EVALUATION OF THE IMPLEMENTATION OF SCIENCE LITERACY-BASED LEARNING IN MADRASAH IBTIDAIYAH

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ABSTRACT

This study was conducted to evaluate the implementation of science literacy-based learning in primary schools. The evaluative quantitative investigation used Stake's Countenance Model to measure the implementation of authentic assessments, including three critical stages, namely (1) Antecedent, (2) Process, and (3) Outcomes. A purposive sampling technique was used to select 20 Islamic Elementary Schools (IES) in West Java that participated in the Indonesian Madrasah Competency Assessment (IMCA) result follow-up training programs. Furthermore, data collection methods included observation, interviews, and questionnaires, which were analyzed using a percentage-based analytical approach. This allowed direct understanding into the information disclosed and the identification of specific aspects of the studied problem. Observation and interview data were analyzed using an interactive model, including data collection, display, and conclusion. The results showed that several aspects did not achieve the 100% standard. Planning (Atencedents) in the "Not Good" category with a percentage of 61.40%, while Implementation (Transaction) and Results (Outcomes) stages obtained 70.17% and 52.36% in the "Enough" and the "Very Not Good" categories.

Keywords: evaluation; *Madrasah Ibtidaiyah*; science literacy

INTRODUCTION

The Ministry of Religion is currently contributing to the achievement of education development in Madrasah. Regulation of the Minister of Religion Number 184 of 2019 concerning Guidelines for Curriculum Implementation in Madrasas states that the spirit of Madrasah-Based Management (MBM) has given broad autonomy in managing education. This policy encourages the innovation and implementation of a unique curriculum, character strengthening, anti-corruption education, and development of religious moderation. In this context, education and learning innovation continue to create Critical, Creative, Communicative, and Collaborative from Madrasas students, known as 4C in the Partnership for 21st Century Skills (P21).[1]

Science literacy is one of the basic literacy which is a benchmark for students' 4C abilities. This concept is the essential ability to apply information to formulate new hypotheses, offer scientific justification, draw conclusions based on data, and enhance a

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[1] Partnership for 21st Century Learning, *FRAMEWORK FOR 21st CENTURY LEARNING DEFINITIONS*, 2015. http://www.p21.org/our-work/p21.

reflective mentality to participate in debates regarding scientific issues and concepts[2]. Several studies state a relationship between scientific literacy and students' critical, creative, communicative, and collaborative thinking skills.[3,4,5]

Good scientific literacy is characterized by the ability to make decisions and solve problems by considering the knowledge of existing scientific concepts and principles.[6] Based on the 2018 PISA Framework, scientific literacy includes content aspects, namely knowledge or concepts to understand phenomena, consisting of content, procedural, and epistemic knowledge; aspects of competence, which consists of three abilities, namely explaining phenomena, evaluating and designing scientific investigations, and Interpreting data and evidence; the context aspect is the scope of socioscientific issues including personal, local or national, and international issues.[7]

Science literacy-based learning internalizes the three aspects of literacy (content, competence, and context) in planning, implementing, and evaluating learning. The existence of the integration allows students to carry out activities that lead to the formation of the concept. The content aspect, as described in the PISA 2018 science

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[2] *PISA 2015 Assessment and Analytical Framework*, PISA (OECD, 2017) https://doi.org/10.1787/9789264281820-en. See also Katarina Sperling, et.al., "In Search of Artificial Intelligence (AI) Literacy in Teacher Education: A Scoping Review", *Computers and Education Open*, (March, 2024). https://doi.org/10.1016/j.caeo.2024.100169.

[3] Carlina Anggraeni, Anna Permanasari, and Leny Heliawati, 'Students' Scientific Literacy in Chemistry Learning through Collaborative Techniques as a Pillar of 21st-Century Skills', *Journal of Innovation in Educational and Cultural Research*, 3.3 (2022), 457–62. See also Codding, R. S., et.al. "Meta-Analysis of Skill-Based and Therapeutic Interventions to Address Math Anxiety," *Journal of Psychology, 100*, (2023). https://doi.org/10.1016/j.jsp.2023.101229.

[4] Azimar Rusdi, Herbert Sipahutar, and Syarifuddin Syarifuddin, 'Hubungan Kemampuan Berpikir Kreatif Dan Sikap Terhadap Sains Dengan Literasi Sains Pada Siswa Kelas XI IPA MAN', *Jurnal Pendidikan Biologi*, 7.1 (2017), 72–80. See Vishar Kumar, et.al., "Environmental Socio-Scientific Issues as Contexts in Developing Scientific Literacy in Science Education: A Systematic Literature Review," *Social Sciences & Humanities Open* 9, (2024). https://doi.org/10.1016/j.ssaho.2023.100765.

[5] Devi Ayu Septiani, Eka Junaidi, and Agus Abhi Purwoko, 'Hubungan Antara Keterampilan Berpikir Kritis Dan Kemampuan Literasi Sains Pada Mahasiswa Pendidikan Kimia Di Universitas Mataram', in *Prosiding Seminar Nasional FKIP Universitas Mataram*, 2020, I, 15–19. See also Hugo Luis Moncayo Cueva, et.al., "Utilizing Emerging Technology Trends and Artificial Intelligence in Higher Education" *Journal of Higher Education Theory and Practice* 24, no. 3 (2024). https://doi.org/10.33423/jhetp.v24i3.6847.

[6] Shuoqi Xiang, et.al., "The Interplay between Scientific Motivation, Creative Process Engagement, and Scientific Creativity: A Network Analysis Study," *Learning and Individual Differences* 109, (2024). https://doi.org/10.1016/j.lindif.2023.102385. See also Asnawi Muslem, et.al., "YouTube Teaching Materials with Peer Support to Improve Students' Mastery of Subject Content Learning," *Studies in English Language and Education* 9, no. 2 (2022). https://doi.org/10.24815/siele.v9i2.25236.

[7] *PISA 2015 Assessment and Analytical Framework*.

literacy framework, is achieved by presenting socioscientific issues. This issue is a social problem related to science in a conceptual, procedural, and technological context.[8]

Science literacy can be formed when students have critical reasoning on problems in the environment and real life.[9] This science literacy can be a benchmark for students with adaptive abilities to developments in their environment, as well as challenges of the times. However, in Indonesia, students with good scientific literacy are still minimal and inadequate.[10]

Based on the assessment conducted by PISA in 2018, Indonesia was ranked 70th out of 78 countries with a score of 396 in the scientific literacy assessment. Furthermore, through the IMCA, the Ministry of Religion of the Republic of Indonesia also identified the scientific literacy of madrasah students. IMCA is designed to diagnose the development of student learning outcomes in the classroom through testing, including reading, numeracy, scientific, and socio-cultural literacy.[11]

Based on the meaning of IMCA results in 2020, 66% of Islamic elementary school students occupy the "basic" level for the scientific literacy category. The description of the results in the international and national arena certainly shows a severe problem of low scientific literacy in IES students. Therefore, learning reform that does not only pursue completing all the material in textbooks is needed and should be conducted by most

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[8] Li Ke and others, 'Developing and Using Multiple Models to Promote Scientific Literacy in the Context of Socio-Scientific Issues', *Science & Education*, 30.3 (2021), 589–607. See also Steffi Domagk, et.al. "Interactivity in Multimedia Learning: An Integrated Model," *Computers in Human Behavior* 26, no. 5 (2010): 1024-1033. https://doi.org/10.1016/j.chb.2010.03.003. See also Qinling Huang, "Recent Advances of Information Literacy Education for International Students in Chinese Academic Libraries", *The Journal of Academic Librarianship* 48, no. 2 (2022). https://doi.org/10.1016/j.acalib.2022.102497.

[9] Zakaria Sandy Pamungkas and others, 'Students Critical Thinking Skill in Solving Scientific Literacy Using a Metacognitive Test Based on Scientific Literacy', *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 7.2 (2018), 161–69. See also Fauzan, et.al., "Misconception of Reading Literacy and Its Impacts on Literacy Acculturation in School", *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan* 42, no. 1 (2023). http://dx.doi.org/10.21831/cp.v42i1.53041. See also Zheng Zhang, "Pedagogical Variations of Critical Literacies Practices in a Secondary Transnational Education Program", *Linguistics and Education* 75, (June, 2023). https://doi.org/10.1016/j.linged.2023.101185.

[10] Anggito, A., Sartono, E. K. E., Mustadi, A., Nawangsari, N. S., & Widyasari, A. "Effectiveness of Multicultural-based Comic to Improve Learning Achievement and Tolerance Characters in Elementary School". *Proceedings of the 5th International Conference on Current Issues in Education (ICCIE 2021)*, *640*, (2022) 275–280. https://doi.org/10.2991/assehr.k.220129.050. See also Evi Fatimatur Rusydiyah, et.al., "How to Use Digital Literacy As a Learning Resource for Teacher Candidates in Indonesia," *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan* 39, no. 2 (2020). http://dx.doi.org/10.21831/cp.v39i2.30551.

[11] Ditjen Pendis, *Pemaknaan Hasil AKMI.* (Jakarta: Ditjen Pendis, 2021).

teachers.[12] The implementation cannot maximize students' higher thinking abilities when standard learning is conducted according to the activities in student books. [13] This includes the ability to reason critically and creatively to solve scientific problems in their environment.[14]

Teachers have a very important role in improving students' science literacy in the classroom through science literacy-based learning.[15,16,17] The understanding is one of the important factors that influence students' science literacy.[18] Furthermore, students can be encouraged to ask questions and analyze data and facts with logical reasoning.[19]

The results of research conducted in one of the big cities in Indonesia show that the science literacy skills of teachers are only 44.3% without receiving training in science

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[12] M Sofyan Alnashr, 'Analisis Faktor Penghambat Guru Madrasah Ibtidaiyah Dalam Pembelajaran Tematik (Studi Kasus Di MI Al-Hikmah Kajen, Margoyoso, Pati)', *Al Ibtida: Jurnal Pendidikan Guru MI*, 5.2 (2018), 191–204.

[13] Sulistiya Ingwarni, 'Developing the Socioculture-Based Thematic-Integrative Learning Module for Improving the Learning Motivation and the Critical Thinking', *Jurnal Prima Edukasia*, 6.2 (2018), 157–65. https://doi.org/10.21831/jpe.v6i2.9447. See also Hussien Mohamad Razak, et.al. "Enhancing Students' Digital Literacy at EFL Classroom: Strategies of Teachers and School Administrators", *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan* 41, no. 3 (2022). http://dx.doi.org/10.21831/cp.v41i3.43107.

[14] Nur Luthfi Rizqa Herianingtyas, 'Penguatan Literasi Sains Siswa MI/SD Melalui Pengembangan E-Modul Dengan Instrumen Asesmen Berbasis Higher Order Thingking Skills', *Elementar: Jurnal Pendidikan Dasar*, 2.1 (2022), 15–26. See also Utami, Niken Wahyu, Suminto A. Sayuti, and Jailani. "Indigenous Artifacts from Remote Areas, Used to Design a Lesson Plan for Preservice Math Teachers Regarding Sustainable Education" *Heliyon, 7*(3), 2021. https://doi.org/10.1016/j.heliyon.2021.e06417.

[15] Nindiasari Agung Pangesti, 'Elementary School Teachers' Science Literacy Capabilities In Diy And Their Implementation In Preparation For The Asesmen Standarisasi Pendidikan Daerah (ASPD)', *Al Bidayah: Jurnal Pendidikan Dasar Islam*, 14.2 (2022). https://doi.org/10.33828/sei.v34.i3.5. See Anuraga Jayanegara, et.al. "Innovative Learning Methods of Islamic Education Subject in Indonesia: A Meta-Analysis," *International Journal of Evaluation and Research in Education (IJERE)* 13, no. 2 (2024). http://doi.org/10.11591/ijere.v13i2.26364.

[16] Siti Aisyah, Minnah El Widdah, and Sukarno Sukarno, 'Analysis of Science Literacy Ability and Teachers' Capability in Implementation of Learning by Science Literacy Oriented in Islamic Kindergarten at Bangko City', *Jurnal Penelitian Pendidikan IPA*, 7.SpecialIssue (2021), 77–83. https://doi.org/10.29303/jppipa.v7ispecialissue.1125.

[17] Dhitia Octaviani, Usman Usman, and Desni Yuniarni, 'Peran Guru Dalam Pengenalan Sains Pada Anak Kelompok B2 Di TK Bina SarI', *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, 7.9.

[18] Maaike Koopman, et.al., "Nuances and Details in Student Approaches to Learning in Innovative Secondary Education Using Profiles," *International Journal of Educational Research Open* 6, (2024). https://doi.org/10.1016/j.ijedro.2023.100316. See also Haiying Dong, et.al., "The Effectiveness of Using Interactive Visual Multimedia Technology Intervention in Improving the Literacy Skills of Children in Rural China," *Learning and Motivation* 86, (2024). https://doi.org/10.1016/j.lmot.2024.101964.

[19] Melek Demirel and Belkız Caymaz, 'Prospective Science and Primary School Teachers' Self-Efficacy Beliefs in Scientific Literacy', *Procedia - Social and Behavioral Sciences*, 191 (2015), 1903–8. https://doi.org/10.1016/j.sbspro.2015.04.500. See also Julie Goulet, et.al. "Supporting Academic Achievement of Children in Out-of-Home Care Through Effective Interventions: Results of a Systematic Review and Meta-Analyses" *Children and Youth Services Review, 156*, (2024). https://doi.org/10.1016/j.childyouth.2023.107388.

literacy and implementation in classroom learning. The IMCA program provides follow-up recommendations for improving the quality of madrasah education. In this context, one of the recommendations is to increase the activities of teachers and students to develop scientific literacy activities in madrasas. IMCA has also disseminated scientific literacy-based modules and prototypes of science learning steps. However, there is no evaluation of the implementation of science literacy-based learning. In this study, an evaluation was conducted to identify the implementation of science literacy-based learning in madrasahs. Therefore, the suitability of the planning, process, and evaluation of science literacy-based learning can be determined. The three aspects of science literacy (content, competence, and context) are the main reference for teachers in developing the planning, implementation, and evaluation of science literacy-based learning. Therefore, the implementation of this learning in Madrasah Ibtidaiyah should be evaluated.

RESEARCH METHODS

This quantitative research conducted in 20 Islamic elementary schools evaluates the implementation of science literacy-based learning in IES West Java Province. The determination of the sample used a purposive sampling technique from a school that participated in the IMCA result follow-up training programs. Meanwhile, the selection of class V is based on the ongoing learning process with science literacy. The evaluation results are expected to be the basis for measuring the IMCA's follow-up related to improving literacy-based learning and providing assessments or recommendations to improve the quality of its implementation.

The evaluation approach is the Stake's Countenance Model, which measures the implementation of authentic assessments with standards, serving as criteria for determining success. This evaluation analyzes two main aspects, namely description and assessment. The aspects are divided into three evaluation stages, namely (1) Antecedent, (2) Process, and (3) Outcomes. The stake model is a systematic method for evaluating the implementation of science literacy-based learning, including planning, implementation, and assessment. The Stake evaluation model was selected with the consideration of evaluating the implementation of science literacy-based learning The evaluation design has several stages, including (a) Antecedent, describing the teacher's experience in learning design, namely the ability to develop science literacy-based plans, (b) Process,

explaining the implementation of learning, (c) Outcomes, explaining scientific literacy-based assessment. Furthermore, the fifth IES teacher's understanding of the implementation of authentic assessment was accessed in elementary schools. Decisions are based on (1) absolute standards, which explain existing processes, and (2) relative standards dependent on criteria that are consistent with the definition of scientific literacy.

The data collection techniques used were observation, interviews, and questionnaires. The instruments were subjected to a validation process before being used for the intended measurement.[20] Instrument validation, namely observation and interview sheets, was carried out with the help of experts. The results of estimating construct and content validity using the Aiken index formula on 20 items of observation sheet, interview sheet, and questionnaire instruments. The validity estimation on the observation sheet, interview sheet, and questionnaire instruments used was 13, 8, and 10 items with high validity. The reliability of the three instruments used the Fleiss' Kappa scale which states a coefficient > 0.40 is reliable.[21] Reliability for observation, interview, and questionnaire is 0.871, 0.866, and 0.853, respectively. The questionnaires were analyzed using percentage analysis techniques. The percentage in each category indicates the information disclosed directly, and the position of each aspect can be identified. Observation and interview data were analyzed using an interactive model consisting of data collection, display, and conclusion.[22]

Table 1
Criteria for the Implementation of Science Literacy-based Learning

Average (%)	Criteria
86 – 100	Very Good
71 – 85	Good
61 – 70	Enough
51 – 60	Not Good
0 – 50	Very Not Good

Source : [23]

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[20] S Azwar, *Reliabilitas & Validitas (IV)* (Yogyakarta: Pustaka Pelajar, 2016).

[21] K. L Gwet, *Handbook of Inter-Rater Reliability: The Definitive Guide to Measuring the Extent of Agreement among Multiple Raters (3rd Ed.)* (Gaithersburg, MD: Advanced Analytics., 2012).

[22] M.B, Huberman, A.M, & Saldana, J. Miles, *Qualitative Data Analysis, A. Methods Sourcebook, Edition 3* (New York: Sage Publications, 2014).

[23] M.B, Huberman, A.M, & Saldana, J. Miles, *Qualitative Data Analysis, A. Methods Sourcebook, Edition 3* (New York: Sage Publications, 2014)

RESULT AND DISCUSSION

Evaluation studies in implementing science literacy-based learning in grade fifth Madrasa were carried out based on the principles of description and assessment. These are obtained through the description of the preliminary (antecedents), process (transactions), and results stages (outcomes). The data obtained can be divided into three parts, Antecedent (input/ planning); Transaction (process/ implementation); and Outcomes phase (evaluation/ result). At each stage, compatibility (horizontal) is carried out between the plan and the data obtained from the implementation of the observations. In this context, there are considerations in implementing science literacy-based learning by the actual conditions with discrepancy, as shown in Table 2.

Table 2
Evaluation of Science Literacy-Based Learning

Stages	Aspect	Percentage	Category	Judgement Matrix	
				Standard	**Judgements**
Planning (Antecedents)	Preparation of Lesson plan based on Scientific Literacy	60,50%	Enough	100%	Yet needs to be given appropriate consideration
	Preparation of Students' Worksheets based on Scientific Literacy	62,30%	Enough	100%	Yet needs to be given appropriate consideration
Process (Transaction)	Presentation of factual content material	84,22%	Good	100%	Yet needs to be given appropriate consideration
	Presentation of procedural content material	78,50%	Good	100%	Yet needs to be given appropriate consideration
	Presentation of epistemic content material	62,40%	Enough	100%	Yet needs to be given appropriate consideration
	Presentation of socioscientific issues in the local context	72,50%	Good	100%	Yet needs to be given appropriate consideration

Stages	Aspect	Percentage	Category	Judgement Matrix	
				Standard	**Judgements**
	Presentation of socioscientific issues in the national context	82,20%	Good	100%	Yet needs to be given appropriate consideration
	Problem-solving through scientific explanation of phenomena	64,55%	Enough	100%	Yet needs to be given appropriate consideration
	Problem-solving through data interpretation	50,33%	Not Good	100%	Yet needs to be given appropriate consideration
	Problem-solving through scientific investigation	66,67%	Enough	100%	Yet needs to be given appropriate consideration
Evaluation (Outcomes)	Stimulus	42,50%	Very Not Good	100%	Yet needs to be given appropriate consideration
	Diversity of Question Types	50,25%	Not Good	100%	Yet needs to be given appropriate consideration
	Scientific literacy competencies	64,35%	Enough	100%	Yet needs to be given appropriate consideration

Source : Personal Documents

The evaluation results are processed systematically with the Stake's Countenance Model, which measures the implementation of science literacy-based learning. This receives the lowest category compared to the planning and process stage. The planning stage which consists of preparation of lesson plan and student worksheet is included in the Enough category. The learning process stage obtained various results, and the best category in the presentation of factual content material was Good. Furthermore, the lowest category in Problem-solving through data interpretation was in the Not Good category.

The Stake Model evaluation design shows the application of two main things, namely a description and consideration of decisions (judgments) a nd the chart is presented in Table 3 below:

Table 3
Results of Stake Model Evaluation

The Expected Conditions			Actual Sate (*observed*)
Antecedent Understanding of science literacy-based learning design	**100%**	**Conformity** ⟷	61,40 %
Discrepancy			Discrepancy
Transaction Implementation of science literacy-based learning	**100%**	**Conformity** ⟷	70,17 %
Discrepancy			Discrepancy
Outcomes Scientific literacy-bassed assessment	**100%**	**Conformity** ⟷	52,36 %

Source : Personal Documents

This chart can be analyzed vertically, showing the stages of planning, process, and output. Under the expected conditions, the third stage has a percentage of 100%, meaning the absence of a gap. In actual conditions (observed), there is a percentage gap between the three stages. At the planning stage, teachers do not have a good understanding of preparing Lesson Plans (RPP) and Student Worksheets (LKPD) based on scientific literacy. The evaluation results show that the ability to plan science literacy-based learning is in the Enough category. In interviews, teachers generally understand the form of lesson plans and science literacy-based LKPD. However, several obstacles are experienced including, Difficulty in making learning steps in line with the syntax of the model. Some teachers stated that scientific inquiry-based learning models such as Problem-Based Learning (PBL), Project Based Learning (PjBL), Discovery Learning, and Inquiry, possessed complicated syntax when compiling steps in lesson plans; Obstacles are also encountered when compiling science literacy-oriented LKPD with content, context and competency coverage. According to the explanation of several teachers, the most difficult competency is "Interpreting data and scientific evidence", most teachers find it difficult to operationalize these competencies into activities on LKPD.

According to previous studies, one of the obstacles in preparing lesson plans is adjusting learning steps with the syntax of a particular model. [24] In this context, science literacy-based lesson plans are characterized by the application of an inquiry-based learning model. [25] In the implementation of the model, students are subjected to scientific methods to train their critical thinking skills in solving problems. [26] Meanwhile, LKPD includes instructions and steps for an activity.[27] Scientific literacy-based lesson plans and worksheets should include activities that lead to the formation of students' literacy by internalizing aspects of content, context, and competence. [28] Literacy competency indicators that become the main reference in developing student activities include, Explaining phenomena, Evaluating and designing scientific investigations, and Interpreting data and evidence.[29]

At the implementation stage of science literacy-based learning, materials are presented in factual, procedural content and socio-scientific issues (SSI) to develop students' science literacy. Therefore, teachers must be active and creative in presenting current and contextual issues related to SSI.[30] This can be presented through text, pictures,

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[24] Nunung Adha, I Nyoman Karma, and Husniati Husniati, 'Identifikasi Kesulitan Guru dalam Penyusunan Rencana Pelaksanaan Pembelajaran (RPP) Kurikulum 2013 Di Sekolah Dasar Gugus 1 Kediri', *Renjana Pendidikan Dasar*, 1.3 (2021), 218–29.

[25] Ditjen Pendis. 2021. Pemaknaan Hasil Akmi. Jakarta: Ditjen Pendis.

[26] Yunika Apriyani, Yetti Supriyati, and Gaguk Margono, *The Influence of Learning Models on Scientific Literacy in Physics Course: A Meta-Analysis Research*, International Journal of Science and Society, 2021, III http://ijsoc.goacademica.com. See also J D Chesloff, "STEM education must start in early childhood," *Education Week* 32. No. 23 (2013): 27-32. See also Merfat Ayesh Alsubaie, "Distance Education and the Social Literacy of Elementary School Students during the Covid-19 Pandemic," *Heliyon* 8, no. 7 (2022). https://doi.org/10.1016/j.heliyon.2022.e09811.

[27] Joviana Marshel and Ratnawulan, 'Analysis of Students Worksheet (LKPD) Integrated Science with the Theme of the Motion in Life Using Integrated Connected Type 21st Century Learning', in *Journal of Physics: Conference Series* (Institute of Physics Publishing, 2020), MCDLXXXI https://doi.org/10.1088/1742-6596/1481/1/012046. See also Samuel Kai Wah Chu, S K Tse, and Ken Chow, "Using Collaborative Teaching and Inquiry Project-Based Learning to Help Primary School Students Develop Information Literacy and Information Skills," *Library & Information Science Research* 33, no. 2 (2011): 132–43, https://doi.org/10.1016/j.lisr.2010.07.017.

[28] Siska Rita Mahyuny and others, 'Development of Students Worksheet Learning Tools Made by Ethnoscience Based on Science Literacy', *Jurnal Penelitian Pendidikan IPA*, 8.4 (2022), 2001–7. See also H. M. Alakrash, et.al., "Technology-Based Language Learning: Investigation of Digital Technology and Digital Literacy", *Sustainability* 13, no. 21 (2021).

[29] Anita Ekantini and Insih Wilujeng, 'The Development of Science Student Worksheet Based on Education for Environmental Sustainable Development to Enhance Scientific Literacy.', *Universal Journal of Educational Research*, 6.6 (2018), 1339–47. See also H. M. Alakrash, et.al., "Towards the Education 4.0, Readiness Level of EFL Students in Utilising Technology-Enhanced Classroom", *International Journal of Interaction, Humanity and Change* 13, (2020), 161–180.

[30] Dana L Zeidler and Bryan H Nichols, 'Socioscientific Issues: Theory and Practice', *Journal of Elementary Science Education*, 21.2 (2009), 49–58. See also Cherise McBride, et.al. "Tinkering Toward Teacher Learning: A Case for Critical Playful Literacies in Teacher Education," *English Teaching: Practice & Critique* 22, no. 2 (2023): 221-233. https://doi.org/10.1108/ETPC-08-2022-0114.

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videos, stories, or infographics, allowing students to be more critical in analyzing, making decisions, or solving problems. However, the ability to present epistemic content needs to be improved, and it is infrequent to provide scientific explanations of phenomena. In this context, the student activities to solve problems through data interpretation are also very limited. Previous research confirmed that most teachers used memorization strategies to build students' knowledge.[31] This shows that activities in class mostly lead to simple comprehension abilities, and to enhance scientific literacy, different inquiry processes should be adopted, such as asking questions, controlling variables, designing experiments to test hypotheses, analyzing data, and interpreting the results. Students gain knowledge to relate the material learned in class to the context of their lives.[32] Scientific literacy can be interpreted as the ability to master, communicate, and apply knowledge in solving problems.[33]

At the output stage, the teacher compiles science literacy-based learning evaluations. The competence in assessing students is one of the important components required in learning, in this study teacher competence in preparing science literacy-based assessments is very important .However, the ability to compose questions should be improved in the Not Good category based on scientific literacy.

The questions in the IMCA follow-up module include several criteria, namely, the presence of a stimulus, diversity in question types, and assessment of three distinct scientific literacy competencies. The assessment questions are similar to science learning and do not test students' scientific literacy. Previous research showed that the compilation of evaluation instruments did not use stimuli or pay attention to the cognitive process.[34] In the preparation of HOTS questions based on scientific literacy, a stimulus is generally used in a contextual and engaging context.[35] Based on the observation results, there were a lot of C1 (knowledge) and C2 (understanding) questions, and the teacher did not vary

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[31] Rusdi, Sipahutar, and Syarifuddin.

[32] Ying-Chih Chen, Jia-Ling Lin, and Yen-Ting Chen, 'Teaching Scientific Core Ideas through Immersing Students in Argument: Using Density as an Example', *Science Activities*, 51.3 (2014), 78–88.

[33] E.L. dan T.R. Koballa Chiappetta, *Science Instruction in The Middle and Secondary Schools: Developing Fundamental Knowledge and Skills* (United State of America: Pearson Education Inc, 2010).

[34] Fajar Okta Widarta and others, 'Analysis of Science Subject Evaluation Instruments in Elementary Schools Based on Stimulus Types and Cognitive Process Dimensions', *JURNAL EKSAKTA PENDIDIKAN (JEP)*, 7.1 (2023), 135–44.

[35] Jiahong Su, et.al., "Artificial Intelligence (AI) Literacy in Early Childhood Education: The Challenges and Opportunities," *Computers and Education: Artificial Intelligence* 4, (2023). https://doi.org/10.1016/j.caeai.2023.100124.

the questions. Some were entirely multiple-choice questions, while others were in essay format. According to previous research, teachers rarely ask questions at the analysis, synthesis, and evaluation levels without using an open-ended format.[36] Therefore, the ability and skills to conduct assessments are needed according to predetermined standards, including compiling various questions.[37] This includes expanding insight into the types and techniques of scientific literacy-based assessment as exemplified in IMCA. In this context, the implementation requires more excellent teacher knowledge, which can be carried out effectively, especially in compiling questions based on scientific literacy.

CONCLUSION

In conclusion, Planning (Antecedents), Implementation (Transaction), and results (outcomes) were classified into Not Good, Enough, and Very Not Good categories with a percentage of 61.40%, 70.17, and 52.36 %, respectively. Numerous obstacles were encountered at each stage, decreasing the proper execution of the implementation process. Therefore, it was important to provide input aimed at enhancing the process and this required efforts to offer teachers additional, specific, and practical guidance regarding scientific literacy. Furthermore, stating the importance of teacher commitment and professionalism in the execution of science literacy-based learning was essential. The evaluation conducted in West Java Province showed that some aspects did not meet the 100% standard. Therefore, these results could be used as material for the reflection to improve teacher understanding and skills in implementing science literacy-based learning.

ACKNOWLEDGMENT

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[36] Wilayat Bibi, Muhammad Naeem Butt, and Amjad Reba, 'Relating Teachers' Questioning Techniques with Students' Learning within the Context of Bloom's Taxonomy', *FWU Journal of Social Sciences*, 14.1 (2020), 111–19.

[37] Suppiah Nachiappan and others, 'Application of Higher Order Thinking Skills (HOTS) in Teaching and Learning through Communication Component and Spiritual, Attitudes and Values Component in Preschool', *Southeast Asia Early Childhood Journal*, 7 (2018), 24–32.

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DECLARATION OF CONFLICTING INTERESTS

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