

Description of the Level of Procedural Mathematical Fluency in Students of SMP Negeri

1 Baitussalam.

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Abstract :

The aim of this study is to describe the level of procedural mathematical fluency among students in solving problems related to number patterns in grade VIII at SMP Negeri 1 Baitussalam. This research employs a qualitative descriptive approach with three participants categorized into three levels: high, medium, and low. The instruments used in this study are a procedural mathematical fluency test sheet and an interview guide. Data collection was conducted through written tests and interviews. The results indicate that (1) students in the high category met all indicators, (2) students in the medium category met two out of three indicators, and (3) students in the low category met only one indicator.

PENDAHULUAN

Regulation of the Ministry of Education and Culture Number 20 of 2016 explains that in the dimension of knowledge, students are required to possess factual, conceptual, procedural, and metacognitive knowledge so they can connect various types of knowledge in different contexts (Permendikbud No. 20, 2016). Regulation Number 21 of 2016 also states that students are expected to understand and use concepts, utilize symbols in modeling, identify information, and select the most effective strategies when facing mathematical problems (Permendikbud No. 21, 2016).

This aligns with the goals of mathematics education set by the 2013 curriculum, which states that mathematics should enhance and create a balance between attitudes, knowledge, and skills (Agus Pahrudin, Dona Dinda Pratiwi, 2019). The National Council of Teachers of Mathematics (NCTM) has also established standards for mathematical abilities, including mathematical communication, mathematical reasoning, mathematical problem-solving, mathematical connections, and mathematical representation (Mohammad Archi Maulyda: 14).

The mathematical abilities of students are crucial in the learning process and in solving mathematical problems. To achieve the desired mathematical abilities, students must possess skills in engaging in mathematical activities, referred to as mathematical proficiency. Kilpatrick, Swafford, and Findell define mathematical proficiency as a comprehensive term for mathematical expertise, knowledge, competencies, and the importance of these areas for successful mathematics learning. They identified five interconnected components of mathematical proficiency: 1) Conceptual Understanding; 2) Procedural Fluency; 3) Strategic Competence; 4) Adaptive Reasoning; 5) Productive Disposition (Jeremy Kilpatrick, Jane Swafford, et al., 2001).

Indonesia's participation in the Programme for International Student Assessment (PISA) shows that in 2018, Indonesia scored 379 in mathematics. This score represents a decline from the 386 obtained in 2015, which is unfortunate given that the international average score is 489, and Indonesia has not been able to reach scores above 400 (Mikael Dewabrata, 2019). This indicates that the mathematical literacy of Indonesian students remains low. Furthermore, the quality of mathematics education is reflected in the average scores of the National Examination for junior high schools in Indonesia, particularly in Aceh Province, which can be considered unsatisfactory. The average score for the 2017/2018 National Examination was 35.15, while in 2018/2019 it was 38.72. Although there was an increase of 3.57 in 2018/2019, it still does not indicate satisfactory mathematics learning outcomes.

The weaknesses in certain mathematical proficiency skills are also evident from observations at SMP Negeri 1 Baitussalam, particularly in class VIII-1 with 27 students. The researcher observed the five components of math proficiency by providing problems covering four components: conceptual understanding, procedural fluency, strategic competence, and adaptive reasoning. The fifth component, productive disposition, was assessed through 30 statements regarding students' attitudes towards mathematics learning.

Of all the components of mathematical proficiency tested on the students, only the conceptual understanding component showed satisfactory results. The other four components—procedural fluency, strategic competence, adaptive reasoning, and productive disposition—did not achieve optimal results.

The deficiencies in these essential skills indicate that students have not mastered them adequately and do not meet expectations. As revealed in research by Uray Windi Haryandika, students have not fully developed good procedural mathematical fluency, often asking what steps to take to solve the problems they work on. They still do not know when and how to

apply procedures flexibly, efficiently, and effectively; they can only work on problems similar to those demonstrated by the teacher on the board (Uray Windi Haryandika, 2017).

Based on the discussed issues, it is necessary to examine the procedural mathematical fluency and productive disposition of students to guide them in using their procedural knowledge fluently, correctly, and flexibly in solving mathematical problems, as well as to foster a positive attitude and perspective towards mathematics itself. Given the background presented above, the researcher will conduct a study titled "Description of Procedural Mathematical Fluency in Students of SMP Negeri 1 Baitussalam."

RESEARCH METHOD

This study aims to describe the level of procedural mathematical fluency and productive mathematical disposition possessed by the students. Based on this objective, the researcher employs a qualitative approach with a descriptive research type. The qualitative approach in this study is characterized by findings that are not obtained through statistical calculations, but rather as research results presented in the form of texts or descriptions explaining how the research was conducted. The study was carried out from October 12 to 14, 2022, at SMP Negeri 1 Baitussalam. The subjects of this study were three students from class VIII-1 at SMP Negeri 1 Baitussalam.

The test instruments used included open-ended questions on the topic of number patterns, followed by interviews with the subjects. The researcher analyzed the data based on the students' responses, focusing on their level of procedural mathematical fluency. The levels of procedural mathematical fluency are as follows:

Table 1: Classification of Students Based on Procedural Mathematical Fluency.

Nilai	Kategori
75% – 100%	Tingkat Tinggi
50% – 74,55%	Tingkat Sedang
< 50%	Tingkat Rendah

Dengan perhitungan skor kelancaran prosedural matematis peserta didik:

$$TKPM = \frac{Skor_{yang\ diperoleh}}{Skor_{maksimal}} \times 100$$

RESULTS AND DISCUSSION

The data from the research presented here includes activities and descriptions of the results from the tests and interviews conducted by the researcher. The data collection process was carried out in two stages. The first stage involved administering the Procedural Mathematical Fluency Test (TKPM-1) followed by interviews with each selected subject after they completed TKPM-1. In the second stage, the TKPM-2 test was administered again, followed by interviews with each subject after they completed TKPM-2. The level of procedural mathematical fluency in solving problems related to number patterns and the level of productive mathematical disposition among students can be identified from the students' answers and further supported by the interviews.

The subjects selected from each category based on the results of the procedural mathematical fluency test and the productive disposition questionnaire can be seen in the table below:

Table 2: Subject Codes in the Study of Procedural Mathematical Fluency and Productive Mathematical Disposition

No	Nama Peserta Didik	Kategori
1.	AN	Tinggi
2.	MIR	Sedang
3.	AR	Rendah

The student selected as the subject representing the high category is Subject AN, who achieved very good scores on both the first and second procedural fluency tests. Subject AN demonstrates excellent procedural fluency in terms of general procedural knowledge. In questions 1, 2, and 3, Subject AN can accurately and completely write down the information provided in the problems. Subject AN also shows excellent procedural fluency in knowing when and how to use procedures correctly. For questions 1, 2, and 3, Subject AN can create a solution plan and write out the procedure completely, leading to the correct answer. Furthermore, Subject AN exhibits excellent procedural fluency in displaying procedures flexibly, accurately, and efficiently. In questions 1, 2, and 3, Subject AN carefully checks each step of the solution and the results obtained.

The student selected as the subject representing the medium category is Subject MIR, who achieved satisfactory scores on both the first and second procedural fluency tests. Subject MIR shows good procedural fluency in terms of general procedural knowledge. In questions 1, 2, and 3, Subject MIR can accurately and completely write down the information provided in

the problems. Subject MIR demonstrates good procedural fluency in knowing when and how to use procedures correctly. For questions 1, 2, and 3, Subject MIR can create a solution plan and write out the procedure completely, leading to the correct answer. However, Subject MIR has less satisfactory procedural fluency in displaying procedures flexibly, accurately, and efficiently. In questions 1, 2, and 3, Subject MIR cannot carefully check each step of the solution and the results obtained.

The student selected as the subject representing the low category is Subject AR, who achieved lower scores on both the first and second procedural fluency tests. Subject AR demonstrates satisfactory procedural fluency in terms of general procedural knowledge. In questions 1, 2, and 3, Subject AR can accurately and completely write down the information provided in the problems. However, Subject AR shows less satisfactory procedural fluency in knowing when and how to use procedures correctly. In questions 1, 2, and 3, Subject AR cannot create a solution plan or write out the procedure completely, and does not lead to the correct answer. Subject AR also has poor procedural fluency in displaying procedures flexibly, accurately, and efficiently. In questions 1, 2, and 3, Subject AR cannot carefully check each step of the solution and the results obtained.

Table 3: Data Triangulation Analysis of Procedural Mathematical Fluency for the Three Subjects.

Indikator	Data TKPM-1	Data TKPM-2	Kesimpulan
Kelancaran Prosedural			
SUBJEK AN	Subjek AN memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai prosedur secara umum. Pada soal nomor 1,2,3 subjek AN dapat menuliskan informasi yang diketahui pada soal secara lengkap dan benar.	Subjek AN juga sama memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai prosedur secara umum. Pada soal nomor 1,2,3 subjek AN dapat menuliskan informasi yang diketahui pada soal secara lengkap dan benar.	Subjek AN memiliki kelancaran prosedural yang sangat baik untuk indikator pengetahuan mengenai prosedur secara umum pada soal TKPM-1 dan TKPM-2.
Pengetahuan	Subjek AN memiliki	Subjek AN juga sama	Subjek AN memiliki

mengenai kapan dan bagaimana menggunakan prosedur dengan benar kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar. Pada soal nomor 1,2,3 subjek AN dapat membuat rencana penyelesaian dan menulis prosedur secara lengkap dan mengarah pada jawaban yang benar. memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar. Pada soal nomor 1,2,3 subjek AN dapat membuat rencana penyelesaian dan menulis prosedur secara lengkap dan mengarah pada jawaban yang benar. kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar pada soal TKPM-1 dan TKPM-2.

Pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien Subjek AN memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien. Pada soal nomor 1,2,3 subjek AN mengecek kembali dengan teliti setiap langkah penyelesaian dan hasil yang diperoleh. Subjek AN juga sama memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien. Pada soal nomor 1,2,3 subjek AN mengecek kembali dengan teliti setiap langkah penyelesaian dan hasil yang diperoleh. Subjek AN memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien pada soal TKPM-1 dan TKPM-2.

SUBJEK MIR

Pengetahuan mengenai prosedur secara umum Subjek MIR memiliki kelancaran prosedural yang baik pada indikator pengetahuan mengenai prosedur secara umum. Pada soal nomor 1,2,3 subjek MIR dapat memiliki kelancaran prosedural yang cukup baik pada indikator pengetahuan mengenai prosedur secara umum. Pada soal nomor 1,2,3 subjek MIR dapat memiliki kelancaran prosedural yang baik untuk indikator pengetahuan mengenai prosedur secara umum pada soal TKPM-1 dan TKPM-2.

menuliskan informasi yang diketahui pada soal secara lengkap dan benar.

menuliskan informasi yang diketahui pada soal secara lengkap dan benar.

Pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar

Subjek MIR memiliki kelancaran prosedural yang baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar. Pada soal nomor 1,2,3 subjek MIR dapat membuat rencana penyelesaian dan menulis prosedur secara lengkap dan mengarah pada jawaban yang benar.

Subjek MIR juga sama memiliki kelancaran prosedural yang cukup baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar. Pada soal nomor 1,2,3 subjek MIR dapat membuat rencana penyelesaian dan menulis prosedur secara lengkap dan mengarah pada jawaban yang benar.

Subjek MIR memiliki kelancaran prosedural yang sangat baik pada indikator pengetahuan mengenai kapan dan bagaimana menggunakan prosedur dengan benar pada soal TKPM-1 dan TKPM-2.

Pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien

Subjek MIR memiliki kelancaran prosedural yang kurang baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien. Pada soal nomor 1,2,3 subjek MIR tidak dapat mengecek kembali dengan teliti setiap langkah penyelesaian dan hasil yang diperoleh.

Subjek MIR juga sama memiliki kelancaran prosedural yang kurang baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien. Pada soal nomor 1,2,3 subjek MIR tidak dapat mengecek kembali dengan teliti setiap langkah penyelesaian dan hasil yang diperoleh.

Subjek MIR memiliki kelancaran prosedural yang kurang baik pada indikator pengetahuan dalam menampilkan prosedur secara fleksibel, akurat dan efisien pada soal TKPM-1 dan TKPM-2.

SUBJEK AR

Pengetahuan mengenai prosedur secara umum

Subjek AR memiliki kelancaran prosedural yang baik pada indikator pengetahuan mengenai

Subjek AR juga sama memiliki kelancaran prosedural yang cukup baik pada indikator pengetahuan

Subjek AR memiliki kelancaran prosedural yang baik untuk indikator pengetahuan

prosedur secara umum. mengenai prosedur secara mengenai prosedur
 Pada soal nomor 1,2,3 umum. Pada soal nomor secara umum pada soal
 subjek AR dapat 1,2,3 subjek AR dapat TKPM-1 dan TKPM-2.
 menuliskan informasi menuliskan informasi yang
 yang diketahui pada soal diketahui pada soal secara
 secara lengkap dan benar. lengkap dan benar.

Pengetahuan Subjek AR memiliki Subjek AR juga sama Subjek AR memiliki
 mengenai kapan kelancaran prosedural memiliki kelancaran kelancaran prosedural
 dan bagaimana yang kurang baik pada prosedural yang kurang yang kurang baik pada
 menggunakan indikator pengetahuan baik pada indikator indikator pengetahuan
 prosedur mengenai kapan dan pengetahuan mengenai mengenai kapan dan
 dengan benar bagaimana menggunakan kapan dan bagaimana bagaimana
 prosedur dengan benar. menggunakan prosedur menggunakan prosedur
 Pada soal nomor 1,2,3 dengan benar. Pada soal dengan benar pada soal
 subjek AR tidak dapat nomor 1,2,3 subjek AR TKPM-1 dan TKPM-2.
 membuat rencana tidak dapat membuat
 penyelesaian dan menulis rencana penyelesaian dan
 prosedur secara lengkap menulis prosedur secara
 dan belum mengarah pada lengkap dan belum
 jawaban yang benar. mengarah pada jawaban
 yang benar.

Pengetahuan Subjek AR memiliki Subjek AR juga sama Subjek AR memiliki
 dalam kelancaran prosedural memiliki kelancaran kelancaran prosedural
 menampilkan yang kurang baik pada prosedural yang kurang yang kurang baik pada
 prosedur secara indikator pengetahuan baik pada indikator indikator pengetahuan
 fleksibel, akurat dalam menampilkan pengetahuan dalam dalam menampilkan
 dan efisien prosedur secara fleksibel, menampilkan prosedur prosedur secara
 akurat dan efisien. Pada secara fleksibel, akurat dan fleksibel, akurat dan
 soal nomor 1,2,3 subjek efisien. Pada soal nomor efisien pada soal
 AR tidak dapat mengecek 1,2,3 subjek AR tidak dapat TKPM-1 dan TKPM-2.
 kembali dengan teliti mengecek kembali dengan
 setiap langkah teliti setiap langkah
 penyelesaian dan hasil penyelesaian dan hasil yang
 yang diperoleh. diperoleh.

Based on the data triangulation in Table 3 above, there is a consistency in the procedural mathematical fluency of subjects AN, MIR, and AR in each question of TKPM-1 and TKPM-2. Thus, the data on the procedural mathematical fluency of the three subjects is valid.

In terms of general procedural knowledge, subjects were able to analyze problems by understanding them, linking information to the problem's objectives, and planning solutions. This means students must recognize the information given, relate it to the goal of the problem, and translate verbal statements into mathematical models (Arsety Ambar Suryani Huzaimy, 2019). This illustrates the subjects' ability to connect algorithmic processes with problem situations and use algorithms correctly.

Next, regarding the knowledge of when and how to use procedures correctly, subjects were able to select appropriate methods and apply them to solve mathematical problems. Additionally, subjects must understand the principles of the methods used (Rini Aprianti, 2014). As stated by Novita Sari et al., in solving a problem, attention should be given to how the steps will be applied by considering the form and situation of the problem and the suitable method to use (Novita Sari, Edy Yusmin, et al., 2018).

For the indicator of displaying procedures flexibly, accurately, and efficiently, subjects performed the entire problem-solving process. They used clear procedures, carried out basic calculations correctly, and understood alternative procedures to verify that their answers were correct by rechecking their completed solutions. This aligns with the research conducted by Deni Pratidiana and Nunung Muhayatun, which found that subjects were able to solve problems accurately and provide explanations for their solutions (Deni Pratidiana and Nunung Muhayatun, 2021).

CONCLUSION

Subjects with high procedural fluency were able to completely and accurately write down the information given, create solution plans, and fully outline procedures leading to correct answers, as well as carefully check each step of their solutions and the results obtained. Therefore, subjects with high procedural mathematical fluency meet all three indicators of procedural fluency.

Subjects with medium procedural fluency could write down the information given accurately and completely, create solution plans, and fully outline procedures leading to correct answers, but they could not carefully check each step of their solutions and the results

obtained. Thus, subjects with medium procedural mathematical fluency meet two indicators of procedural fluency.

Subjects with low procedural fluency could accurately and completely write down the information given but could not create solution plans or fully outline procedures leading to correct answers. Furthermore, these subjects could not carefully check each step of their solutions and the results obtained. Therefore, subjects with low procedural mathematical fluency only meet one indicator of procedural fluency.

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