RSF Conference Proceeding Series: Business, Management and Social Science, Vol. 3 No. 2 (2023) https://doi.org/10.31098/bmss.v3i2.656

Research Paper

Assessment of Student Numeration Literacy Levels Based on the 2021 National Assessment Data Study

Safari[1]*, Khasanah[2]
[1] Center for Educational Research (Pusrisdik) and National Research and Innovation (BRIN), Indonesia
[2]Universitas Islam As-Syafi'iyah, Indonesia

Received : June 24, 2023	Revised : August 5, 2023	Accepted : August 6, 2023	Online : August 7, 2023

Abstract

The Indonesian government regulates a national assessment to measure students' numeracy literacy skills as a reference in planning education policies. One of the latest national assessment data is the 2021 National Assessment Data. This data provides an overview of the numeracy literacy level of students in Indonesia and identifies challenges faced and opportunities for improvement and further development. The research that has been carried out aims to determine the numeracy literacy level of students based on education level: Elementary School (SD/MI), Junior High School (SMP/MTs), Senior High School (SMA/MA), Vocational High School (SMK/MAK) and provinces based on the 2021 National Assessment (AN). They are using a quantitative approach—data based on AN 2021 data, which has become publicly available and endorsed for research development purposes. The population is all schools in Indonesia. The sample is a school whose students (grade 5 SD/MI, grade 8 SMP/MTs, and grade 11 SMA/MA and SMK/MAK) are randomized to participate in the national assessment (AN). The data is a questionnaire answered by students in 34 provinces, 255649 students. Results: The highest and lowest average scores for numeracy competency levels were SMA (1.71), SMK (1.69), SMP (1.66), and SD (0.19). At the provincial level, the highest was DKI Jakarta (1.77), and the lowest was North Maluku (1.46). The study concludes that the average numeracy scores of students, both at the education level and at the provincial level, are still at the lower middle level.

Keywords *Numeration, Student, National Assessment*

INTRODUCTION

Education in Indonesia in the 2018 PISA assessment shows a low literacy level. This is because the methodology and orientation of educational policies are still pursuing standardization (Kania et al., 2023). The unsatisfactory results of the numeracy literacy tests obtained by Indonesian students in PISA were one of the factors that became the reason for developing numeracy literacy-based mathematics assessments for SD/MI students so that they are accustomed to solving numeracy-based questions from an early age (Lessy et al., 2023). Numeracy skills in Indonesia could be better due to several factors, one of which is low awareness of the importance of numeracy literacy in solving math problems (Purnama & Widenisah, 2023). To realize Indonesia's vision of becoming a golden Indonesia in 2045, the world of education needs to change its mindset. Teachers have a very strategic role in the world of education. The challenge of quality education requires teachers to be more creative, innovative, and inspiring. The problems that exist in schools are based on interviews that have been conducted with school principals and teachers. Educators complain about students' low literacy and numeracy abilities (Adawiyah & Prihandini, 2023).

Field data shows that students' literacy skills are still low, so learning innovation is needed (Munahefi et al., 2023). The factor affecting low literacy in Indonesia is the lack of interest in reading among Indonesians (Pratiwi et al., 2023). In addition, students' literacy and numeracy experienced setbacks due to sub-optimal education, lack of facilities, and lack of understanding of

Corresponding author's email: safari_puspendik@yahoo.com

the independent curriculum during the Covid-19 pandemic (Wahyuni & Tranggono, 2023). The quality of student learning is deficient, reflected in the poor scores on international assessments such as PISA, TIMSS, and PIRLS. Structural educational reforms to foster citizenship and civic responsibility are urgently needed. (Boudihaj and Sahli, 2022). Findings from the data indicate that mathematics teachers need to be better prepared to meet the needs of socioculturally diverse students in their different classes (Meeran & Wyk, 2022).

From the various descriptions above, the problem in this research is to determine the numeracy literacy level of SD/MI, SMP/MTs, SMA/MA, and SMK/MAK students based on the 2021 National Assessment (AN) and the numeracy literacy level of students in each province. The state-of-the-art (SOTA) that is useful/can be used by others in science regarding the level of numeracy literacy of students both at the education level and the provincial level based on AN 2021. This is the quality of the novelty of this study.

The purpose of this study was to determine the numeracy literacy level of students based on education level: Elementary School (SD/MI), Junior High School (SMP/MTs), Senior High School (SMA/MA), Vocational High School (SMK/MAK) and province based on the 2021 National Assessment (AN).

LITERATURE REVIEW

The number is a mathematical concept used for enumeration and measurement. The symbols or symbols used to represent a number are referred to as numbers or number symbols (Wahyuningtyas, 2016). The research results of Nasution and Hasanah (2023) show that the process of learning mathematics for grade IV students in fractional operations material could have gone better. Factors causing student learning difficulties come from internal factors and external factors. Internal factors, namely the negative perspective of students towards mathematics lessons, which are considered problematic, and the lack of motivation in students to participate in the learning process. External factors, namely the community environment, such as student activities playing outside school, and the use of mass media, such as cellphones and games that are increasingly accessible, harm students (Nasution & Hasanah, 2023).

In the results of interviews conducted by Novianti and Barera (2023), the teacher stated that he had used various learning tools such as picture cards and various learning videos, and interactive PowerPoint. According to Rosalianisa et al. (2023) that, language is not only an instrument or a means of communicating with other people and the environment but also a factor that contributes to the development of other aspects in children, one of which is the cognitive aspect in recognizing the concept of numbers.

Guerrero and Park (2023) propose that generative numbers arise from children's awareness of how the combinatorial rules of numbers allow the representation of arithmetic quantities (notably addition and multiplication). This can be done through various learning media models, such as developing problem-based math comics in integer learning and determining the feasibility of problem-based math comics in elementary schools, such as those developed by Fadli and Sujarwo (2023). *Rujak-rujakan* games as a medium for learning mathematics on the material for integer multiplication operations developed by Meishinta et al. (2023). To find out how students understand the concept of addition and subtraction of integers with tile simulation developed by Rahayu and Soleha (2023). The result is that by simulating tiles, students can quickly master the concept of integer operations.

Research results show that some difficulties include difficulty understanding questions, knowing variables, coefficients, and constants, or needing help understanding how algebraic concepts are operated (Syarah et al., 2023). Algebraic arithmetic operations are material that students learn at the junior high school level, including arithmetic operations of addition,

subtraction, multiplication, and division (Sari & Afriansyah, 2020; Lestari & Suryadi, 2020). Algebraic arithmetic operations benefit students, especially for studying mathematics material at a higher education level (Zulaika & Febrilia, 2019). So far, algebra material is still considered difficult by students. Students' understanding of algebraic material is still low, so learning is needed that involves many parties, including colleagues and parents; in this case, caring community-based learning is used (Hosnan & Purnomo, 2022).

Jones and Fujita (2013) argue that the geometry curriculum is related to teaching reasoning, proof, and problem-solving. Moriotti and Balacheff (2008) suggest that geometry can provide other learning possibilities. Geometry learning aims to develop students' logical thinking skills (Hidayah & Fitriani, 2021).

RESEARCH METHOD

This study uses a quantitative approach with secondary data analysis from the 2021 National Study Data. The data to be used is aggregate data, including the numerical literacy level of students in various provinces or regions in Indonesia. The population of this research is all schools in Indonesia. The sample consisted of schools whose students were (grade 5 SD/MI), grade 8 SMP/MTs, and grade 11 SMA/MA and SMK/MAK—randomly selected to participate in AN. The sample was selected to represent students taking the AN 2021 exam.

The data in this study came from a questionnaire filled out by students from 34 provinces, a total of 255,649 students. The data collection process is based on the 2021 national assessment data from trusted sources, such as the Indonesian Ministry of Education and Culture. Secondary data were analyzed statistically to get an overview of the numeracy literacy level of students in Indonesia.

The steps in the data analysis method include the following activities. (1) Collection of numerical data resulting from the 2021 national assessment. (2) Examination of data thoroughly to ensure its validity and accuracy. (3). Arrange the collected enumeration data into an appropriate format. (4) Use statistical techniques and other analytical methods to identify numerical data patterns, trends, or relationships. (5) Interpretation of the results of the analysis to understand the level of numeracy literacy based on national assessment data. (6) Prepare a research report summarizing the essential findings from the numerical data analysis.

Data analysis data were analyzed using descriptive statistical methods to get an overview of the numeracy literacy level of students in Indonesia. Linear regression analysis and other relevant factors will be used to identify the effect of independent variables on students' numeracy literacy. Comparative analysis between provinces was also conducted to find significant differences in students' numeracy skills.

FINDINGS AND DISCUSSION

Based on the percentage of the number of students who have filled out the questionnaire, 255,735 students from 34 provinces. For the results of this research analysis to be obtained accurately, all data in this study were processed or analyzed using the SPSS 22.00 program.

Table 1. Mean, Standard Deviation and Standard Error of Students' Numeracy Literacy Ability

No.	School	Means	Std Deviation	Std Error	N
1.	Elementary School (SD/MI)	1.5714	.20998	001	163107
2.	Junior High	1.6643	.18791	001	56557

	School (SMP/MTs)				
3.	Senior High School (SMA/MA)	1.7104	.24095	001	24109
4.	Vocational High School (SMK/MAK)	1.6889	.17711	002	11962
	Total				255735

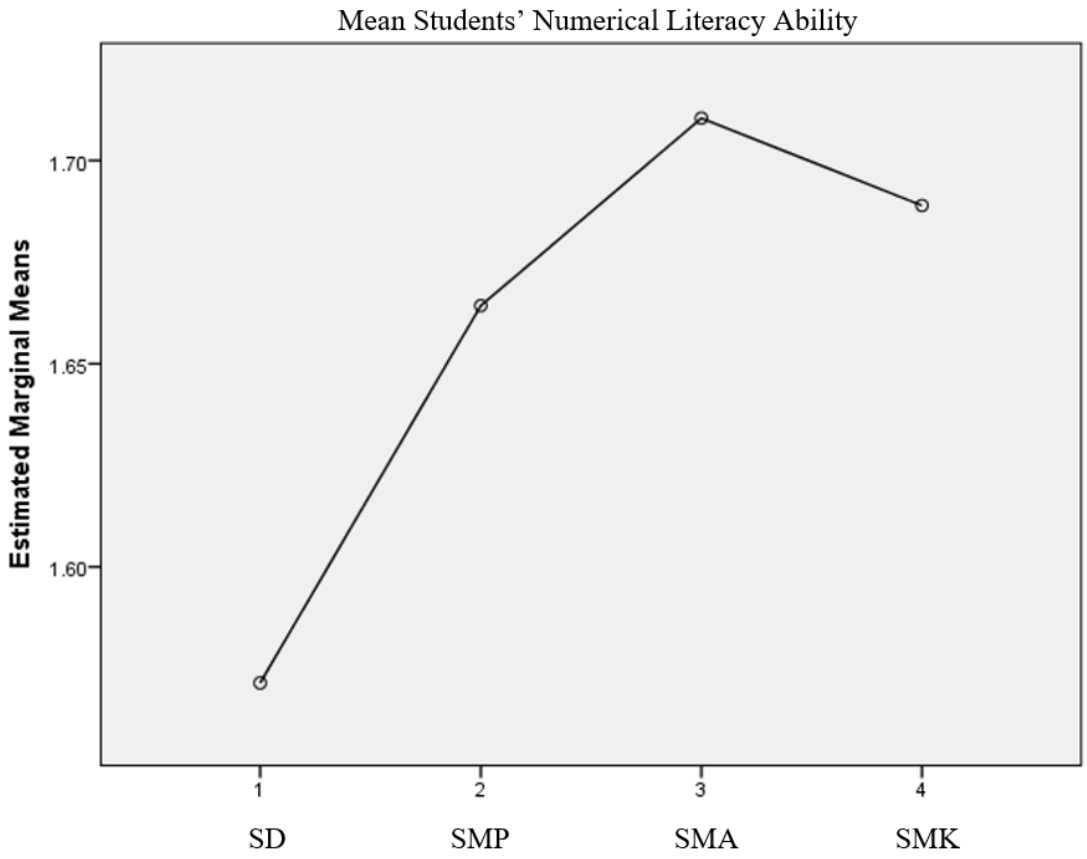

Figure 1. Mean Students' Numerical Ability Each Level

Table 2. Mean and Standard Deviation of Students' Numerical Literacy Ability in Each Province

No.	Province	Means	Std Deviation	N
1.	Aceh	1.5248	.18327	6413
2.	Bali	1.6732	.22183	3319
3.	Banten	1.5912	.22508	9497

4.	Bengkulu	1.5504	.18185	2260
5.	In Yogyakarta	1.7508	.21951	3055
6.	DKI Jakarta	1.7736	.22088	5057
7.	Gorontalo	1.5372	.18361	1583
8.	Jambi	1.5834	.18277	4151
9.	West Java	1.6372	.20835	37785
10.	Central Java	1.6638	.20154	31722
11.	East Java	1.6594	.22976	38383
12.	West Kalimantan	1.5249	.19676	6588
13.	South Kalimantan	1.6254	.21884	5109
14.	Central Kalimantan	1.5834	.21497	3672
15.	East Kalimantan	1.6505	.19391	3190
16.	North Kalimantan	1.5785	.20033	759
17.	Bangka Belitung Islands	1.6331	.17618	1310
18.	Riau islands	1.6863	.22170	1763
19.	Lampung	1.5557	.17664	8428
20.	Maluku	1.5198	.19199	3002
21.	North Maluku	1.4574	.18083	2095
22.	West Nusa Tenggara	1.5533	.19924	6334
23.	East Nusa Tenggara	1.5074	.18577	7649
24.	Papuan	1.5350	.19389	1250
25.	West Papua	1.5064	.19769	1022
26.	Riau	1.6227	.20383	6491
27.	West Sulawesi	1.5167	.19474	2084
28.	South Sulawesi	1.5741	.18808	10444
29.	Central Sulawesi	1.5161	.18596	4281
30.	Southeast Sulawesi	1.5557	.20510	3821
31.	North Sulawesi	1.5391	.20426	3254
32.	West Sumatra	1.6266	.18678	6142
33.	South Sumatra	1.5529	.18057	7834

34.	North Sumatra	1.5791	.20544	15988
	Total	1.6106	.21381	255735

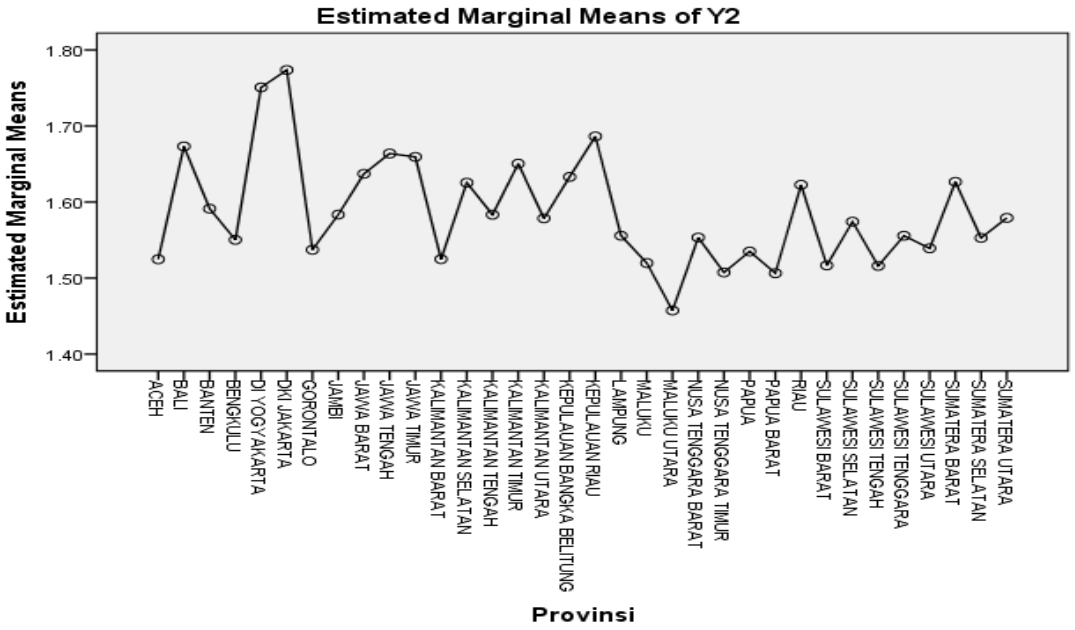

Figure 2. Mean Students' Numerical Ability Each Province

Based on Table 2 and Figure 2, the highest average ranking of the top 10 are the Provinces: DKI Jakarta (1.77), DI Yogyakarta (1.75), Riau Islands (1.69), Bali (1.67), Java Central (1.66), East Java (1.66), East Kalimantan (1.65), West Java (1.64), Bangka Belitung (1.63), and West Sumatra (1.64). The lowest average order of the top 10 in the Province: North Maluku (1.46), West Papua (1.51), NTT (1.51), Central Sulawesi (1.52), West Sulawesi (1.52), Maluku (1.52), Aceh (1.52), West Kalimantan (1.52), Papua (1.54), and Gorontalo (1.54).

Discussion

The findings above show differences in the average AKM scores of students from various regions in Indonesia, some at a high average level and some at a low level. Even very far behind from one region to another. These findings are reviewed and discussed based on several experts' opinions and research findings to better understand this study's meaning.

Some students often have a fixed mindset toward mathematics and science as complex subjects (Kadunz et al., 2021; McNabb, 2021; Stohlmann, 2022). This mindset leads them to run away or refuse to join these subjects in their further education. This bias can make teachers less interested in engaging students in math and science classes. However, teachers can introduce innovative resources while teaching to make learning math and science accessible and straightforward, following the needs of students. According to related research (e.g., Ouahi et al., 2022; Salas-Rueda, 2021; Wieman et al., 2008), innovative resources help teachers to engage students in their lessons. Gilbert et al. (2021) found that innovative methods support teachers' lesson preparation.

The author also suggests that using innovative methods increases student participation, interaction, and communication during teaching and learning. A study by Beena (2021) argues that

using more than one teaching method and innovation in teaching mathematics and science prevents students from losing interest in learning mathematics and can also be evidence of effective teaching. Currently, most teachers use innovative methods to build the attractiveness of the learning environment and improve student performance (Byukusenge et al., 2022; Byusa et al., 2021; Iyamuremye et al., 2022; Mukagihana et al., 2021; Musengimana et al., 2022; Mukagihana et al., 2021; Musengimana et al., 2021).

In learning mathematics, students are trained to improve logical thinking skills (Dawkins et al., 2017). Thinking logically can hone students' reasoning ability (Bronkhorst et al., 2020). This ability must be built in students because students need it when working on these Assessment questions.

CONCLUSIONS

The conclusions of this study are as follows.

1. The numeracy literacy of Indonesian students still needs to improve.
2. Differences in numeracy literacy between regions. Some regions have higher numeracy literacy levels compared to other regions.
3. Efforts are needed to improve numeracy literacy.
4. Further research is needed: The research "Numerative Literacy of Indonesian Students Based on the 2021 National Assessment Data" provides an initial description of the level of numeracy literacy of students in Indonesia. However, further research still needs to be done to understand the factors influencing numeracy literacy.

REFERENCES

Adawiyah, R. & Prihandini, R. M. (2023). Educator Assistance in the Development of Mathtrail-Based Meaningful and Joyful Learning to Improve Students' Numerical Literacy Using the ADDIE Model. *JPKMI: Journal of Indonesian Community Service*, *4*(1). https://doi.org/10.36596/jpkmi.v3i4.609.

Beena, M. (2021). Innovative practices in teaching mathematics. *International Journal of Multidisciplinary Research, 816*(7), 18–23. http://ijmer.in.doi./2021/10.07.238.

Boudihaj, A. & Sahli, M. (2022). *Education in the Mena Region*. Wolhuter, CC and Wiseman, AW (Ed.) World Education Patterns in the Global South: The Ebb of Global Forces and the Flow of Contextual Imperatives (International Perspectives on Education and Society, Vol. 43B), Emerald Publishing Limited, Bingley, pp. 19–41. https://doi.org/10.1108/S1479-36792022000043B002

Bronkhorst, H., Roorda, G., Suhre, C., & Goedhart, M. (2020). Logical Reasoning in Formal and Everyday Reasoning Tasks. *International Journal of Science and Mathematics Eduation, 18,* 1673–1694. https://doi.org/10.1007/s10763-019-10039-8.

Byukusenge, C., Nsanganwimana, F., & Tarmo, A. P. (2022). Effectiveness of virtual Laboratories in Teaching and Learning Biology: A literature review. *International Journal of Learning Teaching and Educational Research, 21*(6), 1–17. https://doi.org/10.26803/ijlter.21.6.1.

Byusa, E., Kampire, E., & Mwesigye, A. R. (2021). A case study on chemistry classroom practices in Rwandan secondary schools. *Heliyon, 7*(6), e07352. https://doi.org/10.1016/j.heliyon.2021.e07352.

Dawkins, P. & Cook, J. P. (2017). Guiding reinvention of conventional tools of mathematical logic: Students' reasoning about mathematical disjunctions. *Educational Studies in Mathematics, 94*, 241-256. https://doi.org/10.1007/s10649-016-9722-7.

Fadli, K. & Sujarwo. (2023). Development of Problem-Based Mathematical Comics in Integer Learning in Elementary School. *Journal of the Center for the Study of People's Education*, *3*(1).

https://doi.org/10.51178/jpspr.v3i1.1092

Gilbert, A., Tait-McCutcheon, S., & Knewstubb, B. (2021). Innovative teaching in higher education: Teachers' perceptions of support and constraints. *Innovations in Education and Teaching International, 58*(2), 123–134. https://doi.org/10.1080/14703297.2020.1715816

Guerrero, D. & Park, J. (2023). Arithmetic thinking is the basis of children's generative number concepts. *Developmental Review, 67*(March 2023), 101062. https://doi.org/10.1016/j.dr.2022.101062

Hidayah, I. S. & Fitriani, N. (2021). Analysis of Class VII Middle School Students' Difficulties in Understanding Quadrilaterals and Triangles Material in Online Learning. *JPMI (Journal of Innovative Mathematics Learning), 4*(3), 631-642.

Hosnan & Purnomo, USA (2022). Algebra Learning Through Caring Community Based Lesson Study For Learning Community. *Literacy: Scientific Journal of Madrasah Education, 1*(1), 25–42. Retrieved from https://literasi.mtsn2jember.sch.id/index.php/ltr/article/view/2

Iyamuremye, A., Mukiza, J., & Nsabayezu, E. (2021). Web-based discussions in teaching and learning: secondary school teachers' and students' perceptions. *Education and Information Technologies, 25*(1), 2695–2715. https://doi.org/10.1007/s10639-021-10725-7

Jones, K. & Fujita, T. (2013). Interpretations of National Curricula: The case of geometry in textbooks from England and Japan. *ZDM Mathematics Education, 45*, 671–683

Kadunz, G., & Zudini, V. (2021). Secondary School Mathematics Teacher Training in Austria. *Turkish Online Journal of Educational Technology - TOJET, 20*(1), 53–59.

Kania, MA; Faza, MR; Nuryanti, RE; Izzati, L.; and Rini, HM. (2023). Analysis of Learning Innovation Needs in the Form of Mathematics Learning Media for Junior High School Students to Improve Numerical Literacy. *ProSANDIKA UNIKAL: Proceedings of the Pekalongan University Mathematics Education National Seminar, 4*(1). Retrieved from https://proceeding.unikal.ac.id/index.php/sandika/issue/view/17

Lessy, D., Nukuhaly, N. A., & Rumasoreng, M. I. (2023). Development of Numerical Literacy-Based Mathematical Student Worksheets (LKS). *AKSIOMA: Journal of the Mathematics Education Study Program, 12*(1). http://dx.doi.org/10.24127/ajpm.v12i1.6449.

Lestari, K. E., Utami, M. R., & Yudhanegara, M. R. (2022). Exploratory Analysis on Adaptive Reasoning of Undergraduate Students in Statistical Inference. *International Journal of Instruction, 15*(4), 535–554. https://doi.org/10.29333/iji.2022.15429a

Mariotti, M., & Balacheff, N. (2008). Introduction to the special issue on didactic and epistemological perspectives on mathematical proof. *ZDM International Journal on Mathematics Education, 40*(3), 341–344.

McNabb, B. (2021). A fixed mindset in Mathematics. *BU Journal of Graduate Studies in Education, 13*(2), 28–32.

Meeran, S. & Wyk, M. (2022). Mathematics teachers' perceptions of socio-cultural diversity in the classroom. *JPR: Journal of Pedagogical Research*, *6*(3), 72-87. https://doi.org/10.33902/JPR.202215441

Meishinta, M., Farisma, S., Perdana, F., Munawwar, M., & Apriani, F. (2023). Game of Rujak-Rujak as a Media for Learning the Concept of Multiplication of Integers. *Journal of Scholars: Journal of Mathematics Education, 7*(1), 658-667. https://doi.org/10.31004/cendekia.v7i1.1028

Mukagihana, J., Nsanganwimana, F., & Aurah, CM (2021). Effect of resource-based instructions on pre-service biology teachers' motivation toward learning biology. *Creamed, 9*(1), 873–891. https://doi. org/10.31129/LUMAT.9.1.1637.

Munahefi, D., Lestari, F., Mashuri, M., & Kharisudin, I. (2023). Development of Numerical Literacy Skills Through Project-Based Integrated Thematic Learning. *PRISMA, Proceedings of the*

National Mathematics Seminar, 6, 663-669. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/66721

Musengimana, J., Kampire, E., & Ntawiha, P. (2021). Factors affecting secondary school students' attitudes toward learning chemistry: a literature review. *EURASIA Journal of Mathematics Science and Technology Education, 17*(1), 1–12. https://doi.org/10.29333/ejmste/9379

Nasution, I., & Hasanah, H. (2023). Analysis of Students' Learning Difficulties in Mathematics on Fractional Operations in Class Iv Sdn 101893 Bangun Rejo. *Journal of Research Innovation, 3*(9), 7767-7774. https://doi.org/10.47492/jip.v3i9.2487

Novianti, DN and Barera, RO. (2023). Analysis of the Difficulties Teachers Face in Learning Mathematics in the Material of Counting Numbers. *Journal of Elementary Schools*, *8*(1). https://doi.org/10.36805/jurnaldindingschool.v8i1.2223

Ouahi, M., Ben, Lamri, D., Hassouni, T., & Al Ibrahmi, E. M. (2022). Science teachers' views on the use and effectiveness of interactive simulations in science teaching and learning. *International Journal of Instruction, 15*(1), 277–292. https://doi.org/10.29333/iji.2022.15116a.

Pratiwi, A. D., Nugroho, A. A., Setyawati, R. D., & Raharjo, S. (2023). Analysis of Numerical Literacy Ability in Grade IV Students at SD Negeri Tlogosari 01 Semarang. *JANACITTA: Journal of Primary and Children's Education, 6*(1). https://doi.org/10.35473/jnctt.v6i1.2263

Purnama, R. & Widenisah, W. (2023). The Influence of Students' Numerical Literacy Ability in Solving Mathematical Problems. *National Seminar on Mathematics Education*, *4*(1). Retrieved from https://www.fkip-unswagati.ac.id/ejournal/index.php/snpm/article/view/1071

Rahayu, E. & Soleha, D. (2023). Using the Concept of Addition and Subtraction of Integers in Mathematics Learning at Madrasah Ibtidaiyah (MI). *Mandala Education Scientific Journal*, *9*(1). DOI: http://dx.doi.org/10.58258/jime.v9i1.4070

Rosalianisa, R., Purwoko, B., Nurchayati, N., & Subrata, H. (2023). Analysis of Children's Language Skills and Number Concepts through Technology in the Digital Era. *Journal of Educational Technology and Instruction, 2*(1), 87–100.

Salas-Rueda, R. A. (2021). Analysis of Facebook in the teaching-learning process about mathematics through data science. *Canadian Journal of Learning and Technology, 47*(2), https://doi.org/10.21432/cjlt27895.

Sari, H. M. & Afriansyah, E. A. (2020). Analysis of Middle School Students' Misconceptions on Algebraic Computing Operation Material. *Mosharafa: Journal of Mathematics Education, 9*(3), 439-450. https://doi.org/10.31980/mosharafa.v9i3.511.

Stohlmann, M. (2022). Growth mindset in K-8 STEM education: a literature review since 2007. *Journal of Pedagogical Research, 6*(2), 149–163. https://doi.org/10.33902/jpr.202213029.

Syarah, F., Harahap, Y., & Putri, J. (2023). Students Difficulties in Learning Algebra Material. *Journal on Education, 5*(4), 16067-16070. https://doi.org/10.31004/joe.v5i4.2656

Wahyuningtyas, D. (2016). *Learning Numbers for PGSD.* Malang: Edition Infographic Publisher.

Wieman, C. E., Adams, W. K., & Perkins, K. K. (2008). PhET: Simulations that Enhance Learning. *Science, 322*(October), 682–684

Zulaika, I., & Febrilia, B. R. A. (2019). Analysis of students' difficulties in solving arithmetic operations on algebraic forms in class VIII students of MTs Negeri 2 Central Lombok regarding cognitive maps. *Journal of Indonesian Educators, 2*(1), 316762.