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Development of Instrument Numeracy Skills Test of Minimum Competency Assessment (MCA) in Indonesia

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Indonesia has changed the national assessment of school students from the national exam (NE) to the minimum competency assessment (MCA) in 2021. In the minimum competency assessment, one of the student's abilities measured is numeracy skills. So that the valid, practical, and effective assessment instruments that evaluate students' numeracy skills are needed. This study described the feasibility of developing a numeracy test instrument for minimum competency assessments and described students' numeracy abilities. This research was development research. This research involved junior high school students with different mathematical abilities. The data were analyzed descriptively by collecting observations, tests and document analysis. This study showed that the development of test instruments could be used as a reference to measure students' numeracy skills. The test instrument was categorized as very feasible, valid and practical. The test results indicated that there was a potential effect on students' numeracy skills. In solving numeracy test questions, the potential effect of the test instrument on numeracy skills was 75.69%, with the emerging mathematical understanding ability of 80.22%, the ability to apply mathematics in problem-solving by 74.94%, and mathematical reasoning ability of 71.93 %.

Keywords: assessment, numeracy skills, thinking skills, numeracy task, skills

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INTRODUCTION

National assessments are carried out to monitor and evaluate the quality of the education system. Still, they are also designed to produce information that triggers improvements in the quality of teaching and learning, which in turn will improve student learning outcomes (Ministry of Education and Culture, 2020). The change in Indonesia's national assessment from the national examination (NE) to the Minimum Competency Assessment (MCA) was carried out by the Ministry of Education and Culture (MoEC) as one of the efforts to improve the quality of education. This change in the national assessment responds to the achievement of Indonesian students' national achievements in the 2003-2018 international assessment. In addition, the minimum competency test is the best way to serve the needs of students (Grise, 1982).

According to Coates (1994), Minimum Competency Assessment (MCA) attempts to establish a minimum level that is acceptable for educational attainment. As an essential competency assessment, MCA is needed by students to be able to develop their capacity and participate positively in society. There are two critical competencies measured by MCA, namely reading literacy and mathematical literacy (numeracy). MCA is intended to measure competence in-depth, not just content mastery. So that in MCA, problems are presented with various contexts that are expected to be solved by students using their reading and numeracy literacy competencies (MoEC, 2020).

Furthermore, MoEC (2020) explains that MCA is carried out to obtain information about student achievement of the expected competencies. Teachers can use these competencies to develop effectively and quality learning strategies according to student achievement. MCA is designed to produce information that triggers improvements in the quality of teaching and learning, which in turn can improve student learning outcomes. MCA is expected to measure a specific topic or content and a variety of content, a variety of contexts, and at multiple levels of cognitive processing. There are two essential competencies measured in MCA, one of which is numeracy.

Experts have carried out studies on numeracy (Carter, 2015; Geiger, 2015; Parnis, 2016; Fisher, 2018; Jonas, 2018; Hwang, 2020; Ismail, 2020; Yalcin, 2019). Parnis (2016) examined the attitudes of junior high school students towards numeracy based on national assessment investigations. Fisher (2018) develops numeracy skills using play-based interactive technology in a learning environment. Yalcin (2019) examines the differences in student competencies in literacy, numeracy, and problem-solving by gender. Hwang (2020) tested the effect of early numeracy activities at home on fourth-grade students' mathematics learning achievement. Ismail (2020) identified the numeracy competencies of primary school aboriginal students and investigated the relationship between their achievements in written and oral tests.

The importance of numeracy skills in the world of work and daily life is an increasingly relevant issue (Xiao et al., 2019; Jain & Rogers, 2019). According to Sepulveda et al. (2020), during the first few years of a student's life, the development of numeracy competence becomes very important. The importance of students to acquire numeracy

skills demands research in understanding the development of numeracy skills in each student who has different abilities (Grasby & Coventry, 2016).

The development of adequate numeracy skills is a sustainable development target (Bellini et al., 2019). Various efforts to improve and grow student numeracy have been carried out by several previous researchers in Indonesia (Prabowo et al., 2018; Andika et al., 2019; Rohendi, 2019; Samad et al., 2021). For example, Andika et al. (2019) explained that students' self-concept would support students' numeracy skills through board game activities. This is confirmed by Samad et al. (2021) that traditional games can improve students' numeracy skills. Furthermore, Prabowo et al. (2018) apply lesson study in learning to improve students' numeracy skills. Besides this, Rohendi (2019) stated that multimedia-based games could support children to develop numeracy skills.

Based on the explanation above, it is necessary to develop an instrument to measure student numeracy in minimum competency assessment in Indonesia. The development of this instrument refers to the MoEC in Indonesia. Based on the preliminary analysis in the field, it was found that teachers and students in the new assessment system did not experience interacting with questions related to numeracy skills. Furthermore, based on observations on the test instruments used in international Islamic boarding schools in Malang, East Java, teachers have not used numeracy test instruments. Therefore, the instrument developed by the teacher has not been able to measure students' numeracy skills in MCA.

On the other hand, the ability of teachers to develop students' numeracy test instruments is very low. More than 78% were unable to develop a numeracy skills test instrument due to the novelty of the numeracy system as a national assessment in the education unit level curriculum. On the other hand, students should be given a learning experience and evaluation related to their numeracy skills with the MCA framework. Students who are on average 15 years old in the school still have little access to questions in numeracy instruments because of the newness of the MCA system. Therefore, it is necessary to conduct research entitled "Instrument Test Development of Numeracy Skills on Minimum Competency Assessment in Indonesia." Based on this description, this study aims to describe the feasibility of developing a numeracy test instrument and to describe students' numeracy abilities.

METHOD

Research Design

This study is research with development design. This research method, namely Research and Development (R&D), modifies the development design with a preliminary stage through the preparation and design stages of questions and the formative evaluation stage through the evaluation, prototyping and field test stages (Tessmer, 1994; Borg & Gall, 2013; Bakker, 2018; Zulkardi, 2020).

Participant

This study involved junior high school students at international boarding schools in East Java, Indonesia. All of the students were 15 years old. They had different mathematical

abilities. This study involved junior high school students because the target for the minimum competency assessment (MCA) at one school level was 8th-grade junior high school students.

Procedures

Preliminary Stage

The first activity in the early stage was an analysis of the needs of teachers and students. The next step was to review numeracy skills based on the MCA Framework. The next phase was determining the place and subject of research and coordinating with teachers and the school used as a place of study.

The next stage was the design stage, namely the initial prototyping. The initial prototyping stage was by compiling items for the numeracy test instrument. Test questions by following the MCA framework. Then the design process continued with the analysis of test questions through focus group discussions for 5 times with promoters and 4 expert lecturers in mathematics education. Furthermore, based on focus group discussions, the draft was equipped with other supporting instruments, such as a scoring rubric.

Formative Evaluation Stage

The stages of formative evaluation were self-evaluation, design and field testing. In the self-evaluation stage, the researchers analyzed the instruments themselves. At the design stage, we conducted expert reviews, one-to-one and small groups. Next, the field test was carried out by involving students of international boarding schools in East Java, Indonesia. Field test aimed to reveal the emergence of potential effects of test instruments on students' numeracy skills in MCA in Indonesia. Competency analysis in developing this instrument followed the MCA framework as follows.

Table 1
Analysis competency based on MCA framework

MCA Aspect	Numeracy task components
Content	• Numbers, including representation, sequence properties, and operations of various types of numbers (count, whole, fraction, decimal). • Algebra, including equations and inequalities, relations, and functions (including number patterns), and ratios and proportions. • Measurement and geometry, including recognizing flat shapes to using volume and surface area in everyday life. Also assessing students' understanding of measuring length, weight, time, volume, and discharge, as well as units of area using standard units. • Data and uncertainty, including understanding, interpreting, and presenting data and opportunities.
Cognitive	• Understanding, understanding facts, procedures, and mathematical tools. • Application, able to apply mathematical concepts in real situations that are routine. • Reasoning, reasoning with mathematical concepts to solve non-routine problems
Context	• Personal, related to personal self-interest. • Socio-Cultural, related to the interests of individuals, culture, and social issues. • Scientific, related to issues, activities, and scientific facts, both those that have been carried out and futuristic.

Source: (MoEC, 2020)

Data collection techniques

We applied a methodological triangulation to collect data by means of different data collection methods such as observation, test, and documentation. Data analysis was carried out by analyzing validation results by experts, one-to-one, small group and field tests and was used to revise the test instrument made by the researcher. The data were analyzed through descriptive qualitative methods to describe the results of each stage of development in this study. Analysis of the test data was then used to determine the potential effect of students' numeracy skills by providing numeracy instruments.

FINDINGS

Preliminary

Based on observations on the test instruments used in international boarding schools in East Java, 44 teachers had not used numeracy test instruments. As a result, the instrument developed by the teachers had not been able to measure students' numeracy skills in MCA. On the other hand, the ability of teachers to develop students' numeracy test instruments was very low. More than 78% were unable to develop a numeracy skills test instrument due to the novelty of the numeracy system as a national assessment in the education unit level curriculum.

On the other hand, students should be given a learning experience and evaluation related to their numeracy skills with the MCA framework. Students who were on average 15 years old in the school were not familiar with the questions in numeracy instruments because of the newness of the MCA system in Indonesia. Students in the school who were used as subjects in the study were categorized with 35% high mathematical ability, 35% moderate ability and 30% low ability.

The next stage was the design of the initial prototype, namely the numeracy test item instrument. The test developed in this study was a written test in the form of questions in daily life, specific content and measures students' cognitive level.

Formative Evaluation

Self-evaluation

The numeracy task designed in this development was reviewed by researchers continuously and produces an initial prototype. The initial prototype developed in this study consisted of 3 problem contexts, namely the theme of hydroponic, building materials and Covid-19 which consisted of 7 types of questions. The numeracy test instrument consisted of content, context and cognitive level. The content of numeracy questions was divided into numbers, algebra, measurement and geometry, and data and uncertainty. The context of numeracy questions consisted of personal, socio-cultural and scientific. Cognitive levels in numeracy consisted of understanding, application and mathematical reasoning. The following was a presentation of instrument development and development of numeracy test tests based on cognitive aspects of the MCA framework.

Table 2
Analysis cognitive competency based on MCA framework

Cognitive Level	Indicators of numeracy skills	Number of questions
Mathematical understanding	understand facts, procedures, and mathematical tools	1a, 1b, 1c, 2a, 2b, 3a, 3b
Application of mathematics	able to apply mathematical concepts in real situations that are routine	1a, 1b, 1c, 2a, 2b, 3a, 3b
Mathematical reasoning	reason with mathematical concepts to solve non-routine problems	1a, 1b, 1c, 2a, 2b, 3a, 3b

Table 3
Analysis content based on MCA framework

Content Competency	Indicators of numeracy	Number of questions
Number	representation, sequence properties, and operations of various types of whole numbers, integers, fractions, decimals	1a, 1b, 2a, 2b
Algebra	equations and inequalities, relations and functions, number patterns, and ratios and proportions.	1a, 1b, 1c, 3a
Measurement and geometry	recognize flat shapes to use volume and surface area, measurement of length, weight, time, volume and discharge, and unit area.	2a, 2b
Data and uncertainty	understanding, interpreting, and presenting data and opportunities	3a, 3b

Table 4
Analysis context based on MCA framework

Context Questions	Indicators of numeracy context	Number of questions
Personal	related to personal interests	1a, 1b, 1c
Socio-cultural	related to inter-individual interests, cultural and societal issues	2a, 2b, 3a, 3b
Scientific	related to issues, activities, and scientific facts, both those that have been carried out and futuristic ones	3a, 3b

Prototyping

The next development was through the expert reviews and one-to-one stages to see the validity of the test instrument. These stages were carried out simultaneously. One-to-one was conducted for three students with different mathematical abilities. Three students were asked to complete the questions that have been designed and provide written responses on the completed test sheet. Based on the test results and student responses, improvements were made. Students responded that questions like this were the first time they had interacted and were very interesting and close to their context as individuals. Students can complete well according to their abilities.

Expert review of this prototype was Assoc. Prof, a lecturer in mathematics education from the State University of Surabaya, Indonesia. Expert review validated each problem in the test instrument based on the characteristics of content assessment, problem construction assessment and problem language assessment in the development of this

test instrument. The aspects of the prototype assessment of instrument questions validated by experts are shown in Table 5.

Table 5
Characteristics of the prototype of the instrument based on focus group discussions

Assessment focus	Assessment criteria
Content assessment	• Content can be used to assess problem solving skills • Content has the characteristics of non-routine problems • Content can be used to assess numeracy skills • Content allows subjects to find relationships/mathematical models/patterns or generalizations • Problems can be solved using various solving strategies • Problems according to students' cognitive development • Content in accordance with the current mathematics curriculum for students as research subjects
Construction Problem Assessment	• Problems allow subjects to use numeracy skills to solve them • Problems enable subjects to relate content and context in finding relationships/mathematical models/patterns or generalizations • Problems can be solved using various solving strategies • Problems are arranged using sentences that do not cause multiple interpretations • Problems are structured using sufficient information to solve
Problem language assessment	• Problems are arranged using good and correct Indonesian rules • Formulation of the problem using words or sentences that can be understood by the subject

The expert reviewed assessment based on the assessment criteria as above follows the scoring guidelines used as follows.

Table 6
Expert validation scoring guidelines

Score	Evaluation Criteria
1	The statement in the descriptor does not match the instrument
2	The statement in the descriptor less match the instrument
3	The statement in the descriptor is in accordance with the instrument, but needs improvement before use
4	The statement in the descriptor fits the instrument very well, and there is no need for any changes

The general assessment of the instrument based on the evaluation of expert reviews states that the prototype can be implemented by making a few revisions. Based on the validator's response, suggestions for improvements that need to be made for several components of writing were:

1. Question design drawings that need to be increased in image resolution.
2. Need for completeness of the Republic of Indonesia currency unit in question symbol 2b.
3. Complete punctuation marks on questions.
4. Suggestions for adding one question to the covid-19 problem.

The validation of expert reviews based on the scoring guideline criteria above is presented in Table 7 below.

Table 7
Expert review results

Assessment focus	Assessment criteria	Score number			Average	%
		1	2	3		
Content assessment	• Content can be used to assess problem solving skills	4	4	3	3,67	91,67%
	• Content has the characteristics of non-routine problems	4	4	3	3,67	91,67%
	• Content can be used to assess numeracy skills	4	4	3	3,67	91,67%
	• Content allows subjects to find relationships/mathematical models/patterns or generalizations	4	4	3	3,67	91,67%
	• Problems can be solved using various solving strategies	4	4	3	3,67	91,67%
	• Problems according to students' cognitive development	4	4	4	4	100%
	• Content in accordance with the current mathematics curriculum for students as research subjects	4	4	4	4	100%
Construction Problem Assessment	• Problems allow subjects to use numeracy skills to solve them	4	4	4	4	100%
	• Problems enable subjects to relate content and context in finding relationships/mathematical models/patterns or generalizations	4	4	3	3,67	91,67%
	• Problems can be solved using various solving strategies	4	4	3	3,67	91,67%
	• Problems are arranged using sentences that do not cause multiple interpretations	3	3	4	3,33	83,33%
	• Problems are structured using sufficient information to solve.	4	4	4	4	100%
Problem language assessment	• Problems are arranged using good and correct Indonesian rules	4	3	4	3,67	91,67%
	• Formulation of the problem using words or sentences that can be understood by the subject	4	3	4	3,67	91,67%
Total score		55	53	49	52,3	93,45%

Based on the results of the expert reviews above, the development of this instrument obtained an average score of 93.45% as the initial instrument with very feasible criteria. The score was a component of the content feasibility assessment with an average score of 94.05%, the problem construction feasibility assessment component with an average score of 93.33% and the problem language feasibility assessment component with an average score of 91.67%.

The results of the expert reviews and one-to-one were used to revise the instrument. Then it was tested in a small group involving six students with different mathematical abilities. Two students with high math ability, two students with medium math ability and two students with low math ability were asked to solve problems and respond to the designed instruments. Students responded that questions like this were the first time they

had interacted and were close to their context as individuals. As a result, students could complete well according to their abilities. Then the instrument was refined to be tested with a broader range of participants.

Field Test

The field test involved 8th-grade junior high school students for the 2020/2021 academic year, with 48 students as research subjects. This step was done by allocating the time for students to take the test for 3 hours of lessons (3x40 minutes). The field test stage was conducted at international boarding schools in Malang, East Java, with various mathematical abilities. The following is the percentage of students' numeracy abilities for each question from the field test.

Table 8
The percentage of students' numeracy skills on each test instrument

Instrument number	Numeracy Skills (%)			
	mathematical understanding	Mathematics Application	mathematical reasoning	Average
1a	91,25	86,78	81,09	86,37
1b	89,36	82,06	78,62	83,35
1c	78,42	70,56	68,22	72,40
2a	73,16	68,74	60,04	67,31
2b	66,45	60,56	53,76	60,25
3a	81,23	79,02	80,68	80,31
3b	81,64	76,87	83,10	80,54
Average (%)	80,22	74,94	71,93	75,69

Students' numeracy skills scores were grouped into very low, low, moderate, high and very high categories. This student's numeracy skills score category was also in line with the categorization of scores in the research of Kurniawan et al. (2018). The percentage of students' numeracy skills scores can be presented in table 9 below.

Table 9
Distribution of students' numeracy skills

Student scores	frequency	percentage	Category
81-100	12	25	Very high
71-80	18	37,5	High
60-70	5	10,42	Moderate
51-59	5	10,42	Low
0-50	8	16,66	Very low
Total	48	100	

DISCUSSION

The results of this development research showed that the test items were valid, practical, and feasible. The validity of the test items was obtained from the expert review stage and one-to-one through formative evaluation. At the same time, the practicality of the test questions was obtained from the small group stage. The practicality of the questions was seen when students can understand the problem and respond to the test questions. Thus, testing prototypes obtained practicality on students with different abilities in small groups. According to Risnawati et al. (2019) that the practicality test was carried out to

see how far the instruments developed were practically used by students. It is on this basis that the questions in the instrument can be stated practically.

The feasibility of developing this instrument could be seen from the results of the expert review evaluation. Expert review in this development research was Assoc. Prof., a lecturer in mathematics education at the State University of Surabaya. Based on the responses, the expert review suggested improvements in instrument development for several writing components, namely (1) question design drawings that need to be improved in image resolution, (2) the need for completeness of the Republic of Indonesia currency unit in question symbol 2b, (3) complete punctuation marks on questions, and (4) suggestions for adding one question to the covid-19 problem. As a result, the development of this instrument obtained a score of 93.45%. According to Sarwanto et al. (2021), the instrument with the criteria is feasible if the expert review score is 91.75%. So it can be concluded that the development of this instrument with a score of 93.45% is a very feasible instrument.

The field test results were analyzed to see the potential effect of the instrument on students' numeracy abilities. Based on the results and analysis of the 7-question field test, 80.22% of students showed mathematical understanding skills, 74.94% of students developed the ability to apply mathematics in context, and 71.93% showed mathematical reasoning abilities. Overall, the average percentage of students who show numeracy skills is 75.69%. The emergence of this numeracy ability is based on knowledge of mathematical facts that are close to them. According to May (2020), knowledge of students' mathematical fact skills will be useful in solving problems, especially those related to numeracy. Through non-routine problems, students will master the ability to answer complex problems using good reasoning skills (Kurniati, 2019; Purnomo et al., 2021; Subanji et al., 2021). According to Kartono & Sora (2020), it is necessary to provide peer feedback to make students complete mathematical reasoning questions.

Overall, the development of this test instrument was valid, practical, and very feasible and has potential effects to be applied on an ongoing basis. From the analysis above, it could be seen that most students can bring up their numeracy skills while solving the given problem. Thirty-five students had scores categorized as moderate, high and very high, and 13 students were in the low and very low categories. Therefore, 72.92% of these students were classified as having good numeracy skills. Based on the analysis of students' answers to solve the questions given, it could be concluded that the test instrument can influence students' numeracy abilities. However, the need for student-centered learning and making students active in learning will make students' understanding of concepts and numeracy skills develop (Mursalin et al., 2018; Nurjanah et al., 2020; Sadijah et al., 2021). This experience informs the design of new approaches to teaching and assessment of numeracy (Pettigrew et al., 2020). Although according to Geiger (2015), a field of research on numeracy is different and abundant, many important issues need to be investigated in each theme in this field. Especially in the MCA and Character Survey, which will be implemented in Indonesia, the development of related instruments can be used as recommendations and guidelines for developing the classroom learning environment (Rahayu et al., 2021).

CONCLUSION

Based on the results of the preliminary stage, the instrument was compiled, and then an evaluation was carried out. The evaluation was carried out through an expert review and one-to-one followed by a small group test to determine the validity, practicality and feasibility. The research instrument was valid based on the expert review and one-to-one evaluation scores. The results of the 93.45% expert review evaluation indicated that the instrument was very feasible. The practicality of the instrument was measured through a small group test. Based on the small group test results, students' responses to the instrument, students could understand the problem in the instrument. In the field test, the developed test instrument had a potential effect on students' numeracy skills of 75.69%. The students' numeracy skills were categorized as good, with 72.92% having moderate, high, and very high numeracy skills. This study concludes that the development of the student's numeracy test instrument was categorized as feasible, valid, and practical, and the numeracy abilities of junior high school students on this numeracy task were categorized as good. Teachers can use the developed test instrument to evaluate the numeracy assessment of students in learning in mathematics class.

Based on previous research, researchers had not found an instrument to measure students' numeracy skills, specifically in junior high school students, especially in the Indonesian context. However, this does not mean that this study is less important. This study is the first step to continue the following research to explore students' mathematical abilities from other themes using the numeracy task generated from this research. This study is critical because students' numeracy at the national level in Indonesia has just changed the pattern and form of assessment. The implementation of the results of this study can also be expected to have a broader impact on Indonesia's national assessment. Therefore, it is important to develop valid, practical, and feasible assessment instruments that measure numeracy skills.

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REFERENCES

Adhiya, E., & Laksono, E. W. (2018). Development and validation of an integrated assessment instrument to assess students' analytical thinking skills in chemical literacy. *International Journal of Instruction*, *11*(4), 241–256.

Andika, W. D., Akbar, M., Yufiarti, & Sumarni, S. (2019). Playing board games with mathematical self-concept to support early numeracy skill of 5-6 years old children. *Journal of Physics: Conference Series*, *1166*(1). https://doi.org/10.1088/1742-6596/1166/1/012019

Bakker, A. (2018). *Design research in Education: A Practical Guide for Early Career Researchers*. London: Routledge.

Bellini, D., Crescentini, A., Zanolla, G., Cubico, S., Favretto, G., Faccincani, L., Ardolino, P., & Gianesini, G. (2019). Mathematical Competence Scale (MCS) for primary school: The psychometric properties and the validation of an instrument to enhance the sustainability of talents development through the numeracy skills assessment. *Sustainability (Switzerland)*, *11*(9). https://doi.org/10.3390/su11092569

Borg, W.R and M.D Gall. (2013). *Educational Research: And Introduction*. Person Education Inc. Boston

Carter, M. (2015). Challenges in embedding numeracy throughout the curriculum in three Queensland secondary schools. *Australian Educational Researcher*, *42*(5), 595-611, ISSN 0311-6999, doi:10.1007/s13384-015-0188-x

Coates, R. D., & Wilson-Sadberry, K. R. (1994). Minimum Competency Testing: Assessing the Effects of Assessment. *Sociological Focus*, *27*(2), 173–185. https://doi.org/10.1080/00380237.1994.10571018

Fisher, M.H. (2018). Noticing numeracy now! Examining changes in preservice teachers' noticing, knowledge, and attitudes. *Mathematics Education Research Journal*, *30*(2), 209-232, ISSN 1033-2170, doi:10.1007/s13394-017-0228-0

Geiger, V. (2015). A critical orientation to numeracy across the curriculum. *ZDM - International Journal on Mathematics Education*, *47*(4), 611-624, ISSN 1863-9690, doi:10.1007/s11858-014-0648-1

Grasby, K. L., & Coventry, W. L. (2016). Longitudinal Stability and Growth in Literacy and Numeracy in Australian School Students. *Behavior Genetics*, *46*(5), 649–664. https://doi.org/10.1007/s10519-016-9796-0

Grise, P., Beattie, S., & Algozzine, B. (1982). Assessment of minimum competency in fifth grade learning disabled students: Test modifications make a differen. *Journal of Educational Research*, *76*(1), 35–40. https://doi.org/10.1080/00220671.1982.10885420

Hwang, S. (2020). Examining the effect of students' early numeracy activities at home on later mathematics achievement via early numeracy competencies and self-efficacy beliefs. *International Electronic Journal of Elementary Education*, *13*(1), 47-56, ISSN 1307-9298, doi:10.26822/iejee.2020.172

Ismail, Z. (2020). Numeracy competency of year 5 aboriginal students using written and oral tests. *Mathematics Enthusiast*, *17*(1), 31-62, ISSN 1551-3440

Jain, P. & Rogers, M. (2019). Numeracy as critical thinking. *Adults Learning Mathematics: An International Journal*, 14(1), 23-33

Jonas, N. (2018). Numeracy Practices and Numeracy Skills among Adults. *OECD Education Working Paper No. 177*, (177). Retrieved from http://dx.doi.org/10.1787/8f19fc9f-en

Kartono, & Shora, R. Y. (2020). Effectiveness of process oriented guided inquiry learning with peer feedback on achieving students' mathematical reasoning capabilities.

International Journal of Instruction, *13*(3), 555–570. https://doi.org/10.29333/iji.2020.13338a

Kurniati, D., Purwanto, As'ari, A. R., & Dwiyana. (2019). The truth-seeking and open-mindedness of pre-service mathematics teachers in the solution of non-routine problems. *International Journal of Instruction*, *12*(1), 915–930. https://doi.org/10.29333/iji.2019.12159a

Kurniawan, H., Putri, R. I. I., & Hartono, Y. (2018). Developing open-ended questions for surface area and volume of beam. *Journal on Mathematics Education*, *9*(1), 157–168. https://doi.org/10.22342/jme.9.1.4640.157-168

May, P. L. (2020). Number talks benefit fifth graders' numeracy. *International Journal of Instruction*, *13*(4), 361–374. https://doi.org/10.29333/iji.2020.13423a

Ministry of Education and Culture. (2020). AKM dan Implikasinya pada Pembelajaran. *Pusat Asesmen Dan Pembelajaran Badan Penelitian Dan Pengembangan Dan Perbukuan Kementerian Pendidikan Dan Kebudayaan*, 1–37.

Mursalin, M., Nuraini, N. L. S., Purnomo, H., Damayanti, N. W., Kristanti, D., Rohim, A., Widyastuti, R., Wulandari, Y. O., Saleh, H., Mayangsari, S. N., Fonna, M., Rohantizani, R., Muhammad, I., Nufus, H., Sulastri, R., Amalia, R., Nuraina, N., & Muliana, M. (2018). The development of algebra teaching materials to foster students' creative thinking skills in higher education. *Journal of Physics: Conference Series*, *1088*. https://doi.org/10.1088/1742-6596/1088/1/012101

Nurjanah, Dahlan, J. A., & Wibisono, Y. (2020). The Effect of Hands-On and Computer-Based Learning Activities on Conceptual Understanding and Mathematical Reasoning. *International Journal of Instruction*, *14*(1), 143–160. https://doi.org/10.29333/IJI.2021.1419A

Parnis, A. (2016). Secondary school students' attitudes towards numeracy: an Australian investigation based on the National Assessment Program—Literacy and Numeracy (NAPLAN). *Australian Educational Researcher*, *43*(5), 551-566, ISSN 0311-6999, doi:10.1007/s13384-016-0218-3

Pettigrew, J., Stunden, A., & McGlynn, S. (2020). Contextualising numeracy skill development and assessment in a first-year undergraduate nursing subject: A mixed methods research study. *Nurse Education Today*, *92*(December 2019), 104426. https://doi.org/10.1016/j.nedt.2020.104426

Prabowo, A., Asih, & Jumardi. (2018). Lesson study on 2nd grader of elementary school to improve the student's numeracy skill. *Journal of Physics: Conference Series*, *983*(1). https://doi.org/10.1088/1742-6596/983/1/012077

Purnomo, H., Sa'dijah, C., Cahyowati, E. T. D., Nurhakiki, R., Anwar, L., Hidayanto, E., & Sisworo, S. (2021). Gifted students in solving HOTS mathematical problems. *AIP Conference Proceedings*, *2330*(March). https://doi.org/10.1063/5.0043728

Rahayu, W., Putra, M. D. K., Rahmawati, Y., Hayat, B., & Koul, R. B. (2021). Validating an indonesian version of the what is happening in this class? (wihic)

questionnaire using a multidimensional rasch model. *International Journal of Instruction*, *14*(2), 919–934. https://doi.org/10.29333/iji.2021.14252a

Risnawati, Andrian, D., Azmi, M. P., Amir, Z., & Nurdin, E. (2019). Development of a definition maps-based plane geometry module to improve the student teachers' mathematical reasoning ability. *International Journal of Instruction*, *12*(3), 541–560. https://doi.org/10.29333/iji.2019.12333a

Rohendi, D. (2019). Game-based multimedia for horizontal numeracy learning. *International Journal of Emerging Technologies in Learning*, *14*(15), 159–170. https://doi.org/10.3991/ijet.v14i15.10679

Sa'dijah, C., Murtafiah, W., Anwar, L., Nurhakiki, R., & Cahyowati, E. T. D. (2021). Teaching higher-order thinking skills in mathematics classrooms: Gender differences. *Journal on Mathematics Education*, *12*(1), 159–179. https://doi.org/10.22342/jme.12.1.13087.159-180

Samad, F., Salasa, M., & Ramadali, W. O. R. L. O. (2021). Improving numeracy skill through leng kali leng traditional game in learning early math to young learners. *Journal of Physics: Conference Series*, *1832*(1). https://doi.org/10.1088/1742-6596/1832/1/012031

Sarwanto, Fajari, L. E. W., & Chumdari. (2020). Open-Ended Questions to Assess Critical-Thinking Skills in Indonesian Elementary School. *International Journal of Instruction*, *14*(1), 615–630. https://doi.org/10.29333/IJI.2021.14137A

Sepúlveda, F., Rodríguez, C., & Peake, C. (2020). Differences and Associations in Symbolic and Non-Symbolic Early Numeracy Competencies of Chilean Kinder Grade Children, considering Socioeconomic Status of Schools. *Early Education and Development*, *31*(1), 137–151. https://doi.org/10.1080/10409289.2019.1609819

Subanji, Nusantara, T., Rahmatina, D., & Purnomo, H. (2021). The Statistical Creative Framework in Descriptive Statistics Activities. *International Journal of Instruction*, *14*(2), 591–608.

Tessmer, M. (1994). Formative Evaluation Alternatives. In *Performance Improvement Quarterly* (Vol. 7, Issue 1, pp. 3–18).

Xiao, F., Barnard-Brak, L., Lan, W., & Burley, H. (2019). Examining problem-solving skills in technology-rich environments as related to numeracy and literacy. *International Journal of Lifelong Education*, *38*(3), 327–338. https://doi.org/10.1080/02601370.2019.1598507

Yalcin, S. (2019). Competence Differences in Literacy, Numeracy, and Problem Solving According to Sex. *Adult Education Quarterly*, *69*(2), 101–119. https://doi.org/10.1177/0741713619827386

Zulkardi, Meryansumayeka, Putri, R. I. I., Alwi, Z., Nusantara, D. S., Ambarita, S. M., Maharani, Y., & Puspitasari, L. (2020). How students work with pisa-like mathematical tasks using covid-19 context. *Journal on Mathematics Education*, *11*(3), 405–416. https://doi.org/10.22342/jme.11.3.12915.405-416.