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Understanding and Implementation of Numerical Literacy in Teachers of Madrasah Tsanawiyah in Pemalang Regency, Indonesia

[1]Imam Sayekti, [*2]Yohanes Leonardus Sukestiyarno, [3]Wardono Wardono, [4]Zaenuri Zaenuri

[1]Doctoral Student, Postgraduate Program of Mathematics Education, Universitas Negeri Semarang, Indonesia
[2]Mathematics Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia, sukestiyarno@mail.unnes.ac.id
[34]Mathematics Department, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia

Abstract

The performance of mathematics teachers in literacy during teaching correlates with the increase in students' critical thinking skills. However, numerical literacy in the learning process is still rarely done. The purpose of this study was to analyse the numerical literacy of mathematics teachers at Madrasah Tsanawiyah (MTs) as basic data to develop a numerical literacy-based learning framework. This research is a case study research. The sample in this study was 50 mathematics teachers from MTs schools in Pemalang Regency, Indonesia. Data was collected by using a self-assessment questionnaire through an online survey platform to measure the understanding, implementation, evaluation, number of references, involvement in school literacy boards and school policies. Numerical literacy comprehension was only observed in 56% of the respondents. The results of this study show that teachers tend to use conventional learning because it is more accessible, time-saving and easy to do. The lack of experience, support capacity and poor habit of using numeric literacy in schools make it challenging to apply it in learning. Recommendations on the need for literacy implementation training, providing appropriate references, developing school literacy boards and preparing numerical literacy-based education are provided.

Keywords: Analytical thinking, math teacher, MTs, numerical literacy.

1. INTRODUCTION

Literacy has various forms, including numerical literacy, which is considered necessary in improving critical thinking and analysis skills (Sihaloho et al., 2019). Low achievement on numerical literacy is associated with incompatible reading materials (De Lange, 2006) and lack of adoption in the educational system, especially the literacy-based evaluation model (Laksono & Retnaningdyah, 2018). Numerical literacy is a piece of knowledge or skill to 1) use various numbers and symbols related to basic mathematics to solve practical problems in multiple contexts of daily life (Masters, 2009) and 2) analyse the information presented in various forms to predict the possibility in decision-making (Laksono & Retnaningdyah, 2018).

Based on previous research, two factors influence teachers' quality in providing numerical literacy in the learning process: 1) teachers' understanding related to numerical literacy-based evaluation models; and 2) the practice of compiling numerical literacy-based

evaluation. For this reason, a poor literacy score from PISA may be caused an unfamiliar literacy-based evaluation model that makes students incapable of solving the case (Argina et al., 2017). Therefore, teachers play an essential role in training their students to get used to working on numerical literacy-based evaluation (Abdurrahman et al., 2019). Generally, school teachers in Indonesia are still using textual or closed-answer-based evaluation models that can only be solved using material from the teacher (Nurhattati et al., 2020). Therefore, improving teachers' quality in building students' numerical literacy skills needs to be prioritised.

Numerical literacy implementation in the learning process cannot be separated from the teacher's role as a facilitator for helping students analyse a case and generate a solution. Teachers are proven to influence the development of literacy characters, especially at the junior high school level. Junior school becomes a critical point for students to develop their thinking skills through scientific experiences and socialise (Yerizon et al., 2019). In addition, the junior high school level is the general limit for compulsory schooling in various countries (Stacey, 2011), including Indonesia. This is in line with teachers' ability to teach at the junior high school, which correlates with an increase in students' critical skills (Goos et al., 2014). In addition, numerical literacy is identical to understanding numbers and numeric symbols as a standard application in basic mathematics. Therefore, mathematics teachers are frontline workers who improve the numerical literacy skills of students and other teachers in the school environment.

In addition to a teachers' knowledge, a literacy understanding is also influenced by the country's educational approach and ideological views. In Indonesia, the education curriculum is assimilated with the society's sociocultural conditions and religious backgrounds, for example, Madrasah Tsanawiyah (MTs). It is a junior school level that is combination of a modern and an Islamic religion-based education system. The influence of religious moderation on teachers' numerical literacy skills is exciting to be studied. In addition, the lack of research in this field retards the information flow to develop literacy skills for teachers at the MTs level. The research data is also helpful for mapping the problems of MT teachers in developing numerical literacy enhancement programmes. The results are also expected to create a baseline for formulating policies to increase numerical literacy in schools. Therefore, this study aims to analyse the numerical literacy knowledge of mathematics teachers in MTs as an information source to develop numerical literacy strategies.

2. METHOD

2.1. Data Collection

This study was case study research through self-assessment questionnaires using the online Google Forms platform for mathematics teachers. A total of 50 mathematic teachers from MTs in the Pemalang Region were involved as volunteer respondents. This study used 29 questions for assessing teachers' knowledge and understanding of numerical literacy. The teacher's experience then followed up with an in-depth interview to reveal the main obstacles in implementing numerical literacy in the MTs.

Furthermore, teachers' readiness in implementing numerical literacy during the learning process was deeply analysed based on seven indicators, including initial understanding (A1), application of numerical literacy in learning (A2), evaluation based on numerical literacy (A3), types and sources of references used to develop the literacy-based learning process (A4), implementation of numerical literacy in school daily life (A5), the existence of a literacy team in the school environment (A6) and school policies to support the implementation of numerical literacy (A7). The results that have been obtained were classified into three criteria, as presented in Table 1.

Table 1. *Criteria for achievement and implementation of numerical literacy*

Score	Percentage (%)	Criteria
≤ 1.33	≤ 33.00	High
1.34 – 2.67	34.00 – 67.00	Moderate
≥ 2.68	≥ 67.00	Low

2.2. Data analysis

Qualitative descriptive analysis was carried out based on data obtained from survey results and literature studies through data reduction, presentation and conclusion. The questionnaire data were then tabulated and analysed descriptively in a narrative manner to determine the basic understanding of numerical literacy. The data were grouped based on knowledge of numerical literacy and demographic conditions. Qualitative research was conducted to describe and analyse the effects of identifying the description of understanding and implementation of numerical literacy for mathematics teachers from MTs in Pemalang Regency.

3. RESULTS AND DISCUSSION

3.1. Teachers' responses to numerical literacy

Numerical literacy, part of higher-order thinking skills, should have become a basic understanding for teachers to develop critical thinking skills. The results show that almost half of the total respondents did not understand the concept of numerical literacy (Table 2). This indicates that the possibility of information and training access related to numerical literacy has not been spread evenly.

Table 2. *Descriptions of mathematics teachers at MTs Pemalang Regency based on understanding the concept of numerical literacy.*

Category		Understand				Lack of understanding			
		Male		Female		Male		Female	
		Σ	(%)	Σ	(%)	Σ	(%)	Σ	(%)
Total Respondents		10	20.00	18	36.00	10	20.00	12	24.00
Age (years)	< 27	-	-	2	4.00	-	-	-	-
	28 – 34	-	-	1	2.00	2	4.00	1	2.00
	35 – 41	2	4.00	3	6.00	1	2.00	2	4.00
	42 – 48	6	12.00	9	18.00	2	4.00	3	6.00
	> 49	2	4.00	3	6.00	5	10.00	6	12.00
Affiliation status	Public school	8	16.00	12	24.00	7	14.00	8	16.00
	Private school	2	4.00	6	12.00	3	6.00	4	8.00
Employment status	Settle or Government employee	9	18.00	17	34.00	10	20.00	12	24.00
	Contract	1	2.00	-	-	-	-	-	-
	Internship	-	-	1	2.00	-	-	-	-
Working period (years)	< 6	1	2.00	3	6.00	2	4.00	-	-
	7 – 12	-	-	1	2.00	1	2.00	2	4.00

	13 – 18	4	8.00	4	8.00	4	8.00	4	8.00
	19 – 24	3	6.00	8	16.00	3	6.00	4	8.00
	> 25	2	4.00	2	4.00	-	-	2	4.00
Profession accreditation	Not certified	3	6.00	6	12.00	1	2.00	1	2.00
	Certified	7	14.00	12	24.00	9	18.00	11	22.00
Teacher Professional education	Experienced	3	6.00	8	16.00	2	4.00	3	6.00
	Not experienced	7	14.00	10	20.00	8	16.00	9	18.00

The low literacy of teachers' understanding may correlate to the absence of numerical literacy introduction in the studied material during pre-teaching or college (Nahdi et al., 2020), especially for senior teachers. It aligns with the numerical literacy concept first introduced and proclaimed as a new national programme starting in 2016. It means that teachers who graduated before 2016 did not have a basic knowledge of numerical literacy and how to implement it in the learning process because the term has not been adopted in the national curriculum yet. On the other hand, a long teaching period, which is correlated with age, may cause a decrease in teachers' enthusiasm in learning numerical literacy (Bay, 2020). In contrast to senior teachers, young teachers are generally more adaptable to literacy growth because of their enthusiasm and ability to master media as a literacy tool (Nurhabibah et al., 2018). However, it is crucial to update the information to improve the teachers' skills in following the development of information.

According to Argina et al. (2017), updating scientific skills, soft skills, information flow access and the latest news is needed to improve teaching competencies. This study found that updating competencies in senior teachers (who have been teaching for more than 15 years) is quite challenging, due to their limitations in using technology. This is in contrast to young teachers and fresh graduates who are more abreast of technological developments, highly motivated and enthusiastic in teaching, and following the development of relatively new knowledge (Jiang & Hill, 2018).

However, the number of senior teachers who know about numerical literacy is also quite a lot. It is influenced by a teacher certification programme that provides access to numerical literacy training. The length of the teaching experience also creates an awareness of thinking in understanding literacy needs. This arises due to the teacher's sensitiveness in sensing student's learning obstacles in the study. In addition, according to Choi and Dobbs-Oates (2014), the increase in teaching experience also impacts improving teachers' capability in the literacy aspect.

Moreover, teacher certification programmes conducted by the government can be a holistic solution to improve teacher competence in understanding numerical literacy. Determining mandatory prerequisites for the teachers to enrol in more training and seminars can encourage certified teachers to be more enthusiastic in following literacy developments (Hall & Zmood, 2019). There are many ways for teachers to improve their competence independently, including a scholarship for further study, attending training and educational seminars (Hanifa, 2018). However, this step requires effort in its implementation. Therefore, the government is expected to provide supporting facilities in numerical literacy for teachers to develop themselves easier.

3.2. Numerical literacy implementation

The application of numerical literacy in mathematics learning is an effort to build critical thinking skills for students. The teachers' self-assessment regarding the learning process shows that the average achievement

value of the numerical literacy implementation is classified as a medium and tends to be low, as presented in Table 3.

Table 3. *Implementation of numerical literacy in supporting mathematics learning at MTs Pemalang Regency*

Category		A1	A2	A3	A4	A6	A7	A8
Gender	Male	63.34	47.50	54.50	23.33	56.58	52.50	40.00
	Female	66.11	42.78	52.50	18.89	52.68	38.33	31.67
Ages (years)	< 27	66.67	58.33	70.00	16.67	25.00	25.00	-
	28 – 34	66.67	50.00	50.00	41.67	75.00	37.50	37.50
	35 – 41	62.50	39.58	55.63	25.00	60.71	50.00	37.50
	42 – 48	67.50	43.33	54.00	20.00	57.89	50.00	40.00
	> 49	62.50	45.83	50.00	14.58	45.00	37.50	31.25
Affiliation status	Public school	65.72	44.76	52.14	20.95	53.13	45.71	35.00
	Private school	63.34	44.44	56.00	20.00	56.67	40.00	35.00
Employment-status	Settle or Government employee	65.28	54.17	60.00	25.00	52.09	47.92	39.59
	Contract	65.08	43.65	52.74	20.63	54.49	44.05	36.31
	Internship	66.67	83.33	80.00	33.33	50.00	25.00	-
Working period (years)	< 6	66.67	44.44	53.33	22.22	45.83	25.00	25.00
	7 – 12	66.67	37.50	58.75	33.33	75.00	37.50	37.50
	13 – 18	62.50	44.79	53.75	20.83	53.33	46.88	34.38
	19 – 24	64.82	47.22	52.78	22.22	57.35	48.61	38.89
	> 25	69.45	41.67	50.00	5.56	45.83	45.83	33.33
Profession accreditation	Not certified	62.12	40.91	57.73	21.21	61.36	47.73	31.82
	Certified	65.81	45.73	52.05	20.51	52.08	42.95	35.90
Teacher Professional education	Experienced	63.54	41.67	53.44	20.83	53.49	48.44	35.94
	Not experienced	65.69	46.08	53.24	20.59	58.09	41.91	34.56
Rata-rata per aspek		65.18	47.36	56.03	22.38	54.26	42.10	35.54
		Middle	Low	Middle	Low	Middle	Low	Low

Description: A1 = initial understanding; A2 = application of numerical literacy in learning; A3 = evaluation based on numerical literacy; A4 = types and sources of references used to develop literacy-based learning; A5 = implementation of numerical literacy in school daily life; A6 = existence of a literacy team in the school environment; and A7 = and school policies to support the implementation of numerical literacy

Based on the scoring, four aspects of numerical literacy implementation have low scores in supporting mathematics learning: application, use of references, supporting literacy teams and

policies related to numerical literacy. These four aspects are described as causing the common understanding of numerical literacy in mathematics teachers. Changing from conventional learning models to numeracy-based learning requires learning methods, material adjustments and evaluation forms. Then, the difficulties of applying numerical literacy in mathematics learning cannot be separated from material complexity and the limited learning methods (Jimenez-Hernandez et al., 2020). Changing conventional and commonly used models into the numeracy-based model is quite hard for senior teachers because of time limitations and overwork in teaching responsibilities. Typically, the teachers are burdened with administrative, official duties and student affairs, preventing them from developing literacy-based learning models (Revina et al., 2020). Besides that, the reason why teachers prefer to use the conventional approach is that they inherit the previous education system according to their learning experiences in the past (Haritos, 2004).

Often, the more complex teaching load, including applying numerical literacy in learning, is left or given to young teachers who are considered to have fewer dependents, work faster and keep up with technological developments. Young teachers are deemed to have high enthusiasm and innovation in compiling learning according to literacy. Furthermore, the young teachers tend to be futuristic and pay attention to the development of science and technology, making it easier to adapt and use digital media in literacy-based learning (Smagorinsky, 2018). On the other hand, teacher seniority is still very prominent, where young teachers feel reluctant to refuse workload outside of their teaching responsibilities.

In addition, the number of numerical literacy references, which has the lowest value, implies a lack of supporting facilities for sharing an interest in reading (Hossain et al., 2019). The current conditions showed that references supply, including numerical-related books, papers or articles, is rare, especially in Bahasa. Furthermore, several factors, such as busyness, age, low awareness and the need for numerical literacy, are the driving factors that lead to a shared interest in reading and learning (Suryawati et al., 2018). It correlates with the study results, where young teachers had more references related to numerical literacy than senior teachers. At the same time, numerical literacy learning resources are widely available from books, scientific papers or the articles on the Internet for free and easy to get. Furthermore, current technology provides a platform for teachers to more easily find references that are relevant, factual and easily accessible.

Increasing numerical literacy is essential and affordable as long the references as learning and information supplement is available. This causes teachers who are accustomed to reading books to find it challenging to obtain reading material. Then, schools can initially form a literacy team that ensures the implementation of the school literacy movement and provides assistance in preparing literacy-based learning. In her research Wahyuningsih et al. (2012) explained that the literacy team is tasked with 1) making and agreeing on practical guidelines for implementing reading programmes at the school level and 2) facilitating students to connect emotionally and mentally with books.

To improve the understanding of numerical literacy, Md-Ali et al. (2016) used the group discussion forum method for teachers to gain literacy skills. The results showed that the teachers who participated obtained a better understanding of numerical literacy. But, separately, a maximum achievement of numerical literacy skills can only be gained by strengthening the teacher's willingness to mastering the primary material of literacy (Lee & Oxelson, 2006).

Numerical literacy is not only homework for teachers but also policymakers. In this case, numerical literacy is concerned with the Indonesian government's priority to change the education system to be more futuristic and adaptable, even though the result of numerical literacy policy implementation requires time to be realised. Cooperation with various parties in arranging numerical literacy as a foundation in

the education system is needed to give a holistic point of view. Changes in the education system certainly require time for adjustment, especially since each individual has a different level of adaptation (Cragg et al., 2017). The learning and teaching processes are always correlated; teachers must continue to update the learning system and student culture in the future. Therefore, young teachers who have just finished their studies can conduct teaching and learning tasks simultaneously. Therefore, young teachers are considered better able to deal with the latest changes in the learning system (De Lange, 2006).

3.3. Achievement and implementation of mathematics teachers' numerical literacy

External factors are the most influencing triggers affecting mathematics teachers' understanding of numerical literacy. To assess the most dominant external factor contributing to the mathematics teacher knowledge, this study grouped the factors into 13 aspects, as presented in Table 4.

Table 4. *Factors affecting the numerical literacy ability of mathematics teachers at MTs, Pemalang Region.*

Activities	Score	Criteria
Access to numerical literacy training	0.16	Low
Application of numerical literacy in learning mathematics	1.89	Middle
The suitability of numerical literacy with the material being taught	1.55	Middle
The effectiveness of the numerical literacy-based learning evaluation model	2.61	Middle
Strengthening numerical literacy knowledge through reading habits	0.83	Low
Teachers' assessment of students' reading interest	1.88	Middle
Teachers' assessment of students' abilities in presenting data and information	1.74	Middle
Literacy development in school	2.04	Middle
Literacy activities at school	1.76	Middle
Literacy policy at school	1.40	Middle
Availability of literacy facilities and infrastructure	1.89	Middle
Policy support for literacy	2.61	Middle
A habit of discussing literacy	1.47	Middle

Overall, there were two aspects with low achievement in numerical literacy implementation: 1) access to numerical literacy training for teachers and 2) interest in reading. It is in line with the common understanding of numerical literacy in mathematics teachers' in MTs. It is possibly caused by no compulsion from the institution for teachers to master numerical literacy. On the other hand, the lack of seminars or workshops may also be an obstacle to access numerical literacy training. However, the Indonesian government launched the school literacy movement, and it should be a platform for educational institutions to reform numerical literacy training activities to be easily accessible and visible. The process of implementing numerical literacy depends on the mathematics teachers' capability to create and provide a numerical literacy-based evaluation (Goos et al., 2020). According to Piper et al. (2018), training can improve teachers' understanding of applying numerical literacy in the learning process. But to optimise the output, a monitoring and evaluation system should be developed to ensure numeracy literacy in teaching.

Based on the observation, the effectiveness of the numerical literacy-based learning

evaluation model in mathematics teaching is considered relatively moderate to high. These results show that the basic knowledge in numerical literacy may positively impact the teaching and learning processes. In line with the teachers' responses to the literacy team, numeracy-based learning is also considered capable of increasing teacher competence in developing learning methods (Jiang & Hill, 2018). Based on the observation, the concept of numerical literacy implementation in school was closely related to provide references and infrastructures for teachers because the teacher needs it to deliver the idea for students in the learning process. By accessible literacy support during the learning process, the teacher and student are expected to understand numerical literacy quickly.

On the contrary, the value of strengthening numerical literacy knowledge through reading activities is low, which shows that the teacher's reading habits have not been formed well (Nurdiyah, 2019). By elaborating the mathematics teacher activity achievement in numerical literacy, it indicates that the basic knowledge of literacy in school mostly given may only be from external parties, not from internal motivation. On the contrary, literacy skills are closely related to reading activities, so that the culture of reading educational references needs to be improved (Shara et al., 2020). Through the policy mechanism of each school, reading interest can be increased through the provision of reading media, mandatory reading regulations, literacy events and literacy teams between teachers (Obasi & Anyachebelu, 2020). Improving reading culture can be carried out through various ways, such as providing reading facilities, policies for compulsory reading and selecting teacher candidates with literacy skills as an indicator of graduation (Gunes & Bahcivan, 2018). It is important to implement policies related to increasing numerical literacy because reading and analytical thinking activities dominate almost all aspects of education.

Currently, many schools and teachers have not prioritised how to provide instruments that can improve students' ability to answer various numeracy-based questions. The limitations of teachers in designing an instrument may be caused by overwork that demands various achievements at one time, such as teaching, assessing, managing administration and learning implementation plans (Utari et al., 2020). This causes many teachers to focus only on teaching activities, while the learning design only follows the previous pattern or takes questions for students to work on. To overcome these problems, it is necessary to simplify the main tasks of the teacher as much as possible, and the teacher focuses on teaching and learning activities.

To improve the quality of teachers in educating students related to numerical literacy, the government must focus on implementing the right curriculum system. For teachers who do not have adequate knowledge regarding the importance of numerical literacy, counselling on these problems is not comprehensive and is only done sporadically by several researchers and education activists. Furthermore, the things that must be prioritised in improving the quality of teachers are strengthening the curriculum as a learning guide for teachers in schools; with the right curriculum, it is hoped that teachers can independently apply various appropriate learning methods to improve the quality of students' numerical literacy.

4. CONCLUSION

Overall, the awareness regarding the importance of implementing numerical literacy has begun to form among MT mathematics teachers, although the application in learning is still low. Teachers' positive responses can be used as indicators that programmes related to strengthening teacher numerical literacy can be carried out. The absence of extraordinary efforts to improve numerical literacy skills independently and by agencies is the driving force for implementing numerical literacy. To enhance the quality of understanding of numerical literacy, access to supporting facilities and training should be increased. Furthermore, binding policies from relevant agencies and schools that encourage teachers to be more literate must be improved. In

particular, government support in promoting literacy at the school level, literacy-based learning and evaluation must be immediately compiled and activated as a national need.

However, this study still has problems examining fundamental issues such as teachers' cognitive and psychological conditions, which are the background of low literacy skills. Therefore, further research on the value of understanding the numerical literacy of mathematics teachers in MTs in the Pemalang Regency can be focused on measuring quantitatively using evaluation questions based on numerical literacy. Through quantitative measurements and the results of this research, it is hoped to provide a comprehensive picture of what aspects need to be improved. Furthermore, this research is expected to be a stepping stone in formulating policies for developing literacy skills for MTs teachers.

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