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Exploring Metacognitive and Discursive Activities Using a Video Transcript

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Abstract: Metacognition plays an essential role in learning mathematics. However, due to the lack of observational systems for evaluation of metacognition in mathematics instruction, rarely anything is known about how metacognition is practiced and fostered when teaching and learning mathematics in class. The study aims to evaluate the metacognitive-discursive activity in a real class when solving mathematical problems. During the learning implementation, we use document camera technology so that students can present their solutions and show that they are responsible for them. The type of research used is interpretative qualitative. The data collection methods used were documentation and learning videos. Data collection procedures in this study are 1) the teacher asks all students to solve the given problem 2) students are asked to discuss the problem with all other students in front of class, 3) the researchers observe and listen to the results of discussion, choose a conversation during discussions, transcript it 4) Interpretate of each utterance by using the system for an evaluation of metacognitive-discursive activities, 5) Analysis of all selected learning scenes guided by several questions, The results show that (1) there are a metacognitive activities both from the teacher and from the students, (2) there are metacognitive activities with justification when students give answers without being asked by the teacher, (3) there are discursive activities with special qualities, (4) there are negative discursive activities that make difficult to understand the mathematical content.

Keywords: Technology, Video transcript, Metacognition,

Introduction

Many studies in education have been conducted to improve the quality of mathematics learning. The purpose of learning mathematics is learning to reason, learning to control mathematical activities, learning to solve problems; learning to link ideas; and learning to represent ideas and to communicate. These competencies are needed so that students can have the ability to obtain, manage, and utilize information to survive in an ever-changing, uncertain, and competitive situation. However, in reality, mathematics learning has not achieved optimal results. The results of Programme for International Student Assessment (PISA) test, especially in the field of mathematics from students in Indonesia are still very low. In 2003, Indonesia ranked 38th out of 40 participating countries with an average score of 360, in 2012, Indonesia ranked 64th out of 65 participating countries, with an average score of 375, in 2015, Indonesia ranked 74th out of 79 participating countries, with an average score of 386, and in 2018, Indonesia ranked 73rd out of 79 countries with an average score of 379 (OECD, 2019).

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Various studies have been conducted in an effort to improve PISA results including the development of PISA model statistics questions (Junika et al., 2019), and the development of questions using the context of Lampung (Putra et al., 2016), the application of problem-solving-oriented learning approaches, the development of teaching materials and curriculum changes, However, these efforts seem to have brought little success or have not experienced significant changes, as seen from the results of the last PISA assessment. Indonesia consistently ranked in the bottom 10 of all countries involved in the assessment.

This fact is reinforced by several studies, such as Hamidi (2019) who reported that students' ability to solve mathematical problems of the PISA model is still low, with an overall score of 415 below the average OECD score (500). Similar findings were also reported by Andriani (2018) regarding students' ability to solve science literacy problems using the PISA framework, where only 54.9% of students could work on problems at level 2. Noviana (2020) reported that students' mathematical literacy skills in solving problems were also still very low, only 7.13% of students were able to solve problems. Ate (2021) stated that students' numeracy literacy skills were still very low, with 90% of students unable to solve problems. Thus, these various studies indicate the challenges still faced in improving the quality of mathematics learning in Indonesia.

The efforts that have been made have focused more on improving output and there does not seem to be any systematic research to evaluate the learning process i.e. the actual instruction provided that affects output. Cohors-Fresenborg and Kaune (1993) see metacognition as a feature of teaching quality that can be used to evaluate the learning process. In general, metacognition is defined as thinking about what one thinks (Schoenfeld, 1992), but this definition does not adequately explore students' metacognition when solving mathematical problems. Some experts more specifically define that metacognition is one's knowledge of cognitive processes and one's awareness of a mathematical problem that involves the process of planning, monitoring, and evaluating problem solutions (Flavell, 1976; Wilson and Clarke, 2002). Most definitions of metacognition distinguish between metacognitive knowledge (e.g. one's knowledge about cognitive tasks in mathematics, about strategies for coping with these tasks, and about one's competencies related to these tasks and strategies), metacognitive skills (e.g. one's procedural knowledge for organizing one's own problem solving and learning activities) and the exercise of such skills in the form of metacognitive activities (Veenman at al., 2006). Such differentiation is important for theoretical considerations regarding the meaning of metacognition, whereas in concrete situations it is almost impossible to distinguish between these different components.

Metacognition has been considered to play an important role in regulating students' cognitive processes in problem solving and in mathematics learning in general, particularly when constructing and organizing knowledge (Schraw & Moshman, 1995; Wilson & Clarke, 2004), as well as in the use of self-regulated mathematics in different contexts to achieve some goals (Boaekaerts, 1999). Thus, from a teacher's point of view, promoting students' metacognition can be considered as a means for effective teaching - to engage students in the cognitive processes necessary to understand the mathematical concepts and methods to be learned. Metacognition should also be considered as an instructional goal - as an important aspect of students' mathematical competence to be enhanced through teaching.

Much research has been conducted on modeling, analyzing and promoting metacognition in solving mathematical problems. Many of the paradigms adopted in this context in previous research are based on the assumption that the way students learn to solve problems is to "first acquire the needed mathematical knowledge, then acquire problem-solving strategies that will help them decide which procedures to deploy, then acquire metacognitive strategies that will trigger the proper use of the problem-solving strategies (...)." (Lesh & Zwojewski, 2007). Such paradigms not only separate problem solving from concept development. They also separate metacognition from teaching mathematical concepts and reduce the promotion of metacognition to teaching a list of simple rules (e.g., make a plan, draw a picture, mark important words, control your solution, evaluate the result). This separation is considered one of the possible reasons for the unimpressive results (ibid.) of this kind of research, as it seems almost impossible to acquire sufficient metacognitive knowledge to solve problems without engaging in metacognitive processes when building substantial meta-mathematical knowledge. It is therefore necessary to shift the focus of research on metacognition from teaching problem solving to ordinary teaching situations where learners have to learn mathematical concepts and methods.

Since little is known about how metacognition can be effectively developed, this article will deeply analyze metacognitive practices in regular classrooms so as to improve students' metacognition. Moreover, promoting metacognition does not mean simply teaching one student how to organize, control and evaluate his/her cognition when learning and applying mathematical concepts and methods, but needs to organize teaching in such a way that as many students as possible engage in metacognitive activities. This can be achieved by building a culture of discursive discussion that encourages students to control and regulate their own cognition and understanding when other students or the teacher explain their ideas, solutions, conceptions or difficulties in understanding the mathematical ideas discussed. This concept is known as metacognitive-discursive activity. Metacognitive-discursive activities can be stimulated, maintained and habituated through tasks (Kaune, 1999, 2001a, b; Kaune, et al., 2010; Sjuts, 2001b) and appropriate didactic contracts (Sjuts, 2003). The tasks are designed in such a way that students are not only instructed to use metacognitive activities to support the problem solving process, but also students use metacognitive activities to understand mathematical terms (understand definitions, theorems), use these terms to justify problems, check the use of mathematical terms, check for possible misunderstandings, reflect on mathematical terms, discuss combinations between explanations and results of thinking as a form of problem solving that uses metacognitive activities.

Didactic contract is a conceptual framework that emphasizes the importance of interaction between teachers and students in the process of learning mathematics (Brousseau, 1986). This concept aims to create an effective learning environment. In this study, the didactic contract includes students who want to ask questions or answers or argue, must raise their hands first and will speak if they have been asked by the teacher or other students; students explain and give reasons for arguments or answers and if possible students do it themselves without being asked by the teacher; students ask questions about explanations that are not understood, and students argue when they disagree. In order for the didactic contract to be implemented, it is necessary to have digital technology that makes it easy for students to point to the parts that are being explained, makes it easy for other participants to see the answers clearly, or if another participant wants to check or comment on certain parts, then the participant can easily point to the part in question. Thus, this technology can facilitate discursive discussions. By presenting their solutions via a document camera students show that they are responsible for their writing. In Moza et al. (2024) there is analyzed a lesson at the beginning of grade 7, where the teacher and the students learn to practice that contract.

Method

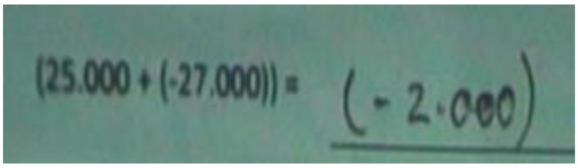
This research analyzes the discussions conducted by teachers and students, as well as between students as far as these discussions can be heard by all students in the class and does not analyze the teacher's remarks to individual students when they work in small groups or discussed in small groups when solving problems. The population in this study was seventh grade students and the sample was selected by purposive sampling technique. Data was collected through audio-visual recordings. From these recordings, the researcher will select the part, which will be analyzed~~,~~ transcribing it using Video Transcript-10.8 program. The documents used in this study are photos from a document camera. This way one can see better what students or teachers display under the document camera. Data analysis in this research uses inductive data analysis and the theory used is *grounded theory*. This *grounded theory* research uses three sequential steps, namely *open coding, selective coding* and *theoretical coding* (Jones and Alony, 2011). In the *open coding* stage, the researcher interpreted the transcribed teaching scenes into codes that fit the metacognitive-discursive activity category system developed by Cohors-Fresenborg and Kaune (2007), further developed by Nowińska (2018) and Cohors-Fresenborg and Nowińska (2021). The researcher has to justify his coding in the separate column "Comments". At the *selected coding* stage, *the* researcher deepened the code obtained from the *open coding* process. Deepening analysis is carried out by validating data to experts. *The theoretical coding* stage is the last stage in *grounded theory,* namely the preparation of theories or conjectures.

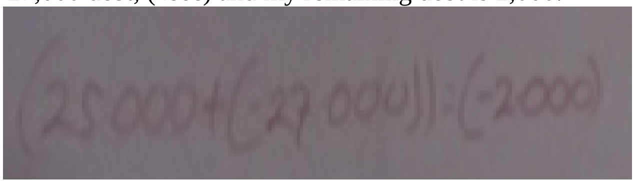
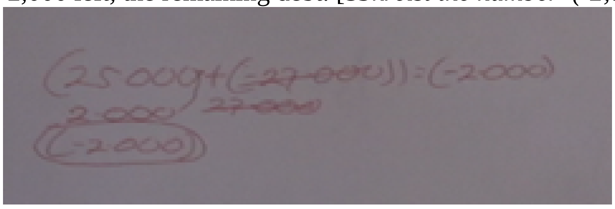
Results and Discussion

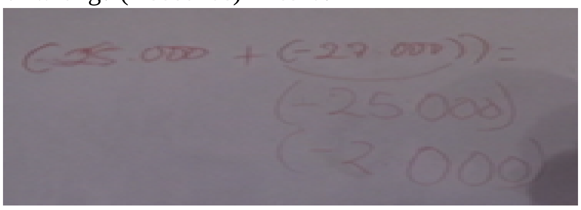
In this study, a 7th grade class was observed that had been taught mathematics since the beginning of the school year according to the new concept (Kaune & Cohors-Fresenborg, 2021). The transcripts were analyzed with the aim of seeing how teachers and students practiced metacognitive-discursive activities after only a few weeks in class. This lesson was chosen because it was a very interesting discussion between several students who all had different thoughts about the presentation of the given problem. The following will present transcripts of conversations between students and teachers when solving simple arithmetic calculation problems and the results of analyzing the transcripts. The entire conversation is not written in this article as there is not enough space. However, the graph depicts the entire discussion during solving the problem.

In the prefix of the code the letter "*b*", written in italics, means that the person gives a justification, in the prefix of the code the letter "*f*", written in italics, means that the person requests a metacognitive-discursive activity, in the prefix of the code the two letters "*bf*", written in italics, mean that the person gives a justification of her/his request for a metacognitive-discursive activity.

Table 1. Text, code and comments

P	Text	Code	Comments
L.	We continue with part a. (4sec) [*Some students raise their hands.*] S1.		It is a question of mathematical discussion of the tasks set. Therefore, no metacognitive or discursive activities were classified.
S1	Min 2,000. Open bracket, min 2,000 close bracket. [*S1's answer from his chair and the teacher wrote S1's answer under KD.*] Sa... I have 25,000 money and I deposit 27,000 debt. So, I paid the debt with 25,000, (3sec) paid paid the debt 27,000, so sa so the final balance is min 2,000. How about you guys, is my answer right or wrong? Anyone want to comment? 	R7 ND3b *f* M5	S1 imagined algebraic calculation as a bookkeeping process (R7). The argumentation is incomprehensible because there are missing sentences, so it can be classified as ND3b. S1 also asked his friends to check his argument (*f*M5).
S2	That's because it says [we] have to increase the debt. But actually we have to borrow 2,000 to the bank, then we form the opposite, so that the initial balance does not change, we add minus 2,000. That money, we combine 25,000 money with 2,000 money, it will work ... yes ... it will be 27,000 money, then we will pay it.	*b*M2 D1a D1b R7 *b*R3c	S2 explained that he disagreed with the formulation in S1's answer (*b*M2 with respect to D1a and D1b). As a result of the reflection process, he chooses a specific decomposition to make his calculations understandable (*b*R3c).
L.	How is S1?		The teacher encourages S1 to say something about S2's utterance. This is not classified as an invitation for metacognitive activity.
S1	My explanation is also correct. I have 25,000 so I subtract me... minus 27,000. So I pay first, I divide 27,000 into minus two... 27,000 becomes minus 25,000 and minus 2,000. So, I paid. So I paid 25,000 debt from 27,000, so the remaining 2,000, which is minus 2,000. (6sec)	*b*R3c D1b R7	S1 ignored S2's explanation and maintained his explanation. He explained his strategy in a simpler way so that his calculation could be understood (*b*R3c in relation to D1b).S1 envisioned the division of debt precisely into 25,000 debt and 2,000 debt (R7).
L.	What do you think, S2?		The teacher encourages S2 to say something about what S1 said. This is not classified as an invitation for metacognitive activity.
L.	Okay, I ask S2 to make it on the board as S2 has said earlier about this. Let's demonstrate on the board, later S1 will have a version on the board too, then we will see which reason is appropriate for the term [*Teacher asks S2 to present his explanation on the board*]. Come on S2, as you explained earlier, make it on the board here. Like using cards, right you explained earlier visualization, try it!. (5sec) Try S2! (4sec) Come on, as S2 explained earlier, just make it on the board. Write this, this, so that it is clear to, friends can also understand. Can you? [*S2 ignores the teacher's invitation and questions*] S1, want S1...? Want to? (8sec). [*S3 raised his*	*bf*R3c P2 D1d	In this part, an L. plays the role of a teacher. The teacher suggested that S2 and S1 write their versions on the board. With the following statement she also gave a reason for her request "then we will see which reason fits the term" (*bf*R3c). Then she wants both versions to be analyzed

	hand, then S1 got up *from his chair*] S3 want to help? Yes, you two can make the same version how? According to S1's thinking. [*teacher gives marker to S1*] (6sec) Who wants to go first? Oh S3 first yes. Others try to pay attention, later you can comment on the explanation, pay attention to every word that is said.	P2 D1d	to see which version fits the term better. The teacher planned how the students' metacognitive activities would be organized (P2). This step also facilitates the debate. Therefore, D1 is also classified. By requesting that students pay attention to each word, the teacher wants to lay the foundation for the students' subsequent metacognitive activity. So he is planning a metacognitive activity. That's why P2 is classified. This reprimand is a measure for structuring the debate later, which is why D1d is also classified.
S3	[*S3 demonstrated it with the visualization method. At the same time he writes on the board what he says*]. I have, here I wrote 25,000 money, and I paid my money, I paid 20 ... min 27,000 debt, (4sec) and my remaining debt is 2,000.  I got minus 2,000 because here, I have minus 27,000 debt, and here I only have 25,000 money. So that I can pay two ... minus 27,000 debts, I borrow money, add money 2,000. (3sec) [*S3 writes 2,000 with the number 25,000 on the board.*] So that my initial balance remains, mena ... I then borrowed money, I borrowed minus twoapu... 2,000 debt. (5 seconds) [*S3 writes (-2,000) under the number 2,000 on the board*] minus 27,000 can already be paid here, this is added, minus you ..., 25,000 plus 2,000 equals 27,000. [*S3 writes 27,000 on the board.*] This is the remaining debt, here I have 2,000 left, the remaining debt. [*S3kreist the number (-2,000)*]  How about you guys, is my answer right or wrong? (3 sec) S4.	*b*R3c D1a *f* M5	S3 explained his idea again in great detail (so here with bR3c in conjunction with D1a is classified). S3 asked his classmates to check his reasoning (*f*M5).
S4	S3, I'm still confused about this, said S3, uh S3 I ... mem ... make doubling of words, minus and debt. And that's it, what he pays is still owed *to* [*dialect*], can it be paid with money? Uh right, I was wrong. (4dtk)	*b*M5 D1b M8e	First S4 said that he was still confused with the explanation of S3 (D1b). S4 gave reasons after checking the explanation of S3 (*b*M5). When giving reasons for S3's explanation, he checked his own argument (M8e).
S3	Anyone else want to comment? (13 sec)	*f* R4	S3 asked his friends to recheck the solution method that had been explained

			(*f*R4).
L.	S1 want to explain too? [*S1 nods*] okay.	P1a D1a	Here the teacher has determined the steps that S1 will take so this is categorized as one-step planning (P1a).The teacher also immediately mentions the person (D1a).
S1	I have 25,000 money, [*S1 did not write the amount of money but the amount of debt (-25,000) on the board*].	R3b ND3b	Since the explanation of S1's chosen representation was not grammatically comprehensible, it was coded R3b with respect to ND3b.
S	Money, not debt.	M2	Students comment on the choice of words used, S1 mentions Rp 25,000 but writes Rp 25,000 debt (M2).
S1	[*S1 removes useless minus signs and brackets*]. I had 25,000 debt and I paid minus two...debts, uh mem...I...paid, paid 27,000 debt. (3sec) So the final result is 2,000 debt. (4sec) [*While S1 was explaining, he wrote each number he mentioned on the board*]. I divide by two... 27,000 becomes minus 25,000 becomes minus 2,000. (3sec) So, I deleted this one because this one is already split. [*S1 wants to delete (-27,000) off.*] This is already there, this will be 25,000, I de...ut...u...money 25,000, pay, I pay with 25,000 debt. So, I remove this, [*S1 wants to remove 25,000 and (25,000) and leave (-2,000) there.*] so that the final balance becomes 2,000 debt. How about you guys, is my answer right or wrong? (4 seconds) Kresna.	M8b D1d *b*R5 *f*M5 D1a	S1 self-monitored the choice of words he used to review his strategy explanation (M8b). He also wrote down what he said on the blackboard so as to make it easier for other students to understand (D1d). Here S1 explained his argument in a structured manner (*b*R5).
			At the end of his explanation, S1 asked friends to check his argument (*f*M5). S1 also mentioned the person who meant Kresna (D1a).
S6	That's right.	M5	S6 checked the argumentation of S1 (M5).
S1	Does anyone have any comments? [*S4 raises her hand.*] (8 seconds) Lora.	*f* R4	S1 asked his classmates for comments (*f*R4); since it was not only asking if it was correct, it was not classified with *f*M4.
S4	S1 here, what do we want to pay, can we split it? (3sec) Uh, what do we want to deposit, can we split it? (4sec) [*S1 erases result (-2,000) and L. helps him*].	R4	S4 assessed S1's use of methods through a question (R4).

a) : How are cognitive teaching activities seen in this scene?

It can be seen from the transcript that the teacher himself conducts monitoring or reflection at the end of the discussion. This activity serves to summarize what has been discussed previously between students. From the transcripts, it can also be seen that from the beginning students practiced metacognitive activities without special instructions from the teacher.

The first two statements from the teacher, classified as requests, are more of an encouragement for students to debate on their own. Even after that, students were metacognitively active without being prompted by the teacher. It is noteworthy that two students monitored their own statements such as: S4 checked his own argument (M8e) and S1 checked his own choice of words (M8b). This part shows that it is important that both students formulate what they mean. This kind of behavior is remarkable for students of their age.

Figure 1. The overall output results using the video transcript software

b) Does the metacognitive activity contain detailed reasoning or explanation?

Many students' statements were immediately made in great detail and with reasons without being asked by the teacher. Often, students asked other students to do metacognitive activities accompanied by reasons. Only at the end of the conversation was there a metacognitive activity with reasoning (*b*R3c) on the part of the teacher.

The teacher's explanation was remarkable in that she explained why she required two students who had made different judgments to present their thoughts, namely for all the other students to see (*bf*R3c).

c) Are there discursive activities with special qualities?

In this scene, the first surprising thing is that teacher P2's specific discursive activity has been classified twice with respect to D1d. This shows that the two alternatives are seen as the basis of a complex discourse.

But even among the students, discursive activity of a special quality can be found in some places: S5 repeats what S1 says so that it is clear what is being said (D1c). S1 repeats in two places, what he said earlier so that his opinion becomes clear (D1c). S2 refers to what S1 said (classified as D1c).

The teacher also refers to her summary analysis according to what S1 said (classified as D1c). The specific discursive activities mentioned here (D1d and D1c) show that not only the teacher knows how important it is that all students involved in the discussion always know exactly what is going on. The students have also learned how to quote statements (or mathematical representations) from their classmates to ensure that a discussion relates precisely to its topic.

d) Are there negative discursive activities that make it difficult to understand the mathematical content?

There are only a few places where negative discursive activity has also been coded: four times, it was not possible to understand exactly what he meant when S1 made a statement (ND3b). He tried to explain what he was imagining, but S1 was not yet linguistically capable at these points.

The teacher did not try to urge S1 to use a clearer expression of language, but rather offered S1 a formulation that better expressed what S1 meant.

e) To what extent do students practice discussion among themselves, or does the teacher comments with a metacognitive activity on students' individual statements before they speak again?

In the chart above those parts are framed in blue color, in which there are no such interventions practiced. The following activities have been agreed with the class for the cognitive-discursive teaching activity:

When a student (in front of the class) gives a longer explanation (R);

- Then in the end, the student first asked a classmate whether the statement or calculation was correct; (*f*M)
- a student answers (M); if possible, he should justify his answer (*b*M)

- then the student asks his classmates if they have any comments on what he said (calculated); (*f*R)
- Then one or more classmates should comment (R).

f) Relationship between learning process analysis and metacognitive-discursive activity analysis

At the beginning of the transcript, S1 imagined the abstract math problem in the banking world. This activity has been classified as R7. In the *Theoretical Background* chapter of the textbook (Kaune & Cohors-Fresenborg, 2021), where the theoretical considerations behind this teaching *concept are explained,* in the sub-section *Model Concepts, Micro-worlds and Elementary Metaphors* (pp. 1-2) it is explained, that the discussion of ordering credit and debt balances should be done in such a way that later students can translate the task at hand into the banking world when calculating "abstract" arithmetic problems so that it becomes clear what is meant and what should be done. The whole discussion between students shows that this idea of metaphor can add to understanding. After S1's first statement, there was another interesting interaction between representation and imagination (R7): S2 imagined that he borrowed an additional 2,000 from the bank and compensated it with credits; then he had 27,000 credits and could continue counting. S1 imagined the exact division of debt into 25,000 debt and 2,000 debt. Then he could continue counting. By being asked to document the different forms of solving under the document camera or on the blackboard, and the practiced discursive activities (D1a, D1b and D1c), students can precisely follow the different thinking of S1, S2 and S3.

Complex discussions can be deciphered very precisely due to the accurate classification and reasoning given by each student during the conversation. Comprehension can be difficult (characterized by ND3a, ND3c, or ND3d) when participants in a conversation talk together without responding to the question or topic being discussed. Comprehension can also be impaired if each participant conveys their thoughts in a way that is difficult to understand linguistically (ND3b) or if the arguments presented are too brief or incomplete (ND3a).

Such a classification then makes it clear that the public classroom discussion is likely to be directionless or perhaps even chaotic. An assessment of the quality of teaching can be obtained through analyzing the entire teaching scene, not just from individual contributions to the conversation. The beam line helps to provide an overview, while the pattern of the conversation is described in the previous section. Justification in teaching culture can be observed at the first level when the teacher asks students to give reasons, the second level when students follow the request, the third level when students voluntarily give reasons without being asked, and a higher level when students ask their classmates to give reasons. Another indicator of teaching quality is seen when teachers or students, in difficult discussions, take steps to facilitate orientation in the discussion. For example, pointing appropriately to the point of the question, naming classmates who want to speak, clarifying different opinions at the beginning of contributions, and making appropriate notes to ensure differences in arguments are clear. Although, there are sometimes discrepancies between teachers' claims to summarize what students say and what is actually conveyed, which can affect the quality of teaching (ND3c).

Conclusion

From the discussion, it can be seen that learning with metacognitive-discursive activities and supported by teaching materials, didactic contracts and advanced digital technology is effective. Through the provision of teaching materials, students are helped to solve mathematical problems that refer to the micro world to build confidence when solving abstract tasks. In addition, teachers can exhibit different behaviors, listening and analyzing more than talking to themselves. Students can actively participate and provide clear arguments and listen to each other. Through digital technology, learning can take place quietly, students do not give answers in chorus so that the discussion can run well. So the effectiveness of the learning process, is not only determined by the number of metacognitive activities of individuals, but the quality of these activities shown in the interaction between participants; the more detailed the metacognitive activities are presented, the more precise and directed the control of the process of learner understanding.

Recommendations

In order to be able to conduct this kind of teaching analysis, the theoretical basics must first be practiced. The transcripts of these teaching videos, *especially the column "Comments",* can be used as learning materials. Furthermore, teachers should always train students to get used to raising their hands if they want to express their opinions or questions in class and get used to students automatically asking other friends for an answer or argument without waiting for the teacher's direction. In addition, when designing lessons, steps are needed that motivate students to carry out metacognitive activities and when implementing learning, it is necessary to use digital technology such as document cameras so that it helps to present students' answers and ideas.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM Journal belongs to the authors.

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References

Andriani, N., Saparini, & Akhsan, H. (2018). Kemampuan literasi sains fisika siswa smp kelas vii di sumatera selatan menggunakan kerangka pisa (program for international student assessment). *Jurnal Berkala Ilmiah Pendidikan Fisika, 6*(3*)*, 278-291.

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research*, *31*, 445–457.

Brousseau, G. (1986). Foundations and methods of the didactics of the mathematics. *Researches in Didactics of the Mathematics*, *7,* 33-115.

Cohors-Fresenborg, E. & Kaune, C. (1993). Zur konzeption eines gymnasialen mathematischen Anfangsunterrichtes unter kognitionstheoretischem Aspekt. *Der Mathematikunterricht, 39*(3), 4–11.

Cohors-Fresenborg, E. & Kaune, C. (2007). Modelling classroom discussion and categorizing discursive and metacognitive activities. In *Proceedings of CERME, 5*, 1180–1189.

Cohors-Fresenborg, E., & Nowińska, E. (2021). *Pengantar* kategorisasi kegiatan metakognitif-diskursif para siswa dan guru dalam pelajaran matematika. Weetebula: Lembaga Matematika Kognitif STKIP Weetebula, Weetebula.

Flavell, J. (1976). Metacognitive aspects of problem solving. In L. Resnik (Ed.). *The nature of intelligence* (pp.231-236). Hillsdale, NJ: Lawrence Erlbaum.

Hamidy, A., & Jailani, J. (2019). Kemampuan proses matematis siswa Kalimantan Timur dalam menyelesaikan soal matematika model PISA. *Jurnal Riset Pendidikan Matematika*, *6*(2), 133-149.

Junika, N., Izzati, N., & Tambunan, L. R. (2020). Pengembangan soal statistika model pisa untuk melatih kemampuan literasi statistika siswa. *Jurnal Pendidikan Matematika*, *9*(3).

Kaune, C. & Cohors-Fresenborg, E. (2017). *Kontrak untuk Perhitungan. Buku Kerja untuk Siswa Kelas 7*. Weetebula: Lembaga Matematika Kognitif STKIP Weetebula.

Kaune, C. & Cohors-Fresenborg, E. (2021). *Pedoman perhitungan sesuai kontrak*. Weetebula: Lembaga Matematika Kognitif STKIP Weetebula.

Kaune, C. (2010). Unterrichtsanalyse hinsichtlich des Einsatzes von metakognitiven Aktivitaten und Identifikation spezieller Unterrichtsskripte am Beispiel von vermischten Kopfubungen. In C. Kaun & E. Cohors-Fresenborg (Eds.). *Mathematik gut unterrichten. analyse von mathematikunterricht bezüglich metakognitiver und diskursiver aktivitäten*. Osnabrück: Forschungsinstitut für Mathematikdidaktik.

Kaune, C. (1999). Förderung metakognitiver aktivitäten durch geeignete Aufgabenstellungen. In *Beiträge zum Mathematikunterricht 1999* (pp. 281-284). Hildesheim: Franzbecker.

Kaune, C. (2001a). Merkmale eines konstruktivistischen Uunterrichtsskripts und eine Analyse dazugehöriger Lehr- und Lernprozesse. *Der Mathematikunterricht*, *47*(1), 14–34.

Kaune, C. (2001b). Weiterentwicklung des Mathematikunterrichts. Die kognitionsorientierte Aufgabe ist etwas mehr als die etwas andere Aufgabe. *Der Mathematikunterricht*, *47*(1), 35–46.

Lesh, R., & Zwojewski, J. (2007). Problem solving and modeling. I. F. Lester (Ed.). *Second Handbook of research on mathematics teaching and learning. a project of the national council of teachers of mathematics* (pp.763–804). Charlotte, NC: Information Age Publishing.

Moza, F., Cohors-Fresenborg, E., Ana Rato, E., Bulu, S.I., Bida, A., & Ate, S.M.S. (2024). Analisis proses pembelajaran matematika di kelas vii dengan menggunakan sistem kategori aktivitas metakognitif-diskursif. *Kognitif Jurnal Riset HOTS Pendidikan Matematika*, *4*(1), 256-270.

Nowińska, E (Ed.). (2018). *Metakognitiv-diskursive unterrichtsqualität: Eine Handreichung zu deren Analyse und Einschätzung in den Fächern Geschichte, Mathematik und Religion*. Osnabrück: Forschungsinstitut für Mathematikdidaktik.

Noviana, K. Y., & Murtiyasa, B. (2020). Kemampuan literasi matematika berorientasi pisa konten *quantity* pada siswa smp. *Jnpm (Jurnal Nasional Pendidikan matematika)*, *4*(2), 195-211.

OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. Paris: OECD Publishing.

Putra, Y. Y., Zulkardi, & Hartono, Y. (2016). Pengembangan soal matematika model PISA level 4, 5, 6 menggunakan Konteks Lampung. *Jurnal Matematika Kreatif-Inovatif*, *7*(1), 10-16.

Schoenfeld, A. H. (1992). learning to think mathematically: problem solving, metacognition, and sense-making in mathematics. In D. Grouws (Ed.). *Handbook of research on mathematics teaching and learning* (pp.334-370). New York, NY: MacMillan.

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, *7*(4), 351-371.

Sjuts, J. (2001b). Metakognition beim mathematiklernen. Das denken uber das denken als hilfe zur selbsthilfe. *Der Mathematikunterricht, 47*(1), 61–68.

Sjuts, J. (2003). Metakognition per didaktisch-sozialem Vertrag. *Journal für Mathematik-Didaktik, 24*(1), 18–40.

Veenman, M.; Van Hout-Wolters, B., & Afflerbach, P. (2006). Metacognition and learning. Conceptual and methodological considerations. *Metacognition and Learning, 1*(1), 3-14.

Wilson, J. und Clarke, D. (2004). Towards the modelling of mathematical metacognition. *Mathematics Education Research Journal, 16*(2), 25–48.

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