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EXPLORATION OF NUMERACY LEVELS USING *PEMANTIK* ASSESSMENT TOOL: A CASE STUDY OF ELEMENTARY STUDENTS AT LENTERA HARAPAN SCHOOL IN INDONESIA

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Abstract

Mathematics learning is capable of cultivating various abilities, including the development of numeracy skills, which are crucial for students to acquire and apply in their daily lives. Therefore, this study aimed to comprehensively and systematically map the numeracy levels achievements of elementary students using PEMANTIK assessment tool. By employing a cross-sectional design with a phenomenological approach, the current study was conducted at Lentera Harapan School (LHS) in Indonesia, including 4,279 elementary students ranging from Grades 1 to 6. In addition, the instrument used was a numeracy test accessed through PEMANTIK. The results showed that students in Grade 3 and above still faced challenges in developing numeracy skills. It was also observed that LHS focused on implementing best practices and pedagogical strategies to support teachers in enhancing numeracy skills of students.

Keywords: PEMANTIK assessment tool, Lentera Harapan School, numeracy, elementary students

INTRODUCTION

Mathematics learning is capable of cultivating various abilities (Hwang & Tu, 2021), including the development of numeracy skills, which are crucial for students to acquire and apply in their daily lives (Cahyani & Mohammad, 2023). Several studies across scientific fields also supported the importance of numeracy skills. For example, in the context of undergraduate nursing students, numeracy skills are defined as the ability to perform complex calculations and analyze the situations of patients in clinical settings (Nurumal et al., 2022). This study also shows that providing numeracy skills training for nursing students can reduce medical errors and enhance efficiency in nursing care for patients. On the other hand, from the perspective of patients, another study focusing on healthcare issues emphasizes the need to assess numeracy skills, as it directly affects the comprehension and understanding of students regarding health-related information (Omidbakhsh & Ormandjieva, 2016).

Sharpening numeracy skills can significantly improve the mathematical abilities of students, positively impacting their academic success and future career prospects (Lakhani,

2021). Numeracy skills play a vital role in mathematics learning, enabling students to access, interpret, and communicate numerical ideas in various contexts (Yustitia et al., 2021). The recent pandemic, which lasted approximately two years, had prompted governments and educators to recognize numeracy as an essential skill for active participation in society (Kalogeropoulos et al., 2021). As a result, numeracy skills have become highly valued in the workplace, leading to increased job opportunities and improved performance (Peters, 2020).

The levels of numeracy skills vary significantly across countries, influenced by factors such as changes in educational systems, cultural backgrounds, and teaching practices (Forgasz & Hall, 2019; Hall & Zmood, 2019; Nortvedt & Wiese, 2020). Acknowledging the significance of numeracy skills and the potential benefits they brought, numerous studies explored efforts to enhance this competency in mathematics learning among students. These efforts include presenting the Probing Prompting learning model (Cahyani & Mohammad, 2023), developing e-books based on local wisdom (Hidayah et al., 2021), and designing high-order thinking skills (HOTS) mathematical problems (Rohmah et al., 2022). The results highlight the commitment of teachers to explore diverse learning media and pedagogical strategies to optimize numeracy skills among students.

In Indonesia, numeracy skills among students are still in the poor category (Rakhmawati & Mustadi, 2022). The latest PISA report shown in Figure 1 showed that Indonesia achieved only 379 score points in the mathematics category, ranking 69th out of 79 countries (Sahyar et al., 2019). This ranking is influenced by several regions in the country where students show low performance in numeracy. For example, a study conducted in Aceh found that the skills were in the medium category, with a lack of proficiency in higher-order thinking (Marhami et al., 2023). Another study in East Java highlighted the topic of numeracy and discovered a low level of numeracy skills among elementary students (Lestari et al., 2022). This pattern is evident in various regions across the central and eastern parts of the country (Suciyati et al., 2022).

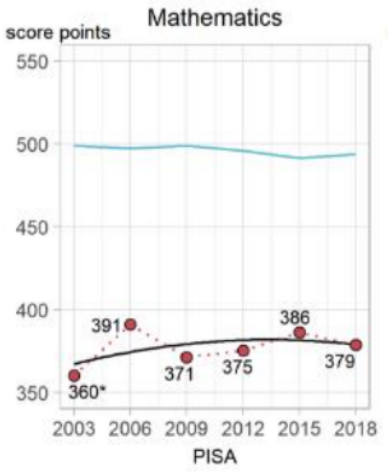

Figure 1. Indonesian PISA Score

Source: https://www.refoindonesia.com/

The situation has been further exacerbated by the pandemic, which has been affecting Indonesia for approximately two years. During this prolonged crisis, the quality of online learning implementation has not been optimal (Irfan et al., 2020; Rahiem, 2021), leading many students to seek a transition to limited face-to-face learning (Soesanto & Dirgantoro, 2021). The suboptimal condition arises due to infrastructure unpreparedness, socioeconomic factors, and a lack of digital learning literacy among both teachers and students. Numerous studies confirmed these challenges (Hidayati & Rudiyanto, 2021; Pramana et al., 2021; Soesanto et al., 2022; Solekhah, 2020), all of which have an impact on the dynamics of numeracy quality and hinder expected improvements. This implied that numeracy skills are still a significant challenge for those in various regions of Indonesia, despite the efforts made by educational stakeholders to improve the situation (Cahyani & Mohammad, 2023; Hidayah et al., 2021; Rohmah et al., 2022).

This study focuses on one particular school in Indonesia, namely Lentera Harapan School (LHS), which has branches spread across several provinces, serving students from grades K-12. Figure 2 shows the distribution of LHS, which are located on Nias Island, Sumatra, Java, Nusa Tenggara, Sulawesi, Molucca, and Papua Interior. The diverse cultural contexts in each LHS unit lead to varied student characteristics, including numeracy skills.

Figure 2. Distribution Map of LHS Indonesia

According to the education report in 2021, 9 out of the 17 total elementary school levels in LHS scored below the minimum competency, accounting for 52.94% of the levels. This study aims to conduct a comprehensive and systematic mapping of numeracy levels achievements among elementary students, taking into account the context and demographics of LHS. The objective is to provide a reference for implementing suitable treatments or interventions based on numeracy levels. This mapping process requires a compatible measurement tool to obtain accurate scores. It was important to note that no studies constructed assessment tools specifically for measuring elementary numeracy skills of students. Although several studies centered on the digital presentation of numeracy tests using various platforms (Aishalya et al., 2022; Gittens, 2015; Suciyati et al., 2022) and offered learning strategies for numerical comprehension examination needs (Ghazali &

Ashari, 2020; Iswara et al., 2022), the development of a comprehensive measurement tool had been lacking.

To address the identified gap, this current study introduces a tool called PEMANTIK, which stands for Independent Measurement of Literacy and Numeracy. PEMANTIK serves as a community-led assessment tool, enabling individuals to intervene in numeracy by developing targeted and measurable learning plans based on the PISA numeracy indicators. In simpler terms, the tool provides a platform that assists literacy and numeracy communities in presenting interventions to suit the diverse capacities of students. Considering student diversity and the nature of the instrument, this study aims to conduct a detailed and systematic mapping of numeracy levels achievements, providing valuable insights for treatment and intervention strategies.

LITERATURE REVIEW

Numeracy Skills in Indonesia: Students Portraits and 2018 PISA Test Results

According to the information from the OECD on the Indonesian Ministry of Education and Culture website https://gurudikdas.kemdikbud.go.id/, there were approximately 4,439,086 students in Indonesia during the 2018 PISA test. Although PISA score trend had shown improvement from 2000 to 2018, with a notable increase in math, the scores experienced a relative decline in all areas in 2018. As mentioned earlier, the score in the mathematics category reached 379 points, ranking 69th out of 79 countries (Sahyar et al., 2019). Based on Table 1, which outlines seven levels of proficiency in mathematics and science in PISA, only around 28% of Indonesian students achieved Level 2 or higher in mathematics (compared to the OECD average of 76%). At the very least, students interpreted and recognized, without direct instructions, how simple situations could be represented mathematically, such as comparing the total distance across two alternative routes or converting prices into a different currency. The percentage of those who attained minimum proficiency levels in mathematics (Level 2 or higher) varied significantly – from 98% in Beijing, Shanghai, Jiangsu, and Zhejiang (China) to 2% in Zambia, which also participated in PISA 2018. On average, 76% of students across OECD countries attained at least Level 2 proficiency in mathematics. Approximately 1% of Indonesian students scored at Level 5 or higher in mathematics, compared to the OECD average of 11%. The largest shares of those students who achieved this level were in six Asian countries, namely Beijing, Shanghai, Jiangsu, and Zhejiang (China) (44%), Singapore (37%), Hong Kong (China) (29%), Macao (China) (28%), Chinese Taipei (23%), and Korea (21%). Students possess the ability to mathematically model complex situations and select, compare, and evaluate appropriate problem-solving strategies for dealing with them.

Table 1. Summary description of the seven levels of proficiency in mathematics in PISA (Source: oecd.org)

Level	Characteristics of tasks
6	Level 6 students possess a comprehensive understanding of interrelated mathematical ideas and concepts derived from physical and space sciences. Students adeptly use their content, procedural, and epistemic knowledge to propose explanatory hypotheses for novel mathematical phenomena, events, and processes, as well as to make accurate predictions. Furthermore, they exhibit proficiency in discerning between relevant and irrelevant information when interpreting data and evidence, drawing upon external knowledge beyond the standard school curriculum. This category of individuals can differentiate between arguments supported by mathematical evidence and theory and those grounded in other considerations. Moreover, they are capable of evaluating and justifying choices regarding competing designs for complex experiments, field studies, or simulations.
5	At Level 5, students demonstrate the ability to apply abstract mathematical ideas and concepts to elucidate unfamiliar and complex phenomena, events, and processes, considering multiple causal links. They skillfully use more sophisticated epistemic knowledge to assess and justify alternative experimental designs, as well as to interpret information and make accurate

	predictions based on theoretical knowledge. Moreover, Level 5 students exhibit the capacity to evaluate various mathematical approaches for exploring a given question and identify limitations in interpreting data sets, including their sources and the effects of uncertainty in data.
4	At Level 4, students are proficient in using more complex and abstract content knowledge, whether provided or recalled, to construct explanations for intricate or less familiar events and processes. They confidently conduct experiments involving two or more independent variables within specific constraints and can justify the experimental designs by drawing on elements of procedural and epistemic knowledge. This group competently interprets data derived from moderately complex data sets or less familiar contexts draw appropriate conclusions that transcend the data, and provide justifications for their choices.
3	Level 3 students exhibit the ability to draw upon moderately complex content knowledge to identify or construct explanations for familiar phenomena. They can construct explanations with some cueing or support in less familiar or more complex situations, relying on elements of procedural or epistemic knowledge when carrying out simple experiments in constrained contexts. Moreover, students show their proficiency in distinguishing mathematical issues and identifying the evidence supporting a mathematical claim.
2	Level 2 students can draw upon daily content and basic procedural knowledge to identify appropriate mathematical explanations, interpret data, and address questions in simple experimental designs. Additionally, they use basic or daily scientific knowledge to discern valid conclusions from simple data sets. Showing basic epistemic knowledge, this group of students can identify mathematical questions that are suitable for investigation.
1a	At Level 1a, students use basic or daily content and procedural knowledge to recognize and identify explanations of simple mathematical phenomena. These students were able to engage in structured mathematical inquiries based on the support they received. Moreover, students show the ability to identify simple causal or correlational relationships and interpret graphical and visual data requiring a low level of cognitive demand. In familiar personal, local, and global contexts, Level 1a students can select the most suitable mathematical explanation for specific data.
1b	At Level 1b, students rely on basic or daily mathematics knowledge to recognize aspects of familiar or simple phenomena. They proficiently identify simple patterns in data, recognize basic mathematics terms, and accurately follow explicit instructions to carry out systematic procedures.

According to the PISA country publication, Indonesia has actively participated in PISA since 2001. Since that period, performance in science has experienced fluctuations but has remained relatively stable. In the aspect of reading and mathematics, performance has followed a hump-shaped trajectory. Specifically, reading performance in 2018 reverted to the 2001 level after peaking in 2009, and in mathematics, it fluctuated more during the early years of PISA but has shown relative stability since 2009 (OECD, 2019). Regarding numeracy skills, approximately 71% of students did not attain the minimum competency level. This indicates that many Indonesian students still encounter challenges in applying problem-solving skills using mathematics, particularly when dealing with arithmetic calculations not involving integers or problems with unclear and inadequately detailed instructions.

The latest PISA 2018 results show key results, including the significant percentage of low-achieving students. Despite the commendable efforts of Indonesia to enable students access the school system, further endeavors are necessary to enhance educational outcomes. This leads to a reduction in the proportion of low-achieving students to a minimum. Additionally, the cultural diversity, ethnicity, and archipelagic landscape present challenges in ensuring equitable distribution of numeracy skills across the country. It is crucial to acknowledge that the rate of improvement in numeracy skills of Indonesian students does not proportionately match the progress in access to education. This is reinforced by PISA 2018 results showing that rural students tend to exhibit lower numeracy skills compared to those from other demographic groups, indicating a lack of adequate educational services in schools situated in remote areas.

PEMANTIK as an Assessment Tool to Map Numeracy Skills

PEMANTIK is a relatively new assessment tool designed to map numeracy skills od students in Indonesia. Its novelty is attributed to the limited existing study examining the tool. PEMANTIK stands for *Pengukuran Mandiri Literasi dan Numerasi PSPK* (Independent Measurement of Literacy and Numeracy by PSPK). The acronym PSPK refers to Pusat Studi Pendidikan dan Kebijakan (Center for Education and Policy Studies), an independent non-profit foundation dedicated to reinforcing learning policies for children in Indonesia. Relying on scientific data, PSPK shares best practices within the education ecosystem of the country. PEMANTIK serves as an assessment tool specifically for children aged 6-12 years, facilitating a comprehensive evaluation of numeracy skills. Consequently, it is expected to serve as a valuable reference for designed learning planning, corresponding to the ability stage of each student. PEMANTIK operates as a community-led assessment, empowering the community to intervene in numeracy education by creating measurable and targeted learning trajectories that align with the PISA numeracy indicators.

Regarding its historical background, PEMANTIK 2018 was adapted from ASER (Annual Status of Education Report - Mathematics tools), a foundational numeracy measurement instrument initiated by the Pratham-India organization. For use in Indonesia, the development and adaptation process of the ASER instrument was undertaken by PSPK, leading to the creation of PEMANTIK 2018. To expand its user base and streamline the assessment process, PEMANTIK 2021 was introduced as a technology-assisted assessment that students could independently use. This new version allows students to engage with stimuli in the form of audio, images, and text through multiple-choice responses or short written entries. The framework for PEMANTIK 2021 assessment was developed by numeracy experts, building upon the foundation established in the 2018 version. Furthermore, practitioners were actively involved in question compilation.

The development of the numeracy test involved adjustments to the NCTM (National Council of Teachers of Mathematics) framework, primarily to (1) position PEMANTIK 2021 as a community-based measurement tool rather than school-based, (2) optimize the functionality of PEMANTIK 2021 with technology for independent use, and (3) provide user-friendly assessment tools for children, parents, and schools without compromising test quality. The numeracy learning progression within PEMANTIK 2021 encompasses five content standards, namely (1) Number and Operations, (2) Algebra, (3) Geometry, (4)

Measurement, and (5) Data Analysis and Probability. The learning progression matrix for the numeracy subtests is presented in Table 2 below:

Table 2. The Learning Progression Matrix for 2021 PEMANTIK Numeration

	Level 0 (Having quantitative sensitivity and recognizing the characteristics of shapes)	Level 1 (Recognizing numbers, patterns, and classification of shapes)	Level 2 (Addition and subtraction operations, continuing patterns, shapes, and data)	Level 3 (Multiplication and division operations, apply understanding of patterns, structures, and data)	Level 4 (Fraction operation, determined based on patterns, structures, and data)
Number and Operations	Recognizing the quantity of many and few	Recognizing numbers	Be able to perform addition and subtraction of integers	Be able to perform multiplication and division	Be able to perform operations with fractions, decimals, and whole numbers
Algebra	Sorting and classifying objects	Recognizing patterned objects and connecting them to corresponding numbers	Recognizing patterns in geometric and numeric addition	Understanding patterns in geometric and numeric multiplication	Be able to compare two patterns/ relationships and provide justification
Geometry	Recognizing two-dimensional shapes	Classifying and categorizing objects	Recognizing combinations of geometric shapes	Determining whether shapes are congruent or similar	Determining angles, side lengths, perimeter, area, and volume of similar objects
Measurement	Recognizing the quantity of many/few and heavy/light	Determining the appropriate measuring tool to measure an object	Understanding measurement using objects	Be able to perform unit conversions	Using models to determine length, area, volume, or angles accurately
Data Analysis and Probability	Determining probabilities of the most likely, least likely, equally likely, etc	Be able to determine the more likely event to occur	Be able to interpret tally and bar graphs	Be able to determine appropriate data representation	Be able to determine the probability of simple events

METHODOLOGY

Participants

This study comprised 4,279 primary school students, with 49.82% male (N = 2132) and 50.18% female (N = 2147), spanning from Grades 1 to 6. All respondents were LHS students from various regions across Indonesia. Figure 3 showed the color-coded dots indicating school locations and the number of participating students. It was evident that respondents came from 16 LHS across multiple islands, namely Sumatra (Nias LHS, Medan LHS, Banjar Agung LHS, Jati Agung LHS, Gunung Agung LHS), Java (Curug LHS, Koja LHS), Sulawesi (Toraja LHS, Tomohon LHS, Palopo LHS, Sangihe LHS), Nusa Tenggara (Kupang LHS, Labuan Bajo LHS, Rote LHS), Maluku (Ambon LHS), and Papua (Kampung Harapan LHS).

Figure 3. The LHS distribution and number of the participated students (Note: the term "SLH" means *"Sekolah Lentera Harapan,"* which is the abbreviation in the Indonesian version, but this study used the term LHS)

Furthermore, this study presented a detailed composition of LHS students based on their grades in Table 3. The total number of participants was evenly distributed among the different grades, indicating no significant differences in numbers across grades.

Table 3. The total participated students by grade (presented alphabetically)

School Units (LHS)	N	Grade					
		1	2	3	4	5	6
Ambon	369	64	60	62	63	57	63
Banjar Agung	271	42	35	49	50	48	47
Curug	385	83	66	55	63	61	57

Gunung Agung	126	21	25	24	15	21	20
Jati Agung	67	0	6	15	14	16	16
Kampung Harapan	408	73	56	53	71	80	75
Koja	136	20	24	17	25	24	26
Kupang	504	82	86	82	88	82	84
Labuan Bajo	152	27	24	18	27	30	26
Medan	299	48	40	47	49	54	61
Nias	179	28	30	30	32	28	31
Palopo	308	60	52	51	48	57	40
Rote	108	13	10	17	22	21	25
Sangihe	274	50	44	48	50	43	39
Tomohon	340	57	59	48	61	53	62
Toraja	353	56	54	56	63	63	61
Total	4279	724	671	672	741	738	733

Based on Table 1, the distribution of LHS students from 6 islands in Indonesia included Sumatra (N = 942, 22.01%), Java (N = 521, 12.18%), Sulawesi (N = 1275, 29.80%), Nusa Tenggara (N = 764, 17.85%), Maluku (N = 369, 8.62%), and Papua (N = 408, 9.54%).

Instrument

As previously mentioned, this study introduced PEMANTIK assessment tool to map numeracy skills of LHS students. The tool comprised five levels, ranging from Level 0 to 4, each with five problems designed following mathematics content standards such as Number and Operations, Algebra, Geometry, Measurement, Data Analysis, and Probability (Reys et al., 2007). To elaborate further, based on Table 1, the distribution of LHS students from 6 islands in Indonesia included Sumatra (N = 942, 22.01%), Java (N = 521, 12.18%), Sulawesi (N = 1275, 29.80%), Nusa Tenggara (N = 764, 17.85%), Maluku (N = 369, 8.62%), and Papua (N = 408, 9.54%).

Table 4. Problem Sample in *PEMANTIK*

Level	Sample Content Standards	Problem Sample
0	Number and Operations	Pilih gambar pencil yang paling sedikit  *Translate: Select the pencil image with the least quantity.*

1	Algebra	 *Translate: The correct number to fill the empty flag is ….*
2	Geometry	 *Translate: According to the short clip, if we want to combine all the 2D shapes, the formed 3D shape is …*
3	Measurement	 *Translate: According to the image, what is the length of the following earthworm?*

4	Data Analysis and Probability	 *Translate: According to the table, what is the probability that the selected student is a basketball enthusiast?*

The working rules in PEMANTIK adopted a one-time working system. When students entered the application, they were directed to work on the questions sequentially, starting from level 0. In a situation where a student made a mistake in selecting the right answer, the system would close, and they could not proceed further. The result showed the numerical level achieved by students. For example, completing all five items in level 0 would enable students to proceed to Level 1, which also consisted of five items. Answering incorrectly on the second item of Level 1 placed students back in Level 0. Students who were unable to answer all items correctly in Level 0 independently were still categorized as entering Level 0 in terms of numeracy skills. Similarly, when students completed all items in Level 0 and 1 but encountered difficulties with items in Level 2, they would be categorized at Level 1.

Procedure and Data Collection

As part of the data collection process, this study established a collaboration with the Head of School (HO) team. Prior to conducting the briefing for the school units, a socialization process was carried out by the assessment tool team to ensure alignment of perceptions. Figure 4 showed how the socialization process was conducted in a hybrid manner, including both the HO and PEMANTIK teams.

Figure 4. Hybrid meeting with HO and *PEMANTIK* team

The subsequent stage involved the implementation of briefings by the HO team to each principal and homeroom teacher in the selected school units. During the online briefing, the HO team presented information about the numeracy level mapping, socialization of PEMANTIK assessment tool interface, and explanations of the test rules and school infrastructure readiness. Students took the test in the computer laboratory provided by the school unit, with homeroom teachers acting as supervisors. The school principal was responsible for ensuring the internet network and school infrastructure were prepared before the test. The estimated time to complete the test was between 1 to 1.5 hours, and the implementation spanned two weeks due to participants from Grades 1 to 6 and limited computer lab capacity, as well as some school holidays. Ultimately, the test results were entered into PEMANTIK team database and collaboratively processed by the HO and study team.

Design and Data Analysis

This case study employed a cross-sectional design with a phenomenological approach, encompassing students from various islands in Indonesia in a single period to map numeracy levels. Regarding the objectives, the data, in the form of numeracy test results using PEMANTIK, were analyzed using descriptive statistics techniques. This choice was made to comprehensively capture the numeracy level mapping of elementary students, supported by numerical information (Creswell, 2014). The presentation of the data was expected to offer an opportunity for teacher observers to devise future treatment trajectories for LHS students.

RESULTS AND DISCUSSIONS

Mapping Numeracy Level Based on Mathematics Content Standards

The first mapping unveiled the numeracy levels related to the five mathematics content standards, namely (1) Numbers and Operations, (2) Algebra, (3) Geometry, (4) Measurement, and (5) Data Analysis and Chance. Table 5 showed numerical information about the numeracy test results of students after using the assessment tool.

Table 5. Numeracy test scores according to numeracy levels and mathematics content standards

Level	Mathematics Content Standards					Total	Mean	SD
	(1)	(2)	(3)	(4)	(5)			
0	4171	3720	4219	4190	3975	20275	4055	210.48
1	3388	3247	2271	3365	2219	14490	2898	598.78
2	1419	1288	1330	1525	1416	6978	1395.6	91.64
3	541	1025	941	1025	791	4323	864.6	204.59
4	250	90	173	310	164	987	197.4	84.69
Total	9769	9370	8934	10415	8565			
Mean	1953.8	1874	1786.8	2083	1713			
SD	1743.41	1544.32	1555.51	1632.27	1475.67			

Since the test was in multiple-choice format, each correct answer was worth 1 point, while an incorrect answer was worth 0 points. The total maximum score was 4279, corresponding to the number of those who participated as respondents. According to Table 5, in terms of numeracy levels, 94.77% and 67.73% of LHS students were at Levels 0 and 1, with respective Mean values of 4055 and 2898 as well as Standard Deviation of 210.48 and 598.78. Furthermore, only a few individuals achieved the targeted results for high numeracy test levels, namely 32.61%, 20.21%, and 4.61% at Levels 2, 3, and 4, with respective Mean values of 1395.6, 864.6, and 197.4, as well as Standard Deviations of 91.64, 204.59, and 84.69. Based on the learning progression matrix of PEMANTIK 2021 shown in Table 2, LHS elementary students were able to recognize numbers, patterns, characteristics, and classifications of shapes.

When examining the context of the mathematics content standards, Measurement achieved the highest score (M = 2083, SD = 1632.27), outperforming the other standards. On the contrary, the Data Analysis and Probability standards scored the lowest (M = 1713, SD = 1475.67), and the other three standards, in descending order of scores, were Number and Operations (M = 1953.8, SD = 1743.41), Algebra (M = 1874, SD = 1544.32), and Geometry (M = 1786.8, SD = 1555.51). When breaking down the numeracy at Level 0, the Geometry standard obtained the highest score compared to the other four standards, and Algebra had the lowest. At Level 1, Number and Operations achieved the highest score, while Data Analysis and Probability had the lowest. At Levels 2, 3, and 4, the Measurement standard outperformed the others, but the lowest scores varied, with Algebra at Levels 2 and 4, as well as Number and Operations at Level 3.

Mapping Numeracy Levels Based on School Grade

The subsequent mapping results presented were pertaining to the primary school level (Grades 1 to 6). Table 6 showed numerical information about the results obtained by students after taking the numeracy test by PEMANTIK according to their grade, with specific details for each content standard.

Table 6. Numeracy test scores according to numeracy levels and elementary school grades

Content Standard 1: Number and Operations						
Level	**Elementary School Grades**					
	1	**2**	**3**	**4**	**5**	**6**
0	694	652	653	726	725	722
1	458	483	500	624	650	673
2	127	160	184	238	278	432
3	42	52	53	88	112	194
4	11	16	16	44	52	111
Content Standard 2: Algebra						
Level	**Elementary School Grades**					
	1	**2**	**3**	**4**	**5**	**6**
0	541	549	569	669	695	697
1	422	448	473	599	639	666
2	124	160	155	208	255	386
3	78	106	111	161	205	364
4	11	6	5	15	12	41
Content Standard 3: Geometry						
Level	**Elementary School Grades**					
	1	**2**	**3**	**4**	**5**	**6**
0	708	659	662	735	734	721
1	364	376	307	340	392	492
2	126	168	155	204	256	421
3	76	102	97	153	181	332
4	8	8	15	34	40	68
Content Standard 4: Measurement						
Level	**Elementary School Grades**					
	1	**2**	**3**	**4**	**5**	**6**
0	703	654	658	731	729	715
1	446	482	506	623	637	671
2	159	196	194	244	291	441
3	79	108	108	161	207	362
4	19	21	22	55	65	128
Content Standard 5: Data Analysis and Probability						
Level	**Elementary School Grades**					
	1	**2**	**3**	**4**	**5**	**6**
0	659	603	610	687	708	708
1	227	284	313	423	451	521
2	138	179	178	222	278	421
3	62	79	67	121	166	296
4	3	9	6	41	37	68

The numeracy information was integrated with the latest learning curriculum reference from Indonesia. Based on the curriculum, Table 7 showed a matrix indicating the relevance of PEMANTIK numeracy levels with numeracy learning outcomes based on the mathematics content standards, as follows:

Table 7. PEMANTIK numerical relevance matrix with Indonesian curriculum learning outcomes

	Level 0	Level 1	Level 2	Level 3	Level 4
Number and operations	all grade	Grades 1 & 2	Grades 3 & 4	Grades 3 & 4	Grades 5 & 6
Algebra	all grade	Grades 1 & 2	Grades 3 & 4	Grades 5 & 6	-
Geometry	all grade	Grades 1 & 2	Grades 3 & 4	Grades 5 & 6	-
Measurement	all grade	Grades 1 & 2	Grades 1 & 2	Grades 3 & 4	Grades 5 & 6
Data Analysis and Probability	all grade	Grades 1 & 2	Grades 3 & 4	Grades 5 & 6	-

The matrix shown in Table 7 suggested that all primary school grades passed at level 0 in numeracy. In Grades 1 and 2, students were expected to pass Level 2 in Measurement and Level 1 in the other four content standards. In Grades 3 and 4, they were expected to pass Level 3 in Numbers and Operations and Measurement, and Level 2 in the other three content standards. At Grades 5 and 6, they were also expected to pass Level 4 in Numbers and Operations and Measurement and Level 3 in the other three content standards. It should be noted that Level 4 in Algebra, Geometry, and Data Analysis and Probability was mandatory for Grades 7-9 and was not required for elementary school students.

Upon further examination of the information in Tables 3, 6, and 7, it became evident that the majority of students from LHS achieved mastery at Level 1 for various content standards. Specifically, 63.26% and 71.98% of Grades 1 and 2, respectively, mastered Numbers and Operations, 58.29% and 66.77% were proficient in Algebra, 50.28% and 56.04% understood Geometry, 60.61% and 71.83% became proficient in Measurement, and 31.35% and 42.32% mastered Data Analysis and Probability. Additionally, at numeracy level 2, 21.96% and 29.21% of students in Grades 1 and 2, respectively, achieved mastery in Measurement. Based on the results, more than 50% of those in Grades 1 and 2 achieved proficiency in the majority of content standards, except for Data Analysis and Probability at Level 1 and Measurement at Level 2, which recorded less than 50% in these areas.

At numeracy level 2, around 27.38% and 32.19% of Grades 3 and 4 students, respectively, mastered Numbers and Operations, 23.07% and 28.07% were proficient in Algebra, 23.07% and 27.53% developed mastery in Geometry, as well as 26.49% and 29.96% had proficiency in Data Analysis and Probability. At numeracy level 3, approximately 7.89% and 11.88% of Grades 3 and 4, respectively, mastered Numbers and Operations, while 16.07% and 21.73% understood Measurement. These percentages indicated that the majority of students in Grades 3 and 4 did not optimally meet the achievement standards, as the numeracy mastery was below 50% for all mathematics content standards.

The assessment revealed that 7.05% of grade 5 students demonstrated mastery in Number and Operations, increasing to 15.14% among grade 6 counterparts. Similarly, in Measurement, 8.81% of grade 5 students and 17.46% of grade 6 students attained level 4 mastery for both content standards. At Level 3, 1.63% of grade 5 students and 5.59% of grade 6 students mastered Algebra, while Geometry saw mastery in 5.42% of grade 5 students and 9.28% of grade 6 students. For Data Analysis and Probability, percentages were 5.01% for grade 5 and 9.28% for grade 6, underscoring that less than 20% of students in Grades 5 and 6 achieved mastery in content standards, according to Table 7. The results showed that less than 20% of students in Grades 5 and 6 were assessed to have mastered the content standards corresponding to the matrix in Table 7.

Recent studies indicate that the numeracy skills of elementary school students in Indonesia remain in the poor category and have not been adequately developed (Rakhmawati & Mustadi, 2022; Sinaga et al., 2023). The results highlighted the persisting challenges faced by many students, particularly those in Grades 3 and above, within the context of LHS. The mapping of numeracy levels using PEMANTIK, in alignment with the latest Indonesian curriculum standards, showed ongoing difficulties for Grade 3 and above students in meeting mathematics content standards. Several studies identified various factors contributing to the lack of numeracy skills, which included limited familiarity with mathematics word problems and problem-solving (Aishalya et al., 2022). Furthermore, the absence of supporting facilities, such as media sources or books, posed a significant challenge to the development of numeracy skills (Cahyani & Mohammad, 2023).

LHS faced the issue of inadequate learning resources for teaching numeracy (Wulandari et al., 2023), particularly in remote areas with limited access to books and electronic resources. Books specifically addressing numeracy were not readily available in these schools. Based on this situation, teachers often relied on textbooks from the old curriculum, which might have reinforced memorization and mechanistic calculations. However, the situation was expected to improve as the HO had recently distributed a handbook containing numeracy materials that could be used as a reference for training and teaching students, starting from the academic year 2023/2024. This presented an interesting opportunity to study the effects of using the new handbook.

The lack of effective teaching methods (Sari et al., 2022) also contributed to numeracy problems in Indonesia. The expository method remained dominant in teaching, particularly in schools with limited infrastructure. Moreover, the economic status of most families of students fell in the middle to lower category, and the economic crisis further impacted their mathematics performance (Dewi, 2022). Teachers faced challenges in exploring diverse teaching methods to enhance numeracy skills of students. To address this issue, LHS should seek best practices and pedagogical strategies to support teachers in delivering effective teaching methods that fostered the capability in students.

CONCLUSIONS

In conclusion, the data on numeracy levels mapping using PEMANTIK showed that elementary students in LHS, including Grades 3 and above were still primarily entrenched at Levels 0 and 1. Situational factors suspected to have contributed to their weak numeracy levels included insufficient learning resources for teaching numeracy, the effectiveness of teachers in teaching numeracy, and economic factors. The results served as a basis for future studies to explore and implement best practices in teaching numeracy at LHS. As mentioned earlier, in the past academic year, the HO instructed LHS math teachers to adopt the Juara math book, which incorporated the CPA (Concrete-Pictorial-Abstract) method for teaching numeracy. Therefore, the effects of using Juara math books on numeracy levels of students should be examined in order to pave the way for further investigations in this direction.

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