Assistance in preparing teaching modules containing literacy and numeracy for the art and culture MGMP of Semarang Regency Middle School

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ABSTRACT

Since 2022, the Merdeka Curriculum has incorporated literacy and numeracy into arts and culture education. However, a major challenge faced by arts and culture teachers is that not all of them fully understand or have mastered how to integrate literacy and numeracy into their teaching, particularly in the development of existing teaching modules. The purpose of this community service initiative is to provide mentoring in developing teaching modules that integrate literacy and numeracy into the subjects of music, dance, and visual arts for the Arts and Culture Teachers' Working Group (MGMP). The method used in this program involved several stages: beginning with the dissemination and introduction of key concepts, followed by practical assistance in developing literacy- and numeracy-based teaching modules, and concluding with simulations to support the practical implementation of learning. The results of this initiative show that the development of literacy and numeracy skills can be facilitated through theoretical and practical learning materials, differentiated and contextual methods, educational field trips, various learning media and tools (both digital and conventional), as well as through the use of effective teaching models, strategies, and assessment techniques. The benefits of this program include improved teacher understanding of literacy and numeracy, enhanced teacher competence in module development, increased creativity in delivering learning materials, the establishment of collaborative and professional learning environments, and the successful creation of arts and culture teaching modules that incorporate literacy and numeracy. Based on these outcomes, it can be concluded that the development of integrated literacy and numeracy teaching modules for music, dance, and visual arts subjects in the MGMP for arts and culture has provided significant and valuable benefits
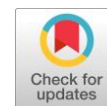
KEYWORDS
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1. Introduction

Since 2022, the Ministry of Education has introduced the *Merdeka* Curriculum, which requires teaching modules to integrate literacy and numeracy components [1]. The *Merdeka* Curriculum was designed and implemented in Indonesia with the aim of fostering the development of literacy and numeracy skills across all subjects, including Arts and Culture. Arts and Culture is one of the subjects taught in schools, particularly at the primary and secondary levels. It aims to introduce students to various forms of art and culture while developing their creativity, skills, and appreciation for artistic works, which include music, dance, and visual arts [2]. While this subject primarily focuses on creative and expressive skill development, integrating literacy and numeracy is essential to support students' understanding of core concepts and practical skills in music, dance, and visual arts [3] .

Literacy in Arts and Culture refers to students' ability to comprehend, interpret, and communicate ideas or messages through artworks, whether in text, visuals, or other forms of expression [4]. Teaching

modules in Arts and Culture are expected to guide students in understanding cultural contexts, the history of art, and the theoretical foundations of artistic works [5]–[7]. This also includes developing students' writing, reading, and speaking skills through discussions related to art. Numeracy involves using numbers, measurements, patterns, and estimation in artistic contexts [8]. For instance, in visual arts, numeracy is applied in measuring proportions, using perspective techniques, and incorporating geometry in design. In music, numeracy is essential for understanding rhythm, timing, and musical notation. In dance, it helps in organizing structured movement and timing.

The Subject Teachers' Working Group for Arts and Culture (*MGMP* Seni Budaya) in Semarang Regency envisions increasing appreciation and creativity among middle school Arts and Culture teachers. Their mission includes organizing structured and consistent meetings, enhancing pedagogical, professional, personal, and social competencies through art seminars and training, improving artistic appreciation, fostering creativity in art-making, revitalizing the artistic climate, especially local cultural traditions, and strengthening the sense of community among members. The group also aims to expand teachers' knowledge, especially in mastering teaching content, syllabus development, lesson planning, teaching strategies, and methods, as well as maximizing the use of learning resources and facilities. It provides opportunities for members to share experiences, offer support and feedback, enhance knowledge and skills, empower members in their teaching roles, and cultivate a professional work culture within the *MGMP*. Ultimately, these efforts seek to improve the quality of teaching and learning, as reflected in better student outcomes, and enhance teachers' competencies through *MGMP*-level activities.

Over the course of three years of community service programs, many Arts and Culture teachers, whether in music, dance, or visual arts, have expressed challenges in adapting to the *Merdeka* Curriculum. [9] Learning outcomes are no longer measured by the traditional Minimum Mastery Criteria (*KKM*) using numeric scores. Instead, achievement is identified based on whether learning objectives are met. Teachers are given the flexibility to define the criteria for achieving these objectives according to the characteristics of the subject matter. One of these criteria is the integration of numeracy content in each artistic subject, particularly in practical lessons [10]–[13]. Initial observations revealed that although many teachers hold degrees in arts education, a significant number still struggle to grasp and apply the integrated approach of literacy and numeracy in Arts and Culture lessons. Many also admitted to a lack of motivation in creating teaching modules or further developing the subject.

In junior high schools, teachers are expected to master specific subjects, meaning that a teacher assigned to a particular class should have in-depth knowledge of the subject being taught [14]–[18]. According to the curriculum, an Arts and Culture teacher must be proficient in three disciplines: music, dance, and visual arts. As professionals, teachers must provide a realistic understanding of their subject [19]–[21]. To assess their professionalism, teaching materials play a crucial role. Teaching materials are essential resources that all teachers must possess, as they represent the collection of content that needs to be taught to students. The teacher, student, and material form an inseparable unit in the learning process [22], [23]. One essential form of teaching material is the teaching module, which serves as a primary reference for teachers. However, a recurring issue within *MGMP* Arts and Culture is the difficulty in developing modules that integrate literacy and numeracy as recommended by the *Merdeka* Curriculum [24].

Several factors contribute to this difficulty. First, the nature of Arts and Culture education, focused on creative and expressive skill development, makes it challenging to incorporate literacy and numeracy, which are typically associated with text- or number-based learning. The curriculum often does not explicitly outline how to integrate these elements, requiring teachers to innovate and make meaningful connections between artistic and academic concepts [25]. Second, many teachers emphasize personal expression in their teaching, which often involves encouraging individual creativity that may not align with traditional literacy or numeracy assessments. Thus, integrating these academic elements into artistic instruction can feel unnatural. Moreover, differences in instructional approaches present a challenge: literacy and numeracy often require structured and systematic methods, whereas arts education typically embraces more fluid and expressive strategies. Lastly, the lack of resources and training remains a significant barrier. Many Arts and Culture teachers have not received specialized training on how to incorporate literacy and numeracy into their teaching [26], [27]. They are more familiar with artistic and expressive approaches and may not place a strong emphasis on developing literacy and numeracy skills. In response to these challenges, our team from Universitas Negeri Semarang felt compelled to provide service and support to teachers in the *MGMP* Arts and Culture of Semarang Regency. The focus of this

initiative is on mentoring teachers in developing teaching modules for music, dance, and visual arts that are aligned with the *Merdeka* Curriculum and integrate literacy and numeracy.

The goal of this community service project is to assist teachers in creating instructional modules that incorporate literacy and numeracy in practical Arts and Culture subjects. This is intended to improve the quality of arts education, enhance psychomotor learning, and strengthen teachers' capacity in instructional design. In the long term, this mentoring initiative will contribute to a national model for developing Arts and Culture teaching modules that are based on literacy and numeracy.

2. Method

The problem-solving phase was carried out through several stages: understanding the problem, developing a solution plan, implementing the plan, and evaluating the results [28]–[31]. The community service program was implemented through several phases. The first phase involved a socialization session and an introduction to the concepts of literacy and numeracy in the Cultural Arts subject. This phase emphasized the importance of integrating literacy and numeracy into Cultural Arts education to enhance teachers' critical and creative thinking skills. The session also included examples of how literacy and numeracy can be applied within the context of Cultural Arts material. The second phase was Practical Assistance in Developing Teaching Modules. During this stage, teachers were guided in creating teaching modules that integrated literacy and numeracy. The focus was on developing relevant and applicable learning materials. Teachers received assistance in designing lesson plans (*RPP*) that aligned with the curriculum while incorporating literacy and numeracy elements. This guidance was provided in small groups to facilitate discussion and Q&A sessions, forming part of a collaborative workshop activity. The third phase was Developing Literacy and Numeracy-Based Teaching Modules, during which teachers independently or collaboratively drafted teaching modules with support from facilitators. These modules included learning steps that integrated literacy and numeracy. Examples included teaching art through data (e.g., statistics on artworks), using digital media to support learning, and fostering critical and analytical thinking skills. This phase involved intensive mentoring from the facilitators.

Once the modules were completed, teachers conducted teaching simulations using the modules in front of their peers. These simulations were essential in providing a deeper and more comprehensive experience of teaching art, helping teachers prepare for real classroom situations [32]. Constructive feedback was given on content delivery, the integration of literacy and numeracy, and the overall effectiveness of the teaching modules within the context of Cultural Arts using the classroom simulation method [33]. A reflective discussion and feedback session was conducted as part of the final mentoring activity. The final stage of the mentoring process involved evaluating the teaching modules that had been developed, focusing on whether the content effectively integrated literacy and numeracy and whether it could be used effectively in classroom instruction. The program concluded with the refinement of the teaching modules based on the results of the evaluation and the feedback provided.

3. Results and Discussion

3.1. Worksop Activities to Support Literacy and Numeracy Content in Art and Culture Subjects

This mentoring activity emphasized the need for strategies to foster literacy and numeracy in art and culture education by considering environments rich in text, effective social environments, and academic settings. A teacher can gauge students' success by observing the characteristics of good literacy skills, such as the mastery of knowledge and abilities. This can be seen through their ability to analyze, reason, and communicate. The development of literacy and numeracy can be supported using various resources that enhance students' understanding and numeracy skills [34]. The following is an explanation of these resources. [35] The development of literacy and numeracy can be supported using various resources that enhance students' understanding and numeracy skills, such as: 1.) Materials or Practical Theory. The materials used for developing literacy and numeracy include fundamental mathematical concepts and their applications in everyday life. A strong understanding of mathematical theory helps students master numeracy skills. Practical experience, such as performing calculations in daily activities, is also an important part of developing numeracy. 2.) Differentiated, Contextual, and Field Trip Methods. The differentiated method uses an approach that takes into account the varying abilities and needs of each student. For instance, providing tasks suited to students' levels of ability. The contextual method connects numeracy concepts to real-life situations or problems that are relevant to students' lives, making it easier for them to apply mathematics in more familiar contexts. The field trip method involves out-of-classroom

activities, such as field studies or excursions, to provide direct experiences related to numeracy concepts, such as calculating distances or ratios. 3.) Media or Learning Tools (Digital and Conventional). Digital media, such as learning applications for mathematics, educational videos, and interactive platforms, can help students understand numeracy concepts in a more engaging way. Conventional media, including textbooks, teaching aids, whiteboards, and other visual tools, are also used in math instruction. 4.) Models, Approaches, and Learning Strategies. Learning models such as problem-based learning (PBL), project-based learning (PjBL), and contextual approaches allow students to learn through real-world applications. These approaches focus on active and collaborative learning, allowing students to work independently or in groups. Learning strategies involve using various techniques to enhance student engagement and understanding, such as group discussions, educational games, or the use of mathematical puzzles to make learning more enjoyable. 5.) Assessments. Assessments used to measure students' numeracy understanding and skills include various types of evaluations, both formative (e.g., quizzes, daily assignments, and observations) and summative (e.g., final exams) [36]. In addition, project-based assessments or portfolios can be used to measure students' numeracy abilities in a broader context. With these resources, it is hoped that the literacy and numeracy skills being taught will develop optimally and meet the specific needs of each teacher's curriculum. The mentor provides an example of applying literacy and numeracy in Art and Culture Education show in Fig.1.

Fig. 1. The mentor provides an example of applying literacy and numeracy in Art and Culture Education

3.2. Benefits of Literacy and Numeracy Assistance for Teachers

The results of the service to MGMP teachers in assisting the development of numeracy and literacy-integrated teaching modules can encompass several important aspects. These include an increase in the teachers' understanding of literacy and numeracy, which enables them to better grasp the significance of these skills in education. Teachers learn that literacy and numeracy do not only involve basic arithmetic skills but also the ability to understand, analyze, and solve problems related to counting in musical notation and dance movements. In practice, when implementing dance movements, it is not simply about adhering to rigid counts but about bringing a sense so that the art form remains expressive and fluid. It is here that the value of literacy and numeracy in art and culture becomes evident. Discussion among MGMP participants during the mentoring activity show in Fig. 2.

Fig. 2. Discussion among *MGMP* participants during the mentoring activity

Development of Competence in Teaching Module Creation: Teachers were equipped with the knowledge on how to create teaching modules that align with the curriculum and integrate literacy and numeracy into the teaching materials. They also receive guidance on using teaching strategies that can

enhance students' literacy and numeracy skills, such as solving problems based on numbers or calculations, interpreting art, and performing mathematical analysis in the context of art. Mathematical analysis in art demonstrates that art and mathematics are not separate entities, but rather interconnected, with mathematics providing structure and rules that can enrich and deepen the understanding of art [37], [38].

Creativity in Teaching Material Presentation: This mentoring aims to help teachers become more creative in developing teaching modules by incorporating various resources, such as texts, images, graphs, and challenging problems that stimulate students' numeracy skills. The goal is to create a more effective, engaging, and beneficial learning experience for students' development during classroom teaching [39]. Teachers are also given exercises to design problems that stimulate critical thinking and students' numeracy abilities, as well as to facilitate discussions and reflections based on numbers and calculations. The benefit of critical thinking is to develop deeper intellectual skills in art and encourage students to think logically and analytically [40].

Collaboration and Professional Learning: *MGMP* provides a platform for teachers to share experiences, exchange ideas, and discuss the challenges they faced in teaching literacy and numeracy. Through this collaboration, teachers are expected to support each other in improving their teaching quality and collectively seek solutions to overcome challenges in learning.

Development of Numeracy and Literacy-Integrated Modules: The main outcome of this activity is the creation of teaching modules that systematically integrate literacy and numeracy. These modules can be used by teachers to teach mathematics concepts relevant to everyday life and enhance students' numeracy skills. The developed modules can also include various types of questions and assignments to train students in applying their numeracy skills in art [41]. Of the 56 participants, 39 teaching modules are successfully created and completed: 9 modules for music, 15 for dance, and 15 for visual arts.

Evaluation and Reflection on the Learning Process: Teachers involved in this service are expected to evaluate the effectiveness of the teaching modules they have developed and identify areas for improvement. This evaluation is conducted to enhance the quality of teaching, provide guidance for further improvements, and ensure that learning objectives are achieved. They are also expected to reflect on the learning process to refine their teaching methods for future materials [42]. Overall, this service aims to strengthen teachers' abilities in developing and teaching materials that not only focus on theory but also prepare students with practical skills needed for everyday life through literacy and numeracy.

4. Conclusion

The assistance activities aim to support the development of teaching modules that integrate literacy and numeracy into the subjects of music, dance, and visual arts. These activities begin with an introduction and dissemination of key concepts, followed by practical mentoring and the development of literacy- and numeracy-based teaching modules. The process concludes with a simulation of arts learning practices. The results reveal a significant need for strategies to foster literacy and numeracy within cultural arts education, taking into account environments that are rich in text, socially effective, and academically supportive. Teachers can observe students' literacy skills through their mastery of knowledge and competencies, which can be identified through their ability to analyze, reason, and communicate effectively. The tools for developing literacy and numeracy include: (1) content or theoretical material related to practice, (2) differentiated, contextual methods and field-based learning experiences, (3) media or learning tools, both digital and conventional, (4) instructional models, approaches, and strategies, and (5) assessment methods. In addition to producing teaching modules based on literacy and numeracy, the outcomes of this mentoring program for cultural arts teachers include improved teacher understanding of literacy and numeracy, enhanced competence in developing teaching modules, increased creativity in delivering learning materials, stronger collaboration and professional learning, and the successful creation of arts modules that incorporate literacy and numeracy elements. With these results, teachers are not only able to write literacy- and numeracy-integrated modules, but they are also able to implement these elements in cultural arts learning, especially in practice-based lessons in music, dance, and visual arts. The outcomes achieved by the MGMP Cultural Arts teacher partners after the mentoring program show that the teachers have gained an understanding that literacy and numeracy are not limited to counting skills alone. They also include the ability to comprehend feeling, analyze, and solve problems related to counting in music notation and in dance movements. In practice, implementing movement should not be rigidly tied to counts but should also involve a sense of expression so that the essence of art can be delivered

fluidly. This is where the values of literacy and numeracy in cultural arts are formed. The teachers acquire the knowledge and skills needed to develop cultural arts teaching modules that incorporate literacy and numeracy elements. A total of 39 teaching modules are successfully created—9 for music, 15 for dance, and 15 for visual arts. It is recommended that cultural arts teachers share their insights with teachers from other subjects to encourage the integration of literacy and numeracy across disciplines. Future researchers are encouraged to explore topics such as evaluating the effectiveness of these modules in cultural arts education, including the extent of active student participation, the design and structure of the modules, assessment and evaluation strategies, and the impact on student learning outcomes.

Declarations

References

[1]   D. Marisana, S. Iskandar, and D. T. Kurniawan, "Use of the Merdeka Mengajar Platform to Improve Teacher Competence in Elementary Schools," *J. Basicedu*, vol. 7, no. 1, pp. 139–150, Jan. 2023, doi: 10.31004/basicedu.v7i1.4363.

[2]   F. S. Fujiawati, R. Permana, D. J. Lestari, and G. M. Roekmana, "Implementation of Integrated Arts Learning Model to Increase Appreciation and Creativity of Traditional Arts and Culture of Banten Region 'Ubrug Folk Theatre,'" *J. Pendidik. dan Kaji. Seni*, vol. 2, no. 1, pp. 51–62, Apr. 2017, doi: 10.30870/jpks.v2i1.2502.

[3]   J. Kneen, T. Breeze, S. Davies-Barnes, V. John, and E. Thayer, "Curriculum integration: the challenges for primary and secondary schools in developing a new curriculum in the expressive arts," *Curric. J.*, vol. 31, no. 2, pp. 258–275, Jun. 2020, doi: 10.1002/curj.34.

[4]   Y. Özrili, "An Evaluation On The Meaning And Expression Of Art History In The Context Of Visual Literacy In Museums," *Uluslararası Sosyal Bilimler ve Sanat Araştırmaları*, vol. 3, no. 1. Yakın Doğu Üniversitesi, pp. 108–123, Oct. 13, 2024. [Online]. Available at: https://dergipark.org.tr/tr/pub/issar/issue/87649/1564856.

[5]   S. Sciences, "Art (History) in Educational Contexts," 2023. [Online]. Available at: https://art-history-education.ffzg.unizg.hr/wp-content/uploads/2023/01/Art_History_in_Educational_Contexts_Zagreb_2023.pdf.

[6]   M. Møller-Skau and F. Lindstøl, "Arts-based teaching and learning in teacher education: 'Crystallising' student teachers' learning outcomes through a systematic literature review," *Teach. Teach. Educ.*, vol. 109, p. 103545, Jan. 2022, doi: 10.1016/j.tate.2021.103545.

[7]   S. Wahyuningsih, S. Sundari, and S. Husnulwati, "Formation of Student Characteristics, Through the Development of South Sumatran Arts and Culture Values, Realizing Pancasila Values Towards the Formation of a Nationalist Attitude," *J. Educ. Dev.*, vol. 11, no. 3, pp. 294–304, Sep. 2023, doi: 10.37081/ed.v11i3.4577.

[8]   M. Goos and K. O'Sullivan, "The Evolution and Uptake of Numeracy and Mathematical Literacy as Drivers for Curriculum Reform," in *New ICMI Study Series*, vol. Part F776, Springer Science and Business Media B.V., 2023, pp. 345–357, doi: 10.1007/978-3-031-13548-4_21.

[9]   A. Anggara, F. Amini, M. Siregar, F. Muhammad, and N. Syafrida, "Implementation of Independent Learning Curriculum in Junior High School Level Education Units," *J. Pendidik. dan Konseling*, vol. 5, no. 1, pp. 1899–1904, 2023, [Online]. Available at: https://journal.universitaspahlawan.ac.id/index.php/jpdk/article/view/11241.

[10] N. K. K. Widiantari, I. N. Suparta, and S. Sariyasa, "Improving Numeracy Literacy and Character Education with E-Modules Containing Ethnomathematics in the Era of the COVID-19 Pandemic," *JIPM (Jurnal Ilm. Pendidik. Mat.*, vol. 10, no. 2, p. 331, Mar. 2022, doi: 10.25273/jipm.v10i2.10218.

[11] D. Haylock, *Mathematics Explained for Primary Teachers*. SAGE Publications Ltd, p. 100, 2024. [Online]. Available at: https://www.torrossa.com/en/resources/an/5730619.

[12] I. Vale and A. Barbosa, "Active learning strategies for an effective mathematics teaching and learning," *Eur. J. Sci. Math. Educ.*, vol. 11, no. 3, pp. 573–588, Jul. 2023, doi: 10.30935/scimath/13135.

[13] S. Timotheou *et al.*, "Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review," *Educ. Inf. Technol.*, vol. 28, no. 6, pp. 6695–6726, Jun. 2023, doi: 10.1007/s10639-022-11431-8.

[14] I. Maulana, N. A. Rahma, N. F. Mahfirah, W. Alfarizi, and A. Darlis, "Improving Teacher Professionalism with the Teacher Professional Education Program (PPG)," *J. Educ.*, vol. 5, no. 2, pp. 2158–2167, Jan. 2023, doi: 10.31004/joe.v5i2.867.

[15] C. Jeschke, C. Kuhn, A. Heinze, O. Zlatkin-Troitschanskaia, H. Saas, and A. M. Lindmeier, "Teachers' Ability to Apply Their Subject-Specific Knowledge in Instructional Settings—A Qualitative Comparative Study in the Subjects Mathematics and Economics," *Front. Educ.*, vol. 6, p. 683962, Jul. 2021, doi: 10.3389/feduc.2021.683962.

[16] L. Hobbs and R. Porsch, "Teaching out-of-field: challenges for teacher education," *Eur. J. Teach. Educ.*, vol. 44, no. 5, pp. 601–610, Oct. 2021, doi: 10.1080/02619768.2021.1985280.

[17] A. S. Munna and M. A. Kalam, "Teaching and learning process to enhance teaching effectiveness: literature review," *Int. J. Humanit. Innov.*, vol. 4, no. 1, pp. 1–4, Feb. 2021, doi: 10.33750/ijhi.v4i1.102.

[18] M. van Geel *et al.*, "Adapting Teaching to Students' Needs: What Does It Require from Teachers?," in *Effective Teaching Around the World*, Cham: Springer International Publishing, 2023, pp. 723–736, doi: 10.1007/978-3-031-31678-4_33.

[19] A. Budiman, R. Sabaria, and P. Purnomo, "Dance Training Model: Strengthening Pedagogical Competence and Teacher Professionalism," *Panggung*, vol. 30, no. 4, pp. 532–548, Dec. 2020, doi: 10.26742/panggung.v30i4.1370.

[20] P. Thomson, "Why bother with arts education in schools?," *Aust. Educ. Res.*, vol. 52, no. 1, pp. 781–801, Mar. 2025, doi: 10.1007/s13384-024-00741-0.

[21] K. A. Ampi and K. A. Jamaludin, "Art Trail And Mastery Of Visual Arts Education Among Non-Option Teachers In Sarawak," *Int. J. Acad. Res. Progress. Educ. Dev.*, vol. 12, no. 4, pp. 583–592, Dec. 2023, doi: 10.6007/IJARPED/v12-i4/19816.

[22] E. Musyrifah, G. Dwirahayu, and G. Satriawati, "Development of Mathematics Teaching Materials for Mi Teachers in an Effort to Support Teaching Skills and Increase Numeracy Literacy," *FIBONACCI J. Pendidik. Mat. dan Mat.*, vol. 8, no. 1, p. 61, Jun. 2022, doi: 10.24853/fbc.8.1.61-72.

[23] L. Darling-Hammond, A. C. W. Schachner, S. K. Wojcikiewicz, and L. Flook, "Educating teachers to enact the science of learning and development," *Appl. Dev. Sci.*, vol. 28, no. 1, pp. 1–21, Jan. 2024, doi: 10.1080/10888691.2022.2130506.

[24] A. C. K. Azis and S. K. Lubis, "Fine Arts Learning Based on the Independent Curriculum Perspective in Elementary Schools," *Pena Anda J. Pendidik. Sekol. Dasar*, vol. 1, no. 1, pp. 10–19, Apr. 2023, doi: 10.33830/penaanda.v1i1.4948.

[25] Hafsah Adha Diana and Veni Saputri, "Model Project Based Learning Terintegrasi Steam Terhadap Kecerdasan Emosional Dan Kemampuan Berpikir Kritis Siswa Berbasis Soal Numerasi," *Numeracy*, vol. 8, no. 2, pp. 113–127, 2021, doi: 10.46244/numeracy.v8i2.1609.

[26] D. Djumadi *et al.*, "Strengthening Indonesian Cultural Literacy for Students of Sentul Kuala Lumpur Learning Center with Traditional Games," *Bul. KKN Pendidik.*, vol. 5, no. 2, pp. 180–190, Dec. 2023, doi: 10.23917/bkkndik.v5i2.23177.

[27] D. T. K. Ng, J. K. L. Leung, J. Su, R. C. W. Ng, and S. K. W. Chu, "Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world," *Educ. Technol. Res. Dev.*, vol. 71, no. 1, pp. 137–161, Feb. 2023, doi: 10.1007/s11423-023-10203-6.

[28] N. E. Zakiah, Y. Sunaryo, and A. Amam, "Implementation of Contextual Approach to Problem-Based Learning Model Based on Polya's Steps," *Teorema Teor. dan Ris. Mat.*, vol. 4, no. 2, p. 111, Sep. 2019, doi: 10.25157/teorema.v4i2.2706.

[29] B. Rott, B. Specht, and C. Knipping, "A descriptive phase model of problem-solving processes," *ZDM – Math. Educ.*, vol. 53, no. 4, pp. 737–752, Aug. 2021, doi: 10.1007/s11858-021-01244-3.

[30]   T.-T. Wu, A. Asmara, Y.-M. Huang, and I. Permata Hapsari, "Identification of Problem-Solving Techniques in Computational Thinking Studies: Systematic Literature Review," *Sage Open*, vol. 14, no. 2, Apr. 2024, doi: 10.1177/21582440241249897.

[31]   P. Ø. Haavold and B. Sriraman, "Creativity in problem solving: integrating two different views of insight," *ZDM – Math. Educ.*, vol. 54, no. 1, pp. 83–96, Apr. 2022, doi: 10.1007/s11858-021-01304-8.

[32]   C. T. Rosidah, Amelia Widya Hanindita, Ida Sulistyawati, and Apri Irianto, "Improving the Competence of Elementary School Teachers in Developing Online Teaching Materials at SDN Margorejo I, Surabaya City, East Java Province," *Kanigara*, vol. 1, no. 1, pp. 23–31, Jan. 2021, doi: 10.36456/kanigara.v1i1.3154.

[33]   T. Andayani and F. Madani, "The Role of Learning Assessment in Improving Student Achievement in Elementary Education," *J. Educ. FKIP UNMA*, vol. 9, no. 2, pp. 924–930, Jun. 2023, doi: 10.31949/educatio.v9i2.4402.

[34]   W. Han *et al.*, "Numeracy Literacy Support Materials," *Minist. Educ. Cult. GLN Team Minist. Educ. Cult.*, vol. 8, no. 9, pp. 1–58, 2017, [Online]. Available at: https://repositori.kemdikbud.go.id/11628/.

[35]   R. Perdana and M. Suswandari, "Numeracy Literacy in Thematic Learning of Upper Grade Elementary School Students," *Absis Math. Educ. J.*, vol. 3, no. 1, p. 9, Mar. 2021, doi: 10.32585/absis.v3i1.1385.

[36]   W. Warsiyah, S. Athoillah, and A. Soqiluqi, "Implications of the Independent Curriculum on the Development of PAI Learning Outcome Assessment Instruments," *J. Prog. Wahana Kreat. dan Intelekt.*, vol. 11, no. 1, p. 1, Jun. 2023, doi: 10.31942/pgrs.v11i1.8231.

[37]   S. Hartanti and R. Ramlah, "Ethnomathematics: Preserving Arts by Learning Mathematics," *Ideas J. Pendidikan, Sos. dan Budaya*, vol. 7, no. 2, p. 33, Jun. 2021, doi: 10.32884/ideas.v7i2.347.

[38]   X. Meng, L. Zhang, P. Meng, Z. Yu, and Z. Diao, "Harmony in Complexity: Unveiling the Symbiotic Dance of Mathematics and Visual Art Through the Lens of Order," *J. Knowl. Econ.*, vol. 15, no. 3, pp. 13654–13672, Dec. 2023, doi: 10.1007/s13132-023-01667-1.

[39]   R. A. Howell, "Engaging students in education for sustainable development: The benefits of active learning, reflective practices and flipped classroom pedagogies," *J. Clean. Prod.*, vol. 325, p. 129318, Nov. 2021, doi: 10.1016/j.jclepro.2021.129318.

[40]   J. Southworth, "Bridging critical thinking and transformative learning: The role of perspective-taking," *Theory Res. Educ.*, vol. 20, no. 1, pp. 44–63, Mar. 2022, doi: 10.1177/14778785221090853.

[41]   T. P. Ahmad, "Meaningful learning planning and independent curriculum assessment," *J. Ilm. Pedagog.*, vol. 20, no. 1, pp. 75–94, 2024, [Online]. Available at: https://jurnal.staimuhblora.ac.id/index.php/pedagogy/article/view/116/0.

[42]   Nur Efendi and Muh Ibnu Sholeh, "Educational Management in Improving the Quality of Learning," *Acad. J. Teach. Learn.*, vol. 2, no. 2, pp. 68–85, 2023, doi: 10.59373/academicus.v2i2.25.