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Profil Metakognisi Mahasiswa dalam Memecahkan Masalah Aljabar Linear Elementer Ditinjau dari Gaya Kognitif Konseptual Tempo

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Abstrak

Metakognisi adalah salah satu faktor yang berpengaruh terhadap keberhasilan siswa dalam pemecahan masalah matematika. Di sisi lain, realita di lapangan ditemukan bahwa mahasiswa mengalami kesulitan dalam memecahkan masalah matematika yang berhubungan dengan Aljabar Linear Elementer karena memuat banyak perhitungan berulang sehingga membutuhkan ketekunan dan ketelitian tinggi. Tujuan dari penelitian ini adalah untuk mendeskripsikan profil metakognisi mahasiswa dalam pemecahan masalah Aljabar Linear Elementer ditinjau dari gaya kognitif. Gaya kognitif yang dipilih adalah gaya kognitif konseptual tempo melalui tes *Matching Familiar Figures* dengan subyek penelitian mahasiswa matematika Universitas Nahdlatul Ulama Purwokerto. Profil metakognisi yang dihasilkan diperoleh dari data tes pemecahan masalah Aljabar Linear Elementer dan wawancara yang dianalisis kemudian disimpulkan melalui serangkaian proses triangulasi metode. Hasil penelitian menunjukkan mahasiswa reflektif dan impulsif melakukan semua aktivitas yang menjadi indikator dari *metacognitive awareness* dan *regulation* serta beberapa indikator dari *metacognitive evaluation*. Mahasiswa *fast accurate* melakukan semua aktivitas yang menjadi indikator *metacognitive awareness*, *regulation*, dan *evaluation*. Sedangkan mahasiswa *slow inaccurate* melakukan semua aktivitas yang menjadi indikator metacognitive awareness, dan beberapa indikator *metacognitive regulation* tetapi belum mampu melakukan aktivitas *metacognitive evaluation*.

Kata Kunci: aljabar linear, gaya kognitif, metakognisi, pemecahan masalah

Profile of Student Metacognition in Solving Elementary Linear Algebra Problems Viewed from Tempo Conceptual Cognitive Style

Abstract

Metacognition is one of the factors that influences students' success in solving mathematical problems. On the other hand, the reality in the field is that students experience difficulties in solving mathematical problems related to Elementary Linear Algebra because they contain a lot of repetitive calculations, so they require high levels of perseverance and accuracy. This research aims to describe students' metacognitive profiles in solving Elementary Linear Algebra problems in terms of cognitive style. The cognitive style chosen is the conceptual cognitive style of pacing through Matching Familiar Figures Tests with research subjects being mathematics students at Nahdlatul Ulama University, Purwokerto. The resulting metacognition profile was obtained from Elementary Linear Algebra problem-solving test data and interviews, which were analyzed and concluded through a series of method triangulation processes. The research results show that students are reflective and impulsive in carrying out all activities that are indicators of metacognitive awareness and regulation, as well as several indicators from metacognitive evaluation. Fast, accurate students carry out all activities that become indicators of metacognitive awareness, regulation, and evaluation. Meanwhile, slowly, inaccurate students carry out all activities that are indicators of metacognitive awareness and several indicators of metacognitive regulation but still need to be able to carry out activities of metacognitive evaluation.

Keywords*: cognitive styles; linear algebra; metacognition; problem solving*

INTRODUCTION

Problem-solving is an essential human activity that plays a vital role in mathematics learning (Novotná et al., 2014). Solving mathematical problems has long been crucial to studying, teaching, and mastering mathematics (Liljedahl et al., 2016). This is reinforced by The National Council of Teachers of Mathematics (NCTM), which states that mathematics has a central focus in the curriculum, namely solving problems (Hendriana & Sumarmo, 2017). Therefore, solving problems falls into the category of non-routine high-level thinking skills.

Developing higher-order thinking skills in students is one of the objectives of mathematics education in the 21st century (Santoso et al., 2019). These days, the emphasis in mathematics education is primarily on problem-solving skills. Students who can solve problems well can think more clearly, follow instructions, and comprehend concepts more (Ranjanie & Rajeswari, 2016). One of the factors that influences students' success in the process of solving mathematical problems is metacognition. According to Chimuma & Johnson (2016), metacognition plays a significant role in problem-solving. Metacognitive skills have been incorporated into mathematics education as a necessary component by several nations, including the US (National Council of Teachers of Mathematics) and Turkey (Ministry of National Education) (Ader, 2019). Additionally, metacognitive abilities are emphasized in mathematics teaching programs as a crucial part of the subject's instruction (Ader, 2019).

Metacognition ability is linked to problem-solving, learning, and cognitive skills in addition to problem-solving ability. According to Aljaberi and Gheith (2015), metacognition abilities are competencies linked to learning and thinking. They comprise a variety of skills required for problem-solving, critical thinking, reflective assessment, practical learning, and decision-making. This is consistent with the research of Radmehr & Drake (2017), who defined metacognition as reflecting on one's thinking process to develop a problem-solving approach. Solving mathematical problems requires a great deal of metacognition. Metacognition helps problem solvers recognize a problem that needs to be solved and understand how to achieve the goal or solution of the mathematical problem presented (Kuzle, 2013). Students who use metacognition can better manage and complete problem-solving steps (Sevgi & Çağliköse, 2020). Because analyzing and observing metacognitive skills is challenging, math educators have not given this topic enough attention (Güner & Erbay, 2021).

Furthermore, researchers encountered an interesting phenomenon when teaching elementary linear algebra (ELA) courses, specifically when solving problems related to elementary line operations (ELO). The ELA course is an introductory course that is a prerequisite to taking several advanced courses in the mathematics study program. Therefore, mastering this primary material becomes crucial so students can master courses at the next level more quickly. At the same time, ELO is a method used to solve problems related to Systems of Linear Equations. This method is carried out through a repeated calculation process until the desired solution is obtained. To obtain the correct solution, high accuracy, and perseverance are required to solve the problem from the beginning to the end of the calculation.

Based on the results of the researcher's observations until the middle of the even semester of the 2022/2023 academic year, students of the class of 2022 mathematics study program at Nahdlatul Ulama University Purwokerto seemed to have difficulty in solving problems related to the use of ELO to determine Systems of Linear Equations solutions, especially when faced with more complicated problems and varied. This is supported by the results of the Mid Semester Examination for courses on this topic, which show that 50% of mathematics students got grades $\leq$65, which, if converted to letters, becomes a grade of C or below. This problem is also reinforced by several previous research results, which state that in solving Systems of Linear Equations questions with ELO, students make errors related to concepts, calculation errors, writing errors, and use of signs as well as errors by answering randomly (Nawafilah, 2019). Furthermore, other research also shows that students make errors of fact and errors of principle when solving problems related to ELA. Furthermore, the research states that internal factors that influence students to make mistakes are student carelessness, lack of interest in mathematics courses, lack of mastery of concepts, and low self-confidence (Patricia, 2019).

On the other hand, even though students are seen as masters in their learning process, Zimmerman (2015) said that this does not mean that students do not make mistakes due to inadequate initial mathematical knowledge. Therefore, the number of errors made when solving problems related to ELA shows that students need help controlling their cognitive processes well in solving problems. Students' lack of awareness of their situation, in this case, the metacognition factor, is one of the factors that causes failure in learning (Wismath et al., 2014).

Apart from that, with the introduction of the concept of independent learning in the “Kampus Merdeka," all people in the world of education must be prepared for the transformation in the world of learning, including lecturers and students in higher education institutions. One manifestation of this is student-centered learning transformation. Therefore, independent learning on the “Kampus Merdeka” currently requires that the resources formed are superior human resources and are expected to increase the metacognitive knowledge possessed by students for the future progress of the nation and state.

Research on metacognitive profiles in solving mathematical problems has been carried out by several researchers, including research on descriptions of metacognitive skills in solving mathematical problems in terms of tempo conceptual cognitive style on class VIII junior high school students with SPLDV material (Ramadanti et al., 2022). Next, research the metacognitive profile of high school students in class XI science in solving mathematical problems about probability (Lestari, 2017). Researchers have also conducted several similar studies, namely about students' metacognitive activities in solving linear programming problems in terms of gender differences (Kartika, 2020) and the metacognitive profile of junior high school students in solving HOTS-type mathematics problems in terms of adversity quotient (Kartika et al., 2023).

From the explanation above, research with student subjects is still rarely found, so the researcher intends to combine several previous studies with different research subjects, namely student subjects, in solving problems related to ELA in terms of one type of cognitive style, namely tempo conceptual cognitive style. This cognitive style was chosen because it has 4 different styles, so it is hoped that it will provide a clear picture of each indicator of the metacognitive profile. Therefore, this research aims to describe students' metacognitive profiles in solving ELA problems regarding tempo conceptual cognitive style.

The results of this research will add new knowledge about student profiles in solving ELA problems, which in previous research only focused on analyzing student errors without describing metacognitive activities. Meanwhile, this research presents the metacognitive profile in detail based on the metacognitive indicators of awareness, regulation, and evaluation in terms of tempo conceptual cognitive style. Therefore, it is hoped that this can be used by related parties, especially lecturers who teach this course because the learning process in the classroom often occurs from generation to generation. When sitting in a lecture, the lecturer gets what is transmitted to his students so that the mistakes students often make have the same error pattern as the lecturer who teaches in that class (Muzangwa & Chifamba, 2012). Therefore, by knowing students' metacognitive profiles based on their cognitive styles, lecturers are expected to be able to find the right solution in choosing a learning model that can improve the quality of learning that accommodates students to explore their metacognitive abilities in the context of student-centered learning transformation.

METHOD

This type of research is descriptive research that uses a qualitative approach. The subjects in this study were selected based on the tempo conceptual cognitive style category. This cognitive style responds to a stimulus based on the time used. According to Rozencwajg and Corroyer in Diana & Nurmawanti (2020), cognitive style is divided into four categories: fast accurate, slow inaccurate, reflective, and impulsive. The fast, accurate cognitive style tends to be fast with a high level of accuracy; the reflective cognitive style tends to take a long time but has a high level of accuracy; the impulsive cognitive style tends to be fast but has a low level of accuracy, and the slow, inaccurate cognitive style tends to take a long time with a low level of accuracy.

This research data is qualitative data obtained from the results of ELA problem-solving tests and interviews of research subjects to produce an in-depth and detailed picture of the metacognition used by fast, accurate, reflective, impulsive, and slow, inaccurate cognitive style students. This research only

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examines students' metacognitive profiles in solving mathematical problems related to ELA, especially in the material on using ELO to determine solutions to Systems of Linear Equations with the Jordan Elimination method. The research subjects were students of the 2022 class of the mathematics study program at Nahdlatul Ulama University, Purwokerto, and was carried out in the even semester of the 2022/2023 academic year. This research instrument includes the Matching Familiar Figures Test (MFFT) to create research subject categories based on tempo conceptual cognitive style, ELA problem-solving test, and interview guidelines to explore metacognition from each category of cognitive style based on metacognitive profile indicators.

Research subjects were selected through the MFFT cognitive style test based on the tempo conceptual cognitive style category, namely fast accurate, reflexive, impulsive, and slow inaccurate. Next, 4 research subjects will be selected, with one research subject each in each category that meets the criteria based on several considerations, namely: 1) Class of 2022 students have received ELA courses, so they are expected to be able to solve problems regarding ELO by Gauss-Jordan Elimination especially those related to calculating solutions to Systems of Linear Equations; 2) the subjects chosen are subjects who, based on the results of the researcher's observations, can solve the problems given correctly and have good communication skills so that the disclosure of the metacognitive profile can take place well.

The data collection techniques for this research include MFFT cognitive style tests, mathematical problem-solving tests, and interviews. Interviews were carried out using task-based interview techniques; the subject was given a written assignment sheet about ELA problems, especially calculations using Gauss-Jordan Elimination, to determine the solution to the System of Linear Equations. The written assignment consists of two problem-solving questions. When solving the problem, the subject is asked to communicate thoughts or ideas about his thoughts.

Furthermore, this research will determine groups of students with a conceptual cognitive tempo style using median t and f data. The median of the t data is the time used each time to answer, while the median of the f data is the frequency of answering correctly (Rahayu & Winarso, 2018). Then, records of the average time and frequency of responses will be used to identify students with conceptual tempo characteristics. Based on the test results obtained, they will be sorted from low to high, and then the middle value (median) will be taken. Table 1 is a table of criteria for determining potential research subjects.

Table 1. Criteria for Determining Research Subjects

Tempo Conceptual Cognitive Style Score	Tempo Conceptual Cognitive Style Category
$t \leq$ t median and $f \leq$ f median	Fast Accurate
$t <$ t median and $f >$ f median	Impulsive
$t >$ t median and $f <$ f median	Reflective
$t \geq$ t median and $f \geq$ f median	Slow Inaccurate

Source: Rosy (2021)

Notes
t: Average subject time in answering the MFFT test
f: the average of the subject's answer choices in answering the MFFT test
t median: median of the average time of all subjects
f median: median of the average answer choices of all subjects

Then, for each stage in the metacognition process that will be studied, in-depth interviews are held to determine the metacognition profile of the research subjects according to the metacognition indicators, namely awareness, evaluation, and regulation. The description and indicators of each metacognition profile, which will be the basis of the interview guide, can be seen in Table 2, which was adapted from the research results of Magiera & Zawojewski (2011).

Table 2. Description and Indicators of Metacognition Profile

Type	Metacognitive Profile Indicators
Metacognitive awareness	Expressions about how to think mathematically about oneself or others, including: 1. things that I/other people know about a problem; 2. known relevant knowledge related to the task; 3. things that have been done at other times that may have helped resolve the problem; 4. know his position in the problem-solving process.
Metacognitive regulation	Opinions about your own/other people's way of thinking about mathematics, including: 1. planning strategy; 2. work steps in solving problems; 3. thinking about what to do next; 4. choose the problem-solving strategy that will be used.
Metacognitive evaluation	Assessments made based on one's own/other people's mathematical thinking include: 1. assessment of the limitations of one's thought processes yourself or someone else; 2. the effectiveness of the chosen strategy; 3. assessment of the results obtained; 4. assessment of the difficulties faced; 5. assessment of the development of one's abilities and understanding.

Next, the data obtained during the interview was compiled into an interview transcript for further analysis regarding the metacognitive profile of the research subjects.

Research subjects' metacognitive profile data from each cognitive style category was analyzed based on each metacognitive profile indicator. In this research, after the data was collected, the researcher used the data analysis model of Miles et al. (2014), which states that qualitative data is processed through the stages of data condensation, data presentation, and conclusion. The data analysis steps can be described as follows.

1. Data Condensation or Reduction
   At this stage, the researcher sorts out which information is relevant and which is not relevant to the research. After being condensed, the data will become smaller and smaller, leading to the core of the problem to provide a clearer picture of the research problem.
2. Data Presentation
   The data that has been reduced is then presented in descriptive form based on predetermined metacognitive profile indicators. In presenting the data, the researcher will arrange the data obtained systematically so that the data obtained can explain and answer the problems being studied, namely the student metacognition profile based on tempo conceptual cognitive style.
3. Drawing Conclusions/Data Verification
   After going through the data analysis process, data verification will then be carried out through data validity testing. The testing technique used in this research is the triangulation method. In this study, researchers used problem-solving tests and semi-structured interviews to reveal the metacognitive profile of each category of cognitive style. Then, after verifying the data, the researcher concluded each research subject's metacognitive profile in each category of tempo conceptual cognitive style for each indicator.

RESULTS

The prospective research subjects that will be selected are 12 students from the mathematics study program at Nahdlatul Ulama University, Purwokerto, class of 2022. Matching Familiar Figure Test (MFFT) selects research subjects with cognitive style categories such as reflective, impulsive, fast accurate, and slow inaccurate. Based on the analysis of the MFFT results and consideration of the excellent communication skills of the prospective subjects, 4 research subjects were selected, namely DA (reflective), FR (impulsive), RD (fast accurate), and SN (slow inaccurate).

The selected research subjects were then interviewed using a task-based interview technique to solve 2 (two) problems related to Elementary Linear Algebra (ELA) in the form of questions on

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calculating solutions to Systems of Linear Equations using the Gauss-Jordan Elimination method. Henceforth, question number one will be called S1, and question number two will be called S2. The questions given are as follows.

Table 2. Elementary Linear Algebra Questions

No.	**Question Code**	**Question**
Solve the following system of linear equations using Gauss-Jordan elimination.		
1	S1	$a + b + c = 5$ $2a + b + 2c = 8$ $a + 2b + 2c = 9$
2	S2	$2x_1 + 2x_2 + 2x_3 = 0$ $-2x_1 + 5x_2 + 2x_3 = 1$ $8x_1 + x_2 + 4x_3 = -1$

Furthermore, the data collection results for each category of research subjects are explained in detail as follows.

a. Reflective Subject (DA)

The results of interview data collection of DA subjects when solving S1 and S2 problems showed that before solving the problem, the subjects could explain the information known from the problem given. Furthermore, subjects know the relevant knowledge related to the task, including the initial knowledge required and the material used to solve the problem, namely Gauss-Jordan Elimination in Systems of Linear Equations. Then, when solving S1 and S2 problems, the research subjects consistently knew what to do first to solve the problem and estimated they would be able to solve the problem within 1-2 hours. This presentation shows that the DA subject is carrying out metacognitive awareness activities, namely being able to mention things that are known about the problem, knowing relevant knowledge that is known to be related to the task, knowing what must be done first to solve the problem and knowing one's position in the problem-solving process.

In the next stage, the DA subject solves problems S1 and S2 according to the estimated time they set, namely around 1-2 hours. The researcher confirmed through interviews after the subject solved the S1 and S2 problems. From the results of interviews during undergraduate problem solving, it is possible to explain the solution steps used and believe that the answer obtained is the correct answer. However, different things were found when solving the S2 problem because the subject needed help solving it, so they felt the answer needed to be more accurate. Furthermore, the subject realized there was an error in the problem-solving steps, so the subject felt the need to correct the final answer. The subject corrected the final answer of the solution by changing the variable x_3 to x_1, as shown in the following figure.

Initial Answer | Final Answer

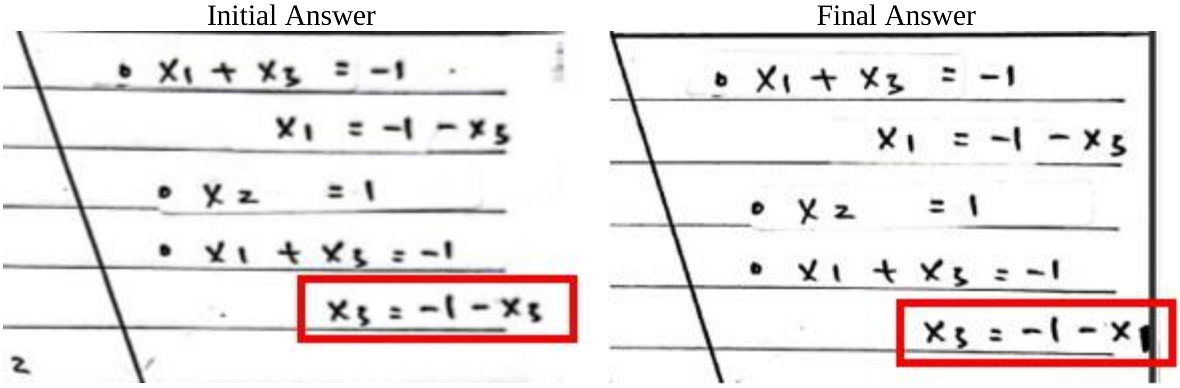


Figure 1. Snapshot of the Final Results of S2 Problem Solving

Based on Figure 1, when solving S1 and S2 problems, the DA subjects can plan problem-solving strategies and explain and choose the solution steps to be used so that it can be said that DA subjects carry out metacognitive regulation activities.

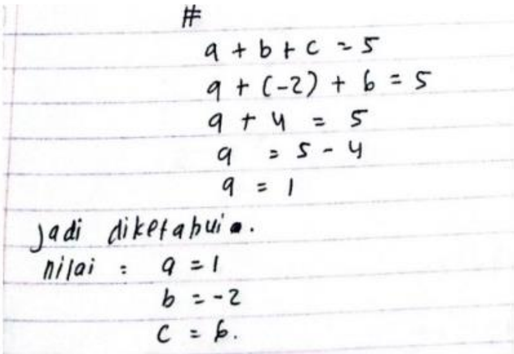
After going through a series of interviews in the form of metacognition questions, the DA subject evaluates the results of the written work that has been completed. The DA subject assessed that the results of his work were correct and by the demands of the problem. The subject explains the effectiveness of the chosen strategy, gives examples of similar problems, and mentions other ways to solve S1 problems. However, for the S2 problem, the DA subject was not able to mention other solution steps that were more effective than the solution steps taken. These results show that during the S1 and S2 problem-solving process, the DA subjects carried out a metacognitive evaluation, namely being aware of the thought process by assessing and believing the results were correct. Apart from that, subjects could also identify strategies used later for other similar problems in general but could not name other alternatives for solving S2 problems more effectively.

b. Impulsive Subject (FR)

The results of the analysis of interview data of FR subjects when solving S1 and S2 problems showed that before solving the problem, the subjects could explain the information from the problem given. Furthermore, subjects know the relevant knowledge related to the task, including the initial knowledge required and the material used to solve the problem, namely Gauss Jordan Elimination in Systems of Linear Equations. Then, when solving S1 and S2 problems, the research subjects consistently knew what to do first to solve the problem and estimated they would be able to solve the problem within 25 minutes. This presentation shows that the FR subject is carrying out activities of metacognitive awareness, namely being able to mention things that are known about the problem, knowing relevant knowledge that is known to be related to the task, knowing what must be done first to solve the problem and knowing one's position in the problem-solving process.

Furthermore, subjects completed the S1 problem faster than the self-estimated time. After the subjects solved the S1 and S2 problems, the researcher confirmed through interviews. From the results of interviews during undergraduate problem solving, it is possible to explain the solution steps used. However, I need to re-check the results to be more confident in the final. Then, after correcting the answers, the following results were obtained.

Initial Answer



Final Answer

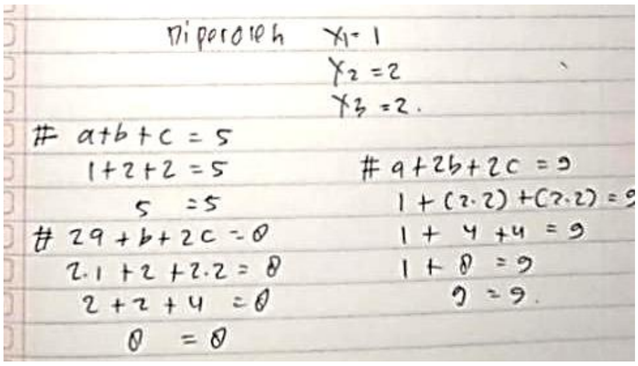


Figure 2. Snapshot of written work at the beginning and end of the S1 problem

Based on Figure 2, FR improved the final answer after realizing a calculation error, thereby changing the final results of SPL solutions a, b, and c.

Likewise, when solving the S2 problem, the subject felt unsure about the final results obtained, so he asked for the opportunity to improve his answer. The subject tried to do the work but still needed help solving the problem due to limited ideas, even though he had been given a series of metacognition questions to explore the knowledge he had that could help the subject solve the S2 problem. However, in the S1 and S2 problem-solving process, subjects can carry out metacognitive regulation activities, namely mentioning and explaining the solution steps taken, even though there are limited ideas that make the subject experience difficulty in solving S2 problems.

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Furthermore, when solving the S1 problem, the subject felt confident that the results of the solution were correct. Meanwhile, when solving the Master's problem, the subject felt unsure. He was dissatisfied with the results of the solution, which did not meet expectations due to his limited ideas, so the subject asked for time beyond the given processing time to learn to understand the material more deeply. Then, the subject stated that there was a more effective solution step to solve problem S1 using the elimination method. In contrast, for problem S2, according to subject FR, the solution step was only as effective as what had been done. However, subject FR has carried out metacognitive evaluation activities by assessing the thinking process, describing the difficulties faced and the results obtained, and assessing the effectiveness of the steps used.

c. Fast Accurate Subject (RD)

The results of interview data collection of RD subjects when solving S1 and S2 problems showed that before solving the problem, the subjects were able to explain the information known from the problem given and know the relevant knowledge related to the task, including knowing the initial knowledge needed and the material used to solve the problem, namely Gauss Jordan Elimination in Systems of Linear Equations. Furthermore, when solving S1 and S2 problems, RD subjects consistently knew what to do first to solve the problem, namely determining the leading one on the first row and first standard. In addition, subjects could assess their position in problem-solving by estimating their ability to solve the problem within 15-20 minutes. This presentation shows that subject RD is carrying out metacognitive awareness activities, namely being able to mention things that are known about the problem, knowing relevant knowledge that is known to be related to the task, knowing what must be done first to solve the problem and knowing one's position in the problem-solving process.

In the next stage, subject RD completed problems S1 and S2 faster than the estimated time he had set himself, namely 12 minutes. The researcher confirmed through interviews after the subject solved the S1 and S2 problems. From the results of interviews during undergraduate problem solving, it is possible to explain the solution steps used and believe that the answer obtained is the correct answer. Likewise, when solving S2 problems, RD did not experience significant difficulties. RD subjects could explain the steps and problem-solving strategies used and believed that the steps used were correct. From this explanation, the RD subject carried out activity metacognitive regulation.

After going through a series of interviews in the form of metacognition questions, the RD subject evaluates the results of written work on undergraduate and graduate problems that have been completed. Subject RD assessed that the results of his work were correct and by the demands of the problem. The subject explains the effectiveness of the chosen strategy, gives examples of similar problems, and mentions other ways to solve the problem. However, for the S2 problem, RD subjects could not mention other solution steps that were more effective than the ones taken. These results show that during the S1 and S2 problem-solving process, RD subjects carried out activities of metacognitive evaluation, namely being aware of the thought process by assessing and believing the results obtained are correct. Apart from that, subjects could also identify strategies used later for other similar problems in general but could not name other alternatives for solving S2 problems more effectively.

d. Slow Inaccurate Subject (SN)

The results of the analysis of interview data of SN subjects when solving S1 and S2 problems showed that before solving the problem, the subjects could explain the information from the problem given. Subjects also have relevant knowledge of the task, including the material used to solve problems, namely Gauss-Jordan Elimination in Systems of Linear Equations. SN subjects estimate that they will be able to solve the problem in an estimated time of 60 minutes but have yet to be able to expressly state what they will do first when solving the problem.

This presentation shows that subject SN is carrying out activities of metacognitive awareness, namely being able to mention things that are known about the problem, knowing relevant knowledge that is known to be related to the task, knowing what must be done first to solve the problem and knowing one's position in the problem-solving process.

Furthermore, the subject completed the S1 problem longer than the self-determined time estimate. After the subjects solved the S1 and S2 problems, the researcher confirmed through interviews. From the results of interviews during undergraduate problem solving, the subjects explain the solution steps used in general but need to be more specific towards solving the problem faced and need clarification on the results obtained. Likewise, when solving S2 problems, SN subjects could explain the steps used in general but not specifically to the problem at hand. Subject SN realized that the results of the solution could have been more optimal and needed to be sure that the answer was correct. Even though they were given the opportunity and a series of metacognition questions, SN subjects still struggled and needed help to solve S1 and S2 problems. However, in the S1 and S2 problem-solving process, subjects can be said to carry out activities metacognitive regulation, namely being able to mention and explain the solution steps taken even though there are limited ideas, which makes the subject experience difficulty in solving S1 and S2 problems.

Next, the subject evaluates the written work that has been done. For solving S1 and S2 problems, the subjects felt confident and satisfied with the results of the solution, which needed to meet expectations due to their limited ideas. Hence, the subjects asked for more time beyond the given processing time to learn to understand the material more deeply. Then, the subjects could not explain the chosen strategy's effectiveness because the results of solving the problem were not yet sure. Therefore, the activity metacognitive evaluation in SN is done so that the subject can assess the thought process and the results obtained but cannot explain the effectiveness of the chosen strategy. Apart from that, subjects were also unable to assess the development of their abilities and understanding. This can be seen when, at the beginning, the subject states that he can do the work, but it turns out that at the end, the subject has yet to solve the problem at hand.

DISCUSSION

The research results on reflective and impulsive subjects showed that in solving the given elementary linear algebra problem, the subjects carried out all activities that were indicators of metacognitive awareness. In solving S1 and S2 problems, both subjects carry out metacognitive regulation activities, namely being able to mention and explain the completion steps taken. However, in practice, impulsive subjects completed answers more quickly. However, they experienced limited ideas, which made subjects experience difficulty in solving S2 problems even though they had been allowed to repeat and check answers, so the final problem-solving results needed to be corrected. This is in line with the results of research by Styoningtyas and Hariastuti (2020), which state that impulsive students need to be more careful and accurate in thinking and be too quick in making decisions.

This is different from reflective subjects who, after being allowed to check their answers, can correct them when they find errors. This can happen because reflective cognitive style students are cautious in solving problems. Therefore, when they find errors, they quickly correct them (Satriawan et al., 2018). Meanwhile, students with impulsive cognitive styles could be more patient in solving problems, so they need to realize when they make a mistake. Furthermore, this is supported by the results of research by Sudia and Lambertus (2017), which states that at each stage of problem-solving, impulsive subjects only provide answers without being able to correct the answers given. Apart from that, they need to confirm the answers' correctness. Meanwhile, reflective subjects can correct the answers given and ensure the correctness of the answers given.

Furthermore, reflective and impulsive subjects are aware of their thinking processes by assessing problem-solving results in the metacognitive evaluation indicator. Both subjects could also identify strategies used later for similar problems in general. However, the reflective subjects could not name other alternatives to solve the problem more effectively and only knew that the problem was solved using the steps that had been used. This can happen because of the influence of the learning model, so students are stuck with only one way when solving a problem. This is supported by the research results by Drozdzial-Szelest and Pawlak (2013), which state that students' tempo-conceptual cognitive style influences the learning process. Therefore, educators should consider their students' conceptual cognitive style and tempo in preparing learning plans to achieve learning objectives.

Next, the fast, accurate subject carries out all activities that are indicators of metacognitive awareness, metacognitive regulation, and metacognitive evaluation. Subject fast accurately solves problems faster than one's estimates and can provide correct final solution results. This is reinforced by research results, which state that individuals with a fast, accurate cognitive style can solve questions relatively quickly and thoroughly so that answers tend to be correct (Diana & Nurmawanti, 2020).

Furthermore, slow, inaccurate subjects only carry out all activities indicators of metacognitive awareness. Then, the subjects completed the problem longer than the estimated time set by themselves. Subjects realized that the results of the solution could have been more optimal and needed to be sure the answer was correct. Even though they were given the opportunity and a series of metacognition questions, the subjects still needed help to solve the problem. However, in the S1 and S2 problem-solving process, subjects can be said to carry out metacognitive regulation activities, namely being able to mention and explain the solution steps taken. However, there are limited ideas that make the subject experience difficulty in solving S1 and S2 problems, so they cannot solve the problem correctly. This is in line with research results, which state that children with a slow, inaccurate cognitive style have the characteristic of being slow in answering questions but not being careful so that the answers they give tend to be correct (Diana & Nurmawanti, 2020). Then, an individual who can write the known information on a question does not necessarily mean that the individual can solve the question that has been given (Sholihah & Afriansyah, 2018).

Next, at the metacognitive evaluation stage, slow, inaccurate subjects could assess the thought process and results obtained. However, they were needed to be able to explain the effectiveness of the chosen strategy. Apart from that, the subject was also unable to assess the development of his abilities and understanding because the subject stated that he could do the work. However, it turned out that, in the end, the subject could not solve the problem. This is supported by research results, which state that students who are slow and careless tend not to apply metacognitive skills activities to themselves (Widadah & Afifah, 2013).

CONCLUSION

Based on the research and discussion results, it can be concluded that students with a cognitive style are reflective and impulsive in solving a given elementary linear algebra problem and carry out all activities that are indicators of metacognitive awareness and metacognitive regulation, as well as several indicators of metacognitive evaluation. Reflective and impulsive subjects know their thought processes by assessing problem-solving results. They can identify strategies to be used next for other similar problems. However, the reflective subjects could not mention other alternatives to solve the problem more effectively and only knew that the problem was solved using the steps that had been used. However, reflective subjects could complete the results of their problem-solving with correct final results, while impulsive subjects solved problems with incorrect results.

Students with a fast, accurate cognitive style can solve elementary linear algebra problems given by mathematics by carrying out all activities: metacognitive awareness, metacognitive regulation, and metacognitive evaluation indicators. Fast, accurate subjects can also solve all problems with the correct final results. Meanwhile, students with a slow, inaccurate cognitive style carry out all activities that are indicators of metacognitive awareness and several indicators of metacognitive regulation but still need to be able to carry out metacognitive evaluation activities. The slow, inaccurate subject could not solve the problem with the correct final result. Educators can consider the results of this research in designing effective student-centered learning methods based on their cognitive style and metacognitive profile so that the desired learning objectives can be achieved.

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