Innovative Development of Guided Inquiry-Based Science Learning Materials to Improve Critical Thinking Skills among Junior High School Students

Yudha Irhasyuarna[1*], Fahmi[1], Hery Fajeriadi[2], Muhammad Kusasi[3]

[1] Department of Natural Science Education, Universitas Lambung Mangkurat, Banjarmasin, Kalimantan Selatan, Indonesia.
[2] Department of Biology Education, Universitas Lambung Mangkurat, Banjarmasin, Kalimantan Selatan, Indonesia
[3] Department of Chemistry Education, Universitas Lambung Mangkurat, Banjarmasin, Kalimantan Selatan, Indonesia.

Abstract: This study aims to develop guided inquiry-based science learning tools to enhance the critical thinking skills of junior high school students on the topic of additive and addictive substances. The research employed a development method using Tessmer's formative evaluation model, which includes the stages of validation, practicality testing, and effectiveness testing. The developed learning tools consist of lesson plans (RPP), student worksheets (LKPD), and instructional materials. Expert validation results indicated that the tools are in the "highly valid" category, with an average percentage score of 92.5%. The practicality of the tools was reflected in the high implementation of learning activities, ease of use by teachers, and positive student responses. Effectiveness testing showed a significant improvement in students' critical thinking skills, with an average N-Gain of 0.49 (moderate category). These findings demonstrate that the guided inquiry-based learning tools are not only theoretically and practically feasible but also have a positive impact on the enhancement of students' critical thinking skills. Therefore, these tools can serve as an alternative solution for implementing instruction that emphasizes both content mastery and the development of students' competencies.

Keywords: Critical thinking; Development; Guided inquiry; Junior high school science; Learning tools

Introduction

Education is a fundamental pillar in shaping the quality of human resources that are adaptive to the dynamics of the times. Social and technological changes demand continuous improvement and innovation in the education system to meet global challenges and the needs of modern society (Tilaar, 2012). In this context, science education plays a strategic role in fostering students' critical thinking skills as essential competencies to face complex real-world problems.

However, various studies have shown that the critical thinking skills of Indonesian students remain relatively low. A report by the Research and Development Agency of the Ministry of Education and Culture (Balitbang Kemendikbud, 2019; Osman & Vebrianto, 2013) indicates poor performance in scientific literacy and non-routine problem-solving. Students generally succeed in answering routine, repetitive problems but struggle with questions presented in new or unfamiliar contexts (Siregar & Nurbaiti, 2020; Fatma & Winarti, 2024; Molefe & Aubin, 2021).

One of the main factors contributing to the low level of students' critical thinking skills is the predominant use of conventional teaching approaches, which tend to neglect the development of higher-order thinking skills

(HOTS) (Fitriani et al., 2022). Hidayati (2016) also found that critical thinking aspects such as data analysis and drawing conclusions had not developed optimally, possibly due to limitations in laboratory facilities and the lack of instructional tools designed to support the enhancement of thinking skills.

To address this issue, the guided inquiry-based learning approach offers a strategic alternative. This approach engages students actively in observation, discovery, and scientific reasoning processes, thereby encouraging reflective and critical thinking patterns (Pedaste et al., 2015; Fahmi et al., 2024; Stout, 2001; Maeots & Padeste, 2014; Gibson & Chase, 2002; Sismek & Kabapinar, 2010). Research conducted by Rusmalina (2012), Ardiyanti et al. (2016), Baharudin et al. (2022), Harahap et al. (2016), and Sutama et al. (2014) demonstrated that the guided inquiry model significantly improves both learning outcomes and students' critical thinking skills compared to direct instruction.

The topic of additive and addictive substances in science education demands strong conceptual understanding and relevance to everyday life. Previous studies revealed that students often experience difficulties in fully understanding this topic when it is delivered solely through verbal explanation (Mulyasa et al., 2013). Therefore, implementing instructional models that emphasize scientific exploration becomes highly relevant in overcoming these learning challenges.

The development of learning tools that are valid, practical, and effective is essential to support the implementation of guided inquiry-based instruction (Plomp & Nieveen, 2013; Ogan-Bekiroglu & Arslan, 2024). Educational design research focuses not only on the final product but also on its iterative improvement throughout the development process. Based on this rationale, the present study aims to develop guided inquiry-based learning tools on the topic of additive and addictive substances in junior high school science to enhance students' critical thinking skills.

Method

Type of Research

This study employed a developmental research method aimed at producing guided inquiry-based science learning tools that are valid, practical, and effective. The development model used refers to Tessmer's formative evaluation model (1998), which emphasizes iterative product revision through formative evaluation stages (Tessmer, 1998). Developmental research allows for the refinement of educational products based on user testing and feedback (Sugiyono, 2018).
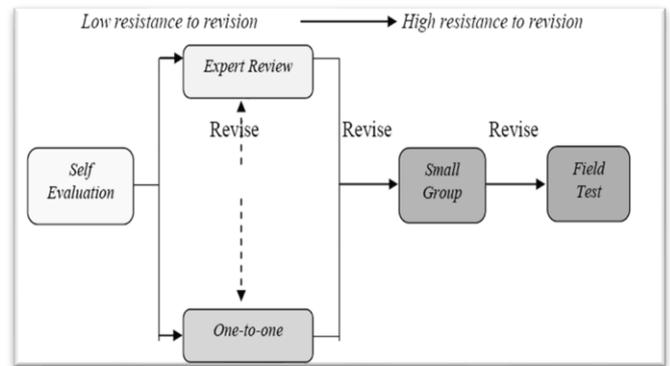

Figure 1. Developmental research model with formative evaluation design (Tessmer, 1998)

Research Subjects

The subjects of this study were eighth-grade junior high school students in South Kalimantan, selected through purposive sampling to ensure alignment between subject characteristics and the research objectives (Creswell, 2014). This selection was essential to ensure that the data collected could reflect the product's effectiveness in real classroom contexts. A total of 30 students participated in the study, representing the target population.

Research Procedure

The research stages included a needs analysis to identify learning characteristics and requirements relevant to the local context (Putri et al., 2020); the design of instructional products such as lesson plans (RPP), student worksheets (LKS), and learning media based on guided inquiry principles (Fitriani et al., 2021); expert validation of the products by subject matter and media experts using standardized validation instruments (Susanto et al., 2019); and limited as well as field trials to assess the feasibility and effectiveness of the products, followed by revisions based on the feedback received (Handayani & Wibowo, 2018).

Data Analysis

Data obtained in this study were analyzed using both quantitative and qualitative approaches to provide a comprehensive understanding of the validity, effectiveness, and implementation of the instructional products. Product validation data were analyzed descriptively by calculating the percentage of validity scores and classifying them into categories such as "very valid," "valid," "moderately valid," or "less valid" (Putri et al., 2020). Student learning outcomes were analyzed using paired t-tests to determine whether there were significant improvements before and after the implementation of the instructional products (Handayani & Wibowo, 2018). This analysis was crucial in statistically assessing the product's effectiveness in

enhancing student competencies. In addition, qualitative data obtained from observations and interviews were analyzed using descriptive qualitative techniques to provide in-depth insights into the feasibility and implementation processes of the learning products in the classroom, including teacher and student

responses during the learning activities (Fitriani et al., 2021). By combining quantitative and qualitative analyses, this study was able to holistically address questions regarding product validity, user acceptance, and impact on student learning outcomes

Table 1. Summary of Research Data Analysis Techniques

Type of Data	Data Collection Instrument	Analysis Technique	Purpose of Analysis
Product Validation Data	Expert validation questionnaires	Descriptive statistics (percentage and category)	To determine the validity level of the product
Student Learning Outcome Data	Pre-test and post-test assessments	Paired t-test	To examine significant improvement in students' learning outcomes
Qualitative Data	Observation and interview	Descriptive qualitative analysis	To describe the feasibility and implementation process of the product

Result and Discussion

Validity of Learning Tools

Validity is a crucial aspect in the development of instructional tools, as it ensures that the developed materials align with the intended competencies and the characteristics of the learners. In this study, the validity of the instructional tools was assessed by experts and education practitioners, focusing on content validity with regard to components such as the syllabus, lesson

plans (RPP), student worksheets (LKPD), teaching materials, and critical thinking skill instruments.

Based on the validation results, all components of the instructional tools received a "very valid" category, with an average score of 3.7 out of a maximum score of 4, equivalent to a percentage of 92.5%. These results indicate that the tools meet content feasibility standards and are considered relevant, accurate, and supportive of learning objectives by the validators.

Table 2. Validation Results of the Instructional Tools

Assessed Aspect	Maximum Score	Average Score	Percentage (%)	Validity Category
Content relevance	4	3.8	95%	Very valid
Material presentation	4	3.7	92.50%	Very valid
Language quality	4	3.6	90%	Very valid
Supporting media	4	3.7	92.50%	Very valid
Overall average	–	3.7	92.50%	Very valid

The validation model used in this study refers to the framework proposed by Nieveen (1999), which states that instructional tools are considered valid if experts judge all components to be relevant and aligned with the needs and context of the learning environment. This is in line with Akbar's (2013) view, which emphasizes the importance of content validity in ensuring the compatibility between instructional materials and the demands of the applicable curriculum.

Furthermore, content validity takes into account the substance of the material, presentation structure, language appropriateness, and the feasibility of supporting media. Expert evaluations indicated that the developed tools addressed these aspects holistically, making them suitable for actual classroom implementation. This is also supported by Widodo et al. (2008), who argue that valid instructional tools must be directly aligned with learning outcomes and capable of accommodating students' characteristics.

Practicality of the Instructional Tools

Practicality in the development of instructional tools refers to the extent to which these tools can be used effectively, efficiently, and are easy to understand by users—both teachers and students—in actual classroom settings. This aspect is crucial because a theoretically valid tool may not necessarily be applicable in practice. Therefore, practicality serves as a bridge between conceptual design and real-world classroom implementation.

In this study, practicality was assessed using three sources of data: Observation of learning implementation, Teacher self-assessment questionnaires, and Student responses to the instructional tools used.

Observations of tool implementation were conducted to evaluate the extent to which the tools were used in accordance with the lesson plan (RPP) design. The results indicated that both teacher and student

activities fell into the good to excellent categories. Teachers successfully delivered content, facilitated discussions, and guided student activities according to the instructions outlined in the tools. Students also demonstrated active engagement throughout the learning process, including completing worksheets (LKPD) and participating in discussions.

Teachers who used the tools provided self-assessments covering aspects such as ease of understanding instructions, completeness of guidance, realistic time allocation, and flexibility of the tools in diverse classroom conditions. The results revealed that teachers found the tools highly supportive for planning and delivering instruction, and could be used directly without the need for intensive training.

Student responses were also considered important indicators of practicality. The questionnaire results showed that most students found the LKPD and teaching materials helpful. They considered the tools visually appealing, the instructions easy to follow, and the LKPD activities encouraged them to think critically and engage in active discussions. Increased interest and understanding were indicators that the tools were user-friendly and applicable in real learning situations.

This finding aligns with Plomp et al. (2007), who emphasize that high-quality instructional tools must be optimally usable by teachers and students without significant difficulties. Wahyuni et al. (2017) also argue that practical tools are those that require no special training and can be readily implemented in the classroom.

Furthermore, positive student responses to tools designed to promote critical thinking suggest that these tools are not only easy to use but also capable of directing learning toward the development of student competencies. This is consistent with findings by Af'idayani et al. (2018), Saputra et al. (2017), Idiege et al. (2017), Ilma et al. (2020), Qing et al. (2010), Abdi (2014), and Rahayu et al. (2018), who found that inquiry-based, structured, and contextually relevant tools can enhance student participation and foster interest in learning content.

Table 3. Practicality Results of the Instructional Tools

Assessed Aspect	Maximum Score	Average Score	Percentage (%)	Category
Implementation of teacher activities	4	3.6	90%	Very practical
Implementation of student activities	4	3.5	87.5%	Very practical
Teacher self-assessment of the tools	4	3.7	92.5%	Very practical
Student response to the LKPD	4	3.6	90%	Very practical
Student response to teaching materials	4	3.5	87.5%	Very practical
Overall Average	–	3.58	89.5%	Very practical

Overall, these results indicate that the instructional tools meet the criteria for practicality in all aspects, including technical implementation, user convenience, and effective support for the teaching and learning process. Accordingly, the developed tools are not only content-valid but also highly practical and ready for use in real classroom environments.

Effectiveness of the Instructional Materials

The effectiveness of the instructional materials was determined based on students' learning outcomes, improvements in critical thinking skills, and attitudes. The results from the small group trial and field testing showed a significant increase from pre-test to post-test scores, with an average N-Gain of 0.49, which falls into the moderate category, indicating that the instructional materials effectively improved cognitive abilities.

According to Hake (1999), an N-Gain value between 0.3 and 0.7 is classified as moderate improvement, which is sufficient to demonstrate the positive impact of an educational intervention. Students' critical thinking skills significantly improved across all assessed components—explanation, analysis, inference, and evaluation—in accordance with the indicators proposed by Facione (1990). This indicates that the learning syntax applied was effective in fostering higher-order thinking skills (HOTS).

In addition, affective and social indicators such as cooperation, responsibility, and accuracy were rated in the good category, supporting the findings of Sutama et al. (2014), which emphasized the importance of integrating character values in inquiry-based learning.

These results affirm that the instructional materials are effective in enhancing both cognitive performance and critical thinking, while also supporting the development of affective and social competencies, which are crucial components of holistic education.

Table 4. Results of Normality Test and Improvement in Critical Thinking Scores Based on N-Gain Test

Class	N	Sig. Value (Kolmogorov-Smirnov)	Distribution	Average N-Gain	Improvement Category
Field testing	30	0.126	Normal	0.49	Moderate

Improvement categories based on Hake (1999): High: ≥ 0.7; Moderate: 0.3 – 0.69; Low: < 0.3

Scientific Contribution and Impact of the Study

This research provides a significant contribution to the development of instructional materials oriented toward critical thinking skills, particularly within the context of science learning at the junior high school (SMP/MTs) level. One of its main theoretical contributions is the reinforcement of a conceptual framework for the development of instructional tools based on an inquiry-based approach integrated with critical thinking skill indicators. Although the development of instructional materials has been widely studied, a focused approach on fostering higher-order thinking skills through inquiry syntax within the framework of the Merdeka Curriculum remains underexplored. Therefore, this study enriches the literature on 21st-century competency-based learning development, which emphasizes analytical, evaluative, and reflective thinking abilities, as formulated by Facione (1990) and King et al. (1998).

From a methodological perspective, the study adopts a design research approach, referring to the formative evaluation model by Plomp et al. (2007), which includes the stages of validity, practicality, and effectiveness. This approach contributes methodologically by offering a systematic and empirical procedure to evaluate the quality of educational materials. By involving expert assessments, practitioner feedback, and field-testing in real classroom settings, the study provides robust evidence of the instructional materials' feasibility in enhancing student learning outcomes and critical thinking skills.

Practically, the instructional materials developed in this study offer a concrete alternative for teachers to design lessons that focus not only on content mastery but also on the structured development of students' critical thinking. These materials can be adapted by teachers to strengthen the implementation of inquiry-based learning without the need for intensive training, as supported by the findings of Wahyuni et al. (2017). This is also in alignment with national education policies that emphasize contextual, meaningful learning that empowers students cognitively and affectively (Kemendikbudristek, 2022).

Furthermore, the results of this study have broad implications for both scientific advancement and educational practice. Scientifically, the developed instructional materials can serve as a foundation for the development of science curricula and learning instruments that are more aligned with the strengthening of scientific literacy and higher-order thinking skills, as emphasized by OECD (2018). In addition, the findings can be utilized in teacher training programs and educational policy development to promote pedagogical transformation focused on the achievement of essential competencies. This study also opens avenues for further research on the integration of critical thinking skills into thematic learning, project-based learning, and STEM approaches, thereby broadening the applicability of the findings across various educational contexts.

Conclusion

This study produced guided inquiry-based science instructional materials that were proven to be valid, practical, and effective in enhancing junior high school students' critical thinking skills on the topic of additives and addictive substances. Expert validation results indicated that the materials were categorized as highly valid (average score of 3.7 out of 4 or 92.5%), reflecting alignment in terms of content relevance, material presentation, language clarity, and supporting media with curriculum demands and learner characteristics. In terms of practicality, the materials were rated highly practical based on implementation observations, teacher self-assessments, and student responses, which revealed that the materials were easy to understand and implement in real classroom settings. Empirically, the effectiveness of the instructional materials was demonstrated by a significant improvement in students' critical thinking skills, with an average N-Gain of 0.49 (moderate category), covering enhancements in the dimensions of explanation, analysis, inference, and evaluation according to Facione's indicators. These findings confirm that the guided inquiry approach is effective in fostering higher-order thinking skills (HOTS) and supports the attainment of student competencies. Therefore, the developed materials are not only theoretically sound but also practically applicable in supporting contextual, reflective, and empowering pedagogical transformation.

Author Contributions
The authors in this research are divided into executor and advisor.

Conflicts of Interest
The authors declare no conflict of interest in this research.

References

Abdi, A. (2014). The Effect of Inquiry-Based Learning Method on Students' Academic Achievement in Science Course. *Universal Journal of Educational Research,* *2*(1), 37-41. https://doi.org/10.13189/ujer.2014.020104

Agung, A. G. (2014). *Metodologi Penelitian Pendidikan*. Yogyakarta: Aditya Media Publising.

Af'idayani, N., Setiadi, I., & Fahmi, F. (2018). The effect of inquiry model on science process skills and learning outcomes. *European Journal of Education Studies*. https://doi.org/10.5281/zenodo.1344846

Akbar, S. (2013). *Instrumen Perangkat Pembelajaran*. PT Remaja Rosdakarya.

Ardiyanti, Y. (2016). 'Berpikir Kritis Siswa Dalam Pembelajaran Berbasis Masalah Berbantuan Kunci Determinasi. *Jurnal Pendidikan Indonesia*, *5*(2), 901. https://doi.org/10.23887/jpi-undiksha.v5i2.8544

Baharuddin, Ananda, R., Rosyida, F., Irawan, L. Y & Utomo, D.H. (2022). 'Model Pembelajaran Self-Directed Learning Berbantuan Website Notion: Meningkatkan Kemampuan Berpikit Kritis Siswa SMA. *Jurnal Inovasi Teknologi Pendidikan*, *9*(3), 245-257. https://doi.org/10.21831/jitp.v9i3.52017

Balitbang, Kemendikbud. (2019). *Laporan Hasil UN dan Asesmen Kompetensi Siswa*. Jakarta: Kemendikbud.

Facione, P. A. (1990). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. The Delphi Report. Retrieved from https://eric.ed.gov/?id=ED315423

Fahmi, Fajeriadi, H., Irhasyuarna, Y., Yulianti, Y. E., & Kusasi, M. (2024). The effect of using inquiry model on science process skills and student learning outcomes. *Jurnal Penelitian Pendidikan IPA, 10*(12), 10426–10433. https://doi.org/10.29303/jppipa.v10i12.8658

Fatma, N., & Winarti, W. (2024). Analisis Profil Kemampuan Berpikir Kritis pada Pembelajaran Sains di Sekolah. *Jurnal Ilmiah Pendidikan Madrasah Ibtidaiyah*, *8*(1). http://dx.doi.org/10.35931/am.v8i1.2934

Fitriani, R., Mustadi, A., & Jumadi. (2022). the impact of inquiry-based learning on students' critical thinking skills in science education: A meta-analysis. *International Journal of Instruction, 15*(1), 21–38. https://doi.org/10.29333/iji.2022.1512a

Fitriani, N., Prasetyo, Z. K., & Harahap, S. (2021). Pengembangan media pembelajaran berbasis inkuiri terbimbing pada materi ekosistem. *Jurnal Pendidikan IPA Indonesia*, *10*(3), 345–354. https://doi.org/10.15294/jpii.v10i3.27215

Gibson, H. L., & Chase, C. (2002). Longitudinal Impact of an Inquiry-Based Science Program on Middle School Students' Attitudes Toward Science. Science Education, *86*(5), 693-705. https://doi.org/10.1002/sce.10039

Harahap, M. B., Manurung, S. R., Marbun, M. A., & Mihardi, S. (2016). Effect Model Inquiry Training on Student's Science Process Skill. *Advances in Social Sciences Research Journal, 3*(11), 38-42. https://doi.org/10.14738/assrj.311.2288

Hake, R. R. (1999). *Analyzing Change/Gain Scores*. Indiana University. Retrieved from https://physics.indiana.edu/~sdi/AnalyzingChange-Gain.pdf

Handayani, S., & Wibowo, A. (2018). Pengembangan perangkat pembelajaran IPA berbasis R&D. *Jurnal Pendidikan dan Pembelajaran, 25*(1), 15–25. https://doi.org/10.15294/jpp.v25i1.6894

Hidayati, L. (2016). Profil keterampilan berpikir kritis siswa pada pembelajaran IPA SMP. *Jurnal Pendidikan Sains, 4*(2), 55–63. https://doi.org/10.26714/jps.4.2.2016.55-63

Idiege, K., Nja, C. O., & Ugwu, A. N. (2017). Development of Science Process Skills Among Nigerian Secondary School Science Students and Pupils: An Opinion. *International Journal of Chemistry Education, 1*(2), 013-021. Retrieved from https://shorturl.at/rlLO3

Ilma, S., Al-Muhdhar, M. H. I., Rohman, F., & Saptasari, M. (2020). The Correlation between Science Process Skills and Biology Cognitive Learning Outcome of Senior High School Students. *JPBI (Jurnal Pendidikan Biologi Indonesia), 6*(1), 55-64. https://doi.org/10.22219/jpbi.v6i1.10794

Kemendikbudristek. (2022). *Panduan Implementasi Kurikulum Merdeka*. Jakarta: Direktorat Jenderal Pendidikan Anak Usia Dini, Pendidikan Dasar dan Pendidikan Menengah. Retrieved from https://kurikulum.kemdikbud.go.id/wp-content/uploads/2022/06/Panduan-Pembelajarn-dan-Asesmen.pdf

King, A., Goodson, L., & Rohani, F. (1998). *Higher Order Thinking Skills: Definition, Teaching Strategies, Assessment*. Educational Services Program.

Maeots, M., & Padaste, M. (2014). the Role of General Inquiry Knowledge in Enhancing Students' Transformative Inquiry Processes in a Wab-Based Learning Environment. *Journal of Baltic Science EducationI*, *13*(1), 19-31. http://dx.doi.org/10.33225/jbse/14.13.19

Molefe, L., & Aubin, J.-B. (2021). Pre-Service Teachers' Views About Ecosystem-Based Fieldwork in Terms of the Nature of Environmental Education, Investigations, Skills, and Processes. *Journal of Baltic Science Education, 20*(4). https://doi.org/10.33225/jbse/21.20.622

Mulyasa, E., Suryana, D., & Rasyid, H. (2013). *Pengembangan dan Implementasi Kurikulum 2013*. Bandung: Remaja Rosdakarya.

Nieveen, N. (1999). *Prototyping to reach product quality*. Design Approaches and Tools in Education and Training. https://doi.org/10.1007/978-94-011-4255-7_10

OECD. (2018). *PISA 2018 Assessment and Analytical Framework: Science, Reading, Mathematics and Financial Literacy*. Paris: OECD Publishing. https://doi.org/10.1787/b25efab8-en

Ogan-Bekiroglu, F., & Arslan, A. (2014). Examination of the Effects of Model-Based Inquiry on Students' Outcomes: Scientific Process Skills and Conceptual Knowledge. *Procedia Social and Behavioral Sciences, 141*, 1187-1191. https://doi.org/10.1016/j.sbspro.2014.05.202

Osman, K., & Vebrianto, R. (2013). Fostering Science Process Skills and Improving Achievement Through the Use of Multiple Media. *Journal of Baltic Science Education, 12*(2). https://doi.org/10.33225/jbse/13.12.191

Pedaste, M., Mäeots, M., Siiman, L.A., de Jong, T., van Riesen, S.A.N., Kamp, E.T., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review, 14*, 47–61. https://doi.org/10.1016/j.edurev.2015.02.003

Plomp, T., & Nieveen, N. (2007). *An Introduction to Educational Design Research*. Netherlands: SLO.

Plomp, T., & Nieveen, N. (2013). *Educational Design Research – Part A: An Introduction*. Netherlands: SLO.

Putri, R. M., Sari, D. K., & Rahmawati, Y. (2020). Analisis kebutuhan pengembangan pembelajaran IPA kontekstual. *Jurnal Pendidikan Sains, 8*(2), 120–129. https://doi.org/10.26714/jps.8.2.2020.120-129

Qing, Z., Jing, G., & Yan, W. (2010). Promoting Preservice Teachers' Critical Thinking Skills by Inquiry-Based Chemical Experiment. *Procedia Social and Behavioral Sciences, 2*(2), 4597-4603. https://doi.org/10.1016/j.sbspro.2010.03.737

Rahayu, A. B., Hadi, S., Istyadji, M., Zaini, M., Sholahuddin, A., & Fahmi, F. (2018). Development of guided inquiry based learning devices to improve student learning outcomes in science materials in middle school. *European Journal of Alternative Education Studies*. https://doi.org/10.5281/zenodo.2261027

Rusmalina, L. (2012). Peningkatan hasil belajar dan keterampilan berpikir kritis melalui model inkuiri terbimbing. *Jurnal Ilmiah Pendidikan IPA, 1*(1), 35–42. https://doi.org/10.25273/jipi.v1i1.1234

Saputra, T. B. R. E., Nur, M. & Purnomo, T. (2017). Pengembangan Pembelajaran Inkuiri Berbantuan Phet untuk Melatih Keterampilan Sains Siswa. *Journal of Science Education and Practice, 1*(1), 20-31. http://dx.doi.org/10.33751/jsep.v1i1.378

Simsek, P., & Kabapinar, F. (2010). The Effects of Inquiry-Based Learning on Elemantary Student Conceptual Understanding of Matter, Scientific Process Skills and Science Attitudes. *Procedia Social and Behavioral Sciences, 2*(2), 1190-1194. https://doi.org/10.1016/j.sbspro.2010.03.170

Stout, B. (2001). Tools for Scientific Inquiry in a FifthGrade Classroom. *Primary Voices, 10*(1), 23-27. Retrieved from https://eric.ed.gov/?id=EJ630706

Siregar, A., & Nurbaiti, E. (2020). Analisis kemampuan berpikir kritis siswa SMA dalam pemecahan masalah kontekstual. *Jurnal Pendidikan Sains Indonesia, 8*(2), 215–224. https://doi.org/10.24815/jpsi.v8i2.12345

Sutama, S., Rahmawati, D., & Nugroho, H. (2014). Pengaruh model inkuiri terbimbing terhadap keterampilan berpikir kritis siswa SMP. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia, 3*(1), 45–51. https://doi.org/10.26714/jppipa.v3i1.6789

Tessmer, M. (1993). *Planning and Conducting Formative Evaluations: Improving the Quality of Education and Training*. London: Kogan Page.

Tilaar, H.A.R. (2012). *Perubahan Sosial dan Pendidikan: Pengantar Pedagogik Transformatif untuk Indonesia*. Jakarta: Grasindo.

Wahyuni, I., Yuliati, L., & Indriwati, S. (2017). Pengembangan perangkat pembelajaran IPA model inkuiri. *Jurnal Pendidikan Sains, 5*(2), 66-72. https://doi.org/10.26714/jps.5.2.2017.66-72

Widodo, C., & Jasmadi. (2008). *Panduan Menyusun Bahan Ajar Berbasis Kompetensi*. Jakarta: Elex Media Komputindo.

Zubaidah, S. (2016). Keterampilan abad ke-21: Keterampilan yang diajarkan melalui pembelajaran. In *Seminar Nasional Pendidikan* (Vol. 2, No. 2, pp. 1-17). Retrieved from https://shorturl.at/EISdc.