Al-Ishlah: Jurnal Pendidikan
Vol.17, 2 (June, 2025), pp. 1868-1878
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v17i2.6991

Investigating Curiosity and Reasoning Through Technology-Based Science Activities: The Role of Photo Journals

Kharisma Ika Nur'aini[1], Izza Aliyatul Muna[2]

[1] Institut Agama Islam Negeri Ponorogo, Ponorogo, Indonesia; rismaikan@gmail.com
[2] Institut Agama Islam Negeri Ponorogo, Ponorogo, Indonesia; izza@iainponorogo.ac.id

ARTICLE INFO

Keywords:

curiosity;
expression;
reasoning;
technology

Article history:

Received 2025-01-21
Revised 2025-03-10
Accepted 2025-04-21

ABSTRACT

This study investigates how students' curiosity and scientific reasoning are expressed through the use of photo journals in learning about food additives. It aims to: (1) characterize students' questions and answers based on scientific inquiry practices; (2) describe variations in the expression of curiosity among Grade VIII students; (3) examine the relationship between individual curiosity and scientific reasoning; (4) assess students' levels of curiosity and reasoning; and (5) compare outcomes between students who used photo journals and those who did not. A mixed-methods approach was employed with a sample of 23 eighth-grade students. Data were collected through photo journals, interviews, questionnaires, and classroom observations. The photo journal served as a technological tool to encourage inquiry and reflection. Student questions and responses were categorized into six inquiry-based types, with the most frequent being teleological and cause-effect questions. Both curiosity and reasoning levels were predominantly high (82.61%), with the remaining (17.39%) falling into the medium category. The photo journal method enhanced students' abilities to express curiosity and apply reasoning. The integration of visual technology supported deeper conceptual engagement and reflection. Individual variations in curiosity were found to be associated with levels of scientific reasoning. While the small sample size and time constraints limit generalizability, the study offers valuable insights into fostering scientific literacy through media-based learning.

Corresponding Author:
Kharisma Ika Nur'aini
Institut Agama Islam Negeri Ponorogo, Ponorogo, Indonesia; rismaikan@gmail.com

1. INTRODUCTION

In the era of Industry 4.0, the rapid circulation of information demands that individuals develop critical skills to filter and evaluate the content they encounter. However, the overwhelming availability of information does not automatically translate into increased motivation to learn or pursue deeper understanding (Zetriuslita, 2014). In the context of 21st-century education, many students demonstrate dynamic characteristics but often engage with information at a superficial level, lacking depth in inquiry and reflection.

Curiosity, as emphasized in Presidential Regulation No. 87 of 2017, is a core competency necessary for preparing students to compete in a rapidly evolving global landscape. This regulation underscores the importance of strengthening character education (Penguatan Pendidikan Karakter/PPK), where fostering curiosity plays a central role (Murayama et al., 2018; Permata & Rakhmawati, 2022; Raharja et al., 2018).

To address this need, innovation in learning approaches—particularly in science education—is essential. Active learning that engages students in scientific practices fosters both curiosity and reasoning skills (Hadiat & Karyati, 2019; Puger et al., 2024; Wardani & Janattaka, 2022). However, many current instructional methods remain conventional and theory-driven, limiting opportunities for meaningful exploration and inquiry. Therefore, integrating technology-based methods, such as photo journals, offers a promising alternative to promote student engagement, reflective thinking, and deeper conceptual understanding.

A preliminary study measuring student curiosity through multiple-choice and descriptive instruments revealed an average score of only 47. The assessment included four indicators of curiosity, administered to 23 students. Of these, only five students were categorized as having high curiosity, while four fell into the low category, and four students scored zero. In terms of reasoning, students predominantly demonstrated low-level reasoning skills. Observational data further indicated that students were generally able to provide only basic responses, lacking critical analysis or depth in their explanations. These findings highlight the need for the development of science learning approaches that incorporate relevant technology to foster students' curiosity and enhance their reasoning abilities.

Researchers characterize students' expressions about science practice, such as making explanations associated with practical activities. Researchers characterize students' responses (based on science material concepts) and questions based on the type of science practice activities reflected in the field. This can provide insights into how students think about science and ways to support their reasoning in science learning. This statement is supported by previous research on a question aligned with a measure of curiosity in students (Weible & Zimmerman, 2016). The study is based on two premises: First, curiosity about scientific topics can be further characterized by the practical aspects of scientific inquiry it reflects; second, expressions of curiosity and reasoning vary among individuals.

This study is different from previous studies because it only measures the cognitive aspect of students' sense of knowledge, but also connects it with the reasoning aspect they use. Based on the literature sources published in the journal, it is stated that new variations (reasoning ability) can be associated with science, even though most of those who use reasoning variables are mathematics. On the other hand, reasoning can be associated with science (Viona, 2020). In addition, according to Megan & Sherry (2015), it shows a method of developing expressions of curiosity and interest in science using the journal photo method, but the scope is still limited, namely not utilizing technology (Mu'jizah, 2019; Musbikin, 2021; Weible & Zimmerman, 2016).

To address the challenges in fostering curiosity and reasoning, this study proposes the use of photo journals as an innovative, technology-integrated learning tool. Photo journals are considered well-suited to the demands of the digital era, offering students opportunities to actively engage in the scientific process by exploring, documenting, and reflecting on their experiences. This method supports authentic expressions of curiosity and encourages the development of critical reasoning skills (Hochberg et al., 2018; Luce & Hsi, 2015).

Through the integration of technology in science learning, this research aims to enhance students' curiosity and reasoning by involving them in relevant, reflective, and experiential science practices (Pan et al., 2020). Such methods can also contribute to a broader conceptual understanding of how curiosity and reasoning are fostered through technology-mediated inquiry (Peterson & Cohen, 2019; Schijndel et al., 2018).

The application of the photo journal approach allows for the characterization and analysis of students' expressions of curiosity and reasoning. Specifically, this study aims to (1) explore how students' questions and responses reflect aspects of scientific inquiry; (2) describe the variation in curiosity expression among a small sample (N = 23) of eighth-grade students; (3) examine the relationship between individual curiosity expression and reasoning, with a focused analysis of three students; (4) determine the levels of students' curiosity and reasoning; and (5) compare the effects of using photo journals versus traditional methods.

2. METHODS

Research on the exploration of curiosity and reasoning in practical science activities aims to deepen our understanding of curiosity and reasoning, examine the influence of the development of innovation methods (photo journal), and explain the correlation of students' curiosity and reasoning through an approach using mixed-method research.

The sampling technique was purposive sampling, using the criteria of schools that have supported and are accustomed to utilizing science and technology. This study took 23 grade VIII students from Junior High School 1 Jetis, Ponorogo regency, East Java region. The research variables include curiosity and reasoning.

The research instruments used were observation sheets, interview sheets and questionnaires. The data collection technique used in the study took five data sources: (1) photo journals involving mobile phone cameras and relevant application designs on the topic of additives, (2) photo journal interviews of interest, (3) interviews about reasoning skills related to photo journal interview results, (4) curiosity questionnaires and reasoning assessments based on interview results, and (5) observation sheets regarding the impact of the photo journal method and without journal photos. The data analysis technique in the qualitative type uses the triangulation approach and the Miles and Huberman approach, which includes data reduction, data presentation, and conclusions drawn. In contrast, the quantitative type uses descriptive statistical analysis. The first step for researchers in the study was to calculate the frequency of science-relevant curiosities in three different sources. Furthermore, they examined the variation of curiosity expressions in each student by creating a special graph in each existing data source, and the researcher limited the differences between data sources, so that they did not report a comparative statistical test in each data or between data.

Researchers encoded the students' expressions of curiosity in photo journal entries and interviews. Photo journals and interviews are associated with scientific concepts expressed through patterns of students' expression of curiosity, where curiosity is reflected in the form of questions, while the answers given are identified as reasoning. All coding is categorized exclusively into six categories of curiosity.

3. FINDINGS AND DISCUSSION

This research involves describing data in several variables to explain the problem and research objectives. To produce data, it is used to categorize expressions to obtain a score for each variable.

3.1 Exploration of Student Questions and Answers Characterized in Aspects of Science Practice Activities

Six coding categories relevant to science and from various data points of view are presented in **Table 1.** Four categories come from scientific practice, namely mechanistic, teleological, inconsistency and causation. Meanwhile, "cause-and-effect" reflects the relationship factors in a process without directly questioning the process. The other two categories are related to knowledge, assuming that students express their curiosity in the nature of scientific knowledge related to scientific names, classifications, and general knowledge that they encounter in daily life. In this coding, general knowledge concerns students' reasoning resulting from science. Most students express their curiosity is associated with general knowledge.

Researchers analyzed students' expressions of curiosity by coding data collected from photo journal entries and follow-up interviews. The coding categories were adapted from the framework developed by Megan and Sherry (2015). Each segment of student expression, whether written in the journal or spoken during the interview, was identified and analyzed for patterns of curiosity. The photo journal entries and accompanying notes were examined in relation to scientific concepts, particularly focusing on how students expressed curiosity about food additives—a topic chosen for its relevance to their daily lives. All expressions were systematically coded and classified into six distinct categories of curiosity.

Table 1. Table of Categories, Description and Examples of Curiosities

Categories	Description	Example
Mechanistic	Curiosity about how things happen	What is the process that will ideally help these doughnuts rise?
Teleologis	Curiosity about the purpose, why the object exists and why it happens (function, design, purpose)	Why does iced tea taste sweet or slightly bitter?
Inconsistencies	Curiosity that is beyond reason	Why is his hole doughnut bread inedible?
Cause and effect	Curiosity about relationships or influences and influencing each other	Why does iced tea taste sweet when added with sugar?
Technique or engineering	Curiosity about a built or made	Why is the tempura red? Is it because it is made with various fish and contains food colouring?
General knowledge	Curiosity about facts, terms, classifications and general information.	What are the ingredients in orange ice?

3.2 Description of Variation in Expression of Curiosity among Small Samples (N=23)

Exploring the diversity of each student's curiosity expression in three data sources, the researcher created a graph illustrating the frequency of each student's curiosity for each type of data source (**Figure 1-3**). The highest frequency (students 15 and 19) expressed more types of curiosity than students who expressed lower for some types of curiosity.

The frequency of curiosity expressions was analyzed across three data sources: photo journals, photo journal interviews, and reasoning interviews. Teleological reasoning, general knowledge, and cause-and-effect explanations were most frequently observed in the photo journals. In the photo journal interviews, teleological and cause-and-effect categories appeared most often, while in reasoning interviews, expressions related to cause and effect and general knowledge were more dominant.

Analysis revealed that students frequently posed "why" questions, indicating a desire to understand phenomena in terms of purpose, function, causal relationships, and broader contextual information. This suggests a tendency toward deeper inquiry, particularly into the design and function of objects or concepts. Graphical data showed variation in the frequency of curiosity expressions among students, with some demonstrating notably higher engagement.

Overall, expressions of curiosity were more frequently and richly observed in the photo journals, indicating that this method supports diverse and in-depth explorations of scientific concepts. Moreover, the study found that the photo journal approach not only enhanced students' curiosity but also contributed to the development of their reasoning skills. By prompting students to explore, analyze, and reflect on real-world phenomena, the method fostered critical thinking and encouraged them to seek answers independently.

An interesting pattern appeared in F10 (Student no 10), who had five expressions of teleological curiosity in the photo journal, the largest frequency in the data source. Students asked questions about why a process could occur (e.g., "*Why does iced tea taste a bit bitter?"* and *"Why does iced orange taste so sweet?"*).

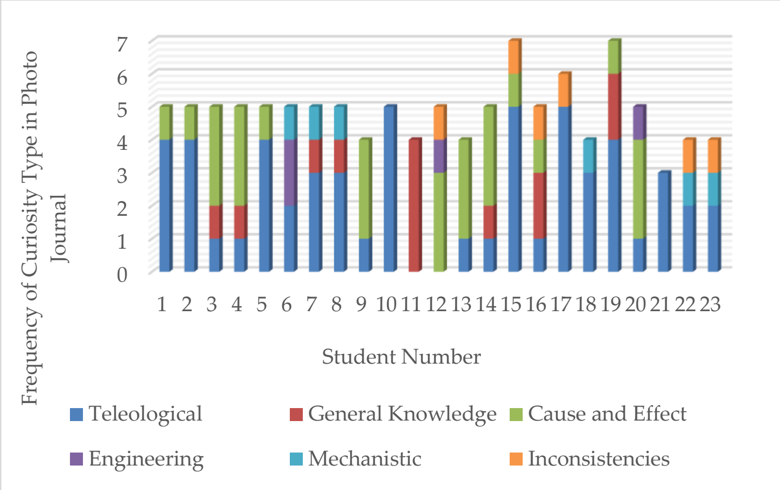

Figure 1. Frequency of Expressions of Curiosity in Photo Journals

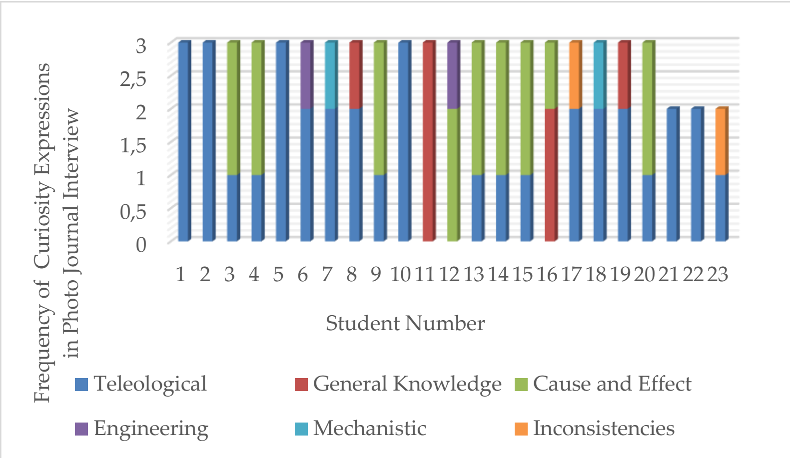

Figure 2. Frequency of Expressions of Curiosity in Photo Journal Interviews

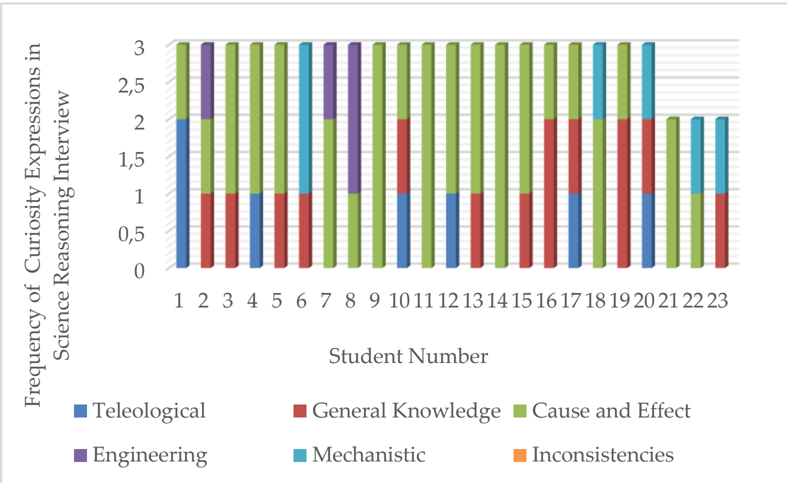

Figure 3. Frequency of Expressions of Curiosity in Science Reasoning Interviews

Table 2. Table of Frequency of Curiosity Types in Three Students

Name	Teleological	General Knowledge	Cause & Effect	Technique or Engineering	Mechanistic	Inconsistencies	Total
Nabilla	8	1	1			2	12
Fitzal	1	6	3			1	11
Ghozy	2	1	7				10

3.3 Description of Individual Variation in Expressions of Curiosity Related to Reasoning that is for Three Students

N17 (Student no 17). Evidence is cited from the results of the interview and photo journal as follows:

Inconsistency: *"Why do all the ice mixes taste so sweet and pink?"*

Teleological: *"Why does seblak have a savory taste?"* (see **Figure 5**)

Reasoning. When asked what the answer or conclusion of his curiosity question was, he explained as follows:

Teleological: *The mixed ice is pink because it contains milk and food colouring content.*

Cause and effect: *because black contains MSG, it causes black to taste savoury.*

F16 (Student no 16). His expression of curiosity only includes general knowledge.

General knowledge: *"What is in orange ice?"*

Cause and effect: *"Why does iced tea taste sweet?"*

Reasoning. He answered the question in a question as follows:

General knowledge: *My reasoning answer is sugar, ice, water, oranges*.

Cause and effect: Because there is sugar that makes iced tea taste sweet.

G13 (Student no 13**).** He expressed his curiosity as follows:

Teleological: *"Why does orange ice have such a sweet taste?"*

Cause and effect: *"Why do meatballs taste salty?"*

Reasoning. He only said in general terms that:

General knowledge: *Orange ice is sweet because it contains sugar, so orange ice has a sweet taste.*

Cause and effect: *Because it contains salt and a message in it.*

3.4 Levels of Students' Curiosity and Reasoning Categories

Indicators of curiosity and reasoning are classified based on Bloom's taxonomy level. It was found that the students' curiosity and reasoning scores were at the same level, namely, in the medium frequency category, as many as four students (17.39%), while the high level was 19 students (82.61%).

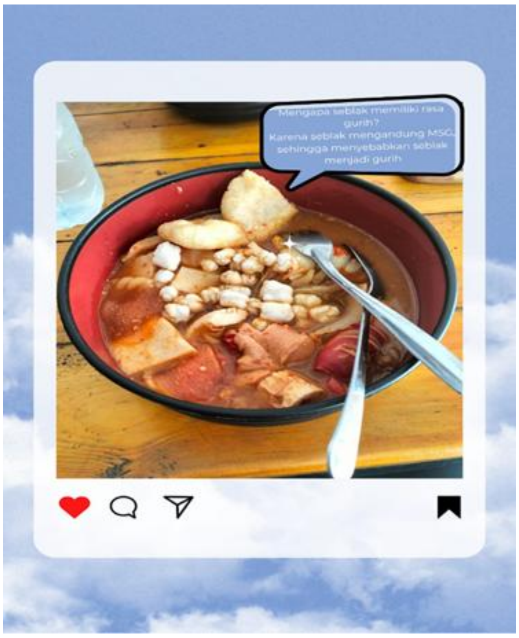

Figure 5. Example of a Photo journal by N17

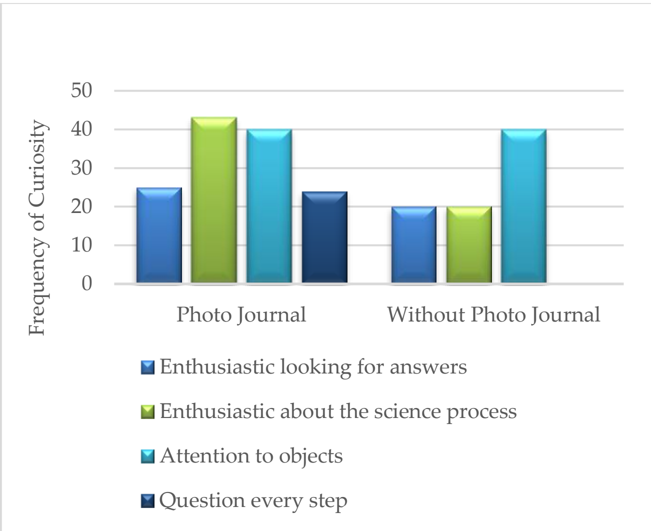

Figure 6. Frequency of Curiosity Based on Using Photo Journals and Without Using Photo Journals

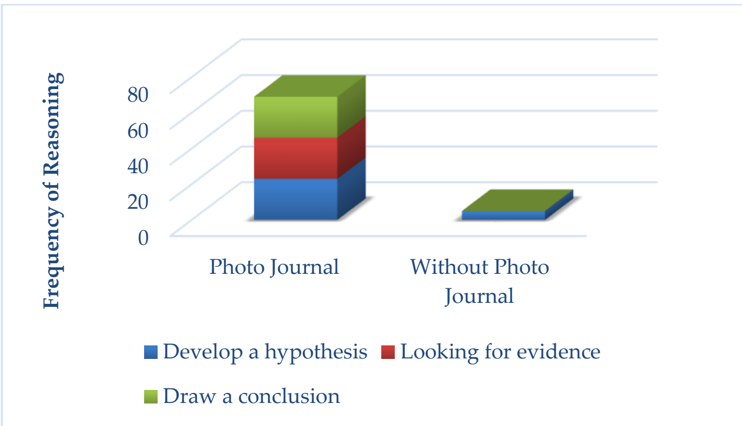

Figure 7. Frequency of Reasoning Based on Using Photo Journals and Without Using Photo Journals

Description of the Impact of the Photo Journal Method

3.5 Description of the Impact of the Photo Journal Method

The journal photo method on the curiosity indicator increased students' involvement in curiosity with a frequency of 132, higher than the method without a photo journal 80 (**Figure 6**). Students actively observe objects, are enthusiastic, and declare this method exciting, as student 16 expressed: "I am interested in this kind of learning because it is exciting and exciting". The photo journal covers curiosity and reasoning, with students asking about an assignment or topic, for example, student 9: "I'm interested in this topic. What question is suitable?" Without a photo journal, student involvement is limited to projects or practicums. At the same time, the reasoning frequency is 69 (**Figure 7**). Indicators such as formulating hypotheses, looking for evidence, and drawing conclusions are more dominant, such as the conclusion of student 13: "Orange ice has a sweet taste because it contains sugar". In addition to curiosity, photo journals also develop reasoning, while with this method, students can formulate hypotheses with limitations on five students.

Discussion

The identification and coding of students' expressions of curiosity in science provide valuable insights into how curiosity and reasoning function as characteristics of scientific engagement in everyday life. This study highlights how the use of relevant, student-centered methods—particularly those grounded in real-world contexts—can enhance students' ability to engage actively in learning. As supported by prior research (Kaplan & Friston, 2018; Nafiati, 2021; Peterson & Cohen, 2019; van Schijndel et al., 2018), fostering curiosity is essential for developing scientific reasoning and inquiry-based skills.

In this study, curiosity was intentionally rooted in students' daily experiences, with photo journals serving as a tool to capture and express their scientific observations and questions through photographs and accompanying reflections. Analysis of these journals, as well as follow-up interviews, revealed diverse patterns in the characteristics and frequency of curiosity. Notably, expressions often focused on teleological and general knowledge—findings that align with previous work by Antink-Meyer et al. (2023) and Luce and Hsi (2015), who emphasize the role of contextual and visual prompts in eliciting student curiosity.

These results further support the findings of earlier studies (Schijndel et al., 2018; Weible & Zimmerman, 2016; Ernst & Burcak, 2019), indicating that curiosity can be meaningfully categorized and measured. The photo journal method proved especially effective in stimulating scientific curiosity, validating the idea that curiosity is not an abstract trait but a measurable and cultivable aspect of student learning. This method facilitates curiosity development across multiple environments—school, home, and community—making science more accessible and personally relevant. The findings also echo Riswari et al. (2024), who emphasized the value of investigative science practices for deepening student understanding.

Interestingly, while students who exhibited high curiosity tended to ask more in-depth questions, there was no consistent pattern differentiating them from students in lower curiosity categories. This suggests that variations in curiosity expression may be influenced more by contextual factors, such as topic relevance and personal experience, rather than inherent ability. As noted by Schijndel et al. (2018), uncertainty and perceived inconsistencies in everyday scientific phenomena often serve as powerful drivers of inquiry and exploration.

The use of photo journals enabled students to connect their scientific inquiries to familiar, real-world settings, making the learning process more engaging and meaningful. This finding supports the argument that technology-enhanced methods are effective tools for eliciting authentic expressions of curiosity (Riyono & Amin, 2015; Gottfried et al., 2016; Ernst & Burcak, 2019). Furthermore, photo journals provide a platform for students who may not participate actively in classroom discussions to articulate their thoughts visually and reflectively. However, the temporality of curiosity expression remains a consideration—whether students' questions reflect long-term interest in science or momentary engagement. As Gottfried et al. (2016) and Kobayashi et al. (2019) suggest, understanding the longevity and evolution of curiosity over time is crucial for designing sustained science learning experiences.

Compared to traditional methods, the photo journal approach demonstrated a clear advantage in promoting both curiosity and reasoning. It encouraged deeper, more meaningful engagement with scientific concepts through personal exploration and critical reflection. Conventional classroom practices, which are often passive and theory-driven, fail to consistently stimulate curiosity, particularly among students who may struggle with verbal expression or classroom participation.

While the findings of this study are promising, there are limitations. The small sample size and the relatively short duration of the study constrain the generalizability of the results. Furthermore, the patterns of curiosity expression identified may not capture the full spectrum of developmental trajectories in student engagement. These limitations suggest the need for expanded research with larger, more diverse samples and longer-term implementation.

Future studies should explore how curiosity expression evolves over time and across different contexts. Longitudinal research could provide insights into how sustained exposure to reflective and technology-based learning tools influences scientific reasoning and interest. Additionally, further investigation into unexamined dimensions of curiosity—such as emotional engagement, social interaction, and cultural background—may offer a more comprehensive understanding of how students develop and express scientific inquiry skills.

4. CONCLUSION

This study found that the use of photo journals effectively enhances students' expressions of curiosity and reasoning by encouraging deeper questioning and more meaningful connections between scientific concepts and everyday experiences. The findings demonstrate that curiosity and reasoning can be categorized, measured, and improved through technology-integrated learning methods. However, the study is limited by its small sample size and relatively short duration, which may restrict the generalizability of the results. Additionally, the exploration of curiosity was limited to specific contexts and did not account for long-term developmental changes. Future research should involve larger and more diverse participant groups over extended periods to capture broader patterns of curiosity expression. It is also recommended that future studies incorporate quantitative statistical analyses to complement qualitative findings and provide more robust insights into the effectiveness of photo journal-based learning in science education.

Acknowledgements: A big thank you to the principal, a science teacher who is an instrument validator expert, and the students of Junior High School 1 Jetis 1 Jetis, Ponorogo Regency, which is the subject of this research. On His involvement and contribution were very valuable in this research.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

Antink-Meyer, A., Brown, M., & Wolfe, A. (2023). The Scientific Curiosity of Preservice Elementary Teachers and Confidence for Teaching Specific Science Topics. *Journal of Science Teacher Education*, *34* (8), 883–902. https://doi.org/10.1080/1046560X.2023.2168858

Ernst, J., & Burcak, F. (2019). Young Children's Contributions to Sustainability: The Influence of Nature Play on Curiosity, Executive Function Skills, Creative Thinking, and Resilience. *Sustainability (Switzerland)*, *11* (15). https://doi.org/10.3390/su11154212

Gottfried, A. E., Preston, K. S. J., Gottfried, A. W., Oliver, P. H., Delany, D. E., & Ibrahim, S. M. (2016). Pathways From Parental Stimulation of Children's Curiosity to High School Science Course Accomplishments and Science Career Interest and Skill. *International Journal of Science Education*, *38* (12), 1972–1995. https://doi.org/10.1080/09500693.2016.1220690

Hadiat, H. L., & Karyati, K. (2019). Hubungan Kemampuan Koneksi Matematika, Rasa Ingin Tahu dan Self-Efficacy Dengan Kemampuan Penalaran Matematika. *Jurnal Riset Pendidikan Matematika*, *6* (2), 200–210.

Hochberg, K., Kuhn, J., & Müller, A. (2018). Using Smartphones as Experimental Tools—Effects on Interest, Curiosity, and Learning in Physics Education. *Journal of Science Education and Technology*, *27* (5), 385–403. https://doi.org/10.1007/s10956-018-9731-7

I. G. N. Puger, J. B. Deng, I. G. W. S. Antara, K. A. K. D., & M. Sugiarta, L. Veliz, I. G. W. Sudatha, I. K. S. (2024). Metacognition-Based Learning Model: Improving Agile Innovation and Critical Thinking Skills Of Students In Science Learning In Elementary Schools. *Jurnal Pendidikan IPA Indonesia*, *3* (2), 146–153. https://doi.org/10.15294/jpii.v13i2.1375

Kaplan, R., & Friston, K. J. (2018). Planning and Navigation as Active Inference. *Biological Cybernetics*, *112* (4), 323–343. https://doi.org/10.1007/s00422-018-0753-2

Kobayashi, K., Ravaioli, S., Baranès, A., Woodford, M., & Gottlieb, J. (2019). Diverse Motives for Human Curiosity. *Nature Human Behaviour*, *3* (6), 587–595. https://doi.org/10.1038/s41562-019-0589-3

Lovika Ardana Riswari, Purbo Jati Kusumo, C. R. H. (2024). *Analisis Kemampuan Penalaran Matematis Siswa Sekolah Dasar Saat Menyelesaikan Soal Persegi*. *8*(1), 47-55.

Luce, M. R., & Hsi, S. (2015). Science-Relevant Curiosity Expression and Interest in Science: An Exploratory Study. *Science Education*, *99* (1), 70–97. https://doi.org/10.1002/sce.21144

Mu'jizah, D. S. (2019). Motivasi Belajar pada Anak Keluarga Broken Home di SMK Piri 1 Yogyakarta. *Jurnal Riset Mahasiswa Bimbingan Dan Konseling*, *5* (7), 410–417.

Murayama, K., FitzGibbon, L., & Sakaki, M. (2018). Process Account of Curiosity and Interest: A reward-learning framework of knowledge acquisition. *OSF Preprints*.

Musbikin, I. (2021). *Penguatan Karakter Gemar Membaca, Integritas dan Rasa Ingin Tahu*. Yogyakarta: Nusamedia.

Nafiati, D. A. (2021). Revisi taksonomi Bloom: Kognitif, Afektif, dan Psikomotorik. *Humanika*, *21* (2), 151–172. https://doi.org/10.21831/hum.v21i2.29252

Pan, M., Huang, A., Wang, G., Zhang, T., & Li, X. (2020). Reinforcement Learning Based Curiosity-Driven Testing of Android Applications. *ISSTA 2020 - Proceedings of the 29th ACM SIGSOFT International Symposium on Software Testing and Analysis*, 153–164. https://doi.org/10.1145/3395363.3397354

Permata, S. D., & Rakhmawati, Y. (2022). Peningkatan Karakter Rasa Ingin Tahu Siswa Kelas V SD Melalui Penggunaan Modul Reflektif Berbasis Ramah Anak. *Paedagogie*, *17* (2), 65–70. https://doi.org/10.31603/paedagogie.v17i2.8420

Peterson, E. G., & Cohen, J. (2019). A Case for Domain-Specific Curiosity in Mathematics. *Educational Psychology Review*, *31* (4), 807–832. https://doi.org/10.1007/s10648-019-09501-4

Raharja, S., Wibhawa, M. R., & Lukas, S. (2018). Mengukur Rasa Ingin Tahu Siswa [Measuring Students'curiosity]. *Polyglot: Jurnal Ilmiah*, *14* (2), 151–164.

Retnoningsih, B. R. dan A. (2015). Efektivitas Model Pembelajaran Picture and Picture dengan Strategi Inkuiri Terhadap Motivasi Dan Hasil Belajar Siswa. *Journal of Biology Education*, *4* (2), 166–172.

Skarstein, T. H., & Skarstein, F. (2020). Curious Children and Knowledgeable Adults–Early Childhood Student-Teachers' Species Identification Skills and Their Views on The Importance of Species Knowledge. *International Journal of Science Education*, *42* (2), 310–328. https://doi.org/10.1080/09500693.2019.1710782

van Schijndel, T. J. P., Jansen, B. R. J., & Raijmakers, M. E. J. (2018). Do Individual Differences in Children's Curiosity Relate to Their Inquiry-Based Learning? *International Journal of Science Education*, *40* (9), 996–1015. https://doi.org/10.1080/09500693.2018.1460772

Viona, D. (2020). *Penerapan Strategi Abduktif-Deduktif pada Pembelajaran Matematika dalam Meningkatkan Kemampuan Penalaran Matematis Siswa: Penelitian Kuasi Eksperimen di kelas VIII SMP*. UIN Sunan Gunung Djati Bandung.

Wardani, S. A., & Janattaka, N. (2022). Analisis Karakter Rasa Ingin Tahu Siswa pada Tema 8 Kelas Iii

Sekolah Dasar. *Prima Magistra: Jurnal Ilmiah Kependidikan*, *3*(4), 365–374. https://doi.org/10.37478/jpm.v3i4.2035

Weible, J. L., & Zimmerman, H. T. (2016). Science Curiosity in Learning Environments: Developing an Attitudinal Scale for Research in Schools, Homes, Museums, And The Community. *International Journal of Science Education*, *38* (8), 1235–1255. https://doi.org/10.1080/09500693.2016.1186853