Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 2346-2353
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.2479

Teachers' perceptions of critical thinking and mathematical literacy in main school PISA 2022 regional survey Yogyakarta, Indonesia

Kintoko[1*], St. Budi Waluya[2], Iwan Junaedi[3], Nuriana Rachmani Dewi[4]
[1,2,3,4]Universitas Negeri Semarang; kintoko@students.unnes.ac.id (K.).

Abstract: To form critical citizens, integrating critical thinking into the school curriculum is a must. Critical thinking is considered a vital skill that can help students tackle problems effectively, improve academic achievement and develop rational thinking. However, there is no agreement among teachers on the definition of this concept or the best way to train students to apply it, especially at the basic education level. Therefore, through a qualitative research approach, this study aims to uncover the views of junior secondary school teachers in the PISA 2022 Main Survey in Yogyakarta, Indonesia, regarding the concept of critical thinking and Mathematical Literacy. Six teachers working in the three schools that were the subject of this survey were interviewed using a semi-structured interview method. Through thematic analysis, this study sought to identify, analyze and report the main findings from the interviews. The results showed that the teachers recognized the importance of reasoning mapping, group discussions and active learning as practices that promote critical thinking and mathematical literacy among students. Although they had previously been exposed to these concepts through project-based learning and 'Philosophy for Kids', they indicated the need for further support through peer learning and the implementation of the 'Philosophy for Kids'.

Keywords: *Critical thinking, Math literacy teacher perception, Professional development.*

1. Introduction

According to (Davies & Barnett, 2015), While it is generally recognized that improving students' critical thinking skills is a significant educational goal, these skills still suffer from limited development due to deficiencies in the basic education system. At this level, it appears that students do not receive adequate guidance to critically evaluate, process and reflect on information due to their teachers' lack of knowledge and training in developing these skills (Taylor & Hamdy, 2013).

Mathematical literacy, as cited in the 2012 PISA report, is the ability of individuals to formulate, apply and interpret mathematics in a variety of contexts. It includes mathematical reasoning and the ability to use mathematical concepts, procedures, facts and functions to describe, explain and predict phenomena (OECD., 2018)

Since participating in the PISA program since its inception, Indonesia has not yet achieved satisfactory results in terms of student achievement (Wijaya, 2012). TIMSS and PISA are external challenges faced by the Indonesian nation regarding the development of education at the international level with the aim of improving the ranking of Indonesian students at the international level (Kemendikbud, 2016). Thus, education in general and teachers often overemphasize 'what to think rather than how to think' (Daud & Husin, 2004). Changing this situation requires major shifts in learning paradigms, public investment in teacher training and school curriculum policies (Al-Zou'bi, 2021) For example, instead of continuing to focus on individual school subjects (Behar-Horenstein et al., 2011).education policymakers need to look across disciplines at how to develop students' critical thinking and mathematical literacy skills. This focus also needs to be reflected in teacher training to

* Correspondence: kintoko@students.unnes.ac.id

ensure that practitioners are well prepared in how to promote critical thinking and mathematical literacy among students.

It's crucial to instill critical thinking and mathematical literacy starting from primary school and continuing through secondary education and beyond. Research indicates significant gaps in higher-order thinking abilities between students who receive early instruction in these areas and those who do not (Osakwe, 2009). Specifically, this entails incorporating exercises that promote critical thinking and mathematical literacy into everyday classroom activities in secondary schools. This approach encourages students to engage not only with basic-level skills, such as understanding the world around them but also with higher-order thinking skills, which involve reflecting on the thinking process itself. (Halpern & Tucker, 2003);(Kuhn, 1999). Furthermore, there is evidence indicating that fostering critical thinking skills during primary education is not an insurmountable challenge. Lombardi et al., (2022) Research has demonstrated that children younger than six years old can be taught to develop basic hypotheses, seek clarification when needed, and provide alternative viewpoints if they disagree with their peers., while Ennis (1989) suggests that the optimal period to develop critical thinking is during the early years of primary education. Additional relevant studies (Bailin et al., 1999; Gelerstein et al., 2016; Ismailet al., 2019; Kennedy et al., 1991) agree and conclude that teaching critical thinking to young children is advantageous, as it encourages them to ask questions, propose hypothetical ideas, and participate in reasoned discussions with their peers. While Ennis is relevant (Bailin et al., 1999; Gelerstein et al., 2016; Ismail et al., 2019; Kennedy et al., 1991) agrees and concludes that children aged 7 to 14 gain advantages from learning critical thinking and mathematical literacy, as it encourages them to ask questions, propose hypothetical ideas, and engage in thoughtful discussions with their peers. While Ennis (1989) suggests that the optimal period for fostering critical thinking skills is during the initial stages of primary education. Furthermore, other pertinent research corroborates this finding. (Bailin et al., 1999; Gelerstein et al., 2016; Ismail et al., 2019; Kennedy et al., 1991) agree and determine that teaching young children critical thinking is advantageous as it stimulates inquiry, encourages proposing hypothetical ideas, and promotes reasoned deliberation through peer discussions. Kusumawardani, D. R., Wardono, W., & Kartono, K. (2018) also argued that mathematical literacy is very important in developing mathematical reasoning.

Despite the existing research, there is a lack of studies focusing on how secondary school teachers perceive and are trained in critical thinking and mathematical literacy to effectively incorporate them into student education. Thus, the significance of this study lies in investigating the perceptions of junior high school teachers regarding critical thinking and mathematical literacy, as well as their training and professional development in these domains, aiming to influence the future integration of critical thinking and mathematical literacy.

The origins of critical thinking stem from the work of prominent educational theorist John Dewey (1993), who in the early 20th century highlighted what he called 'reflective thinking' as a key competency for students, later named critical thinking. Dewey (1910) described this as the active, persistent, and careful consideration of beliefs that examine both the basis on which they are built and the conclusions they imply. Alongside creative thinking, decision-making, and problem-solving, critical thinking has become widely accepted, throughout the 21st century scientific literature, as one of the four components of thinking ability (Costa, 2001). Thus, along with creativity, communication, and collaboration, critical thinking is one of the 4 Cs considered the most important focus of 21st century skills education, (Costa, 2001; Lee, 2018; UNESCO, 2013).

To date, there remains a lack of consensus among scholars, educators, psychologists, and philosophers regarding a universally accepted theoretical definition of critical thinking. Various authors, such as Ennis (1962), Facione (1990), Fisher & Scriven (1997), Glaser (1942), Hatcher & Spencer (2005), Hooks (2010), Lipman (1988), McPeck (1981), Paul & Elder (2006), and Siegel (1988), have proposed definitions highlighting different aspects of skills and fundamental dispositions, yet a consensus on the process remains elusive. Facione's (1990) study, commissioned by the American Philosophical Association, aimed to establish a 'consensus' definition through an international panel of experts but

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

mainly emphasized habits of mind like open-mindedness, cognitive maturity, and curiosity. Consequently, Facione (1990) suggested that critical thinking involves a process of goal assessment and self-regulation. In contrast, UNESCO (2013), with support from Johnson and Hamboy (2015), defines critical thinking as a process encompassing asking pertinent questions, gathering and creatively organizing relevant information, linking new information to existing knowledge, re-evaluating beliefs and assumptions, reasoning logically, and arriving at dependable conclusions. UNESCO underscores the significant effort required to master critical thinking skills, emphasizing the application of theoretical constructs to comprehend an issue, consider evidence, and evaluate methods or techniques to formulate judgments. Hence, the UNESCO definition accentuates the scientific research process essential for identifying questions, formulating hypotheses, and collecting and analyzing pertinent data.

Critical thinking can only be taught by teachers who have in-depth knowledge of it and an understanding of how to incorporate it into their lessons (Al-Zou'bi, 2021; Forawi, 2016). However, several authors (Ab Kadir, 2017; Choy & Cheah, 2009; Forawi, 2016) have shown that primary school teachers do not have a clear understanding of critical thinking and how to stimulate this skill. Many of them have to be taken in by such stimuli (Forawi, 2016). According to Choy and Cheah (2009), there is a need for teachers to better understand the concept of critical thinking to effectively integrate it into their lessons.

21st century skills are defined as a broad set of knowledge, skills, work habits, and character traits considered essential for success in today's world (Moyer et al., 2016). The Queensland Curriculum and Assessment Authority (Tindowen et al., 2017) defines 21st century skills as the high priority skills and attributes believed to be most significant for helping learners live and work successfully in the 21st century. Furthermore, Johnson (Tindowen et al., 2017) emphasizes that these 21st century skills go beyond technological literacy to include critical thinking, problem solving, communication, and teamwork needed to succeed in work and life.

Hixson, Ravitz, Whisman (2012) Identified are eight essential skills deemed crucial for students in the 21st century, namely: (1) Critical thinking skills, involving the capacity to analyze complex problems, explore inquiries with ambiguous answers, assess various perspectives and information sources, and draw reasoned conclusions based on evidence; (2) Collaboration skills, encompassing the ability to collaborate effectively with peers to solve problems or address questions, working cohesively, demonstrating respect, and sharing collective responsibility to accomplish objectives; (3) Communication skills, entailing the aptitude to organize thoughts, findings, and effectively convey them through diverse mediums, both verbally and in writing; (4) Creativity and innovation skills, referring to the capability to generate and enhance solutions to intricate problems or tasks through synthesis, presenting original perspectives or amalgamating knowledge in novel ways; (5) Self-direction skills, indicating students' ability to assume responsibility for their learning by identifying topics for exploration, managing their learning processes, and evaluating their own work while responding to feedback; (6) Global connections, highlighting students' comprehension of global issues, including geopolitical matters, with awareness of geography, culture, language, history, and literature from diverse countries; (7) Local connections, signifying students' capacity to apply acquired knowledge to local contexts and address community issues; (8) Use of technology as a learning tool, indicating students' capability to utilize information and communication technologies effectively to manage learning and create products.

Critical thinking skills are one of the factors that support successful learning. Many people assume that one of the characteristics of smart people is being able to think critically. John Dewey (Sihotang et al., 2012) defines critical thinking as an active, continuous, and thorough consideration of a belief or form of knowledge that is taken for granted by including supporting reasons and rational conclusions. Critical thinking is also seen as a strong and careful belief with the intention of contrasting one's system of thinking that is ineffective or without involving comprehensive thinking. However, the most important thing in Dewey's view is what he calls the grounds that support something so that it can be concluded (Suryati, 2015). Engaging in activities that entail critical thinking skills, such as analysis,

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

synthesis, evaluation, creation, and application of new knowledge to real-world situations, is crucial. Therefore, critical thinking skills are deemed significant in the educational journey as they offer students opportunities for learning through exploration and discovery. These skills lie at the core of the future development of all societies worldwide. (Redhana, 2012).

Based on Edwar Glaser's view (Sanjaya, 2019) a person can be said to have critical thinking skills, if his reasoning work and argumentation skills involve three things, namely (1) an attitude of responding to various problems, considering various problems faced in experience and the ability to think about them deeply. This aims to get a person out of the habit of accepting various information or conclusions without questioning them; (2) knowledge of logical thinking / reasoning and inquiry methods; (3) skills or skills in applying these methods (Sanjaya, 2019). Meanwhile, Shavelson (2010) The breakdown of critical thinking skills consists of three main components: analytical reasoning and evaluation, problem-solving, and argumentation. Analytical reasoning and evaluation entail identifying crucial elements in conflicting information and discerning logical fallacies in conclusions. Problem-solving skills involve drawing conclusions based on sound and validated arguments. Argumentation skills encompass persuasive writing and the capability to construct a well-organized and coherent argument.

2. The Study

The main objective of this study was to examine secondary school teachers' perceptions of the PISA 2022 Indonesia Region Yogyakarta Main Survey on critical thinking and mathematical literacy, their experiences with it during their initial and in-service training and their views on valuable teaching materials to support their approach to promoting critical thinking and literacy among students. The research questions are as follows:

1. How do secondary school teachers in the PISA 2022 Main Survey in Yogyakarta Region, Indonesia perceive critical thinking and mathematical literacy?
2. What teacher training factors encourage and support the development of critical thinking and mathematical literacy in PISA 2022 Main Survey secondary schools?
3. What reading materials consulted or events attended in the last five years related to the promotion of critical thinking and mathematical literacy among students are relevant according to secondary school teachers?

The determination of PISA sample schools in Indonesia based on the Decree on the Determination of the List of School Names as PISA Samples in 2022 is contained in the Decree of the Head of the Education Assessment Center of the Education Standards, Curriculum, and Assessment Agency of the Ministry of Education, Culture, Research, and Technology (PAP and BSKAP Kemendikbudristek) Number: 0426/H4/PG.00.02/2022 About the Main Study Sample Schools of the Program For International Student Assessment (PISA) in 2022. Consideration of the Decree of the Head of PAP and BSKAP Number: 0426/H4/PG.00. .02/2022 on the Determination of Sample Schools for the Main Study of the Program for International Student Assessment (PISA) in 2022, are (a) that in order to monitor the quality of education nationally, the Education Assessment Center, the Education Standards, Curriculum and Assessment Agency, the Ministry of Education, Culture, Research and Technology in fiscal year 2022 will carry out the Main Study of the Program for International Student Assessment (PISA); (b) that in the context of the implementation of the PISA Main Study, 413 schools have been determined as samples of Indonesia based on the decision of the International PISA Team; (c) that the PISA sample schools need to be determined by a Decree. The research was conducted in Yogyakarta PISA sample schools in three schools, namely high category, medium category and low category schools in three districts of Yogyakarta.

3. The Context of the Evaluation Tool System in Indonesia

Indonesia Has Its Own Evaluation Tool The evaluation conducted by Indonesia is called INAP (Indonesian National Assessment Program) or the National Education Assessment Program is a national level study that seeks to bridge the international study exam model with the national exam

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

model. The results of this combination are expected to provide a diagnosis of the success of the education system in a region that is rooted in the Indonesian context. INAP is an assessment model initiated by the Education Assessment Center in order to cover the shortcomings of the UN which is limited in measuring competencies and topics with the number of questions ranging from 40-50 questions. Not intended to replace the function of the UN which is able to compare students with each other, INAP is more focused on mapping and diagnostics.

INAP is also rooted in the national context, which is often a problem in international studies. This longitudinal survey aims to establish an institutionalized system for monitoring the quality of education at the provincial/district/city level (stages in capacity building: question writing, data collection, scoring, data entry), produce policy recommendations at the provincial/district/city unit based on the results of the study, identify the substance of the material (Mathematics, Bahasa Indonesia and Science) and cognitive levels that have not been mastered/weakened and identify background variables of students, teachers, and Perceptions, Motivations, Habits of Students, Teachers and Principals. As an alternative assessment model, the INAP instrument design is richer in terms of content, level of thinking, and item format. Some 20% of INAP items are international study questions as an illustration of a region's ability to international benchmarks so that it is hoped that student achievements in INAP can be formulated to make policies. At the end of 2017 INAP changed its name to AKSI (Indonesian Student Competency Assessment). AKSI is a computer-based application developed by puspendik (puspendik 2017) Action is : Computer-based applications, including CBA (Computer Based Assessment) and questionnaires, Applications run offline, with or without a LAN network, It is possible to run online, Applications can be run directly using a USB flash disk (Plug and Play), Student answers are stored on a flash disk. The benefits of AKSI are paperless, Simulation can be done anytime online, Virtual laboratory allows students to do science experiments in the application, Variations/stimulus questions are more diverse: e-books, videos, animations, etc.

4. Method

The study employed a qualitative research approach, specifically adopting a literature-led methodology where the initial coding framework was derived from existing literature. The primary method involved conducting semi-structured interviews with junior high school teachers, each lasting approximately 90 minutes

Since all data were obtained through self-reporting tools, it is essential to interpret the findings as the teachers' personal perceptions of their own reality. Thomas et al, (2022) Highlight the need for discussion surrounding self-reports due to the potential variance between individuals' reported actions and their actual behaviors. However, the authors stress the significance of understanding teachers' subjective perspectives as they shape instructional practices and offer insights into the rationale behind their pedagogical approaches. Nonetheless, future research could delve deeper into qualitative descriptions of critical thinking skills, mathematical literacy, and classroom observations to explore how teachers facilitate the development of these skills among students. Such an approach could offer a more comprehensive understanding of the beliefs held by PISA 2022 Main Survey school teachers regarding critical thinking and mathematical literacy, as well as shed light on their strategies for promoting these skills. Additionally, a methodological concern arises from the request made to principals not to compel teachers' participation in the study. Consequently, the study may only involve teachers who possess a clear understanding of critical thinking and mathematical literacy.

4.1. Data Collection

The initial step in selecting the sample involved identifying three secondary schools participating in the PISA 2022 Main Survey located in the Yogyakarta Region, Indonesia. The researcher contacted each school's principal to introduce the research project and seek the involvement of their teaching staff. Following this, face-to-face meetings were held with the principals or vice principals responsible for academic and curriculum matters. Among these discussions, three schools expressed their willingness to

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

participate in the research. Subsequently, upon receiving consent from these three schools, we obtained lists of teachers from each school who volunteered to partake in interviews. This procedure resulted in 6 junior high school teachers (2 in Sleman district, Yogyakarta, 2 in Bantul district, Yogyakarta and 2 in Yogyakarta city) Individual contacts were made to arrange practical details for conducting interviews. In order to minimize disruptions to teachers' schedules, it was mutually agreed with the teachers that the interviews would take place at the school during break times or after classes. Respondents had many years of teaching experience in all three schools. Two respondents teach eighth grade mathematics while the others teach eighth and ninth grade mathematics. Some teachers have dual roles, being both teachers and general coordinators in their assigned schools such as the vice principal for curriculum and academic affairs.

Table 1.

No	Common questions	Sub- questions	
(1)	How do you understand the ideas of critical thinking and mathematical literacy?	• What is the reason for CT and Math Literacy? • Requesting examples or clarification; what exactly do you mean by that?	
	Specific Questions	**Sub- Questions**	**Code**
(2)	As a student, how do you believe your teachers fostered critical thinking and promoted understanding of mathematical concepts? If the answer is possitive: 2.1 What strategies did they try to teach you?	• why? • Asking for examples or what you mean specifically? • Are those strategies helpful for you?	• The conceptualization of Critical Thinking and Mathematical Literacy
(3)	During your tenure as a junior high school teacher, did you receive training to enhance students' critical thinking skills? If the answer is positive: 3.1 What strategies were taught to you?	• Why? • Asking for examples or what you mean specifically? • Are those strategies helpful for you?	• Teacher training at the early stages or during tenure.
(4)	How relevant do you consider strengthening students' critical thinking as an educational goal in junior high school? 4.1 How do you assess the priority of this educational goal??	• Why? • Asking for examples, or what do you mean specifically?	• The conceptualization of Critical Thinking and Mathematical Literacy
(5)	Have you read any articles/books or attended seminars in the past five years? If the answer is positive: 5.1 How relevant do you find	• Why? • What did you learn? • How do you implement this in the	• Teacher training at the early stages or during tenure Valuable teaching

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

	those articles, books, or seminars in supporting you to promote critical thinking among students?	classroom? What worked and what didn't?	

Table 2.
Student achievement for problem number 4.

Subject	Question 4				
	R	C	T	P	E
S1	√	√	√	X	X
S2	√	√	√	X	X
S3	√	√	√	X	X
S4	√	√	√	X	X
S5	√	√	√	X	X
S6	√	√	√	X	X

Note: Information: R=Reading; C=Comprehension;T= Transformation; P=Proces Skill;E=Econding.

Patterns of error in identifying relevant information: The subject can write down the problem known but does not understand the identification of the information written to solve the problem. Based on Table 2, all subjects are precisely answered at stages R, C, and T. All subjects can write down what is known, asked, and the formula used but cannot determine the length S(1) and S(5) are unable to complete any tasks at the skill processing stage. S(2) and S(6) incorrectly apply the triangle formula by inserting known quantities inaccurately. S(3) and S(4) utilize the Pythagorean theorem to find the length of side AB. However, the interview results of the subject do not enable them to determine the base and height of the line accurately. The subject still struggles to differentiate between various bases and heights of the same line when determining its width. Despite the beneficial information obtained from the identification results, the subject fails to demonstrate the ability to identify relevant information necessary for problem-solving. According to Setiani et al. (2018), students with low self-efficacy cannot structure problem-solving on math literacy problems. However, according to Taufik & Zainab (2021), Students in dependent fields can recognize information by formulating questions using sentences and utilizing verbal, symbolic, and visual mathematical models. The identification of pertinent information within mathematical problems and arguments influences the problem-solving capabilities of students at various levels of reasoning. (Wulandari & Wutsqa, 2019). A student's proficiency in computational skills dictates their capacity to recognize pertinent information necessary to carry out calculations. (Hegener, 2021). Moreover, the capability to recognize information across various learning contexts aids students in their academic endeavors and supports the development of information literacy skills essential for managing their overall well-being. (Martzoukou et al., 2021).

The mastery of the main material lacks balance with the prerequisite material, which serves as a crucial link. Although the prerequisite material greatly aids in comprehending rectangular and aligned materials, students' grasp of mathematics remains inadequate due to their perception that mathematics is not as essential as the prerequisite material (Nurapriani et al., 2020). The prerequisite materials involve employing algebraic operations to determine the size being sought. Hence, it is crucial to underscore the prerequisite materials that students need to master.

5. Conclusion

This research investigated the viewpoints of junior high school teachers in the Yogyakarta Region who participated in the PISA Indonesia Test Sample regarding critical thinking and mathematical literacy across three junior high schools in Yogyakarta. The majority of interviewed teachers highlighted that a critical thinker is someone who exhibits reflection, collaboration, analytical thinking, and openness to various cultural challenges. Mathematics not only imparts numeracy skills but also fosters critical thinking abilities. Teachers proficient in mathematical literacy can assist students in

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2346-2353, 2024
DOI: 10.55214/25768484.v8i6.2479

cultivating critical thinking skills. As per the findings of our study, professional development focusing on problem-solving, mind mapping, cooperative learning, questioning, and debating are deemed most beneficial in supporting teachers to nurture critical thinking among students. Additionally, secondary educators mentioned project-based learning, rubrics, and mathematical literacy as crucial didactic resources in this aspect. Nonetheless, they expressed a need for support in their teaching practices, preferably through peer learning and the exchange of best practices.

Acknowledgements:
The authors thank to Universitas Negeri Semarang for the support in this research and We would like to express our deepest gratitude to the Indonesian Education Scholarship (BPI) for the support of the scholarship fund provided for the completion of our studies. This assistance is immensely meaningful for us in completing our research and achieving our academic goals.

References

[1] Al-Zou'bi, R. (2021). The impact of media and information literacy on acquiring the critical thinking skill by the educational faculty's students. *Thinking Skills and Creativity*, *39*, 100782.
[2] Behar-Horenstein, L. S., Niu, L., & others. (2011). Teaching critical thinking skills in higher education: A review of the literature. *Journal of College Teaching \& Learning (TLC)*, *8*(2).
[3] Daud, N. M., & Husin, Z. (2004). Developing critical thinking skills in computer-aided extended reading classes. *British Journal of Educational Technology*, *35*(4), 477–487.
[4] Davies, M., & Barnett, R. (2015). The palgrave handbook of critical thinking in higher education. *The Palgrave Handbook of Critical Thinking in Higher Education*, 1–25. https://doi.org/10.1057/9781137378057
[5] Halpern, B., & Tucker, L. (2003). *The Knee Crisis Handbook: Understanding Pain, Preventing Trauma, Recovering from Injury, and Building Healthy Knees for Life*. Rodale Books.
[6] Hegener, M. A. (2021). Design and evaluation of an application-based pharmaceutical calculations review module. *Currents in Pharmacy Teaching and Learning*, *13*(8), 1018–1023. https://doi.org/10.1016/j.cptl.2021.06.016
[7] Kemendikbud. (2016). *Kementerian Pendidikan Dan Kebudayaan Republik Indonesia*. Infograpis.
[8] Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher*, *28*(2), 16–46.
[9] Lombardi, L., Mednick, F. J., De Backer, F., & Lombaerts, K. (2022). Teachers' Perceptions of Critical Thinking in Primary Education. *International Journal of Instruction*, *15*(4).
[10] Martzoukou, K., Kostagiolas, P., Lavranos, C., Lauterbach, T., & Fulton, C. (2021). A study of university law students' self-perceived digital competences. *Journal of Librarianship and Information Science*. https://doi.org/10.1177/09610006211048004
[11] Nurapriani, F., Lestari, S. A. P., & Kusumaningrum, D. S. (2020). Mathematical understanding ability of information system students in discrete mathematics. *International Journal of Scientific and Technology Research*, *9*(3), 3335–3339.
[12] OECD., K. (2018). *OECD science, technology and innovation outlook 2018*. OECD publishing Paris.
[13] Osakwe, R. N. (2009). The effect of early childhood education experience on the academic performances of primary school children. *Studies on Home and Community Science*, *3*(2), 143–147.
[14] Setiani, C., Waluya, S. B., & Wardono. (2018). Analysis of mathematical literacy ability based on self-efficacy in model eliciting activities using metaphorical thinking approach. *Journal of Physics: Conference Series*, *983*(1). https://doi.org/10.1088/1742-6596/983/1/012139
[15] Taufik, A. R., & Zainab, N. (2021). Mathematical literacy of students in solving PISA-like problems based on cognitive styles of field-dependent and field-independent. *Journal of Physics: Conference Series*, *1918*(4), 1–7. https://doi.org/10.1088/1742-6596/1918/4/042080
[16] Taylor, D. C. M., & Hamdy, H. (2013). Adult learning theories: Implications for learning and teaching in medical education: AMEE Guide No. 83. *Medical Teacher*, *35*(11). https://doi.org/10.3109/0142159X.2013.828153
[17] Thomas, V., Peeters, J., De Backer, F., & Lombaerts, K. (2022). Determinants of self-regulated learning practices in elementary education: a multilevel approach. *Educational Studies*, *48*(1), 126–148.
[18] Wijaya, A. (2012). Pendidikan matematika realistik suatu alternatif pendekatan pembelajaran matematika. *Yogyakarta: Graha Ilmu*.
[19] Wulandari, S. Y., & Wutsqa, D. U. (2019). A study of junior high school students reasoning skill in mathematics. *Journal of Physics: Conference Series*, *1320*(1). https://doi.org/10.1088/1742-6596/1320/1/012059