DEVELOPING STUDENTS' NUMERACY SKILLS THROUGH NUMERACY LEARNING ENVIRONMENT

Cynthia Mayang Sari[1], Achmad Ridwan[2], Yuliatri Sastrawijaya[3]

[1]Student at the Department of Educational Research and Evaluation Postgraduate Program of Universitas Negeri Jakarta, Indonesia
[2] Department of Educational Research and Evaluation, Postgraduate Program, Universitas Negeri Jakarta, Indonesia
[3] Department of Educational Research and Evaluation, Postgraduate Program, Universitas Negeri Jakarta, Indonesia
Coresponding author: cynthia.maysha@gmail.com

Abstract

Background: Numeracy skills are one of the abilities measured in the Asessment Kompetensi Minimum (AKM). Numeracy skills need to be developed because numeracy skills are competencies needed as 21st Century life skills where numeracy skills help students to develop logical and creative thinking in daily activities. Numeracy skills can be developed through a numeracy learning environment that is applied in learning activities at school.

Purpose: Knowing how the numeracy learning environment can develop numeracy skills in school learning activities.

Methodology: This research uses the literature review method which is a method of synthesizing, identifying, and evaluating the work or research results and thoughts that have been produced by other researchers in a particular context. The sources of literature used are literature derived from various journal articles both nationally and internationally.

Results: The numeracy learning environment can develop students' numeracy skills through the implementation of several aspects or psychosocial dimensions consisting of self-development aspects where students personally strive to develop numeracy skills. In this aspect, the development of students' basic mathematical abilities such as communication, representation, mathematization and reasoning and argument is carried out. While the relationship aspect emphasizes learning activities in the classroom in the form of student interactions as individuals with other individuals, both peers and teachers as educators in an effort to develop students' understanding and numeracy skills. Classroom activities can include collaboration in solving problems, project-based learning, class discussions, peer tutoring, collaborative activities and group evaluation. The last aspect, system maintenance and change, emphasizes the extent to which the learning environment focuses on students and provides opportunities for all students to have equal opportunities in learning. Activities undertaken in this aspect can include providing equal opportunities for all students to develop mathematical understanding and skills, regardless of background, ability or other personal characteristics.

Keywords: Numeracy Skills, Learning Environment, Numeracy Learning Environment

Introduction

Evaluation of the quality of education in Indonesia has never stopped. This is because education evaluation is a necessity to know the picture of how the education process has been carried out to advance and develop the life of the State and nation. In the national context, evaluation is carried out through a series of test activities to measure the extent of student achievement and mastery of teaching and learning activities that have been carried out at the end of each level of education starting from elementary, junior high and senior high school. The form of evaluation has also changed several times and the latest is the implementation of the Minimum Competency Assessment (AKM), where one of the abilities measured is mathematical literacy or numeracy. This change was made as an effort by the Ministry of Education and Culture to encourage improvements in the quality of learning and student learning outcomes.

Numeracy skills are important to master because numeracy skills are the minimum competencies for 21st century life skills that are needed by everyone, especially students, to continue learning and become the basis for developing other abilities (UNESCO, 2013). Numeracy skills are also the basis of lifelong learning so that one day students can participate in society in various forms of contributions that can be made. In addition, it also helps students to think critically and creatively to reach their full potential and to develop their numeracy skills.

Given the importance of numeracy skills to be possessed and improved by all students, the learning process that occurs in the classroom should be related to efforts to improve learning outcomes, especially student numeracy skills. One of the influencing factors is the learning environment. Several studies have been conducted showing that the learning environment is one of the important factors and influences student learning outcomes, including (Mazlini et al., 2014; Nouby, 2017). Moreover, students spend 20,000 hours at school before they graduate and continue their education to college, which means that what happens during learning activities at school is very significant in the process of social interaction, the formation of learning experiences and knowledge that is very useful for students' future (Fraser, 1998). Thus, the learning environment plays a major role in the learning process and the formation of learning experiences while students are at school (Hussain Malik & Abbas Rizvi, 2018).

The learning environment is one part of the learning process in achieving learning objectives, where the learning environment affects teaching and learning activities at school (Mazlini et al., 2014). The learning environment consists of psychological, social, cultural and physical environments where learning occurs and where experiences and expectations are co-created among the learners.The research resulted in a study of efforts to develop students' numeracy skills through numeracy learning environments. The researcher distinguishes the efforts made with efforts made by other researchers in developing students' numeracy skills where other researchers are more focused on improving numeracy skills through various methods such as those conducted by Susanti & Syam (Susanti & Syam, 2017), Aunio et al (2015), Miller (2018), Anders et al., (2012). While research on the learning environment is conducted in other contexts or topics such as the measurement of the learning environment in the classroom (Herrmann et al., 2016;) (Guney & Al, 2012) measurement of the virtual learning environment (William Ho et al., 2009; (Dyson & Barreto Campello, 2003) (Aluja-Banet et al., 2019) and measurement of the laboratory learning environment (Che Nidzam Che Ahmada & Halim, 2010; (Olubu, 2015).

Methodology

This research uses the literature review method which is a method of synthesizing, identifying, and evaluating the work or research results and thoughts that have been produced by other researchers in a particular context. The sources of literature used are literature derived from various journal articles both nationally and internationally.

Result and Discussion

Numeracy Skills

Ojose (2011) argues that numeracy is the knowledge to know and use basic mathematics in everyday life. In this sense, someone who has good numeracy skills is someone who has sensitivity to mathematical concepts that are relevant to the phenomena or problems he faces, where from the sensitivity is then continued with problem solving using mathematical concepts. In line with this opinion, Stacey & Tuner (2014) define numeracy as the ability to use mathematical thinking in solving everyday problems to be better prepared for life's challenges. Mathematical thinking is intended to include a mindset of problem solving, logical reasoning, communicating and explaining. These mindsets are developed based on mathematical concepts, procedures and facts relevant to the problem at hand. (Stacey, K., & Turner, 2014).

Meanwhile, Steen and Turner define numeracy as the ability to use mathematical knowledge and understanding effectively in facing the challenges of everyday life. A person who is mathematically literate is not only able to use his/her knowledge and understanding but also must be able to use it effectively as a way of solving the problems at hand (Steen, L., & Turner, 2007). The OECD defines numeracy as an individual's ability to formulate, use and interpret mathematical concepts.

Numeracy is one of the competencies assessed in the Programme for International Students Assessment (PISA) conducted under the auspices of the Organization for Economic Cooperation and Development (OECD, 2012). PISA reports comparing student performance have been influential in shaping education policy in several OECD countries, and curriculum developers have tried to reflect PISA competencies in their national curricula (Breakspear, 2012). Bolstad in his research states that numeracy links the value of mathematics and the ability to use mathematics in the context of personal life, work and society (Bolstad, 2020) According to him, numeracy teaching should involve practical and cross-curricular tasks and not rely too much on solving traditional textbook problems. However, the teachers and school leaders who participated in this study found it challenging to find appropriate contexts for students to experience the value of mathematics. They also felt that they were not competent enough to approach teaching across the curriculum and the close relationship between textbooks and the curriculum made it difficult for them to put textbooks aside.

In a similar study, Genc and Erbas (2019) found seven categories related to teachers' conceptions of numeracy. The teachers had diverse but interrelated conceptions where numeracy teaching involves at least: 1) retrievalPendekatan lain yang dapat dilakukan adalah dengan memanfaatkan konteks yang muncul dari kehidupan di luar sekolah. Kaiser dan Willander (2005) menyarankan agar siswa mengerjakan soal-soal terbuka dengan konteks dunia nyata, seperti soal pemodelan matematika, untuk mengembangkan numerasi. Masalah pemodelan adalah tugas terbuka di mana siswa harus merumuskan masalah, mengembangkan model matematika, menyelesaikan masalah, dan menginterpretasikan solusi dalam konteks matematika dan konteks masalah (Blum, Niss, & Galbraith, 2007). Pemodelan masalah semakin penting dalam pendidikan matematika, dan pemodelan matematika dianggap sebagai proses utama dalam kerangka PISA untuk keterampilan dasar (Nordtvedt, 2013). Namun, pengajaran matematika sehari-hari hanya melibatkan sedikit kegiatan pemodelan (Blum & Ferri, 2009). Salah satu alasannya mungkin karena hal ini membuat pelajaran menjadi kurang dapat diprediksi oleh guru. Guru merasa sulit untuk berpikir secara mandiri jika siswa memberikan respon yang tidak terduga. Selain itu, guru juga melaporkan kesulitan dalam mengantisipasi respon potensial siswa sebelumnya dan mengidentifikasi strategi pengajaran yang produktif untuk mengatasinya (Jones & Tanner, 2008). Oleh karena itu, masalah terbuka dan pemodelan matematika membutuhkan pengetahuan dan keterampilan pedagogis tingkat tinggi serta kemauan untuk mengeksplorasi dan menanggapi pemikiran siswa. Bagi banyak guru, hal ini merupakan tantangan bagi praktik-praktik yang ada saat ini, terutama jika mereka memiliki model pengajaran yang didasarkan pada transmisi pengetahuan

dan melatih keterampilan (Tanner & Jones, 2013).

The second reason for the challenges of mathematical modeling problems experienced by teachers is that such problems require real-world knowledge from teachers. In Gainsburg's (2008) study, teachers reported that ideas for real-world connections came mostly from their own thoughts and experiences. Therefore, teachers' understanding of how to apply mathematics in contexts outside of school is an important factor in providing the learning experiences that students need to adapt the knowledge they learn in school to the outside world (Popovic & Lederman, 2015).

To address the complexity of definitions and constructs in numeracy learning, Goos proposed a model that is the result of research and designed to capture the richness of current numeracy definitions (Goos et al., 2012). The model represents the multifaceted nature of numeracy learning and involves five dimensions namely mathematical knowledge, context, disposition, tools, and critical orientation. The dimensions in the model are interrelated and represent the knowledge, skills, processes and modes of reasoning required to use mathematics effectively in the real world (Geiger et al., 2015; Goos et al., 2012).

This model views that in numeracy learning, the ability to use mathematical knowledge in a variety of contexts, both in school and outside of school is required, where in this model individuals position themselves in personal and social, work and citizen contexts. In personal and social contexts, individuals can be involved in personal finance, health and various other activities. Similarly, in the context of work, individuals sometimes use mathematics, for example in company financial reports, financial transactions, and so on. As a citizen, it concerns the social context arising from being a local, national or global citizen such as voting, funding national security or international economics.

Individuals also need to have a positive disposition towards mathematics as well as the confidence, willingness and readiness to flexibly use mathematical approaches and knowledge in working on life-related tasks. A positive disposition creates an expectation of success before attempting a task (Kloosterman, 2002). This needs support from teachers to expand students' thinking by providing problems that are broad, realistic and open and challenging for students (City et al., 2009). By providing challenging tasks, teachers provide opportunities for students to take risks, make decisions and justify their thinking as well as to be able to think for themselves (City et al., 2009).

In this model, there are four main components in the cycle, namely formulating, employing, interpreting, and evaluating. These main components describe basic mathematical skills in problem solving in numeracy learning where individuals formulate problems that exist in various contexts such as personal, social and work life into mathematical form, then use fundamental mathematical skills such as communication, representation, mathematization, use of mathematical symbols, etc. and mathematical tools to then interpret the solution according to the existing problem which ultimately leads individuals to re-evaluate whether the resulting solution is appropriate and appropriate for the problem at hand (Bolstad, 2020; Dave Tout, 2020).

The model presented by PISA includes some of the same elements as Goos' model, including basic mathematical knowledge and skills, mathematical tools and different contexts, which are factors that need to be considered in numeracy learning. Thus, numeracy learning can help individuals to have the ability to recognize and identify how and when mathematics is used, as well as the strategic steps that must be taken to obtain appropriate and appropriate solutions (Dave Tout, 2020).

Numeracy Learning Environment

The numeracy learning environment is a learning environment that supports students in developing numeracy skills. In this study, the numeracy learning environment connects or links numeracy learning aspects with the psychosocial dimensions proposed by Moos, namely the dimensions of personal development, relationships, and dimensions of system maintenance and change. The dimension of personal development in the numeracy learning environment refers to

the development of students' understanding and skills in learning mathematics to understand mathematical concepts to solve problems in the context of everyday life, for example when shopping, managing finances and so on (Lambertus, 2016). Students' self-development in the numeracy learning environment is carried out through the development of basic mathematical abilities such as communication, representation, mathematization and reasoning and argument (Bolstad, 2020; OECD, 2012).

Peters (2007) explained in his research that communication can show a person's level of understanding of something (Peters et al., 2007). If students only hear the explanation delivered, it is not certain that students really understand the explanation of the material that the teacher provides, but if students communicate both orally (speaking) and in writing (writing), it is certain that students understand the information or material presented. In mathematics, communication

This can be done for example by linking real objects, pictures or diagrams to mathematical ideas or describing an object to present a situation such as presenting the condition of student height in one class through tables or graphs (representation). This is in line with what is conveyed by Steffe et. al in Hudoyo (2002) which states that representation is a mental development process to express or visualize mathematical models into verbal forms, images, tables, graphs, mathematical statements, or overall combinations. More specifically, Hwang (2007) divides several types of representations used in mathematics including concrete representations, real world objects, arithmetic symbols, spoken or verbal language and pictorial or graphic representations.

In the process of understanding and solving problems in various contexts, the ability to link and develop mathematical knowledge with new experiences in the mind is needed. In addition, it also requires an understanding of mathematical activities, the use of mathematical knowledge and skills, reasoning, and language to solve problems in various circumstances and needs as well as the ability to reason and reason to produce logical conclusions (reasoning & argument). This mathematical reasoning ability also requires the ability to sort out what is important and not important in solving a problem and to explain or justify a problem.

Meanwhile, the next Moos dimension, namely the relationship dimension, emphasizes learning activities in the classroom in the form of student interactions as individuals with other individuals, both peers and teachers as educators in an effort to develop students' understanding and numeracy skills. These activities can be classroom activities in the form of collaboration in solving problems, project-based learning, class discussions, peer tutoring, collaborative activities and group evaluation (Hussain Malik & Abbas Rizvi, 2018). In collaborative problem-solving activities, students can be invited to work together in solving math problems. Teachers can provide tasks that require teamwork, where students can discuss, share strategies, and find solutions together. Teachers can also facilitate small group discussions or class discussions that encourage students to contribute and learn from each other. In another activity, project-based learning, teachers can provide math projects that require students to work in groups or teams. Teachers provide complex mathematical challenges that require in-depth analysis and students are encouraged to collaborate in planning, researching and presenting the results of their projects (Haryani, 2011).

Teachers can also use class discussion activities, to improve students' cohesiveness in understanding math concepts. Teachers can ask open-ended questions that encourage students to think critically and share their thoughts. The teacher facilitates the discussion by giving each student the opportunity to speak and listen to the views of others. Another activity that teachers can also provide is peer tutoring activities where teachers provide opportunities for students who have a better understanding to help other students who need help (Joni et al., 2020). This allows students to work together, share knowledge, and strengthen understanding of mathematical concepts. Another activity is collaborative activities, where teachers provide activities that involve teamwork in solving math problems (Handayani & Sulistiawati, 2019). For example, students can play team-based math games or work on math puzzles together. This encourages students to support each other and interact positively when exploring math concepts.In addition to all the activities

previously mentioned, the teacher also gives students the opportunity to carry out group evaluation activities, which involve assessing the contribution and cooperation of each group member (Wahyuni, 2020). This activity encourages students to support each other and appreciate joint efforts in understanding and applying mathematical concepts. In addition, it is also important to create an inclusive environment and encourage mutual respect among students. Teachers facilitate activities that promote cooperation, mutual respect and joint problem solving to achieve mathematical goals. By using these strategies, students can build cohesiveness in understanding and applying mathematical concepts collaboratively, and this cannot be separated from teacher support during learning activities.

Teacher support is crucial in building student cohesiveness in a numeracy learning environment (Zepeda et al., 2018). It is important for teachers to create a comfortable atmosphere and develop different ways to provide support in that context. Teachers need to understand the differences in students' abilities in mathematics and devise appropriate teaching strategies in order to use teaching methods and use materials that are tailored to students' level of understanding. In addition, teachers are expected to facilitate collaboration and classroom discussions that encourage students to share ideas, discuss solutions and learn from each other.

While the third dimension, namely system maintenance and change, in this study emphasizes the extent to which the learning environment focuses on students and provides opportunities for all students to get equal opportunities in the learning that is carried out. This can be in the form of providing equal opportunities for all students to develop mathematical understanding and skills, regardless of background, ability, or other personal characteristics (Tang et al., 2017). The variety of backgrounds, abilities and characteristics of students certainly causes differences in the needs and ability levels of students in receiving and understanding the learning provided. This condition requires teachers to consider teaching methods that are tailored to students' learning styles, comprehension levels, and individual needs. This ensures that each student gets the appropriate help and challenge for their progress. Teachers also ensure all students without exception have equal and fair access to the mathematics learning materials and resources provided. This can be in the form of textbooks, digital teaching materials, or online resources that are accessible to all students regardless of cultural diversity and student backgrounds. The existence of cultural diversity and students' backgrounds makes teachers respect and utilize students' experiences, knowledge, and backgrounds in mathematics learning.

Conclusion

The numeracy learning environment is a learning environment in which there are psychosocial aspects that can develop students' numeracy skills. The aspects are aspects of personal development in the form of personal student efforts to develop numeracy skills, relationships emphasizing learning activities in the classroom in the form of student interactions as individuals with other individuals, both peers and teachers as educators in an effort to develop students' understanding and numeracy skills, and aspects of system maintenance and change emphasizing the extent to which the learning environment focuses on students and provides opportunities for all students to get the same opportunities in learning.

Student self-development in the numeracy learning environment is carried out through the development of basic mathematical skills such as communication, representation, mathematization and reasoning and argument. While in the relationship aspect, classroom activities are carried out in the form of collaboration in solving problems, project-based learning, class discussions, peer tutoring, collaborative activities and group evaluation. In the last aspect, namely the aspect of system maintenance and change, activities are carried out that can provide equal opportunities for all students to develop mathematical understanding and skills, regardless of background,

References

Aluja-Banet, T., Sancho, M. R., & Vukic, I. (2019). Measuring Motivation from the Virtual Learning Environment in Secondary Education. *Journal of Computational Science*, *36*. https://doi.org/10.1016/j.jocs.2017.03.007

Anders. (2012). Home and preschool learning environments and their relations to the development of early numeracy skills, Early Childhood Research Quarterly,. *Early Childhood Research Quarterly*, *Volume 27*(Issue 2,), 231–244. https://doi.org/https://doi.org/10.1016/j.ecresq.2011.08.003.

Aunio, P., Heiskari, P., Van Luit, J. E., & Vuorio, J. M. (2015). The Development of Early Numeracy Skills in Kindergarten in Low-, Average- and High-Performance Groups. *Journal of Early Childhood Research*, *13*(1), 3–16. https://doi.org/10.1177/1476718X14538722

Bolstad, O. H. (2020). Secondary Teachers' Operationalisation of Mathematical Literacy. *European Journal of Science and Mathematics Education*, *8*(3), 115–135. https://doi.org/10.30935/scimath/9551

Che Nidzam Che Ahmada, K. O., & Halim, L. (2010). Physical and Psychosocial Aspects of Science Laboratory Learning Environment. *Procedia Social and Behavioral Sciences*, *9*, 87–91.

Darto, D. (2021). Dukungan Guru untuk Kemampuan Komunikasi Matematis siswa dalam Pembelajaran Matematika Realistic Mathematics Education. *Prosiding Seminar Nasional Pascasarjana …*, *4*(1), 141–143. https://proceeding.unnes.ac.id/index.php/snpasca/article/view/837%0Ahttps://proceeding.unnes.ac.id/index.php/snpasca/article/download/837/737

Dave Tout. (2020). Critical Connections Between Numeracy and Mathematics. *Department of Education and Training*, 2–2. https://research.acer.edu.au/cgi/viewcontent.cgi?article=1030&context=learning_processes

Desrina Hardianti, & Dwi Desmayanasari. (2022). Analisis Kemampuan Literasi Matematis Siswa dalam Online Learning pada Masa Pandemi Covid-19. *Inomatika*, *4*(1), 31–44. https://doi.org/10.35438/inomatika.v4i1.316

Dyson, M., & Barreto Campello, S. (2003). Evaluating Virtual Learning Environments: what are we measuring? *Electronic Journal of E-Learning*, *1*(1), 11–20. http://www.ejel.org/

Fitriana, E., & Khoiri Ridlwan, M. (2021). Pembelajaran Transformatif Berbasis Literasi Dan Numerasi Di Sekolah Dasar. *TRIHAYU: Jurnal Pendidikan Ke-SD-An*, *8*(1), 71–80. https://doi.org/10.30738/trihayu.v8i1.11137

Fraser, B, J. (1998). Classroom Environment Instruments: Development, Validity and Applications. *Learning Environments Research*, *1*, 7–33. https://link.springer.com/content/pdf/10.1023/A:1009932514731.pdf%0Ahttps://pdfs.semanticscholar.org/7369/0153632906907539d490d680ae10097bb5e2.pdf

Geiger, V., Forgasz, H., & Goos, M. (2015). A Critical Orientation to Numeracy Across The Curriculum. *ZDM - International Journal on Mathematics Education*, *47*(4), 611–624. https://doi.org/10.1007/s11858-014-0648-1

Goos, M., Dole, S., & Geiger, V. (2012). Auditing The Numeracy Demands of the Australian Curriculum. *Mathematics Education: Expanding Horizons - Proceedings of the 35th Annual Mathematics Education Research Group of Australasia Conference. 35th Annual Mathematics Education Research Group of Australasia Conference (MERGA 2012)*, *July*, 314–321.

Guney, A., & Al, S. (2012). Effective Learning Environments in Relation to Different Learning Theories. *Procedia - Social and Behavioral Sciences*, *46*, 2334–2338. https://doi.org/10.1016/j.sbspro.2012.05.480

Hadi, S., & Novaliyosi. (2019). TIMSS Indonesia (Trends in International Mathematics and Science Study). *Prosiding Seminar Nasional & Call For Papers Program Studi Magister Pendidikan Matematika Universitas Siliwangi*, 562–569.

Handayani, R., & Sulistiawati, E. W. (2019). Application of Collaborative Learning in Mathematics Lessons At Smkn 1 Kotabumi. *Jurnal Eksponen*, *9*(2), 35–41.

http://www.tjyybjb.ac.cn/CN/article/downloadArticleFile.do?attachType=PDF&id=9987
Haryani, D. (2011). Pembelajaran Matematika dengan pemecahan masalah untuk menumbuhkembangkan kemampuan berpikir kritis siswa. *Prosiding Seminar Nasional Penelitian, Pendidikan Dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta*, *14*(1), 121–126.
Herrmann, K. J., Bager-elsborg, A., Herrmann, K. J., Bager-elsborg, A., Parpala, A., Jesper, K., Bager-elsborg, A., & Parpala, A. (2016). *Measuring perceptions of the learning environment and approaches to learning : validation of the learn questionnaire Measuring perceptions of the learning environment and approaches to learning : validation of the learn questionnaire*. *January 2018*. https://doi.org/10.1080/00313831.2016.1172497
Hussain Malik, R., & Abbas Rizvi, A. (2018). Effect of Classroom Learning Environment on Students' Academic Achievement in Mathematics at Secondary Level. *Bulletin of Education and Research*, *40*(2), 207–218.
Joni, I., Vebrianto, R., & Amir MZ, Z. (2020). Metode Pembelajaran Peer Teaching sebagai Solusi Dalam Pembelajaran Matamatika. *Instructional Development Journal*, *3*(2), 69. https://doi.org/10.24014/idj.v3i2.10303
Khanifah, K., Sutrisno, S., & Purwosetiyono, F. D. (2019). Literasi Matematika Tahap Merumuskan Masalah Secara Matematis Siswa Kemampuan Tinggi dalam Memecahkan Masalah Matematika Kelas VIII. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *5*(1), 37. https://doi.org/10.30998/jkpm.v5i1.4544
Lambertus. (2016). Developing skills understanding of mathematical. *International Journal of Education and Research*, *4*(7), 315–326.
Mazlini, A., Mohd Faizal Nizam, L. A., Marzita, P., Che Nidzam, C. A., & Siti Mistima, M. (2014). The Learning Environment and Mathematics Achievement of Students of High Performance Schools (HPS). *Jornal Pendidikan Matematik*, *2*(1), 1–15.
McRobbie, C. J., & Fraser, B. J. (1993). Associations Between Student Outcomes and Psychosocial Science Environment. *Journal of Educational Research*, *87*(2), 78–85. https://doi.org/10.1080/00220671.1993.9941170
Miller, T. (2018). Developing numeracy skills using interactive technology in a play-based learning environment. *International Journal of STEM Education*, *5*(1). https://doi.org/10.1186/s40594-018-0135-2
Moos, R. H. (1973). Conceptualizations of Human Environments. *American Psychologist*, *28*(8), 652–665. https://doi.org/10.1037/h0035722
OECD. (2012). PISA 2012 Assesment and Analytical Framework: Mathematics, Raeding, Science, Problem Solving and Financial Literacy. In *Echinoderms: Durham - Proceedings of the 12th International Echinoderm Conference*. OECD Publishing. https://doi.org/10.1201/9780203869543-c92
Olubu. (2015). Influence of Laboratory Learning Environment on Students' Academic Performance in Secondary School Chemistry. *US-China Education Review A*, *5*(12), 814–821. https://doi.org/10.17265/2161-623x/2015.12.005
Peters, E., Hibbard, J., Slovic, P., & Dieckmann, N. (2007). Numeracy skill and the communication, comprehension, and use of risk-benefit information. *Health Affairs*, *26*(3), 741–748. https://doi.org/10.1377/hlthaff.26.3.741
Pierce, C. (1994). Importance of Classroom Climate for At-Risk Learners. *Journal of Educational Research*, *88*(1), 37–42. https://doi.org/10.1080/00220671.1994.9944832
Reynolds, A. J., & Walberg, H. J. (1992). A Structural Model of High School Mathematics Outcomes. *Journal of Educational Research*, *85*(3), 150–158. https://doi.org/10.1080/00220671.1992.9944431
Rusticus, S. A., Pashootan, T., & Mah, A. (2023). What Are The Key Elements of A Positive Learning Environment? Perspectives from Students and Faculty. *Learning Environments Research*, *26*(1), 161–175. https://doi.org/10.1007/s10984-022-09410-4
Stacey, K., & Turner, R. (Eds). (2014). *Assesing Mathematical Literacy: The PISA Experience*. Springer.
Steen, L., & Turner, R. (2007). *Developing Mathematical Literacy*. Springer.

Susanti, E., & Syam, S. S. (2017). Peran Guru dalam Meningkatkan Kemampuan Literasi Matematika Siswa Indonesia. *Seminar Matematika Dan Pendidikan Matematika*, *November 2017*, 1–6. https://www.researchgate.net/publication/328813314_Peran_Guru_dalam_Meningkatkan_Kemampuan_Literasi_Matematika_Siswa_Indonesia

Tang, G., El Turkey, H., Cilli-Turner, E., Savic, M., Karakok, G., & Plaxco, D. (2017). Inquiry as an entry point to equity in the classroom. *International Journal of Mathematical Education in Science and Technology*, *48*(October), S4–S15. https://doi.org/10.1080/0020739X.2017.1352045

UNESCO. (2013). *Unesco 2012*. 1–124. http://unesdoc.unesco.org/images/0022/002204/220416f.pdf

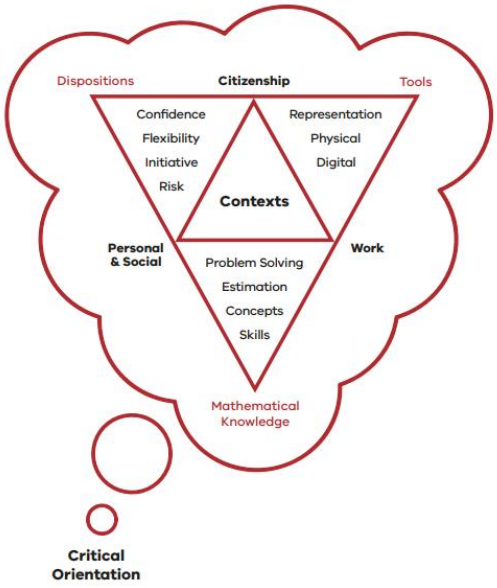
Wahyuni, A. (2020). Jurnal Pendidikan Matematika. *Jurnal Pendidikan Matematika*, *11*(1), 67–76. http://ojs.uho.ac.id/index.php/jpm

Walker, S. L. (2003). *Development and Validation of an Instrument for Assessing Distance Education Learning Environments in Higher Education: The Distance Education Learning Environments Survey (DELES)* (Issue November). Curtin University of Technology.

William Ho, Helen Higson, Prasanta Kumar Dey, X. X. (2009). Measuring Performance of Virtual Learning Environment System in Higher Education. *Quality Assurance in Education*, *17*(1).

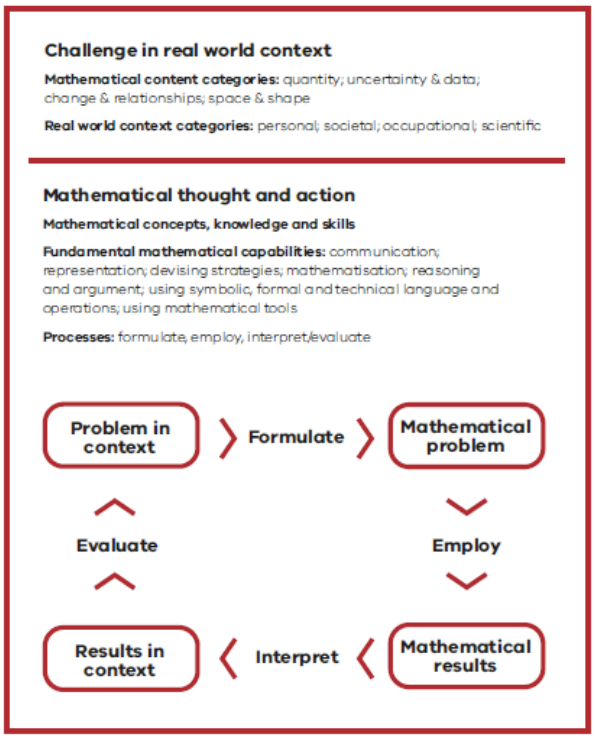
Zepeda, C. D., Hlutkowsky, C. O., Partika, A. C., Nokes-malach, T. J., & Foundation, N. S. (2018). *Relation to Growth in Conceptual Learning*.

FIGURES



Source: Goos et al., 2021

Figure 1 Goos Model in Numeracy Learning



Source: David Tout, 2002

Figure 2 PISA's model in Numeracy Learning