



## The Influence of Project-Based Learning Model on SSI North Maluku on Students' Critical Thinking Skills in Atomic Structure Material

Nurul Aulia Rahman<sup>1\*</sup>, St. Hayatun Nur Abu<sup>1</sup>

<sup>1</sup>Chemistry Education, Faculty of Teacher Training and Education, Khairun University Ternate  
Corresponding Author E-mail: [nurulaulia@unkhair.ac.id](mailto:nurulaulia@unkhair.ac.id)\*

### ARTICLE INFO:

Revised: 2026-05-03  
Accepted: 2026-06-04  
Published: 2026-06-07

### Keywords:

Critical thinking, local Socio-Scientific Issues, Project-Based Learning

### ABSTRACT

*The Influence of This study is an experimental study that aims to see the effect of the SSI local-oriented project-based learning model on students' critical thinking skills on atomic structure materials. The SSI local referred to in this study focuses on social issues in North Maluku. The research design is a one-group pretest-posttest. The sample was selected using a simple purposive sampling technique. Data collection techniques, including tests, were used to measure students' critical thinking skills, and non-test techniques, such as observation sheets, were used to observe the implementation of the SSI locally oriented project-based learning model. The results of the learning observations in the outstanding category, with a 83% percentage. The comparison of pretest and posttest results for students' critical thinking skills also showed a significant increase, reaching 36,19%. The results of the normality test showed sig = 0.200, indicating that the data were normally distributed. The results of the paired-samples T-test showed sig = 0.00; H0 was rejected, and H1 was accepted. Thus, the SSI-oriented PjBL model affects students' critical thinking skills regarding the atomic structure of materials. Project-Based Learning Model on SSI North Maluku on Students' Critical Thinking Skills in Atomic Structure Material*

©2026 Arfak Chem: Chemistry Education Journal  
This is an open access article distributed under the CC BY-ND 4.0 license  
(<https://creativecommons.org/licenses/by-nd/4.0/>)

**How to cite:** Rahman, N. A., & Abu, S. H. N. (2026). The Influence of Project-Based Learning Model on SSI North Maluku on Students' Critical Thinking Skills in Atomic Structure Material. *Arfak Chem: Chemistry Education Journal*, 9(1), 820-825. <https://doi.org/10.30862/accej.v9i1.1272>

## 1. INTRODUCTION

Today's science education requires students to have critical thinking skills involve real-life problems that are complex and dynamic. Critical thinking is a logical, reflective, and analytical way of thinking about how students evaluate information, make decisions, and solve problems. Various scientific studies show that in science learning (Ennis, 2017; Yuliani et al., 2020; Saputri et al., 2020; Ristanto et al., 2019), including chemistry, critical thinking is needed so that students not only receive information, but also: 1) are able to make their own assumptions; 2) are able to analyze; 3) can conclude and make their own premises; 4) realize themselves by asking critical questions, and 5) are able to understand and solve new problems by applying scientific concepts. One approach that can be used to improve these critical thinking skills is project learning. Project-Based Learning or PjBL is an effective way to improve students' ability to learn and improve their learning outcomes through community-planned practical learning.

The PjBL model allows learners to start looking at physical projects where they can ask questions and get solutions for their experiments, planning, and active testing, and so on about actions they don't know (Kokotsaki, Menzies, & Wiggins, 2016). PjBL has five general characters according to Thomas (2020), namely: (1) projects as a significant planning center point, not as an assignment accessory; (2) questions foster anticipatory intellectual activity to obtain student Instagram; (3) investigative-authority and constructive activity to obtain debtors; (4) distribution of extensions to continue transmission; and (5) the results can be presented in public. In chemistry lessons on atomic structure, Project-Based Learning (PjBL) provides an alternative for teachers to implement the material through project-based activities and helps students build a more concrete understanding. Research by Sumarni et al. (2018) found that implementing Project-Based Learning (PjBL) in chemistry learning significantly improved students' conceptual understanding, learning motivation, and critical thinking. This is because Project-Based Learning (PjBL) allows students to explore, experiment, and reflect on their activities.

Furthermore, the effectiveness of PjBL can be enhanced by integrating it into the local social and cultural context through a community-oriented approach. *Socio-Scientific Issue* (SSI). SSI links science topics to relevant and contextual social issues, which can increase student attention and foster reflective and critical thinking (Sadler et al., 2019). The PjBL-local SSI model can produce hands-on and meaningful learning experiences that encourage deeper and more meaningful conceptual understanding by students (Wati & Siahaan, 2022). SSI-oriented learning can support student learning outcomes by improving critical thinking skills, problem analysis, literacy, and building scientific knowledge (Rahman, 2023). Furthermore, integration through real-life projects encourages independent investigation, argumentation, and collaboration to find solutions, which are important characteristics of critical thinking (Suwarni, 2018).

In the context of the North Maluku region, the exploitation of natural resources and environmental challenges have become some of the most potential issues to be socialized locally in PjBL-SSI-based chemistry learning. Some local issues that can be raised here include: (1) Environmental Impacts of Nickel Mining. North Maluku is one of the largest nickel producing areas in Indonesia. Nickel mining activities in Halmahera have triggered various environmental impacts such as heavy metal pollution in water and soil (Rahman, 2021). This issue can be used by students

as a project to evaluate the heavy metal content in both soil and water and relate it to the atomic structure of heavy metals and their chemical properties. (2) Marine Pollution by Domestic and Industrial Waste. The coastlines of Ternate and Tidore have experienced increasing marine pollution from liquid and solid waste. Student projects can include campaigns to reduce pollution based on chemical data regarding seawater pH and metal content. The concepts of atomic structure and chemical bonds can be linked to the reactivity of polluting elements (Suparman, 2018).

Various studies have shown that the implementation of SSI-based Project-Based Learning (PjBL) can improve students' critical thinking skills because they are faced with real-life problems that require analytical, evaluative, and logical reasoning processes (Zeidler & Nichols, 2009; Rahayu et al., 2021). However, not many researchers have specifically developed and discussed SSI-based PjBL in the context of the North Maluku region and chemistry teaching. Therefore, This study aims to examine the influence of the Project-Based Learning (PjBL) model oriented to local Socio-Scientific Issues (SSI) in North Maluku on students' critical thinking skills in atomic structure material. In expanding innovative, contextual, and effective teaching models to improve student competencies, this research is expected to contribute, especially in the field of science education and critical thinking development.

## 2. METHODS

This research is The study used a pre-experimental design with a one-group pretest-posttest design. The sample was selected using a simple purposive sampling technique. The research was conducted at MAN 1 Ternate City, North Maluku, with a sample size of 30 students. Data collection techniques included tests and non-tests. The test technique was used to measure students' critical thinking skills, and the non-test technique, an observation sheet, was used to assess the implementation of the locally-oriented PjBL model SSI. The relationship between the research instruments and the data analysis techniques used can be seen in the following table:

**Table 1.** Relationship between Data Collection Instruments and Research Data Analysis Techniques

No	Data Collection Instruments	Analysis Techniques Used
1	Critical thinking test	Descriptive, inferential
2	Observation sheet	Descriptive

The analysis of research data used descriptive and inferential analysis in the form of normality tests and paired t-tests. Testing criteria: if the significance level  $(p) > \alpha = 0.05$  then the data comes from a normally distributed population and if the significance level  $(p) < \alpha = 0.05$  then the data comes from a non-normally distributed population. After the research data is declared normal, the hypothesis test is carried out using an inferential statistical test in SPSS with the t test (Paired Samples T Test). Hypothesis testing aims to test the truth of the hypothesis being tested, namely whether the SSI local-oriented PjBL model has an effect on students' critical thinking skills

on atomic structure material. The testing criteria are: based on significance, if the significance is  $> 0.05$ , then  $H_0$  is accepted and the significance is  $< 0.05$ , then  $H_0$  is rejected.

### 3. RESULTS AND DISCUSSIONS

#### 3.1 Research Results

Before conducting the research, validation was first conducted by experts on the research instrument, and the validity results were in the valid category. The research began with a pretest, to measure students' critical thinking skills before the implementation of the SSI local-oriented PjBL model. Furthermore, during the atomic structure learning activities, based on the observation sheet, 83% of students were actively able to follow the learning with a very good category. Learning was carried out in 5 meetings and ended with a posttest on critical thinking skills. A comparison of the pretest and posttest results of students' critical thinking skills after going through learning with the SSI local-oriented PjBL model can be seen in the following table.

Table 2. Comparison of Pretest and Posttest Results of Critical Thinking Skills

Types of tests	Average	The greatest value	Smallest value
Pretest	48.53	62	20
Posttest	84.72	97	78

The next test is the normality test and the paired sample T test to see the truth of the hypothesis. Based on the results of SPSS with the *Kolmogorov Smirnov Test*, the sig value is obtained  $> 0.05$ , namely 0.20, which indicates that the data comes from a normal population. The results of the paired sample T test, obtained a sig value of  $0.00 < 0.05$ , so  $H_0$  was rejected and  $H_1$  was accepted, meaning there is an influence of the SSI local-oriented PjBL model on students' critical thinking skills on atomic structure material.

Table 3. Summary of Data Analysis Results

Test	Test Type	Results	Conclusion
Normality	Kolmogorov Smirnov Test	Sig = 0.20	Normal data
Hypothesis	Paired Sample t-test	Sig= 0.00	$H_0$ was rejected, $H_1$ was accepted

#### 3.2 DISCUSSION

The results of the study indicate that the implementation of the Project-Based Learning (PjBL) model oriented to local Socio-Scientific Issues (SSI) in North Maluku has a significant impact on improving students' critical thinking skills on atomic structure material. This improvement is reflected in the results of learning observations and critical thinking ability tests. The active involvement of students in compiling local SSI projects is seen through learning observations, students can construct meaning in a contextual and relevant manner. Students are enthusiastic about working on projects and independent assignments, because what they learn is directly related to their environment. For example, when students investigate the issue of heavy metal pollution due to nickel mining in Halmahera, they not only learn about the concept of metal atomic structure, electron configuration, and its reactivity but are also trained in analyzing

environmental data, assessing its impact on society, and suggesting science-based solutions. The results of the investigation were then presented in the form of a realized in the form of a scientific poster.

Integrating learning with local issues has been shown to increase students' emotional and intellectual engagement. This is in line with the findings of Sadler et al. (2019), Bojeo & Duque (2022), that learning through the SSI framework increases the depth of understanding and critical thinking skills because it requires students to make decisions based on data, social, and ethical considerations. Students build their understanding from various alternative arguments that arise by considering the SSI aspects presented (Rahman et al. 2024). The local context also has a significant contribution to increasing the meaning of learning. As stated by Rahayu et al. (2021), the application of local SSI in chemistry teaching not only increases student motivation but also encourages them to be more reflective and critical of social issues around them (Pratiwi. 2025, Selamat, 2024).

Comparison of pretest and posttest results of students' critical thinking skills also showed a significant increase, reaching 36,19%. The PjBL model naturally hones students' critical thinking skills at project stages, such as planning, investigation, data analysis, and reflection. All of these stages encourage students to not only receive information but also to process and evaluate it in depth before presenting the results. Supporting this, Sumarni et al. (2018) stated that PjBL is an effective approach to improving higher-order thinking skills in science learning. Project-based learning that incorporates local values through ethnochemistry presents a promising alternative for improving the quality of science education in schools (Abu et al, 2025).

## 4. CONCLUSIONS

Based on the results of research on atomic structure material, the success of the local SSI oriented project based learning model has been empirically tested in improving students' critical thinking skills with a percentage increase of 36,19% and student activity of 83%. The learning context presented is collaborative, contextual, investigative, and socially meaningful.

---

## REFERENCES

- Abu. N.,Rahman. NA, Mauraji Ilham. (2025). Keterampilan proses sains dalam konteks project praktikum sederhana berbasis etnokimia: Sebuah telaah literatur. *Arfak Chem: Chemistry Education Journal*. <https://doi.org/10.30862/accej.v8i1.913>
- Badeo,J.M & Duque, D.A. (2022). The effect of socio-scientific issues in teaching science," *Journal of Technology and Science Education*, vol. 12, no. 2, pp. 291–30. <https://www.jotse.org/index.php/jotse/article/view/1340/610>.
- Ennis, R.H. (2017). Critical thinking: A streamlined conception. In Davies, M. & Barnett, R. (Eds.), *The Palgrave Handbook of Critical Thinking in Higher Education*. Palgrave Macmillan.
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- Pratiwi, D, Sudarmin, dan S. Yamtinah. (2025). Assessing students' numeracy literacy Using ethnoscience-SSI," *Jurnal Inovasi Pendidikan IPA*, vol. 11, no. 1, pp. 323– 334. <https://jurnal.uny.ac.id/index.php/jipi/article/view/77709>

- Rahayu, S., Hastuti, US, & Wiyarsi, A. (2021). Developing socioscientific issues-based chemistry teaching materials to improve students' critical thinking skills. *International Journal of Instruction*, 14(2), 623–638. <https://doi.org/10.29333/iji.2021.14235a>
- Rahman. NA, Abu. N., Hamzah. EF, Gustina. (2024). CUPs-SSI: Improving Conceptual Understanding Through Integration Cooperative Learning Model With Social Scientific Issues. *Integrated Science Journal. JIT* 8 (3) (2024) 434-443. <http://ojs.unm.ac.id/index.php/ipaterpadu>
- Rahman. NA, Bundu. P., Mustafa. (2023). Literature Study: Implementation of SSI (Social Scientific Issue) Oriented Learning. *ICMI*. Volume 4. <http://www.conference.unja.ac.id/ICMI/>
- Rahman, S., Mubarak, H., & Ismail, I. (2021). Heavy metal content in Halmahera coastal waters due to nickel mining. *Journal of Environmental Sciences*, 19(1), 12–20.
- Ristanto, RH, Zubaidah, S., Amin, M., & Rohman, F. (2019). Scientific literacy: Critical thinking skills in biology education. *International Journal of Evaluation and Research in Education (IJERE)*, 8(4), 593–600. <https://doi.org/10.11591/ijere.v8i4.20312>
- Sadler, T.D., Foulk, J.A., & Friedrichsen, P.J. (2019). Socioscientific issues as a context for science curriculum and instruction. In *Science Education* (pp. 1–13). Wiley.
- Saputri, FM, Yuliati, L., & Amin, M. (2020). Developing science learning tools with socio-scientific issues (SSI) to improve students' critical thinking skills. *Journal of Physics: Conference Series*, 1491, 012054. <https://doi.org/10.1088/1742-6596/1491/1/012054>
- Selamat. I.N dan Priyanka, L.M. (2024). Integrating local wisdom and socio-scientific issues," *Thinking Skills and Creativity Journal*, vol. 7, no. 2, pp. 182–188. <https://ejournal.undiksha.ac.id/index.php/TSCJ/article/view/93461>
- Sumarni, W., Wardani, DS, & Kurniasih, D. (2018). Project-based learning model to increase students' creativity and critical thinking ability in chemistry. *Journal of Physics: Conference Series*, 1022(1), 012057. <https://doi.org/10.1088/1742-6596/1022/1/012057>
- Suparman, A. R. (2018). Penggunaan Model Kooperatif Tipe Group Investigation (GI) untuk Meningkatkan Aktivitas dan Hasil Belajar Mahasiswa pada Materi Struktur dan Sifat-Sifat Atom. *Quantum: Jurnal Inovasi Pendidikan Sains*, 9(1), 17-22.
- Thomas, J. W. (2000). *A Review of Research on Project-Based Learning*. The Autodesk Foundation.
- Yuliani, K., Wahyudin, & Rusmana, N. (2020). Improving students' critical thinking and creative thinking skills through guided inquiry learning. *Journal of Physics: Conference Series*, 1521, 042045. <https://doi.org/10.1088/1742-6596/1521/4/042045>
- Zeidler, D. L., & Nichols, B. H. (2009). Socioscientific issues: Theory and practice. *Journal of Elementary Science Education*, 21(2), 49–58.
-