positive impression, thereby increasing interest in learning. The fonts used are clear and easy to read. Matching text and background colors
Presentation	Presenting live worksheets encourages students to participate in the learning process actively. Live worksheets are presented in a systematic order. Attractive image presentation
Modification from Nareswari et al. (2021)	

Table 3. Instrument Grid for Practicality Questionnaire

Rated aspect	Indicator
Image View	The images used can help understand the material. The illustrations used do not distract students from listening to the material. Attractive worksheet display
Layout	The layout of images, tables, and questions is displayed clearly and attractively.

Content	The suitability of worksheet activities with learning outcomes, learning objective flow, and student development stages
Presentation	Suitability to student needs Benefits of increasing students' knowledge Compliance with learning activities Ease of using liveworksheets
Display	Titles, commands, images, tables, questions are displayed clearly.
Grammar	The language used in the live worksheet is easy to understand.
Font size	Appropriate font size and comfortable to read

Modification from Haryati et al. (2024)

The data analysis techniques used in this study included qualitative and quantitative methods. In this study, qualitative data were obtained through interviews, observations, responses to a needs analysis questionnaire, and criticisms, suggestions, and comments provided by the validator. The quantitative data consists of numbers obtained from validation by subject matter, media, language, and learning practitioners, as well as student response questionnaires. To determine the validity and practicality of the developed product, the scores obtained from the assessment instrument are categorized according to the criteria outlined in Table 4.

Table 4. Validity & Practicality Criteria

Percentage	Validity Category	Practicality Category
81%-100%	Very Valid	Very Practical
61%-80%	Valid	Practical
41%-60%	Quite Valid	Quite Practical
21%-40%	Invalid	Impractical
0%-20%	Very Invalid	Very Impractical

Source: Handayani et al. (2024)

RESULTS

Needs Analysis, Product Design, and Product Development

The development process began with a needs analysis phase, conducted through initial observations, interviews with fourth-grade teachers at SDN 43 Parepare, and student completion of a needs analysis questionnaire. This phase aimed to identify learning conditions and challenges faced in implementing science and science instruction.

The analysis revealed several significant problems, including the use of worksheets that focused solely on practice questions and did not integrate activities that fostered science process skills. Furthermore, student engagement in learning was suboptimal, as the learning process was still dominated by teacher guidance. Students' science process skills were also relatively low, as evidenced by their limited observation, investigation, and conclusion-drawing abilities. Furthermore,

the use of learning technologies, such as Liveworksheets, has not been optimally implemented, despite the availability of supporting facilities. This was due to technical constraints such as unstable internet connections and limitations in the use of interactive digital learning tools. Therefore, it is necessary to develop inquiry-based Liveworksheets that integrate scientific activities, such as observation, simple experiments, and investigations. Therefore, this needs analysis clearly indicates the need to develop inquiry-based Liveworksheets that focus not only on practice questions but also on facilitating students' science process skills through scientific activities such as observation, simple experiments, and investigations that encourage students to actively discover concepts independently.

The product design stage is a systematic planning phase carried out after learning needs have been comprehensively identified. At this stage, the researcher developed a conceptual framework and the content of the Liveworksheets to meet the identified needs and the set learning objectives. Furthermore, the design also considers the characteristics and cognitive abilities of fourth-grade elementary school students so that the developed product can be used effectively. This design includes several crucial aspects: first, the design of learning activities is based on the six stages of the inquiry learning model, namely orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, and drawing conclusions. Each stage is designed to encourage students to actively observe phenomena, formulate questions, make predictions, conduct observations or simple experiments, analyze data, and independently conclude learning outcomes.

Second, the content design in Liveworksheets presents material on forces that aligns with the learning outcomes of the Independent Curriculum. The material includes types of forces, their effects on objects, and their application in everyday life, presented through simple experiments using objects around students, with inquiry stages. Third, the structure of Liveworksheets is systematically designed, including the cover, student data, instructions for use, learning outcomes and objectives, as well as the core material and activities, all designed to be easy to understand and use effectively. Finally, at this stage, research instruments were also designed in the form of validation questionnaires for material and media experts, as well as response questionnaires for teachers and students, to evaluate the product's feasibility before the trial.

The product development phase included creating Liveworksheets in Canva to create an attractive display and to utilize the available features. At this stage, researchers systematically integrated learning materials on style and various previously designed activities into the product structure. The Liveworksheets were designed with attention to visual aspects such as typography, color, and layout to ensure they were engaging and easy for students to use. Furthermore, the six stages of the inquiry learning model were implemented through activities such as "*Ayo Mengamati*", "*Ayo Bertanya*", "*Ayo Memprediksi*", "*Ayo Mengumpulkan Data*", "*Ayo Membuktikan*", "*Ayo Menyimpulkan*", and "*Ayo Mengomunikasikan*". After the product was developed, subject matter experts conducted validation to assess the content's suitability, and media experts evaluated the design and presentation.





Figure 1. Examples of development product pages

Product Characteristics

The final product produced is Liveworksheets with several main characteristics. First, it is based on an inquiry learning model that encourages students to actively discover concepts independently. Second, it has an attractive, interactive visual design that uses Canva and F4 size for ease of use. Third, utilize the features on the Liveworksheets platform to make learning more varied and increase student engagement. Fourth, it is equipped with clear instructions for use to support independent learning. Fifth, it contains a variety of activities and problems designed to develop students' science process skills. Structurally, the Liveworksheets consist of 42 systematically arranged pages, beginning with an introductory section such as instructions for use, learning outcomes, and objectives, followed by core material covering the effects of force on objects, magnets, elastic objects, and the phenomenon of why we do not float in the air. Figure 1 are some examples of development product pages.

Finally, liveworksheets have characteristics that align with the principles of the inquiry learning model as summarized in Table 5.

Table 5. Implementations of the inquiry learning model in Liveworksheets

Inquiry Stages and Activities in Liveworksheets	Examples of page
Orientation <i>Ayo Mengamati (Let's Observe)</i> This section presents various contextual activities as an orientation stage in inquiry, such as experiments with toy cars & rubber bands, observing various objects around, & simple gravity-related experiments. These activities aim to build students' curiosity & focus their attention on the phenomena to be studied, so that students gain initial experience as a foundation for entering the next stage of inquiry.	
Formulating the Problem <i>Ayo Bertanya (Let's Ask)</i> This section presents activities that encourage students to ask questions about the experiments they have conducted. This activity is part of the inquiry stage of formulating problems, where students are encouraged to identify interesting, unclear, or curious aspects of the experimental results using question words such as why, how, what caused, and whether.	
Formulating Hypotheses <i>Ayo Memprediksi (Let's Predict)</i> This section presents activities that guide students in formulating tentative predictions about the results of experiments that will be or have been conducted. This activity is part of the inquiry stage of formulating hypotheses, where students are trained to make logical predictions based on initial observations. This activity is supported by sentence guides such as "I suspect that...", "The possibility that will happen is...", and "In my opinion, the object will... because...", thus helping students express their predictions in a structured and scientific manner as a basis for proof in the next stage.	
Inquiry Stages and Activities in Liveworksheets	Examples of page

Collecting Data

Ayo Mengumpulkan Data (Let's Collect Data)

This section presents activities that guide students to collect data and information through various experiments and observations. These activities are part of the inquiry stage of data collection, where students conduct experiments such as using toy cars on a slanted board, observing various objects around them, and comparing objects of different weights. Data from these activities is recorded in a data collection table that includes observation questions as a guide and activities to group objects based on certain characteristics, thus helping students compile and organize data systematically.



Testing Hypotheses

Ayo Membuktikan (Let's Prove It)

This section presents activities that guide students in testing the validity of previously formulated assumptions or hypotheses. This activity is part of the inquiry stage of hypothesis testing, in which students verify their hypotheses through experiments or data analysis. This activity is complemented by direct verification activities and the use of tables of proof of assumptions, allowing students to compare initial predictions with the results obtained.



Conclude

Ayo Menyimpulkan (Let's Conclude)

This section presents activities that guide students in formulating conclusions based on experimental results and the data they have obtained. This activity is part of the inquiry-to-conclusion stage, where students process information, compare results with their initial assumptions, and draw meaning from the learning process. This activity is complemented by simple statement guidelines that help students write conclusions coherently and clearly, so they can understand the concepts they have learned comprehensively and based on the evidence they have found.



Ayo Mengomunikasikan (Let us communicate)

This section presents activities that guide students in communicating the conclusions they have drawn from the inquiry process. This activity is still related to the inquiry-concluding stage, where students not only formulate conclusions but also communicate them to others. This activity is carried out through the creation of posters, infographics, and short videos, each with links so that students can present their thoughts and findings in a creative, engaging, and easy-to-understand manner.



Product Validity and Practicality Test

This validation process aims to determine the validity and feasibility of the Liveworksheets product that has been developed. Assessments are conducted using a Likert scale from 1 to 4, and the scores are converted to percentages to determine the product's validity. Next, a small-group trial was conducted to determine the implementation of Liveworksheets in the field and to assess its practicality. Table 7 presents a recapitulation of the results of the product validity and practicality tests.

Table 7. Summary of Product Validity and Practicality Test Results

	Product Validity Test		Product Practicality Test	
	Subject Expert	Media Expert	Teacher	Student
%	97.5%	100%	99.03%	98.15%
Category	Very Valid	Very Valid	Very Practical	Very Practical

During the practicality test, several students appeared to be focused on using a Worksheets based on the inquiry learning model as seen in several photos in Figure 2.



Figure 2. Students use development products in science learning

DISCUSSION

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Needs Analysis, Product Design, and Product Development

The process of creating Liveworksheets begins with a needs analysis stage, which plays a crucial role in identifying key issues in fourth-grade science learning. This stage is conducted through three methods: classroom observation, teacher interviews, and a needs analysis questionnaire. The data show that teachers and students need inquiry-based worksheets that integrate scientific activities, such as observation, simple experiments, and investigations. This aligns with the assertion that science learning in elementary schools requires clear learning guidelines to facilitate students' involvement in various scientific activities (Cai et al., 2022; Oh & Kang, 2019). The data obtained from these three methods serve as the basis for designing products tailored to students' conditions and needs. A precise needs analysis can help design relevant and effective teaching materials, adapt them to students' abilities, encourage active participation, and improve the quality of learning (Firtsanianta & Khofifah, 2022).

Based on the analysis process for developing Liveworksheets using the inquiry learning model, which began with observations, in-depth interviews with teachers, and questionnaires, the findings indicate that science learning has used worksheets as a learning medium. However, their use still tends to focus on problem-solving and has not fully directed students toward scientific activities involving science process skills. Similar findings were also reported by Rahmawati & Agustini (2023), who stated that the use of e-worksheets, such as those provided by Liveworksheets, that are not specifically designed to practice science process skills, tends to function only as a practice medium, so they are not fully able to optimally develop students' scientific abilities.

Product Characteristics

The Liveworksheets developed in this study possess various characteristics that support effective learning. One of the main characteristics implemented is the use of the inquiry learning model, in which material on force is presented through simple experimental activities using objects readily available in students' environments. This model aims to provide a more meaningful learning experience by allowing students not only to receive information but also to engage in the process of independently discovering concepts. Inquiry-based learning can help students understand concepts more deeply through the process of discovery (Alimuddin, 2023). Furthermore, the visual design aspect is also a concern in the development of Liveworksheets. A visually appealing appearance can increase students' learning motivation by creating a more enjoyable, less boring learning atmosphere. An attractive design not only enhances appearance but also increases student interest and engagement in the learning process. Liveworksheets also include detailed, easy-to-understand usage guides. This aims to facilitate students' independent learning without difficulty in understanding the steps for using media.

Furthermore, the variety of questions and activities presented in Liveworksheets is designed in stages, starting from basic conceptual understanding to more complex problem-solving. This structure is intended to support students' science process skills systematically. Thus, the characteristics of Liveworksheets

are expected to improve learning quality and encourage active student engagement in the learning process.

Orientation

The orientation stage in the inquiry learning model builds students' readiness to learn by directing their attention to the topic and fostering curiosity. The teacher does not directly introduce concepts; instead, they create challenging, meaningful learning situations to encourage students to explore phenomena (Mutmainah, 2025). In Liveworksheets, this stage is implemented through the "Let's Observe" activity, where students observe simple phenomena or experiments as a concrete initial experience before understanding the core concepts of learning.

Formulating the Problem

The problem formulation stage is a continuation of the orientation stage in inquiry learning, which aims to identify questions or problems to be investigated. At this stage, students begin to think critically by formulating scientific questions based on observations (Mizwar et al., 2026). In Liveworksheets, this stage is implemented through the "Let's Ask" activity, which prompts students to ask questions about the observed phenomena. This activity encourages students to sharpen their focus on the problem and increase active participation in learning. Questioning plays a crucial role in exploring information and assessing student understanding.

Formulating Hypotheses

The hypothesis formulation stage is a crucial step in inquiry learning, in which tentative assumptions are developed based on prior knowledge, experience, and observations. This hypothesis is tentative and requires further investigation (Amelia et al., 2023). In Liveworksheets, this stage is implemented through the "Let's Predict" activity, which asks students to predict the outcome of an experiment or phenomenon. This activity trains students' critical and logical thinking skills before experimenting; prediction is the first step in testing a problem (Afriska et al., 2024)

Collecting Data

The data collection stage in inquiry learning is a process of investigation aimed at obtaining information to test hypotheses. At this stage, students are directly involved through observation, experimentation, and data recording activities, making learning more meaningful (Mutmainah, 2025). In Liveworksheets, this stage is implemented through the "Let's Collect" activity, where students systematically record the results of observations or experiments. This activity helps students lay the groundwork for analysis and hypothesis testing. Data collection is carried out through observations or experiments that are recorded for further analysis (Widodo et al., 2024).

Testing the Hypothesis

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The hypothesis-testing stage in inquiry learning is the process of evaluating the validity of a provisional assumption through investigative activities or data analysis. At this stage, students compare the hypothesis with empirical evidence to determine whether it is accepted, rejected, or revised (Mutmainah, 2025). In Liveworksheets, this stage is implemented through the "Let's Prove It" activity, in which students conduct experiments based on their predictions. This activity helps students evaluate the validity of the hypothesis through data analysis. Hypothesis testing involves comparing experimental results with the initial assumptions (Amelia et al., 2023).

Conclude

The conclusion-drawing stage in inquiry learning is the final stage, in which students formulate conclusions based on data and analysis. In Liveworksheets, this stage is implemented through the "Let's Conclude" and "Let's Communicate" activities, in which students compare their results with their hypotheses and communicate their findings orally or in writing. These activities strengthen students' scientific understanding and communication skills (Yusnarti et al., 2025).

Product Validity and Product Practicality Test

Based on validation data analysis by material experts, the developed Liveworksheets were categorized as very valid, making them suitable for use in the learning process. The validity of teaching materials is very important because it is assessed by experts to ensure that the developed materials align with learning objectives and are suitable for use in the learning process (Cahyani & Said, 2024). The results of the assessment by media experts also showed a very valid category. This indicates that Liveworksheets not only meets the material's suitability requirements but also boasts excellent, engaging design. A small-group trial was conducted to assess the practicality of Liveworksheets for learning. The student questionnaire was completed and categorized as highly practical.

Meanwhile, teacher responses are also at a very high level of practicality. These findings indicate that the developed Liveworksheets not only benefit students but also facilitate teachers in implementing the learning process. Based on validity and practicality tests, the developed Liveworksheets have met the established criteria for both. Therefore, these Liveworksheets are considered appropriate and can be used effectively in implementing science learning. Worksheets are a teaching tool that facilitate students' interaction with the material presented and are designed to encourage students to be more active in the learning process through activities that directly involve them (Mutlu, 2020). Worksheets based on the inquiry learning model are an alternative solution to low student interest in science learning, which tends to focus only on passive material delivery without active student engagement, as well as a lack of conceptual understanding (Idul & Caro, 2022; Mutlu, 2020; Servitri & Trisnawaty, 2018). Worksheets based on the inquiry learning model provide students with the opportunity to investigate and develop concepts actively. As students engage in these activities, their science process skills will be developed (Nurhayati et al., 2019).

This research provides an important contribution to the development of technology-based science learning in elementary schools, particularly in facilitating students' science process skills through interactive learning media. The integration of inquiry learning stages into the worksheets helps students develop the ability to observe, formulate problems, formulate hypotheses, conduct experiments, analyze data, and draw conclusions systematically. This research also shows that the use of digital technology can support more meaningful and student-centered science learning. Furthermore, the research results can serve as a reference for teachers and researchers in developing innovative, practical, and relevant inquiry-based digital learning tools for 21st-century learning.

CONCLUSION

This research successfully developed inquiry-based Liveworksheets to facilitate elementary school students' science process skills. The product was developed using the ADDIE model, integrating the stages of inquiry learning from orientation through the conclusion of simple contextual experiments. The needs analysis revealed that previously used worksheets lacked meaningful science learning experiences and focused solely on problem-solving activities. Validation by material experts and media experts indicated that the product was highly valid, while practicality tests by teachers and students indicated it was highly practical. Thus, inquiry-based Liveworksheets were deemed suitable for science instruction and have the potential to improve elementary school students' science process skills. Science teachers are advised to use inquiry-based Liveworksheets as an alternative science learning medium to increase student engagement and science process skills. Future researchers are advised to test the product's effectiveness on different science materials and at broader educational levels to obtain more comprehensive results. Further development can be achieved by adding multimedia features, such as experimental videos, animations, or interactive simulations, to enhance the student learning experience. Future research can also examine the effect of using inquiry-based Liveworksheets on other aspects, such as critical thinking skills, creativity, collaboration, and student learning motivation.

REFERENCES

- Afriska, M. N., Damayanti, R., Ramanda, D., & Humaira, N. (2024). The Effect Of Inquiry Learning Model On Science Learning On The Learning Outcomes Of Grade V Students At At-Taufiq Elementary School. *EJoES (Educational Journal of Elementary School)*, 5(1), 11–14. <https://doi.org/10.30596/ejoes.v5i1.18273>
- Akerson, V. L., & Bartels, S. L. (2023). Elementary Science Teaching. In N. G. Lederman, D. L. Zeidler, & J. S. Lederman, *Handbook of Research on Science Education* (1st ed., pp. 528–558). Routledge. <https://doi.org/10.4324/9780367855758-21>
- Alimuddin, J. (2023). Implementasi Kurikulum Merdeka di Sekolah Dasar. *Jurnal Ilmiah KONTEKSTUAL*, 4(02), 67–75. <https://doi.org/10.46772/kontekstual.v4i02.995>
- Amelia, C. R., Suhartono, S., & Wahyudi, W. (2023). Peningkatan Hasil Belajar IPA melalui Penerapan Model Guided Inquiry Based Learning dengan Media

- Konkret di Kelas V SDN 2 Tamanwinangun Tahun Ajaran 2022/2023. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, 11(2). <https://doi.org/10.20961/jkc.v11i2.71940>
- Arifullah, Halim, A., Syukri, M., & Nurfadilla, E. (2020). The development of student worksheets with PhET assisted to improve student science process skill. *Journal of Physics: Conference Series*, 1460(1), 012144. <https://doi.org/10.1088/1742-6596/1460/1/012144>
- Athuman, J. J. (2017). Comparing the effectiveness of an inquiry-based approach to that of conventional style of teaching in the development of students' science process skills. *International Journal Of Environmental & Science Education*, 12(8), 1797–1816.
- Biswal, S., & Behera, B. (2023). Enhancing Science Process Skills through Inquiry - Based Learning: A Comprehensive Literature Review and Analysis. *International Journal of Science and Research (IJSR)*, 12(8), 1583–1589. <https://doi.org/10.21275/SR23817121415>
- Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer US. <https://doi.org/10.1007/978-0-387-09506-6>
- Cahyani, T., & Said, A. (2024). *Validitas dan Kepraktisan Bahan Ajar Modul Cetak Berbasis Multirepresentasi untuk Meningkatkan Keterampilan Proses Sains Siswa*. 8(4), 767–774. https://doi.org/10.28926/riset_konseptual.v8i4.1105
- Cai, S., Jiao, X., Li, J., Jin, P., Zhou, H., & Wang, T. (2022). Conceptions of Learning Science among Elementary School Students in AR Learning Environment: A Case Study of “The Magic Sound.” *Sustainability*, 14(11), 6783. <https://doi.org/10.3390/su14116783>
- Chengere, A. M., Bono, B. D., Zinabu, S. A., & Jilo, K. W. (2025). Enhancing secondary school students' science process skills through guided inquiry-based laboratory activities in biology. *PLOS ONE*, 20(4), e0320692. <https://doi.org/10.1371/journal.pone.0320692>
- Fatimah Millenia Fauziah. (2022). Systematic Literature Review: Bagaimanakah Pembelajaran IPA Berbasis Keterampilan Proses Sains yang Efektif Meningkatkan Keterampilan Berpikir Kritis? *JURNAL PENDIDIKAN MIPA*, 12(3), 455–463. <https://doi.org/10.37630/jpm.v12i3.627>
- Felitasari, A., & Rusmini, R. (2022). Development of E-Worksheet Assisted by Liveworksheets to Improve Science Process Skills and Collaboration on Chemical Equilibrium Materials. *Scientiae Educatia*, 11(1), 10. <https://doi.org/10.24235/sc.educatia.v11i1.10235>
- Firtsanianta, H., & Khofifah, I. (2022). Efektivitas E-LkPD Berbantuan Liveworksheet Untuk Meningkatkan Hasil Belajar Peserta Didik. *Conference Of Elementary Studies Tahun 2022*, 1(1), 140–149. <https://journal.um-surabaya.ac.id/Pro/article/view/14918>
- Gizaw, G., & Sota, S. S. (2023). Improving Science Process Skills of Students: A Review of Literature. *Science Education International*, 34(3), 216–224. <https://doi.org/10.33828/sei.v34.i3.5>
- Greenspan, Y. F. (2016). *A Guide to Teaching Elementary Science*. SensePublishers. <https://doi.org/10.1007/978-94-6300-367-4>

- Handayani, R., Putri, K. E., & Wiguna, F. A. (2024). Pengembangan Media Pembelajaran Interaktif Berbasis Aplikasi Articulate Storyline Berbantuan Website 2 APK Builder Materi Ekosistem Kelas 5 SDN 2 Sugihan. *Prosiding Semdikjar (Seminar Nasional Pendidikan Dan Pembelajaran)*, 7(1), 1023–1033.
- Harlen, W. (2010). Purposes and Procedures for Assessing Science Process Skills. *Assessment in Education: Principles, Policy & Practice*, 6(1), 129–144. <https://doi.org/10.1080/09695949993044>
- Haryati, L., Nulhakim, L. N., & Andriana, E. (2024). Pengembangan Media Pembelajaran IPA Melalui Aplikasi Zepeto Kinemaster untuk Meningkatkan Hasil Belajar Siswa pada Materi Siklus Air di Sekolah Dasar. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, 12(2). <https://doi.org/10.20961/jkc.v12i2.88632>
- Idul, J. J. A., & Caro, V. B. (2022). Does process-oriented guided inquiry learning (POGIL) improve students' science academic performance and process skills? *International Journal of Science Education*, 44(12), 1994–2014. <https://doi.org/10.1080/09500693.2022.2108553>
- Jeong, S., Bryan, L. A., Tippins, D. J., & Sexton, C. M. (Eds.). (2023). *Navigating Elementary Science Teaching and Learning: Cases of Classroom Practices and Dilemmas* (1st ed.). Springer International Publishing. <https://doi.org/10.1007/978-3-031-33418-4>
- Jirout, J., & Zimmerman, C. (2015). Development of Science Process Skills in the Early Childhood Years. In K. Cabe Trundle & M. Saçkes (Eds.), *Research in Early Childhood Science Education* (pp. 143–165). Springer Netherlands. https://doi.org/10.1007/978-94-017-9505-0_7
- Lehrer, R., & Schauble, L. (2015). The Development of Scientific Thinking. In R. M. Lerner (Ed.), *Handbook of Child Psychology and Developmental Science* (1st ed., pp. 1–44). Wiley. <https://doi.org/10.1002/9781118963418.childpsy216>
- Mayasari, I., Setyarini, M., & Diawati, C. (2023). Development of Interactive e-Worksheet to Improve Science Process Skills of Junior High School Students. *Jurnal Pendidikan MIPA*, 24(1), 321–329. <https://doi.org/10.23960/jpmipa/v24i1.pp321-329>
- Mizwar, M., Setiawan, H., Rogahang, M. K., & Tikulembang, G. A. (2026). Implementation of the inquiry learning model to enhance junior high school students' scientific literacy: A qualitative study. *Priviet Social Sciences Journal*, 6(3), 103–114. <https://doi.org/10.55942/pssj.v6i3.1261>
- Mualidiyah, U., Suratno, S., & Nuriman, N. (2025). Development of an electronic student worksheet based on REPIDS to improve students' science process skills and critical thinking. *Edubiotik: Jurnal Pendidikan, Biologi Dan Terapan*, 10(01), 267–279. <https://doi.org/10.33503/ebio.v10i01.645>
- Mumtaza, M. F., & Zulfiani, Z. (2023). Development of Student Worksheets Based on Science Process Skills on Excretory System Concepts. *Jurnal Penelitian Pendidikan IPA*, 9(1), 265–272. <https://doi.org/10.29303/jppipa.v9i1.1474>
- Mutiara, E. A., Suwangsih, E., & Alindra, A. L. (2025). Peningkatan Keterampilan Proses Sains Peserta Didik dengan Model Inquiry Based Learning

- Berbantuan Media Solar System Scope. *Jurnal Pendidikan Tambusai*, 9(1), 467–473. <https://jptam.org/index.php/jptam/article/view/24201/16454>
- Mutlu, A. (2020). Evaluation of students' scientific process skills through reflective worksheets in the inquiry-based learning environments. *Reflective Practice*, 21(2), 271–286. <https://doi.org/10.1080/14623943.2020.1736999>
- Mutmainah, N. (2025). Implementasi Pembelajaran Dengan Pendekatan Inquiry Learning Untuk Belajar Ips Kelas. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, 10(4), 281–291. <https://journal.unpas.ac.id/index.php/pendas/article/view/37480/20022>
- Nareswari, N. L. P. S. R., Suarjana, I. M., & Sumantri, M. (2021). Belajar Matematika dengan LKPD Berbasis Kontekstual. *Mimbar Ilmu*, 26(2), 204. <https://doi.org/10.23887/mi.v26i2.35691>
- Negerie, D., Habtamu, T., & Tafesse, T. (2026). Effects of the 5E guided inquiry-based learning model on science process skills of secondary school biology students in Mattu town, Ethiopia. *Discover Education*, 5(1), 320. <https://doi.org/10.1007/s44217-026-01351-x>
- Nurhayati, Syamsiah, Dr., Hiola, St. F., Faisal, Mr., Rezky, N., R.H, N. I., & Hadis, A. (2019). The Innovation on Biological Learning with Science Process Skills using Student Worksheet. *Proceedings of the 1st International Conference on Advanced Multidisciplinary Research (ICAMR 2018)*. Proceedings of the 1st International Conference on Advanced Multidisciplinary Research (ICAMR 2018). <https://doi.org/10.2991/icamr-18.2019.18>
- Oh, K., & Kang, N.-H. (2019). Participation patterns of elementary students in scientific problem finding activities. *Asia-Pacific Science Education*, 5(1), 16. <https://doi.org/10.1186/s41029-019-0039-6>
- Peterson, C. (2003). Bringing ADDIE to Life: Instructional Design at Its Best. *Journal of Educational Multimedia and Hypermedia*, 12(3), 227–241. <https://www.learntechlib.org/d/2074/>
- Putri, M., & Raharjo, M. (2024). Pengembangan E-LKPD Berbasis Website Liveworksheets dengan Model Discovery Learning pada Pembelajaran IPAS di Sekolah Dasar. *SITTAH: Journal of Primary Education*, 5(1), 17–32. <https://doi.org/10.30762/sittah.v5i1.2653>
- Rahmawati, A. N., & Agustini, R. (2023). Science Process Skills Oriented E-LKPD Assisted by Liveworksheets on The Subject of Shifting Factors in Chemical Equilibrium. *Hydrogen: Jurnal Kependidikan Kimia*, 11(4), 535. <https://doi.org/10.33394/hjkk.v11i4.8422>
- Richey, R. C., & Klein, J. D. (2014). *Design and Development Research: Methods, Strategies, and Issues*. Taylor and Francis.
- Sa'adah, S., Andini, F. S., & Yusup, I. R. (2023). Improving Students' Science Process Skills through Level of Inquiry Learning Assisted by Liveworksheet on The Concept of Environment Change. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3983–3991. <https://doi.org/10.29303/jppipa.v10i7.8120>
- Servitri, M. O., & Trisnawaty, W. (2018). The Development of Inquiry Science Worksheet to Facilitate the Process Skills. *Journal of Education and Learning (EduLearn)*, 12(4), 575–580. <https://doi.org/10.11591/edulearn.v12i4.8937>

- Widodo, R. B., Sumianto, S., Alim, M. L., Ananda, R., & Surya, Y. F. (2024). Penerapan Metode Inquiry untuk Meningkatkan Keterampilan Proses Sains dalam Pembelajaran IPA di UPT SDN 010 Siabu. *Jurnal Dimensi Pendidikan dan Pembelajaran*, 12(1), 37–53. <https://doi.org/10.24269/dpp.v12i1.8524>
- Widyaningsih, D. A., Gunarhadi, & Muzzazinah. (2020). Analysis of Science Process Skills on Science Learning in Primary School. *Proceedings of the 3rd International Conference on Learning Innovation and Quality Education (ICLIQE 2019)*. Proceedings of the 3rd International Conference on Learning Innovation and Quality Education (ICLIQE 2019). <https://doi.org/10.2991/assehr.k.200129.085>
- Yusnarti, M., Yulianti, E., & Wulandari, I. P. (2025). Pengaruh Model Pembelajaran Inquiry Based Learning terhadap Hasil Belajar Siswa Kelas IV. *Jurnal Evaluasi dan Kajian Strategis Pendidikan Dasar*, 2(1), 1–5. <https://doi.org/10.54371/jekas.v2i1.695>
- Zimmerman, C., & Klahr, D. (2018). Development of Scientific Thinking. In J. T. Wixted (Ed.), *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience* (1st ed., pp. 1–25). Wiley. <https://doi.org/10.1002/9781119170174.epcn407>