Mimbar PGSD Undiksha
Volume 12, Number 1, Tahun 2024, pp. 64-72
P-ISSN : 2614-4727, E-ISSN : 2614-4735
Open Access: https://doi.org/10.23887/jjpgsd.v12i1.67642

Growing Numeral Literacy Skills through Science, Technology, Engineering, Arts, Mathematics Based on Local Wisdom

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ARTICLE INFO

Article history:
Received August 29, 2023
Accepted February 11, 2024
Available Online April 25, 2024

Kata Kunci:
Numeral Literacy, STEAM, *Kearifan Lokal*

Keywords:
Numeral Literacy, STEAM, Local Wisdom

ABSTRAK

Kompetensi literasi dan numerasi merupakan kompetensi fundamental di era industri 5.0. Keterampilan berhitung juga diperlukan dalam bidang perdagangan, kesehatan, pendidikan, dll. Keterampilan literasi diperlukan untuk menghadapi tantangan global, memecahkan masalah, mengambil keputusan yang tepat, dan memahami fenomena alam dan sosial. Keterampilan literasi dan numerasi merupakan kemampuan yang esensial dan menjadi landasan pendidikan. Penelitian ini bertujuan untuk menganalisis implementasi pembelajaran STEAM berbasis kearifan lokal dan bagaimana pengaruhnya terhadap kemampuan berhitung dan literasi pada tingkat sekolah dasar. Penelitian metode campuran ini menggunakan model/desain Sequential Exploratory dan pengumpulan data menggunakan observasi, wawancara, dan tes. Hasil penelitian menunjukkan bahwa guru dalam melaksanakan pembelajaran STEAM berbasis kearifan lokal dengan indikator: observasi, ide baru, inovasi, kreativitas, dan masyarakat. Dalam prosesnya, guru mengintegrasikan nilai-nilai kearifan lokal ke dalam pembelajaran pada langkah terakhir yaitu budaya. Hasil pre-test menunjukkan 40% ketuntasan siswa dengan nilai rata-rata, sedangkan post-test menunjukkan 80% ketuntasan siswa dengan nilai rata-rata, sehingga meningkatkan hasil belajar siswa kelas IV SD. Hasil uji berpasangan sampel t-test juga menunjukkan nilai signifikansi yang berarti pembelajaran STEAM berbasis kearifan lokal berpengaruh terhadap kemampuan numerasi dan literasi siswa kelas IV. Literasi dan numerasi diharapkan menjadi bahan pendukung penguatan gerakan literasi yang dilakukan sekolah. Penerapan literasi dan numerasi pada artikel ini akan terus berkembang dan bervariasi sesuai dengan beragamnya konteks kebutuhan dan kondisi sosial budaya sekolah.

ABSTRACT

Literacy and numeracy competencies are fundamental competencies in the industrial era 5.0. Numeracy skills are also needed in trade, health, education, etc. Literacy skills are required to face global challenges, solve problems, make appropriate decisions, and understand natural and social phenomena. Literacy and numeracy skills are essential abilities and are the basis of education. This study aims to analyze the implementation of STEAM learning based on local wisdom and how it affects numeracy and literacy skills in elementary school level. This mixed-methods research uses a Sequential Exploratory model/design and data collection using observation, interviews, and tests. The results showed that teachers in implemented STEAM learning based on local wisdom according to the indicators: observation, new ideas, innovation, creativity, and society. In the process, the teacher integrates local wisdom values into learning in the last step, namely culture. The pre-test results showed 40% of students' completeness with an average score, while the post-test showed 80% of students' totality with an average score, increasing student learning outcomes in class IV elementary school. The results of the paired samples t-test also show a significance value, which means that STEAM learning based on local wisdom affects students' numeracy and literacy skills in fourth grade. It is hoped that literacy and numeracy will become supporting materials for strengthening the literacy movement the school has carried out. This article's literacy and numeracy applications will continue to develop and vary according to the diverse context of needs and socio-cultural conditions of schools.

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1. INTRODUCTION

Education is a culture that continues to develop in society according to the times. This is also in line with the changes continuously being made to improve the qualifications of human resources, which can have a significant impact in the global era (AR et al., 2022; Yuniar et al., 2020). Currently, Indonesia is entering a period of technological transformation, so it must be balanced with science as the basis for sustainable economic development. Education is the primary sector that needs to be prioritized to positively impact community development so that it can participate in sustainable development (Kurratul Aini & Ridwan, 2021; Puspitorini et al., 2023). Education must be able to create human capital as a form of developing relevant 21st-century skills to succeed in a complex and diverse world. One of the breakthroughs in education is STEAM learning to create a science and technology-based economy, combining five primary disciplines: science, technology, engineering, the arts, and mathematics (K Aini et al., 2020; Sama et al., 2022). The main aim of learning STEAM is to integrate various fields of knowledge and skills so that students can develop a more holistic understanding of the natural world and face real-world challenges with more comprehensive skills.

The application of STEAM-laden learning in its implementation is integrated into fields of knowledge focusing on fun, creative, and practical learning experiences based on applications in children's daily lives through a scientific approach to developing critical thinking skills, creativity, collaboration, and problem-solving in students to accelerate the era of digitalization of the field (Aslam et al., 2018; Misbahudholam & Hardiansyah, 2022). STEAM was developed according to the needs of students in the global period and, of course, by creating the curriculum currently used in Indonesia, namely the Merdeka Curriculum. This curriculum was born from the various cultural diversity in society as one of the media and learning content in welcoming the 21st century (Armadi et al., 2022; Astuti & AR, 2023). Based on this, it is necessary to integrate local wisdom into the learning process, of course, while still creating humans who can compete in the global era and preserve the values of local knowledge.

Local wisdom refers to the knowledge, values, practices, and culture developed in a particular community or region for centuries. This includes understanding nature, ways of life, traditions, and methods of interacting with the environment and others with moral values, knowledge, and contextual sources of expertise (Hardiansyah et al., 2022; Permana & Jayanta, 2019). Integrating local wisdom into education has significant benefits in helping students understand their cultural identity, respect ancestral heritage, and understand the relationship between humans and the environment. Integrating local wisdom into education is about respecting cultural heritage and preparing students to understand the wider world, appreciate cultural diversity, and be aware of their role as global citizens. In addition, six basic literacy skills must be mastered to compete. These six essential literacies are critical to helping individuals interact in an increasingly complex society, including numeracy (Hardiansyah et al., 2023; Hendrix-Soto & Mosley Wetzel, 2019).

Numerical literacy refers to the ability to understand, use, and think critically about mathematical concepts in various situations (Hardiansyah & Mulyadi, 2022; Rakhmawati & Mustadi, 2022). The 2018 PISA results in Indonesia show low numeracy and literacy skills. This is a challenge to develop mathematical abilities in the community, which are taught starting from the basic level with the aim that this numerical ability will help in understanding the material, analyzing problems, and solving problems (Hardiansyah & Wahdian, 2023; Yeoh, 2020). Literacy and numeracy competencies have a role in the lives of individuals and society. Both help individuals interact with information full of numbers and data, make informed decisions, and overcome complex challenges in various fields.

Indonesia's numeracy skills are also relatively low. This is based on the 2019 PISA survey, which placed Indonesia's mathematics ability at 73 out of 80 countries. The definition of numeracy ability, according to PISA, is the focus of students' competence in giving reasons, analyzing and conveying ideas effectively, solving, interpreting, and formulating various mathematical problems. In simple terms, numeracy competency is applying mathematical theory practically in life. Numeracy ability is closely related to number sense, often known as sensitivity or mastery of numbers (Hardiansyah & AR, 2022; Purnomo et al., 2022). Number-sense skills make it easier for students to solve problems. Problem-solving is finding answers to issues, which combines the concepts obtained to get the correct solution to a problem. Apart from number sense skills, which can make solving problems easier, students' ability to think critically is also honed. The ability to think critically is used to assess whether a statement is solid and needs to be questioned (Hardiansyah & Mas'odi, 2022; Prots et al., 2021).

Based on the problems above, it is necessary to have innovations in the learning process to create output for students who can play themselves in every aspect of life. Therefore, the teacher as a facilitator must be able to creatively and innovatively manage the class by applying an integrated learning model so that learning objectives can be achieved to the fullest. However, initial observations made by researchers at one of the schools that have implemented the Merdeka Curriculum, namely SDN Pakondang

II, show that the ability of students in numeracy and literacy is still low because, in the learning process, students are less active and tend to get bored with receiving or understanding lessons from the teacher. This is because the teacher provides an understanding of the material in a way that is still conventional and teacher-centered so that students cannot fully explore their abilities during the learning process. Another problem is the lack of interest in numeracy literacy activities because students are not interested in reading problems in the form of story questions and need help understanding the meaning of the questions given.

Based on this, researchers are interested in knowing the implementation of STEAM learning based on local wisdom and how it affects the numeracy and literacy skills of fourth-grade students at SDN Pakondang II. This research is the latest innovation in integrating learning models in elementary schools to improve numeracy and literacy skills amid the demands of the 21st century. The STEAM approach in this research is integrated with science, namely science, technology, engineering, arts, and mathematics, which aim to increase student involvement, creativity, innovation, problem-solving skills, and other cognitive benefits (Frydenberg & Andone, 2011; Tam & Milfont, 2020). The STEAM learning concept emerged as a model for eliminating the boundaries between academic subjects so that science, technology, engineering, arts, and mathematics can be structured into an integrated curriculum (Gupta et al., 2022; Hardiansyah, 2022). STEAM learning is applied so students can incorporate various knowledge in one lesson or on one particular theme. At the same time, local wisdom is a form of innovation so that students learn directly contextually based on environmental conditions in the form of students' goals and can understand the material more concretely, especially in mathematics subjects, which students consider difficult. This research is not only limited to implementing STEAM learning for students' numeracy literacy skills but also provides innovations for implementing STEAM based on local wisdom, which has begun to be largely forgotten in the era of development to improve numeracy literacy skills in elementary schools in the independent period of learning according to the Merdeka Curriculum and currently used. Therefore, this study aims to analyze the implementation of STEAM learning based on local wisdom and how it affects numeracy and literacy skills in elementary school level.

2. METHOD

The subjects of this study were fourth-grade students at SDN Pakondang II Academic Year 2023–2024, whom the researchers randomly selected. This research is mixed-methods research that combines elements of quantitative research methods and qualitative research. In mixed-methods research, researchers use both types of data (quantitative and qualitative) to provide an understanding by utilizing both research methods simultaneously to obtain more comprehensive, valid, reliable, and objective data. This study's mixed-methods research design is a Sequential Exploratory model, which involves a sequence of research stages, where the qualitative step is carried out first, followed by the quantitative phase (Seyfi et al., 2020).

The initial stage of this research model is qualitative research, which aims to implement STEAM learning based on local wisdom in elementary schools. Meanwhile, quantitative analysis was used to determine students' numeracy literacy abilities obtained from each numeracy literacy indicator based on the test results, namely the pre-test and post-test. STEAM learning steps (Foster, 2020) is show in Table 1.

Table 1. STEAM Learning Steps

STEAM Learning Steps	Learning process
Step observation (Observe)	Students observe by exploring the real world, which is related to the concepts in the discussion material, so that it helps students understand the relationship between theory and practice in authentic contexts. This allows students to develop observation, problem-solving, and critical thinking skills, as well as being active.
New idea steps (New Idea)	Students carry out an in-depth understanding of the material discussed, then observe and seek additional information to generate new ideas. These ideas emerge as solutions, innovations, or new approaches to the observed problems. In this step, students need skills to analyze and think critically.
Step innovation (Innovation)	Students are asked to identify the concrete steps needed to apply the ideas generated before. Learners will learn how to design, implement, and evaluate arguments in the context of STEAM learning. This process allows students to think practically, apply theoretical concepts, and develop skills needed in the real world.

STEAM Learning Steps	Learning process
Step creation (Creativity)	This step is the implementation of all suggestions and opinions that arise from the discussion to ensure that the idea can be implemented properly.
Value step (Society)	More broadly, it generates beneficial values or impacts on social life or society that make a positive and relevant contribution to overcoming problems.

Based on the STEAM step, local wisdom is integrated into the final learning activities in the form of helpful ideas for social life. In addition, to determine students' numeracy and literacy abilities, researchers also prepared learning achievement tests according to indicators of numeracy and literacy abilities. To measure students' numeracy literacy skills, which are designed in the form of social story questions based on local wisdom, indicators adapted from (Kurratul Aini & Ridwan, 2021) are used as show in Table 2.

Table 2. Numerical Literacy Ability Indicators

Indicator	Indicator Description
Communication skills	Students can present, explain, and communicate numerical information effectively to others. This involves articulating mathematical ideas, deciphering calculation results, and understanding the meaning behind numbers and data.
Mathematization ability	Students can associate and apply mathematical concepts in various situations in everyday life. This involves the ability to view numerical aspects in multiple contexts, identify problems or concerns that require a mathematical approach, and apply mathematical concepts to understand and solve those problems.
Representational ability	Students can transform numerical or mathematical information into various visual, graphic, or symbolic forms. These representations allow one to understand, communicate, and analyze numerical information more effectively.
Reasoning and argument skills	Students can think critically, analyze numerical information, and build arguments that support opinions or conclusions using data and mathematical concepts. This involves evaluating information, making inferences, and formulating solid ideas based on numerical evidence.
Ability to choose strategies to solve problems	Students can identify and choose the most appropriate ways to solve problems involving numbers or data. This involves evaluating the situation, understanding relevant mathematical concepts, and selecting the most effective approach to arriving at a solution.
Ability to use language and symbolic operations	Students can communicate and interact with mathematical concepts through mathematical symbols and notations. This includes reading, writing, articulating, and manipulating mathematical symbols and expressions correctly and effectively.

To address the existing problems, the data collection in this study used observation and interview methods to find out about the implementation of STEAM learning based on local wisdom and a test to determine students' numeracy and literacy skills. This study used observation sheets, interviews, and numeracy literacy tests to learn mathematics. The analysis of observational and interview data in qualitative data was done through the following steps: 1) reducing data, 2) presenting data, 3) validating or triangulating, and 4) concluding. The test results in the form of quantitative data were analyzed using quantitative descriptive analysis by describing the percentage of quantitative data obtained from the results of the pre-test and post-test.

Research data were also analyzed using a paired sample t-test to determine the effect of STEAM learning based on local wisdom on the numeracy and literacy skills of fourth-grade students at SDN Pakondang II. Students' numeracy and literacy skills have a significant difference if, previously, a normality test was performed (Kolmogorov Smirnov and shapiro-wilk) as the prerequisite test with sig. >0.05.

3. RESULT AND DISCUSSION

Result

The implementation of STEAM learning based on local wisdom to improve numeracy literacy skills in elementary schools during the independent learning era. The research design is a Sequential Exploratory model/design with instruments like observation sheets, interviews, and numeracy literacy tests in learning mathematics consisting of pre-tests and post-tests. The initial stage of this research model is qualitative research using observation sheets and interviews, which aim to implement STEAM learning based on local wisdom in elementary schools. Meanwhile, the quantitative research uses a test that aims to determine students' numeracy literacy skills obtained from each numeracy literacy indicator based on the test results, namely the pre-test and post-test. Based on observations made when learning mathematics on geometrical materials (blocks and cubes) at SDN Pakondang II, the teacher gives *a* pre-test to be done individually by students, and then the teacher carries out the learning process with the steps.

The teacher invites students to visit the Sumenep Palace, also known as the Sumenep Sultanate Palace. This palace complex is in Sumenep, Madura Island, East Java, Indonesia. This palace has a rich history and is a symbol of the culture and history of the empire in the Sumenep region. The Sumenep Palace has typical East Javanese architecture; the buildings are designed with the characteristics of Javanese cultural treasures, such as the open courtyard layout and the roof's distinctive shape. The Sumenep Palace also has a museum that houses various historical, artistic, and cultural artifacts, including collections of ceramics, heirlooms, paintings, and other historical objects. Overall, the Sumenep Palace represents an important symbol of local wisdom and regional culture. Its existence is vital to preserving, teaching, and promoting local knowledge in the community and helping maintain local cultural identity. The teacher invites students to visit the Sumenep Palace to instill local wisdom and values in their learning. Several students answered enthusiastically, arriving after the surface area and volume formulas. This step shows the integration of mathematics in the learning process, which is part of STEAM learning. At this point, the teacher assigns the students a post-test to complete regarding blocks and cubes. This stage allows students to choose problem-solving strategies and carry out mathematical, symbolic operations according to the questions given by the teacher according to the numeracy and literacy indicators. The tests the teacher gives are descriptive questions in the form of story questions that include local wisdom values to make it easier for students to understand the material and provide additional insights about local wisdom in society. The word problems aim to develop students' numeracy literacy skills, which are essential and significantly impact everyday life.

The researcher also interviewed three SDN Pakondang II fourth-grade students with heterogeneous abilities. The results of the interviews showed that students liked the STEAM learning process based on local wisdom; students found it easier to understand lessons because they were given concrete examples; and students enjoyed reading the story problems given because they added insight into local wisdom so that it was easier to plan problem-solving. The observations and interviews demonstrate that teachers at SDN Pakondang II are implementing local wisdom-based STEAM learning in the mathematics subject matter of blocks and cubes, starting with the steps of observation, new ideas, innovation, creativity, and society. Teachers integrate local wisdom by inviting students to visit the Sumenep Palace to associate objects in the museum with block and cube materials. It is intended that students can learn concretely and explore the theory of blocks and cubes in everyday life. Students are very enthusiastic, enjoy learning, and are active in answering questions from the teacher. In the learning process, the teacher also tries to develop students' numeracy literacy skills according to indicators of numeracy literacy, namely communication skills, mathematization skills, representation skills, reasoning, and argument skills, the ability to choose strategies to solve problems, as well as the ability to use language and symbolic operations. So, test results were obtained, which showed an increase in students' numeracy and literacy skills in class IV of SDN Pakondang II.

In the last research stage, a post-test was given to determine student learning outcomes after implementing STEAM learning based on local wisdom and analyzing the average student learning outcomes. The pre-test results showed that 40% of fourth-grade students at SDN Pakondang II had numeracy literacy skills with an average score, while the post-test showed 80% of students had numeracy literacy skills with an average score of. Based on the results of the tests conducted, it can be concluded that there is an increase in numeracy literacy in class IV SDN Pakondang II after the implementation of local wisdom-based STEAM learning. Based on the researcher's data, a normality test is a prerequisite. The results of the research data normality test with SPSS software as show in Table 3.

Table 3. Normality Test

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	Df	Sig.
Pretest	0.221	10	0.181	0.846	10	0.052
Posttest	0.211	10	0.200	0.919	10	0.352

Table 3 shows that the distribution of all research data is normal with a significance value (Sig.) > 0.05. The test results were tested with the paired sample Test *sample t test* to check the average difference in the value of students' numeracy literacy skills. The results of *paired sample t test* with SPSS software as show in Table 4.

Table 4. Paired Sample T-test

Group		Paired Differences					Q	df	Sig. (2-tailed)
		Means	std. Deviation	std. Error Means	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	pretest–post-test	19.200	12.577	3.977	-28.197	-10.203	-4.828	9	0.001

Based on Table 4 output results show a sig. (2-tailed) of 0.001 <0.05, so it can be concluded that STEAM learning based on local wisdom influences students' numeracy literacy skills in class IV SDN Pakondang II. Based on the data analysis using the t-test, it can be concluded that learning using local wisdom-based STEAM learning influences students' literacy and numeracy abilities more.

Discussion

The application of STEAM learning in this study is integrated with a local wisdom project-based learning model. According to previous study STEAM learning is a method that can teach students to think critically, creatively, and innovatively (Puspitorini et al., 2023). The government has noted that these are the competencies that 21st-century learners must possess, precisely the capacity to think critically, creatively, and innovatively. This is, of course, in line with the research conducted which states that there is a positive influence of STEAM learning on the creative abilities of students in elementary schools (K Aini et al., 2020).

The implementation of STEAM learning is close to contextual education or knowledge based on everyday life; for example, students are invited to observe life in the surrounding environment. This is to the demands on the competencies in the Merdeka curriculum so that they will explore soft skills optimally through a series of activities in learning that can be implemented in everyday life (Conradty & Bogner, 2020; Imam et al., 2018). Applying the STEAM approach encourages students to understand each STEAM component in a lesson. In STEAM learning's implementation, some activities contain STEAM components; namely, Scienceexplains factually, conceptually, procedurally, and metacognitively material about biotic and abiotic components; technology explains the use of technology in a lesson and helps student activities; engineering explains the techniques or methods used by students in designing a project, art contains activities that bring out students' creativity in developing a project, mathematics includes student activities in collecting data as material for making a project (Hwang et al., 2022; Qodr et al., 2021).

A series of STEAM learning processes that have been implemented show that learning objectives by applying the STEAM Model can strengthen students' numeracy literacy (Herbein et al., 2018; Warmansyah et al., 2022). Then, students can also solve the problems on the worksheet by writing their opinions. With the habit of listening, reading, and writing, the impact on students' vocabulary increases, students' thinking is more critical, and they can relate various pieces of information. The results of strengthening numeracy are in the work on student worksheets and the effects of student experiments. Students identify objects with characteristics according to mathematical theory; students perform calculations and measurements to make works (Gupta et al., 2022; Suarta, 2017). By strengthening numeracy, students are accustomed to working with numbers and performing calculation operations. Such is the STEAM learning process that can enhance students' numeracy literacy. This research is likely to provide comprehensive new information about the use of STEAM in implementing the independent curriculum for elementary school students. Another impact is recommendations for mathematics teachers to improve the learning outcomes of fifth-grade elementary school students in mathematics learning by implementing the Independent Curriculum through the STEAM learning method (Basyoni et al., 2020; Jacques et al., 2020).

The government has provided training on STEAM to teachers. Many teachers find STEAM training helpful, especially in giving insight into project-based learning and problems that can be implemented in STEAM learning. However, some teachers think the training is theoretical, so they still experience technical issues implementing STEAM. Implementing the Merdeka Curriculum includes STEAM disciplines in elementary school learning, which is included in phase C of the Merdeka Curriculum. so that the independent curriculum can be performed through STEAM in learning. Regarding the results and findings obtained in this research as well as the limitations of existing studies, it is recommended for teachers to (1) apply STEAM in mathematics learning (2) In the process, it is hoped that educators must understand in depth the components and meaning of STEAM (3) Pay attention to the factors things that need to be considered when implementing STEAM, such as not all science and mathematics topics are suitable for teaching using STEAM. 4) In making teaching media for teaching materials, a series of testing processes are needed so that they can meet the characteristics of STEAM.

4. CONCLUSION

Based on the research, class IV of SDN Pakondang II has implemented STEAM learning based on local wisdom through indicators such as observation, new ideas, innovation, creativity, *and* society. In the process, the teacher carries local wisdom values into learning by inviting students to the Sumenep Palace to identify objects in the form of blocks and cubes. In addition, local wisdom is also integrated into the test in the form of story questions, which are done individually. The pre-test results showed 40% of students' completeness with an average score, while the post-test showed 80% of students' totality with an average score, increasing student learning outcomes in class IV SDN Pakondang II. The results of the paired samples t-test also show a significance value, which means that STEAM learning based on local wisdom affects students' numeracy and literacy skills.

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