JRPM, 2024, *9*(1), 1-19
JRPM (Jurnal Review Pembelajaran Matematika)
http://jurnalftk.uinsa.ac.id/index.php/jrpm

Level of Students' Mathematical Literacy Based on Cognitive Conceptual Tempo (Reflective-Impulsive)

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ARTICLE INFO

Article history:
Received 23 Nov 2023
Revised 31 May 2024
Accepted 3 Jun 2024

Keywords:
Mathematical Literacy; Cognitive Style; Conceptual Tempo; Reflective; Impulsive.

ABSTRACT

This research aims to describe students' mathematical literacy abilities based on their cognitive conceptual tempo (Kagan et al., 1964). This study employed a qualitative descriptive research method conducted at SMKN 1 Ngasem within class XI-2 focused on Design, Modeling, and Building Information. Data collection involved tests and interviews. The tests comprised the Matching Familiar Figures Test (MFFT) to assess students' cognitive styles (conceptual tempo) and a mathematical literacy test to evaluate the mathematical abilities of 28 students. Two reflective students (S1 and S2) and two impulsive students (S3 and S4) were selected from this group. The findings revealed that reflective individuals achieved a mathematical literacy level of 3 for S1 and level 4 for S2, positioning them within the medium scale. Conversely, impulsive students scored at level 1 and level 4 for S3 and S4, falling within the medium scale. Furthermore, future researchers can explore more extensive mathematical literacy content and contexts.

How to cite:
Sari, P. O. & Wulan, E. R. Level of Students' Mathematical Literacy Based on Cognitive Conceptual Tempo (Reflective-Impulsive). *JRPM (Jurnal Review Pembelajaran Matematika)*, *9*(1), 1-19.

INTRODUCTION

In the age of globalization, the professional world demands high-caliber human resources. Quality human resources refer to individuals who possess the capacity for critical thinking, creativity, problem-solving, and the ability to make strategic decisions (Carmeli et al., 2013; Khang et al., 2023; Van Woerkom, 2004; Yahya & Goh, 2002). The Indonesian Government's endeavor to enhance the quality of its human resources primarily focuses on education (Dian et al., 2023; Pabbajah et al., 2020; Pratikno et al., 2022; Rulandari, 2021). As part of its commitment to improving education in Indonesia, the Government, particularly the Ministry of Education and Culture Republic of Indonesia, plays a vital role in implementing the minimum competency assessment known as Asesmen Kompetensi

ISSN 2503–1384 (*online*)
DOI: https://doi.org/10.15642/jrpm.2024.9.1.1-19

Minimum (AKM). During the AKM assessment, students' proficiency in two key areas is evaluated, specifically their reading literacy and numerical abilities, commonly referred to as mathematical literacy (Ariyanto & Kusumaningsih, 2022; Aufa & Manoy, 2022; Wahyuni, 2023)

Mathematical literacy is an individual's capability to employ and understand mathematics across various contexts. The Programme for International Student Assessment by the OECD characterizes PISA. This includes employing mathematical reasoning and leveraging concepts, procedures, and factual knowledge to describe and clarify various phenomena or occurrences (OECD, 2019). On the other hand, mathematical literacy is an individual's knowledge to understand and use mathematical concepts in everyday life (Ojose, 2011). Meanwhile, literacy in the context of mathematics is the ability to use mathematical thinking to solve problems in life so that they are better prepared to carry out all existing problems (Stacey & Turner, 2015). From the perspective of Stacey and Turner (2015), mathematical literacy within the realm of mathematics refers to the aptitude to employ mathematical thinking for problem-solving in real-life scenarios, equipping individuals to tackle various challenges more effectively. It can be deduced that mathematical literacy is an individual's competence to *formulate, employ, and integrate* mathematical concepts as a tool for efficiently and effectively resolving everyday problems (Wulan & Astuti, 2022).

PISA categorizes mathematical literacy skills into six distinct levels, ranging from level 1 as the lowest proficiency to level 6 as the highest proficiency (OECD, 2019). In the context of the mathematical literacy levels described by OECD (2019), levels 1 and 2 are positioned at the lower end of the scale. Levels primarily evaluate students' reproductive competence, where students are assessed based on their ability to present facts, objects, and attributes using standardized procedures. Levels 3 and 4 fall into the medium proficiency range, focusing on assessing connection competence. Students are tasked with solving non-routine problems at these levels, although the emphasis is on translating real-world scenarios into mathematical models. Levels 5 and 6 represent the upper end of the scale, reflecting high proficiency in mathematical literacy. These levels gauge reflection competency, involving identifying mathematical concepts from complex mathematical problems and the ability to reason based on mathematical principles.

Several elements play a role in improving students' mathematical literacy abilities. These elements can be categorized into two main groups: internal and external factors (Colwell & Enderson, 2016; Magen-Nagar, 2016; Smirnov et al., 2021; Tariq et al., 2013).

Internal factors impacting an individual's mathematical literacy encompass students' cognitive preferences, motivation, and interests (Chen, 2015; Gabriel et al., 2020; Genc & Erbas, 2019; Hwang & Ham, 2021). In contrast, the external factors that exert influence include knowledge of the surrounding environment, socioeconomic status, and cultural conditions (Holenstein et al., 2021; Maslihah et al., 2021; Smirnov et al., 2021). Cognitive style bridges intelligence and personality traits (Ausburn & Ausburn, 1978; Sternberg & Grigorenko, 1997; Sternberg & Grigorenko, 2014; Zeidner & Matthews, 2000). Cognitive style pertains to an individual's approach to responding, processing, retaining, contemplating, and utilizing information when addressing tasks or situations in their immediate surroundings (Hayes & Allinson, 1998; Larkin & Budny, 2005; Messick, 1984; O'Connor & Kabadayi, 2020)

Numerous cognitive styles have been suggested within the mental approach to studying cognitive style. Two styles have garnered the most attention regarding theory and research (Sternberg & Grigorenko, 1997). These styles are conceptualized in terms of conceptual tempo (Kagan et al., 1964) and psychological differentiation (Goodenough & Witkin, 1977; Witkin, 1967). Cognitive styles, including those based on information processing speed, are called conceptual tempo. Typically, these cognitive styles fall into two primary categories: reflective and impulsive cognitive styles.

Reflectivity is a tendency to consider and reflect on alternative solution possibilities involving some degree of uncertainty (Bush & Dweck, 1975; Kagan et al., 1964). Reflective individuals take a moment to contemplate before embarking on a task or deciding, dedicating time to assess their choices. On the contrary, impulsive ones involve swiftly responding without adequate prior consideration. Those prone to impulsivity rapidly propose solutions to problems, often without thoroughly evaluating their likely accuracy (Sternberg & Grigorenko, 1997). In mathematics, reflective students excel in their capacity to use mathematical tools. In contrast, impulsive students demonstrate strong abilities in making representations and formulating problem-solving strategies, which are components of mathematical literacy skills (Damayanti et al., 2021).

The research suggests that cognitive style can impact mathematical literacy skills (Anif et al., 2023; Damayanti et al., 2021; Taufik & Zainab, 2021). Previously, various experts had investigated mathematical literacy abilities and cognitive styles (Alafif & Swastika, 2023; Ozgen, 2013). It was observed that students with a fast and accurate, reflective cognitive style exhibited significant improvements compared to their counterparts with a slow and precise, impulsive cognitive style (Barstis & Ford Jr, 1977; Denney, 1972; Fitriyani et al., 2021; Lan et al., 1998; Najma & Masduki, 2023). Furthermore, disparities in students' mathematical literacy skills were discernible based on their cognitive styles (Gabriel et al., 2018; Pratiwi et al., 2019). However, a comprehensive understanding of mathematical literacy abilities concerning reflective-impulsive cognitive styles has not yet been established.

Building on the earlier description, this research aims to investigate students' mathematical literacy levels, examining how these are influenced by their conceptual tempo, reflective and impulsive. The anticipated outcome of this study is to provide teachers with valuable insights to design their teaching strategies or instructional models to align with students' characteristics. By carefully selecting a suitable instructional approach, the aim is to enhance students' mathematical literacy skills. This study specifically aims to evaluate the mathematical literacy proficiency of students characterized by reflective cognitive styles and compare it with the mathematical literacy levels of students exhibiting impulsive cognitive styles.

METHOD

This research involved 28 students from class XI-2 DPIB (Building et al.) at SMKN 1 Ngasem, Kediri Regency. The study lasted from June 16, 2022, to August 23, 2022. Subjects were selected using a purposive sampling method based on each cognitive style (reflective and impulsive). The discussion focused on the mathematical literacy of each cognitive style.

This research employs a qualitative approach and follows a case study design, a qualitative strategy where researchers investigate a program, event, activity, process, or one or more individuals more in-depth (Creswell & Creswell, 2017). This research aims to describe students' mathematical literacy abilities based on their reflective and impulsive cognitive styles.

Data collection in this research involved using tests, questionnaires, and interviews. At first, 28 participants were administered a mathematics literacy test, followed by completing a cognitive style questionnaire. The questionnaire results were analyzed for cognitive style data, and two students were chosen to represent reflective and impulsive cognitive styles. The subjects were selected considering the study's limitations, focusing on students with strong communication skills and the ability to express their thoughts clearly. Therefore, the subject selection was based on teacher recommendations, particularly the students' interpersonal and communication skills. The selected subjects were then interviewed, specifically on the mathematical literacy test provided earlier.

Data collection in this study employed a triangulation method. According to Patton, there are two strategies in triangulation methods: (1) checking the credibility of findings from multiple data collection techniques and (2) checking the credibility of multiple data sources using the same method (Moleong, 2007). This study employed the strategy of checking the credibility of findings from multiple data collection techniques, namely checking the consistency of data from written tests and interview results. Data was considered to have met data validity criteria if the data from the written test was consistent with the data from interviews. Subsequently, valid data was analyzed to draw conclusions from the research findings.

Instruments in this research involved a mathematical literacy test, a Matching Familiar Figures Test (MFFT) questionnaire, and interview guidelines. The test consisted of six items aligned with the levels of mathematical literacy as defined by PISA, as indicated in Table 1 (OECD, 2019). The mathematical literacy test is utilized to assess students' mathematical literacy skills. On the other hand, the MFFT is employed to categorize students' cognitive styles and conceptual tempo. Interviews were conducted to gain insights into the students' mathematical literacy processes. The researchers created the test and interview guidelines, which experts subsequently validated. Following a validation process conducted by two mathematics education lecturers, the test instruments and interview guidelines were deemed valid and implementable with necessary revisions.

Table 1. Mapping of Mathematical Literacy Level to Question Indicator

Level	Indicator of Mathematical Literacy Ability	Question Indicator
1	Students can use their knowledge to solve problems in a general context.	A discourse about the process of making dough is presented. Students are asked to use their basic knowledge to solve problems.
2	Students can interpret the problem and then solve it with a formula.	They presented a discourse along with data related to speed and average. Students are asked to utilize their basic knowledge to solve these problems.
3	Students can carry out the order of problem-solving properly and can choose problem-solving strategies.	They presented a contextual discourse with problems related to arithmetic series. Students can apply the concept of arithmetic series they have learned to solve the issues.
4	Students can work effectively with methods, choose and integrate different representations, and then relate them to the real world.	They presented a discourse on gift boxes with two sheets of wrapping paper of different sizes and prices. Students were asked to determine the minimum cost by calculating the amount of wrapping paper needed and the total cost of each paper.
5	Students can work with models for complex conditions and can solve complex problems.	A discourse on social arithmetic was presented: prices of stationery packages from two stores were compared. Students can identify the cheapest prices from the two stores and draw conclusions based on the results of their answers.
6	Students use reasoning to solve mathematical problems, generalize,	A discourse about the decomposition time of inorganic and organic waste was presented. Students are asked to present

Level	Indicator of Mathematical Literacy Ability	Question Indicator
	formulate, and communicate their findings.	the data in the form of a bar chart and provide reasons or explanations regarding the format of the diagram that has been created.

The MFFT used in this research was adapted from the test that Warli (2010) they were developed, based initially on Jerome Kagan's work from 1965. Through MFFT, subjects are classified into four categories: impulsive, reflective, fast accurate, or slow inaccurate. This cognitive style test consists of two parts: one standard (baseline) image, consisting of 1 (one) image, and the second is a set of variation images (stimuli), composed of 8 (eight) images. Among the variation images, one is the same as the standard image. This test comprises items designed to determine the type of cognitive style of students, namely impulsive and reflective cognitive styles. This study focuses on reflective and impulsive cognitive styles due to the larger proportion of students exhibiting these characteristics compared to those with fast-accurate and slow-inaccurate styles(Rozencwajg & Corroyer, 2005; Warli, 2013).

We followed the procedure Warli (2010) outlined to assess cognitive styles. The recorded variables included the time students took to provide their initial responses (t) and the number of correct answers provided by each student (f). The results of the students' tests are then used to find the median value, which is then accumulated and presented in tabular form. Reflective students ($t > 15.02$ minutes, $f > 7$) are those with the longest recorded time (t) and the correct answer (f) in answering all the items. In contrast, impulsive students ($t <= 15.02$ minutes, $f <= 7$) are taken from the impulsive students with the fastest recorded time and the most errors in answering all the items.

Data analysis was conducted using the approach outlined by Miles and Huberman, encompassing three distinct phases (Miles & Huberman, 1994). (1) Data reduction (from the test and interview), (2) data presentation (involves using tables and concept maps for each subject reflective-impulsive individually), and (3) data verification (involves cross-referencing the results with diligent observations and then drawing conclusions regarding the level of mathematical literacy of the subjects). To test the validity of our findings, we use methodological triangulation.

RESULT AND DISCUSSION

The investigation conducted in class XI DPIB 2 SMKN 1 Ngasem involved administering the conceptual tempo cognitive style test (MFFT), and the results are presented in Table 2. Four participants were chosen for further analysis after administering the cognitive style and mathematical literacy ability tests. This selection comprised two subjects with a reflective cognitive style and two with an impulsive cognitive style. The criteria for selecting interview subjects were based on their performance in mathematical literacy skills tests, cognitive style assessments, and recommendations provided by the mathematics teacher in class XI DPIB 2. The purpose of selecting these interview subjects is to delve into the process of solving mathematical literacy questions in written tests that they have already completed, as shown in Table 3.

Table 2. Cognitive style test results

Cognitive Style	The Number of Students
Reflective	6
Impulsive	9

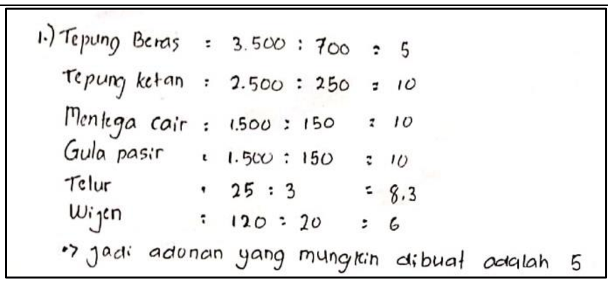
Table 3. Interviewed Subject

No	Initial	Group	Code
1.	EW	Reflective	S1
2.	GS	Reflective	S2
3.	MRA	Impulsive	S3
4.	LS	Impulsive	S4

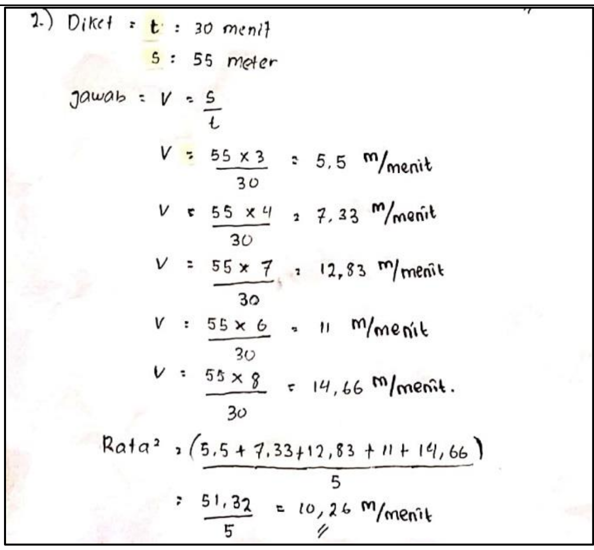
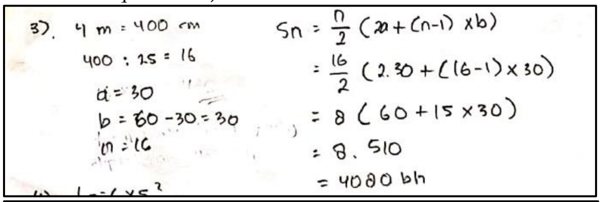
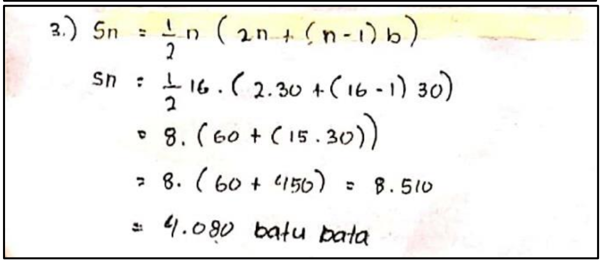
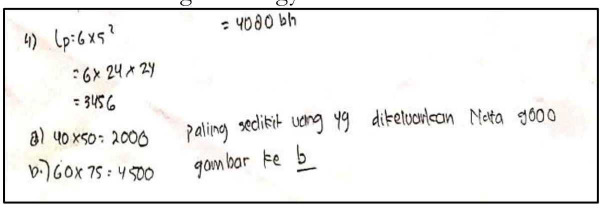
Students' Mathematical Literacy Ability: Reflective Cognitive Style

Table 4 shows the results of the analysis of the answers to the mathematical literacy ability test on interview subjects with a reflective cognitive style.

Table 4. Reflective Students' Mathematical Literacy Ability

<table>
<tr><th>Level</th><th>Mathematical Literacy Level</th><th>Description</th></tr>
<tr><td>1</td><td>Students can use their knowledge to solve problems in a general context.</td><td>


Subject S1 and S2 can:
use their knowledge to solve problems within the context of division,
identify information and be able to solve problems appropriately,
formulate problems in questions,
use the right concept to solve the problem and then integrate the results of the solution of the problem.</td></tr>
</table>

Level	Mathematical Literacy Level	Description
2	Students can interpret the problem and then solve it with a formula.	 Subject S1 and S2 can: interpret the problem and solve it with formulas, explain the need to solve the problem, apply the formula in mathematics to solve mathematical literacy problems (The speed and the average formula used in the level 2 questions).
3	Students can carry out the order of problem-solving properly and can choose problem-solving strategies.	  Subject S1 and S2 can: use the proper problem-solving procedures, write down the information in the questions, formulate problems, write down problem-solving steps well, and choose the right strategy.
4	Students can effectively use methods, choose and integrate different representations, and relate them to the real world.	 S1 did not write a complete answer to the steps for solving the problem and did not write a conclusion from the problem-solving process. Through interviews, S1 can effectively work with strategies and integrate different representations but has not been able to connect a problem with everyday life. S2 cannot reach level 4.

Level	Mathematical Literacy Level	Description
5	Students can work with models for complex conditions and can solve complex problems.	S1 and S2 cannot reach level 5.
6	Students use reasoning to solve mathematical problems, make generalizations, and formulate and communicate their findings.	S1 and S2 cannot reach level 5.

The three processes of mathematical literacy by the subject with a reflective cognitive style were the process of formulating problems, which was confirmed by the interview process. S1 and S2 stated that the problem from the level 1 question was the most significant amount of dough the Gambir cracker maker could make. The process of using mathematics as a problem solver can be seen in the answers of students who use the concept of division to obtain problem-solving at level 1 questions. The process of mathematical literacy integrates problem-solving with everyday life; the reflective cognitive style subject states that the number of possible doughs to make is five doughs because if you want to make more than five doughs, then there will be one ingredient that is not sufficient.

This is inconsistent with previous research, which explains that students who can achieve level 1 mathematical literacy skills can formulate problems, use mathematical concepts, and interpret solving life issues—following indicators of level 1 mathematical literacy ability (Sari et al., 2021). Also, in line with the indicators of the mathematical process domain based on PISA, it is essential to identify mathematical concepts in a contextual problem, use mathematical structures to find solutions, and then convey problem-solving well. Students who can achieve level 1 mathematical literacy skills can formulate problems, use mathematical concepts, and interpret the solutions to real-life problems (Sholikin et al., 2022).

The process of mathematical literacy that occurs in subjects with a reflective cognitive style has achieved three existing literacy processes. The first process is *formulating* the problem; S1 and S2 state that the problem at level 2 is the average speed of 5 children cycling. The second process is involves *employing* mathematical concepts relevant to the research problem. In this case, the study utilizes the speed formula and the average formula. S1 has demonstrated the process of integrating problem-solving with real life well. On the other hand, in S2, the third process of *integrating* mathematical literacy skills was not carried out correctly. Following the indicators fulfilled, the subject with a reflective cognitive style can achieve an indicator of level 2 mathematical literacy ability. Subjects with a reflective cognitive style could solve level 1 and level 2 questions well. This is because level 1 and 2 questions have general context and information that can be used for problem-solving. This information is available in the questions presented clearly so students can easily interpret and recognize the situation in the questions.

The process of mathematical literacy of interview subjects in reflective cognitive style for level 3 questions was that S1 and S2 were able to *formulate* problems at level 3 questions and *employed* mathematical concepts to solve problems at level 3, namely by applying the formula for the sum of arithmetic series. S1 and S2 can *integrate* problem-solving with everyday life. In line with previous research, it is explained that students achieve level 3 mathematical literacy skills if they carry out problem-solving procedures in sequence and can choose effective problem-solving strategies.

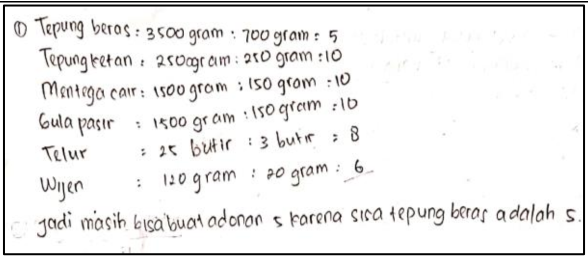
The mathematical literacy process that S1 went through on level 4 questions was that S1 was able to *formulate* the problem on level 4 questions, namely S1 was able to mention that on level 4 questions, Nata was asked to determine the least amount of money spent by Nata to buy wrapping paper. Furthermore, the mathematical concept *employed* by S1 is the concept of the surface area of a geometric shape. The process of *integrating* problem-solving with everyday life can be seen in the interview process; S1 explained that with such a cube surface area, the wrapping paper that might be used is the wrapping paper in the second motif. S1 can solve level 4 questions well. S1 can work effectively with models and connect the problems in real life.

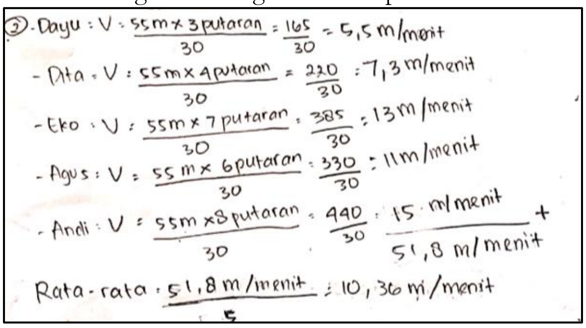
Reflective cognitive-style subjects can provide answers to each interview question correctly and accurately. With high accuracy, it will reduce the opportunity to make mistakes. In addition, the subject of this reflective cognitive style can answer questions from researchers clearly and in detail. Solving questions that S1 and S2 have done looks neat and well structured. S1 and S2 have the characteristic of being careful when taking action. Previous research explained that students with a reflective cognitive style would be more cautious in responding to information. Skemp explained that someone with a reflective cognitive style will have the ability a) to explain what is written, b) to determine the answer to solving the problem with full consideration, c) to be aware of where the error is, and d) to re-examine the answers that have been obtained (Reskiah et al., 2015).

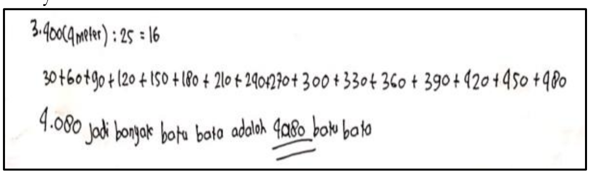
Students' Mathematical Literacy Ability: Impulsive Cognitive Style

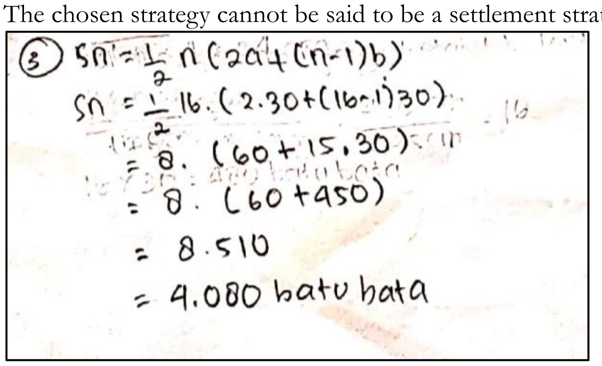
The results of the analysis of the subject's answers to the mathematical literacy ability test and interviews on subjects with an impulsive cognitive style are shown in Table 5.

Table 5. Impulsive Students' Mathematical Literacy Ability

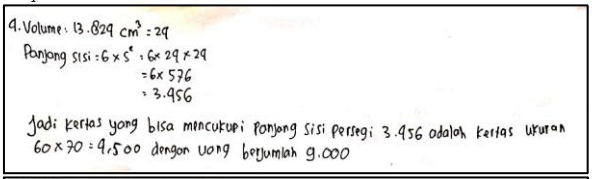
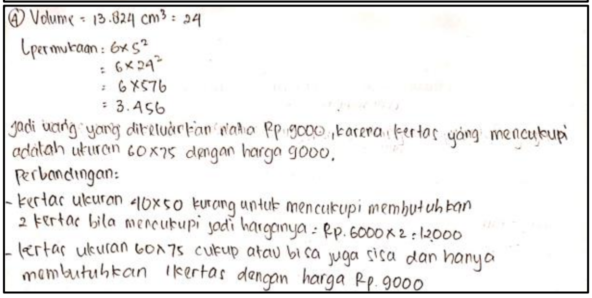
<table>
<tr><th>Level</th><th>Mathematical Literacy Level</th><th>Description</th></tr>
<tr><td>1</td><td>Students can use their knowledge to solve problems in a general context.</td><td>

Subject S3 and S4 can:
find the information contained in the problem,
determine the solution to the problem requested in the question
provide conclusions from the results of their calculations.
Use knowledge in solving contextual problems.</td></tr>
<tr><td>2</td><td>Students can interpret the problem and then solve it with a formula.</td><td>

Subjects S3 and S4 can interpret problems and use formulas as steps to solve problems.
They make errors during the calculation process and do not check back on the obtained answers.
They are not aware of the errors made in the calculations.</td></tr>
<tr><td>3</td><td>Students can carry out the order of problem-solving properly and can choose problem-solving strategies.</td><td>

Subject S3 gets the correct and appropriate final answer.
However, they have not used the troubleshooting procedure properly and do not use the formula for the number of arithmetic series despite manually adding the number of bricks needed with the number of steps made.
The chosen strategy cannot be said to be a settlement strategy.


Subject S4 can provide the correct solution to the problem.
However, the settlement process is not systematically</td></tr>
</table>

Level	Mathematical Literacy Level	Description
		represented in the completion steps. The results of the interviews revealed that the subject can explain the order of well-solution procedures and choose an effective problem-solving strategy by using the formula for the sum of arithmetic sequences.
4	Students can effectively use methods, choose and integrate different representations, and relate them to the real world.	 4. Volume: 13.824 cm³ = 24 Panjang sisi: 6 × s² = 6× 24 × 24 = 6× 576 = 3.456 Jadi kertas yang bisa mencukupi panjang sisi persegi 3.456 adalah kertas ukuran 60×70 = 4,500 dengan uang berjumlah 9.000  (4) Volume = 13.824 cm³ = 24 L permukaan: 6×s² = 6×24² = 6×576 = 3.456 Jadi uang yang dikeluarkan nala Rp 9000, karena kertas yang mencukupi adalah ukuran 60×75 dengan harga 9000. Perbandingan: - kertas ukuran 40×50 kurang untuk mencukupi membutuhkan 2 kertas bila mencukupi jadi harganya = Rp. 6000×2 = 12.000 - kertas ukuran 60×75 cukup atau bisa juga sisa dan hanya membutuhkan 1 kertas dengan harga Rp. 9000 Subject S3 and S4 can: Find all the information that can be used to solve the problem (but not write it down) Determine the steps to solving the problem, starting from determining the side length, selecting the surface area, and then determining the location of the paper that can be used. Work effectively with models, but properly fulfilling indicators' need to choose and integrate different representations is impossible.
5	Students can work with models for complex conditions and can solve complex problems.	S3 and S4 cannot reach level 5.
6	Students use reasoning to solve mathematical problems, make generalizations, and formulate and communicate their findings.	S3 and S4 cannot reach level 6.

Based on previous research, students achieving level 1 mathematical literacy ability indicators could notify information and solve routine problems (Karmila, 2017). S3 and S4 can go through the process of mathematical literacy by interviewing subjects with an impulsive cognitive style and can *formulate* problems. By explaining the situation at level 1, students are asked to determine how much dough can be made. *Employing* mathematical concepts to solve problems can be seen from the answers written by S3 and S4, which use the division concept to find solutions to problems at level 1. The third mathematical process is *integrating* the solution with everyday life. This can be seen from the conclusions written by S3 and S4 on the answer sheet. This ability follows previous research stating that a person can have achieved mathematical literacy skills if he has achieved three indicators of mathematical literacy ability.

S3 and S4 can complete mathematical literacy ability tests for level 2. However, the final result obtained is less precise. The cause of the inaccurate final results obtained is an error in the counting process. Based on the results of the interviews, the impulsive interview subjects were able to *formulate* the problem well. This can be seen in S3 and S4, which explain that in level 2 questions, they are asked to determine the average speed of 5 children cycling. The following process is the *employing* mathematical concepts. At level 2, questions S3 and S4 use speed and average. However, the last process of mathematical literacy, namely *integrating* problem-solving with everyday life, did not appear on the answer sheet or during the interview process. S3 and S4 cannot achieve mathematical literacy skills at level 2 because S3 and S4 cannot fulfill the three indicators of the mathematical literacy process. In line with Karmila's research, students do not achieve indicators of mathematical literacy ability if they cannot properly carry out the three indicators of the mathematical literacy process (Karmila, 2017).

On level 3 questions, S3 and S4 got the correct answer. However, from completing answers S3 and S4, they do not use the same answer completion steps. S3 and S4 cannot reach the indicator of mathematical literacy ability at level 3 because S3 cannot carry out problem-solving procedures and choose effective problem-solving strategies. Then, for S4, the settlement process is not represented systematically in the completion steps. Previous research stated that students did not achieve level 3 mathematical literacy ability indicators if they could not carry out steps to solve problems coherently, communicate the results of interpretation, and provide reasons for the answers written (Karmila, 2017).

The mathematical literacy process that the impulsive subject goes through at level 3 is *formulating* the problem. Furthermore, she *employ* the concept of mathematics, namely the number of arithmetic series. As well as being able to interpret problem-solving with issues in everyday life. This follows previous researchers' statements that subjects with an impulsive cognitive style can explain problems with simple questions, solve issues appropriately, and conclude the results of solving problems (Purwanti et al., 2021). Furthermore, mathematical concepts can be used to solve problems, as can be seen from the answers of students who use the idea of the surface area of a cube to solve problems at level 4 questions. The last mathematical process is *integrating* problem-solving with everyday life. This can be seen in the S3 and S4 processes, which give conclusions from the answers obtained regarding the problems in the question. In line with research by previous experts, which stated that at this level, students can work effectively with models and then relate to the real world, it can be said that these students can achieve level 4 mathematical literacy indicators (Karmila, 2017).

Based on the results of tests and interviews, it is known that subjects with an impulsive cognitive style tend to be quicker in answering the questions posed by researchers during the interview process. Previous research stated that impulsive students respond spontaneously to when questions (Rahayu & Winarso, 2018). Following Sandha's preliminary study, which explains the characteristics of impulsive students, they respond quickly without first looking at it (Soemantri, 2018). The following characteristic is that the impulsive subject does not re-check the answers on the answer sheet. Several studies reveal that someone with an impulsive cognitive style tends to write down what is in their mind faster and more directly. Students are impulsive at the re-examining stage; they check all answers quickly, so they do not realize the location of their mistakes (Azhil et al., 2017; Sinaga, 2022).

This difference in mathematical literacy ability is based on previous studies explaining differences in thinking ability between male and female students. Previous research explained that male students in the impulsive cognitive style tend to think semi-conceptually, while female students in the impulsive cognitive style think conceptually (Wahyuningsih et al., 2019).

CONCLUSION AND SUGGESTION

Students with a reflective cognitive style exhibit mathematical literacy abilities at levels 3 and 4, placing them in the middle range with connection competence in mathematical literacy. On the other hand, students with an impulsive cognitive style can achieve mathematical literacy abilities at levels 1 and 4 for S3 and S4, positioning them within the medium range with connection competence.

This research offers recommendations for students, educators, and future researchers. Students are encouraged to become more familiar with their cognitive styles to determine suitable learning approaches. Educators should better understand their students' cognitive styles to select appropriate instructional models. The CUPs (Conceptual Understanding Procedures) learning model is suggested based on the research findings. Additionally, future researchers are encouraged to explore further the factors contributing to differences in mathematical literacy levels among individuals with the same cognitive style. It is worth noting that this research is limited to contextual problems and calls for broader investigations into content and context.

REFERENCES

Alafif, S. P., & Swastika, A. (2023). Analysis of mathematical literacy ability of class XI students on arithmetic sequences and series in solving HOTS problems reviewed from cognitive styles. *AIP Conference Proceedings*, *2886*(1). https://pubs.aip.org/aip/acp/article/2886/1/020036/2914434

Anif, S., Prayitno, H. J., Sari, D. P., & Adnan, M. (2023). The Ability of Mathematical Literacy in Elementary School Students Based on Cognitive Style. *6th International Conference of Combinatorics, Graph Theory, and Network Topology (ICCGANT 2022)*, 107–119. https://www.atlantis-press.com/proceedings/iccgant-22/125986141

Ariyanto, L., & Kusumaningsih, W. (2022). Minimum Competency Assessment Design to Improve Mathematical Literacy in Junior High Schools. *KnE Social Sciences*, 64–75.

Aufa, N., & Manoy, J. T. (2022). Student's Mathematical Literacy in Solving Asesmen Kompetensi Minimum Question in terms of Gender. *MATHEdunesa*, *11*(1), 219–229.

Ausburn, L. J., & Ausburn, F. B. (1978). Cognitive styles: Some information and implications for instructional design. *ECTJ*, *26*(4), 337–354. https://doi.org/10.1007/BF02766370

Azhil, I. M., Ernawati, A., & Lutfianto, Moch. (2017). Profil Pemecahan Masalah Matematika Siswa Ditinjau dari Gaya Kognitif Reflektif dan Impulsif. *JRPM*, *2*(1), 60–68.

Barstis, S. W., & Ford Jr, L. H. (1977). Reflection-impulsivity, conservation, and the development of ability to control cognitive tempo. *Child Development*, 953–959.

Bush, E. S., & Dweck, C. S. (1975). Reflections on conceptual tempo: Relationship between cognitive style and performance as a function of task characteristics. *Developmental Psychology*, *11*(5), 567-574.

Carmeli, A., Gelbard, R., & Reiter-Palmon, R. (2013). Leadership, Creative Problem-Solving Capacity, and Creative Performance: The Importance of Knowledge Sharing. *Human Resource Management*, *52*(1), 95–121. https://doi.org/10.1002/hrm.21514

Chen, A. (2015). Operationalizing physical literacy for learners: Embodying the motivation to move. *Journal of Sport and Health Science*, *4*(2), 125–131.

Colwell, J., & Enderson, M. C. (2016). "When I hear literacy": Using pre-service teachers' perceptions of mathematical literacy to inform program changes in teacher education. *Teaching and Teacher Education*, *53*, 63–74.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Damayanti, A. P., Juniati, D., & Susanah. (2021). Literasi Matematik Siswa dalam Menyelesaikan Soal Model PISA Ditinjau dari Gaya Kognitif Reflektif-Impulsif. *Math Didactic*, *7*(2), 101–113.

Denney, D. R. (1972). Modeling effects upon conceptual style and cognitive tempo. *Child Development*, 105–119.

Dian, D., Ahmad, C. F., & Arsal, F. R. (2023). Implication And Application MBKM's Curriculum In Education (Madrasah And Universities). *At-Ta'dib*, *18*(1), 106–122.

Fitriyani, H., Setyawan, F., Hendroanto, A., & Istihapsari, V. (2021). Describing student's mathematical power: Do cognitive styles make any difference. *Bulletin of Applied Mathematics and Mathematics Education*, *1*(1), 39-46. https://doi.org/10.12928/bamme.v1i1.3856

Gabriel, F., Buckley, S., & Barthakur, A. (2020). The impact of mathematics anxiety on self-regulated learning and mathematical literacy. *Australian Journal of Education*, *64*(3), 227–242. https://doi.org/10.1177/0004944120947881

Gabriel, F., Signolet, J., & Westwell, M. (2018). A machine learning approach to investigating the effects of mathematics dispositions on mathematical literacy. *International Journal of Research & Method in Education*, *41*(3), 306–327. https://doi.org/10.1080/1743727X.2017.1301916

Genc, M., & Erbas, A. K. (2019). Secondary mathematics teachers' conceptions of mathematical literacy. *International Journal of Education in Mathematics, Science and Technology*, *7*(3), 222–237.

Goodenough, D. R., & Witkin, H. A. (1977). Origins of the field-dependent and field-independent cognitive styles. *ETS Research Bulletin Series*, *1977*(1). https://doi.org/10.1002/j.2333-8504.1977.tb01134.x

Hayes, J., & Allinson, C. W. (1998). [No title found]. *Human Relations*, *51*(7), 847–871. https://doi.org/10.1023/A:1016978926688

Holenstein, M., Bruckmaier, G., & Grob, A. (2021). Transfer effects of mathematical literacy: An integrative longitudinal study. *European Journal of Psychology of Education*, *36*(3), 799–825. https://doi.org/10.1007/s10212-020-00491-4

Hwang, J., & Ham, Y. (2021). Relationship between Mathematical Literacy and Opportunity to Learn with Different Types of Mathematical Tasks. *Journal on Mathematics Education*, *12*(2), 199–222.

Kagan, J., Rosman, B. L., Day, D., Albert, J., & Phillips, W. (1964). Information processing in the child: Significance of analytic and reflective attitudes. *Psychological Monographs: General and Applied*, *78*(1), 1-37. https://doi.org/10.1037/h0093830

Karmila. (2017). Deskripsi Kemampuan Literasi Matematis Siswa Ditinjau dari Gender. *Pedagogy*, *3*(1), 126–155.

Khang, A., Jadhav, B., & Birajdar, S. (2023). Industry Revolution 4.0: Workforce Competency Models and Designs. In *Designing Workforce Management Systems for Industry 4.0* (pp. 11–34). CRC Press. https://www.taylorfrancis.com/chapters/edit/10.1201/9781003357070-2/industry-revolution-4-0-alex-khang-babasaheb-jadhav-sphurti-birajdar

Lan, W., Repman, J., & Chyung, S.-Y. (1998). Effects of Practicing Self-Monitoring of Mathematical Problem-Solving Heuristics on Impulsive and Reflective College Students' Heuristics Knowledge and Problem-Solving Ability. *The Journal of Experimental Education*, *67*(1), 32–52. https://doi.org/10.1080/00220979809598343

Larkin, T., & Budny, D. (2005). Learning styles in the classroom: Approaches to enhance student motivation and learning. *2005 6th International Conference on Information Technology Based Higher Education and Training*, F4D-1. https://ieeexplore.ieee.org/abstract/document/1560310/

Magen-Nagar, N. (2016). The Effects of Learning Strategies on Mathematical Literacy: A Comparison between Lower and Higher Achieving Countries. *International Journal of Research in Education and Science*, *2*(2), 306–321.

Maslihah, S., Waluya, S. B., Karomah, N., & Iqbal, K. (2021). Increasing mathematical literacy ability and learning independence through problem-based learning model with realistic mathematic education approach. *Journal of Physics: Conference Series*, *1918*(4), 042123. https://iopscience.iop.org/article/10.1088/1742-6596/1918/4/042123/meta

Messick, S. (1984). The nature of cognitive styles: Problems and promise in educational practice. *Educational Psychologist*, *19*(2), 59–74. https://doi.org/10.1080/00461528409529283

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. sage.

Moleong, L. J. (2007). *Metodologi penelitian kualitatif edisi revisi*. http://library.stik-ptik.ac.id/detail?id=7251&lokasi=lokal

Najma, L. A. Z., & Masduki, M. (2023). Exploration of Student Algebraic Thinking In Terms Of Implusive Reflective Cognitive Style. *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang*, *7*(2), 219–231.

O'Connor, G. E., & Kabadayi, S. (2020). Examining Antecedents of Health Insurance Literacy: The Role of Locus of Control, Cognitive Style, and Financial Knowledge. *Journal of Consumer Affairs*, *54*(1), 227–260. https://doi.org/10.1111/joca.12266

OECD. (2019). *PISA 2018 Assessment and Analytical Framework*. https://www.oecd-ilibrary.org/content/publication/b25efab8-en

Ojose, B. (2011). Mathematics literacy: Are we able to put the mathematics we learn into everyday use. *Journal of Mathematics Education*, *4*(1), 89–100.

Ozgen, K. (2013). An Analysis of High School Students' Mathematical Literacy Self-efficacy Beliefs in Relation to Their Learning Styles. *The Asia-Pacific Education Researcher*, *22*(1), 91–100. https://doi.org/10.1007/s40299-012-0030-4

Pabbajah, M., Abdullah, I., Widyanti, R. N., Jubba, H., & Alim, N. (2020). Student demoralization in education: The industrialization of university curriculum in 4.0.Era Indonesia. *Cogent Education*, *7*(1), 1779506. https://doi.org/10.1080/2331186X.2020.1779506

Pratikno, Y., Hermawan, E., & Arifin, A. L. (2022). Human Resource 'Kurikulum Merdeka'from Design to Implementation in the School: What Worked and What not in Indonesian Education. *Jurnal Iqra': Kajian Ilmu Pendidikan*, *7*(1), 326–343.

Pratiwi, D. A., Trapsilasiwi, D., Oktavianingtyas, E., & Sunardi. (2019). Level Literasi Metamatika Siswa Dalam Menyelesaikan Soal PISa Konten Change and Relationship Berdasarkan Gaya Kognitif. *Kadikma*, *10*(3). 1-14. https://doi.org/10.19184/kdma.v10i3.17401

Purwanti, A. F., Mutrofin, & Alfarisi, R. (2021). Analisis Literasi Matematika Ditinjau dari Kecerdasaan Matematis-Logis Siswa. *Jurnal Ilmu Pendidikan Sekolah Dasar*, *8*(1), 40–57.

Rahayu, Y. A., & Winarso, W. (2018). Berpikir Kritis Siswa Dalam Penyelesaian Matematika Ditinjau dari Perbedaan Tipe Gaya Kognitif Reflektif dan Impulsif. *Jurnal Ilmiah*

Pendidikan Dan Pembelajaran, *2*(1), 1–11.

Reskiah, Rahman, A., & Dassa, A. (2015). Profil Berpikir Reflektif Siswa dalam Pemecahan Masalah Aljabar Ditinjau dari Gaya Kognitif pada Siswa Kelas VIII SMP Negeri 5 Wonomulyo Sulbar. *Jurnal Uncp*, *03*(1), 138–146.

Rozencwajg, P., & Corroyer, D. (2005). Cognitive processes in the reflective-impulsive cognitive style. *The Journal of Genetic Psychology*, *166*(4), 451–463. https://doi.org/10.3200/GNTP.166.4.451-466

Rulandari, N. (2021). Study of sustainable development goals (SDGS) quality education in Indonesia in the first three years. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *4*(2), 2702–2708.

Sari, E. K., Sugiyanti, & Pramasdyahsari, A. S. (2021). Profil Kemampuan Literasi Matematis Siswa Berkemampuan Matematika Tinggi dalam Menyelesaikan Soal Cerita Berbasis PISA. *Jurnal Gantang*, *VI*(1), 83–92.

Sholikin, N. W., Sujarwo, I., & Abdussakir. (2022). Penerapan Teori Belajar Bermakna untuk Meningkatkan Literasi Matematis Siswa Kelas X. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *06*(01), 386–396.

Sinaga, M. E., & SINAGA, M. E. (2022). *Identifikasi miskonsepsi siswa bergaya kognitif impulsif dan reflektif dalam menyelesaikan soal matematika kelas XII MIPA di SMAN 3 Kota Jambi* [PhD Thesis, Universitas Batanghari]. https://repository.unbari.ac.id/1740/

Smirnov, E. I., Tikhomirov, S. A., & Abaturova, V. S. (2021). The phenomenon of complex knowledge in teaching mathematics as a factor of mathematical literacy forming of school students. *Перспективы Науки и Образования Perspectives of Science and Education*, 285-299. https://doi.org/10.32744/pse.2021.6.19

Soemantri, S. (2018). Pengaruh Gaya Kognitif Konseptual Tempo Terhadap Tingkat Kesalahan Siswa. *Didaktis: Jurnal Pendidikan Dan Ilmu Pengetahuan*, *18*(1). 74-85

Stacey, K., & Turner, R. (2015). The evolution and key concepts of the PISA mathematics frameworks. In *Assessing mathematical literacy* (pp. 5–33). Springer.

Sternberg, R. J., & Grigorenko, E. L. (1997). Are cognitive styles still in style? *American Psychologist*, *52*(7), 700-712. https://doi.org/10.1037/0003-066X.52.7.700

Sternberg, R. J., & Grigorenko, E. L. (2014). A capsule history of theory and research on styles. In *Perspectives on thinking, learning, and cognitive styles* (pp. 1–21). Routledge. https://api.taylorfrancis.com/content/chapters/edit/download?identifierName=doi&identifierValue=10.4324/9781410605986-1&type=chapterpdf

Tariq, V. N., Qualter, P., Roberts, S., Appleby, Y., & Barnes, L. (2013). Mathematical literacy in undergraduates: Role of gender, emotional intelligence and emotional self-efficacy. *International Journal of Mathematical Education in Science and Technology*, *44*(8), 1143–1159. https://doi.org/10.1080/0020739X.2013.770087

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), 042080. 1-6 https://iopscience.iop.org/article/10.1088/1742-6596/1918/4/042080/meta

Van Woerkom, M. (2004). The Concept of Critical Reflection and Its Implications for Human Resource Development. *Advances in Developing Human Resources*, *6*(2), 178–

192. https://doi.org/10.1177/1523422304263328

Wahyuni, D. (2023). The Effect of Language Literacy and Numerical Literacy on the Result of the Minimum Competency Assessment (AKM) of SMAN Ploso Jombang. *Edunesia: Jurnal Ilmiah Pendidikan*, *4*(1), 225–237.

Wahyuningsih, S., Sani, A., & Sudia, M. (2019). Analisis Proses Berpikir Siswa SMP Dalam Memecahkan Masalah Matematik Ditinjau Dari Gaya Kognitif dan Gender. *Jurnal Pembelajaran Berpikir Matematika*, *4*(1), 121–132.

Warli, W. (2010). Profil Kreativitas Siswa yang Bergaya Kognitif Reflektif dan Siswa yang Bergaya Kognitif Impulsif dalam Memecahkan Geometri. Disertasi tidak diterbitkan. *Universitas Negeri Surabaya*.

Warli, W. (2013). Kreativitas siswa smp yang bergaya kognitif reflektif atau impulsif dalam memecahkan masalah geometri. *Jurnal Pendidikan dan Pembelajaran Universitas Negeri Malang*, *20*(2), 190–201.

Witkin, H. A. (1967). A cognitive-style approach to cross-cultural research. *International Journal of Psychology*, *2*(4), 233–250. https://doi.org/10.1080/00207596708247220

Wulan, E. R., & Astuti, F. (2022). Mathematical Literacy with Islamic Nuances Based on Prospective Mathematics Teachers' Personality. *Jurnal Didaktik Matematika*, *9*(2), 230–247.

Yahya, S., & Goh, W.-K. (2002). Managing human resources toward achieving knowledge management. *Journal of Knowledge Management*, *6*(5), 457–468.

Zeidner, M., & Matthews, G. (2000). Intelligence and personality. *Handbook of Intelligence*, 581–610.