Junior high school students' mathematical reasoning skills on integer using PMRI and collaborative learning

Mutia Khoirunnisa, Ratu Ilma Indra Putri [*]

Department of Mathematics Education, Sriwijaya University, South Sumatra, Indonesia

[*] Correspondence: ratuilma@unsri.ac.id
© The Authors 2022

Abstract

Students need to have good mathematical reasoning skills when learning integer material. The utilization of video media and collaborative learning through the PMRI technique can be used in learning activities to improve mathematical reasoning skills. This study aims to determine mathematical reasoning skills after implementing the learning process using video media with the PMRI approach and collaborative learning integer material for class VII students. This study is descriptive research in which participants are pupils in class VII SMP Srijaya Negara Palembang has 23 students (10 females and 13 males). This study consisted of two meetings. The first meeting focused on the learning process using video material with PMRI and collaborative learning. The second meeting was used to test the results. This study employs observational data gathering techniques, written tests, interviews, and descriptive data analysis approaches. The findings of a study are combining video media and the PMRI technique and collaborative learning on integer subjects in class VII. The skills of students in class VII to reason mathematically was discovered. On the subject of excellent integers, SMP Srijaya Negara Palembang students scored an average of 69.61. The sign of creating assumptions appears to be the most frequent in this study, while the indicator of concluding appears to be the least frequent. Students' mathematical thinking skills can be improved by using video media in conjunction with PMRI and Collaborative Learning during the learning process.

Keywords: collaborative learning; mathematical reasoning; PMRI; video media

Introduction

Learning mathematics necessitates a variety of qualities, one of which is the skill to reason. It is based on Permendikbud No. 21 of 2016, which states that one of the reasoning skills in secondary school is the skill to facilitate the learning process (Permendikbud, 2016). According to Oktaviana and Indri (2021), mathematical reasoning is the skill of making new statements based on facts that have been demonstrated to be true. NCTM supports the relevance of reasoning skills by stating that reasoning is one of the typical processes in learning mathematics (NCTM, 2000). Integer material (Purwanti et al., 2020) is one type of mathematical content that requires mathematical reasoning skills to master. Number stuff is material that pupils should learn as well. The item is one of the materials that the Program for International Student Assessment has examined (OECD, 2019). Students are expected to exhibit reasonable reasoning skills, as this skill ensures that students' thinking processes are grounded in reality when solving problems (Ramadania, 2017). According to Putri et al. (2019), the learner will be able to come to a conclusion whose veracity can be demonstrated if they have good reasoning skills.

However, students' mathematical reasoning skills on integer material are still low, according to field study. Examining difficulties is challenging for students (Sofyana & Kusuma, 2018). This is consistent with research on students' low mathematical reasoning skills, as evidenced by the results of students' completion of worksheets for which there is no explanation; they are used to solving problems without knowing the reasons for the answers, and students do not think about how and where the results come from, they merely follow the teacher's instructions for responding sample questions (Juliawati et al., 2016). When it comes to learning, teachers tend to focus solely on the subject by employing the lecture technique, which makes learning tedious and prevents pupils from developing their reasoning skills (Lestari & Sardin, 2020). As a result, adjustments in the mathematics learning process are required to increase student enthusiasm for studying (Munawaroh et al., 2019). Based on Permendikbud No. 22 of 2016, which formulates the implementation learning process that motivates students to be active, fun and provides opportunities for students to develop creativity, independence, and psychological and physical development based on interests, talents, and psychological and physical development of children (Permendikbud, 2016). The teacher should be able to design an enjoyable and relevant learning process for the pupils based on the description. For pupils, learning that is enjoyable is learning that is meaningful (Suciati, 2020). Learning mathematics will be more enjoyable and relevant if it can be related to everyday life so that students may better comprehend the material. According to Rahayu and Putri (2021), a student's knowledge will be more meaningful if the learning process is conducted in a context. As a result, the appropriate strategy is required for the learning process to link to the real world (Mairing, 2016).

The Indonesian realistic mathematics education method, which is in line with these needs, can assist students in better understanding the learning material (Meitrilova & Putri, 2020). The PMRI approach is grounded in reality, but it also promotes learning, allowing students to conceive solutions to issues (Lestariningsih & Trismawati, 2020). If the PMRI

approach is employed, learning mathematics, particularly integer content, is very suited because numbers may be related to real-world objects and contain numerous contextual difficulties (Liu, 2019). The issues offered in PMRI learning begin with a real-world context to make learning more engaging (Putri, 2015). PMRI is a hypothesis that focuses on real-world issues. This problem serves as a bridge between real and formal mathematics learning (Trisnawati et al., 2015). PMRI's principles are guided reinvention or progressive mathematizing, didactical phenomenology, and self-developed models, while its characteristics include real-world problems, modeling, student contributions, interactivity, and integration with other learning topics (Zulkardi & Putri, 2010). PMRI-based interactivity in learning is similar to a collaborative learning model, and it is in line with a 21st-century activity that requires learning that can mold students into critical thinkers, skilled communicators, and collaborators (Ariyanti et al., 2020). Thus, it should refer to four 21st century characters commonly referred to as the 4Cs, namely critical thinking and problem-solving skills (critical thinking and problem solving), communication skills (communication skills), collaboration skills (skills to collaborate), and creativity and innovation (creativity and innovation) (As'ari, 2016). Where this collaboration necessitates students assisting a group of friends who are having trouble completing their projects, each student must also fulfill specific responsibilities within his group (Maulidah, 2021). In this way, PMRI learning can be used through learning activities based on the Collaborative Learning model. There are similarities in PMRI and collaborative learning qualities, especially interaction in learning.

Collaborative learning is a learning model in which students share ideas, learn together, and assist one another in completing tasks in groups (Inah & Pertiwi, 2017). This model is intended for learning in pairs or small groups (Nisa et al., 2018). Students who do not understand will ask their group members to "please teach me," and friends who do understand will have to explain until the student learns. Students will also be provided materials for sharing and jumping assignments (Sato, 2014). In collaborative learning, it is crucial to remember to use learning sharing activities and jumping tasks because this is a way to develop student potential (Asari, 2017).

Furthermore, in the twenty-first century, often known as the digital age, technical advancements have made significant progress, and one part of society that technology advancements have influenced is education (Muthy & Pujiastuti, 2020). Learning media is an example of how technological innovations are being used in education (Firmadani, 2020). The quality and quantity of the learning process will improve with the learning material (Andriani, 2020). One type of media that can be used in the learning process is a video (Furi & Mustaji, 2017). Video media is a type of learning media that is used to communicate messages or information from a lesson that is given in an audio-visual format so that students can understand it and express it completely and clearly (Febriani, 2017). Furthermore, video media employs two senses, namely hearing and sight, allowing students to receive and absorb knowledge more readily while participating in learning (Hidayati et al., 2019). When students are directed to collaborate with their group friends by saying "please teach me," a friend who understands better must explain until the student understands, and students will be given material for sharing tasks and jumping tasks, learning using PMRI and collaborative learning

will make student learning outcomes more leverage when using video media because the video media contains real context problems that are adapted to PMRI and in solving problems given students are directed to collaborate with their group friends by saying "please teach me", a friend who understands better must explain until the student understands (Sato, 2014).

Many research using the PMRI approach to learning have been conducted, each with a particular focus. Kurniawan's research (2020) used the PMRI technique through LSLC to study the capacity to solve issues on straight-line gradient material, while Octriana's research (2018) used the PMRI approach through LSLC to study the skills of mathematical reasoning on number pattern material. In the twenty-first century, often known as the digital century, technical advancements can be applied in education, with one example being the usage of video media in the learning process, which had not been used in the earlier study. As a result, this research aims to measure mathematical reasoning capacity after learning through video media using a PMRI approach and collaborative learning for class VII pupils studying integers.

Methods

This study uses descriptive research to describe the description of mathematical reasoning skills of integers using video media through the PMRI and collaborative in-class VII students. The subjects of this study were students of class VII A of SMP Srijaya Negara Palembang, with 23 students (10 females and 13 males). The instruments used were an observation sheet, a written test consisting of two test questions, and an interview guide sheet. The following table 1 shows the three indicators used in this study.

Table 1. Indicators of mathematic reasoning skills

Indicator	Descriptor
Submit a conjecture	• Able to write down what is already known and what is being asked in the question • Able to create conjectures based on what is known from the inquiries about other information.
Mathematical Manipulation	• Able to answer problems by converting sentence-type inquiries into mathematical form
Draw a Conclusion	• Able to make conclusions that are in accordance with the problem and can be accepted by reason

The research is divided into three stages: (1) the preparation stage, which includes preparing research instruments, observing schools, and handling research correspondence; (2) the implementation stage, which includes two meetings, the first of which includes the learning process using video media through the PMRI and collaborative learning, and the second of which includes the students being asked questions about the mathematical reasoning skills test; and (3) the final stage, which includes the students being given questions about the mathematical reasoning skills test. There are three methods for gathering data: observation, exams, and interviews. There are two types of questions for the test questions: descriptions that can help researchers more easily analyze indicators of students' mathematical reasoning skills that arise from the results of students' answers. For the observations made in

this study, namely direct observation of student activities and video recordings, there are two types of questions: descriptions that can help researchers analyze indicators of students' mathematical reasoning skills that arise from the results of students' answers. Then three female students were chosen for student interviews, and they were interviewed so that researchers could learn more about their responses to the exam questions they had completed.

Two mathematics instructors validated the instrument at Srijaya Negara Palembang Junior High School and a Sriwijaya University mathematics education lecturer who was an expert in this research. Next, the researchers conducted one-on-one and small group trials to determine the instrument's usability. When assessing the results of student test answers, the researchers utilized descriptive methods to describe student actions during the learning process. When analyzing the outcomes of student test answers, the researchers assigned each answer a score based on scoring rules. Table 2 below contains scoring guidelines.

Table 2. Scoring guidelines

Score	Scoring Indicator
4	Perfect answer, the solution is given completely and correctly
3	The answer is correct, but the solution given has one significant error
2	The answer is almost correct, but the solution provided contains more than one significant error/shortcoming
1	Wrong answer, the solution is not completed in its entirety but contains at least one correct argument
0	Wrong answer, the solution is based on the wrong process or argument or contains no response at all

Then, using the qualitative value category of mathematical thinking skills, the acquired score will be transformed into a value as Table 3 follows.

Table 3. Category of qualitative value as table 3 mathematical reasoning skills

Score	Categories
81 – 100	Very good
61 – 80	Well
41 - 60	Enough
21 - 40	Not enough
1 - 20	Very less

The researchers then examined the students' average scores by applying the method to discover the average of the group data, which was then converted back to table 3 to establish the mathematical reasoning skills category of SMP Srijaya Negara Palembang seventh grade students. The interview data was then evaluated using a descriptive method, which converted the recorded interview findings into interview transcripts.

Results

The first meeting used video media to perform a PMRI and collaborative learning process. Students learn in groups of three to four students and teach each other. If a student in the group does not understand, he is directed to ask group mates who understand more than him, and friends who understand must educate their friends who understand better. I will not be able to understand until my friend does. Through the video medium, pupils are given the difficulty of sharing and jumping tasks. Students were given contextual questions (sharing task and jumping task) through video media at the first meeting. Two exam questions were presented during the second meeting, which was completed in 30 minutes.

Sharing task

Suhu udara di kota Pagaralam saat pagi hari 20°C

Kemudian saat siang hari suhu udara naik sebanyak 5°C di bawah 0°C dari suhu udara di pagi hari

Lalu di malam hari suhu udara naik sebanyak 3°C dari suhu udara di siang hari

Berapakah suhu udara di kota Pagaralam pada malam hari ?

Permasalahan 1

a. Tuliskan informasi suhu udara di pagi, siang dan malam hari seperti yang tercantum di soal !

b. Jika suhu udara di pagi hari 20°C lalu di siang hari suhu udara naik sebanyak 5°C di bawah 0°C dari suhu udara di pagi hari, berapakah suhu udara di siang hari ?

c. Jika suhu udara di malam hari naik sebanyak 3°C dari suhu udara di siang hari, berapakah suhu udara di malam hari ?

d. Buatlah kesimpulannya!

Pertanyaan

Translation

The morning temperature at Pagaralam is 20°C

The air temperature increases by 5 °C below 0 °C during the day, compared to the morning temperature.

The air temperature rises by 3°C at night compared to the daytime temperature.

In Pagaralam, what is the nighttime air temperature?

Problem 1

> a. As indicated in the question, write down the air temperature information in the morning, afternoon, and evening !
>
> b. When the air temperature in the morning is 20°C and the air temperature increase the day is 5°C below 0 degrees Celsius, what is the air temperature during the day??
>
> c. if the nighttime air temperature is 3°C higher than the daytime air temperature. What is the temperature of the air at night?
>
> d. Make a decision.!
>
> Question

Figure 1. Problem 1 (sharing task)

Students are given tiered questions that can lead them to the correct solution using the notion of integers. The context used in this one problem is a real context related to air temperature. The following figure 2 is the answer of one of the students from group A.

	Translation
	a. Known :Morning : 20°C
	Afternoon : Increase The Morning Temperature By 5°C Below 0°C
	Night : Temperatures Have Risen By 3°C From Afternoon
	Asked : What Is The Temperature Of The Air At Night?
	b. Day Temperature :
	Morning Temperature + Day Temperature = 20°C + (-5) = 15°C
	c. Night Temperatur :
	Day Temperature + Night Temperature = 15°C + 3°C = 18°C
	d. Conclusion The City Of Pagaralam's Nighttime Temperature Is 18°C

Figure 2. Answer problem 1 sharing task (group A)

Based on the student's answers, he was able to flawlessly bring up markers of mathematical thinking skills, such as making conjectures, manipulating numbers, and drawing conclusions, earning him a score of 12.

Permasalahan 2

a. Tuliskan informasi suhu udara di pagi, siang dan malam hari seperti yang tercantum di soal !

b. Jika suhu udara di pagi hari 35°C lalu di siang hari suhu udara turun sebanyak 5°C dari suhu udara di pagi hari, berapakah suhu udara di siang hari ?

c. Jika suhu udara di malam hari turun sebanyak 5°C dari suhu udara di siang hari, berapakah suhu udara di malam hari ?

d. Buatlah kesimpulannya!

Pertanyaan

Translation

Problem 2

a. As indicated in the question, record the air temperature in the morning, afternoon, and evening.

b. What is the air temperature during the day if the morning air temperature is 35°C and the afternoon air temperature is 5°C lower than the morning air temperature?

c. What is the air temperature at night if the daytime temperature is 5°C lower than the nighttime temperature?

d. Make a decision.!

Question

Figure 3. Problem 2 (sharing task)
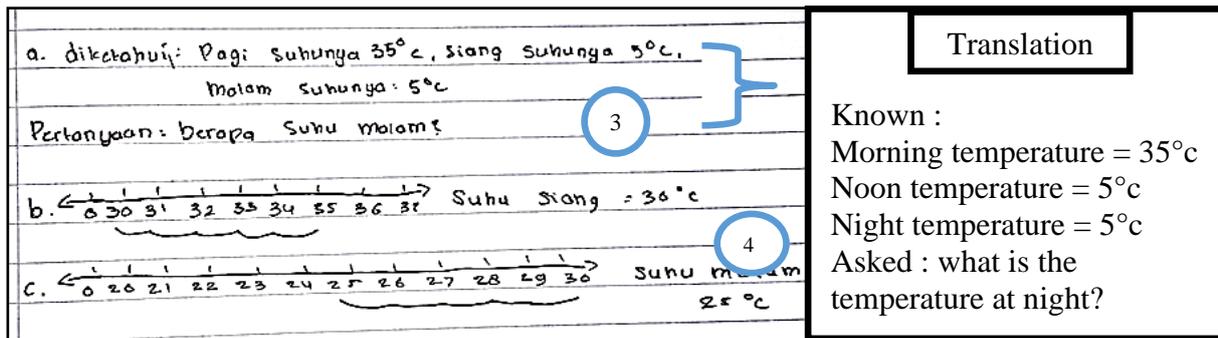
Figure 4. Answer problem 2 sharing task (group D)

Based on figure 4 above, it can be seen that the student can bring up the indicators of proposing conjectures and correct mathematical manipulation. Even though some information is not written down on the indicators of proposing allegations, the student does not work on question d, resulting in a score of 7.
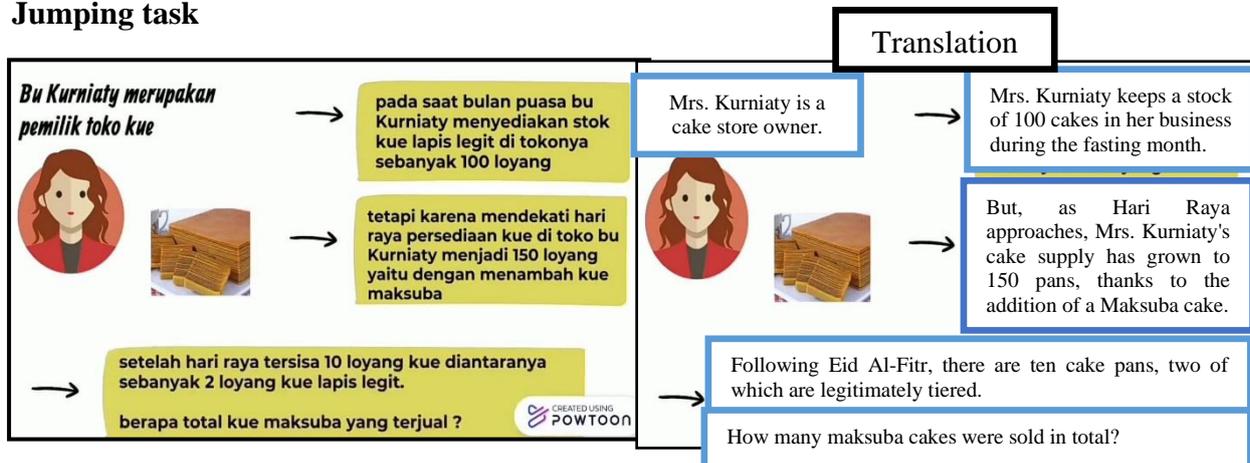
Jumping task

Figure 5. Problem 3 (jumping task)

The jumping task problem uses a real problem, namely the context of the cake. Students are no longer given tiered questions in this problem, and they are expected to solve the jumping task problem independently in groups. However, if one of their group friends does not understand, he is directed to ask a group of friends for help by saying, "please teach me," and the friend who is asked for help must teach until the friend who is asked for help understands.
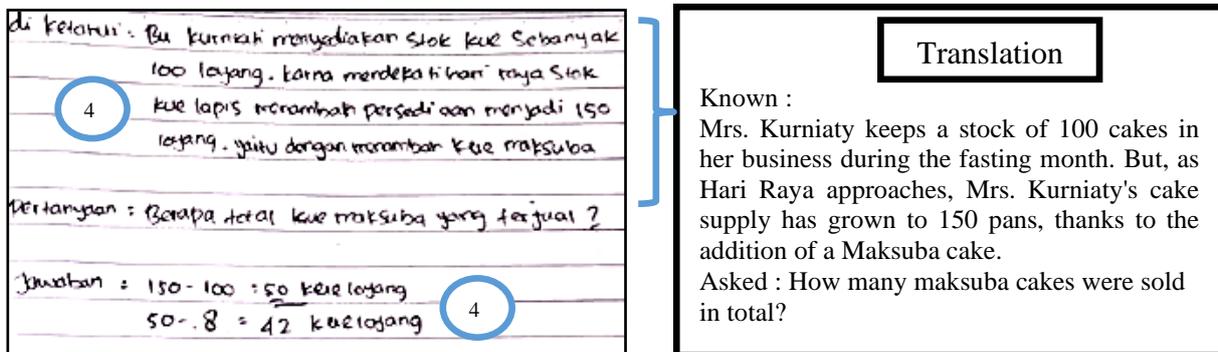
Figure 6. Answer problem 3 jumping task (group D)

Based on figure 6 above, it is clear that the student can flawlessly bring up the indicators f submitting conjectures and mathematical manipulations. However, he cannot bring up the indicators of concluding, earning him an eight on the test.

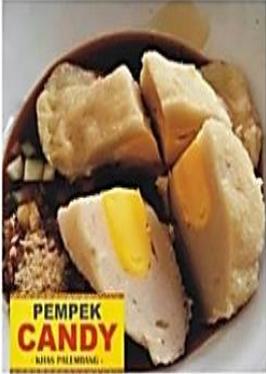**Test question number 1**

Translation

Three clients placed orders for submarine pempek at Pak Hidir's pempek shop: Farhan ordered 20 boxes of submarine pempek, Dela ordered 15 boxes of submarine pempek, and Wahyu ordered 25 boxes of submarine pempek. If you go to Mr. Hidir's business, he already has 10 boxes of submarine pempek on hand. So, how many submarine pempek boxes should Pak Hidir's shop produce?

Figure 7. Test question number 1

a. Test question number 1

Translation

Known :
Farhan ordered 20 boxes of submarine pempek, Dela ordered 15 boxes of submarine pempek, and Wahyu ordered 25 boxes of submarine pempek.
Asked :
How many pempek are produced each year?

Figure 8. TZ's answer for the question number 1

TZ students have been able to come up with indicators of submitting conjectures based on the results of tests and interviews, such as writing down what is known and asked completely. However, TZ students do not write down other information based on what is known from the questions at the time of the interview, and the student cannot answer it, so he receives a score of 3. Then it can be observed that TZ students cannot complete the answer correctly; in this situation, TZ students do not display symptoms of mathematical manipulation. Thus they receive a score of 0. Finally, for indicators of concluding, TZ students appear to be incorrect. TZ pupils received a score of 0 because the solution he wrote was also incorrect. As a result, TZ pupils received a three on question 1.

Figure 9. PA's answer for the question

It can be observed from the results of the PA students' tests during interviews and the test results that PA students understand and can solve question number one. PA students bring up the indicators of submitting conjectures perfectly, earning a score of 4. They can also solve problems by translating questions in sentence form into mathematical forms completely and correctly, earning a score of 4 for indicators of mathematical manipulation. However, PA students do not conclude the answer sheet, earning a score of 0. As a result, PA pupils have an overall score of 8.

Figure 10. ZR's answer for the question number 1

The ZR pupils were able to understand and respond to the questions. So the ZR student raises the indicator of proposing the conjecture perfectly, earning a score of 4. The ZR student can also solve the problem by translating the problem in sentence form into a complete and correct mathematical form, earning a score of 4 for the mathematical manipulation indicator. Finally, the ZR student can draw appropriate conclusions, earning a score of 4. As a result, the student's overall score on test item ZR is 12.

b. Test question number 2

Soal 2

Wardah memiliki kartu memori dengan kapasitas 9GB. Berikut ini rincian data yang dimiliki wardah didalam kartu memorinya

Foto	: 1850 MB
Musik	: 950 MB
Video	: 3100 MB
Data Internal	: 2755 MB
Kosong	: 345 MB

Wardah ingin menambahkan beberapa data baru yang berupa video dengan kapasitas 735MB kedalam kartu memorinya. Namun kartu memori Wardah tidak mencukupi untuk menambahkan video barunya. Oleh karena itu Wardah akan menghapus beberapa datanya akan tetapi ia tidak ingin menghapus foto dan videonya, sedangkan data internalnya juga tidak bisa dihapuskan, tetapi Wardah tidak keberatan jika harus menghapuskan folder musiknya. Adapun folder musik yang dimiliki Wardah didalam kartu memorinya sebagai berikut.

Folder Musik	Ukuran
Folder 1	210 MB
Folder 2	55 MB
Folder 3	65 MB
Folder 4	78 MB
Folder 5	190 MB
Folder 6	177 MB
Folder 7	35 MB
Folder 8	15 MB
Folder 9	150 MB
Folder 10	10 MB

Jika Wardah hanya ingin menghapus 2 folder musiknya untuk dapat menambahkan video barunya kedalam kartu memori yang ia miliki maka folder mana saja yang akan dihapusnya?

Soal 2

Translation

Wardah is equipped with a 9GB memory card. Here are the specifics of the data on Wardah's memory card. Music: 950 MB, Photo: 1850 MB, Video : 3100 MB, Internal data : 2755 MB, Empty : 345 MB

Wardah wishes to add some new data to his memory card in the shape of a film with a size of 735MB. Wardah's memory card, however, is insufficient to accommodate his new video. Wardah will thus erase part of his data, but he does not want to delete his images and movies, and his internal data cannot be destroyed either, but Wardah is fine with deleting his music folder. Wardah has the following music folders on his memory card:

Folder 1	210 MB
Folder 2	55 MB
Folder 3	65 MB
Folder 4	78 MB
Folder 5	190 MB
Folder 6	177 MB
Folder 7	35 MB
Folder 8	15 MB
Folder 9	150 MB
Folder 10	10 MB

If Wardah only wanted to delete 2 of his music folders to be able to add his new videos to his memory card, which folder would he delete?
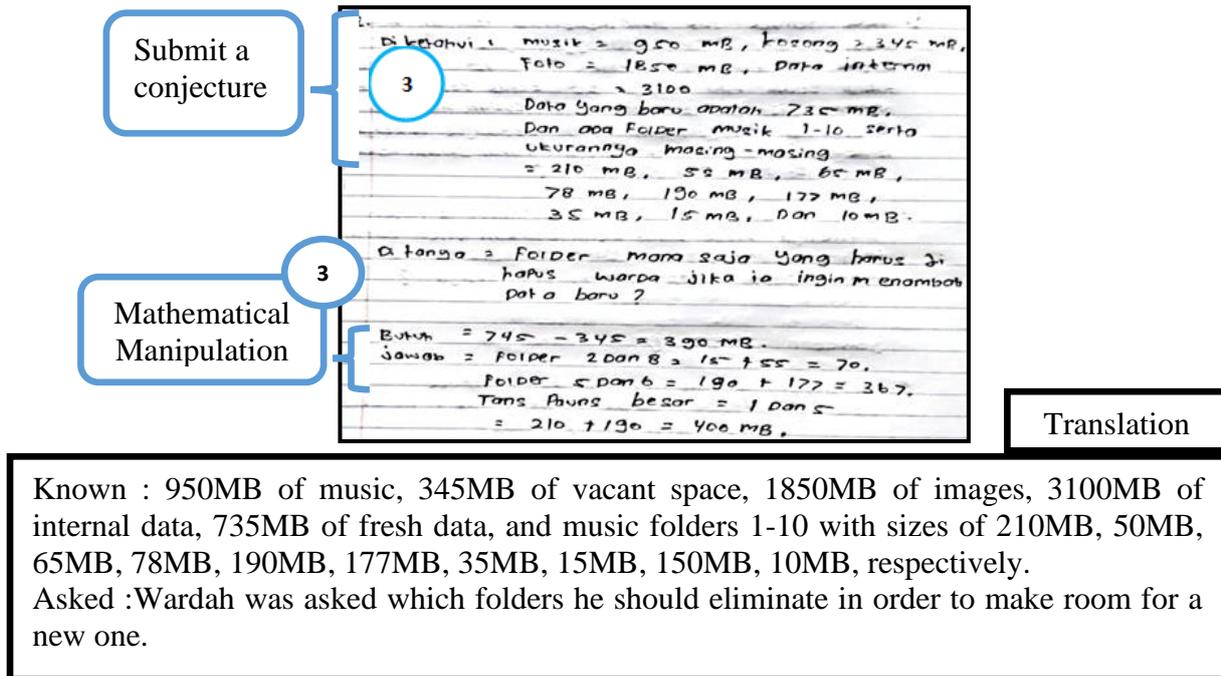
Figure 12. TZ's answer from the question number 2

TZ developed indicators for making allegations, such as writing down what is known and requested but not yet complete. When interviewed, TZ students were unable to respond, so the indicator put out a suggestion, and he received a score of 3. Then, based on the outcomes of the interviews, it can be observed that TZ students were able to write down the solution but were unable to answer the researcher's questions when interviewed, earning him a score of 3 on the indication of mathematical manipulation. The TZ pupil did not write it down for the indicator of concluding, and when interviewed, he could not answer the researcher's questions. Thus he received a score of 0 on the indicator of concluding. As a result, TZ has an overall score of 6.

Asked : the folder that will be removed
Needed : 735MB-345MB = 390 MB

Folder 2 = 55 MB
Folder 5 = 190 MB +
245 MB + 345 MB = 590 MB (No)

Folder 6 = 177 MB
Folder 8 = 15 MB +
192 MB + 345 MB = 537 MB (No)

Folder 1 = 210 MB
Folder 2 = 55 MB +
265 MB + 345 MB = 610 MB (No)

Folder 1 = 210 MB
Folder 5 = 190 MB +
400 MB + 345 MB = 745 MB

So, directories 1 and 5 must be deleted.

Translation

Figure 13. PA's answer from the question number 2

According to the PA test results at the interview, PA students raised the indicators for correctly submitting the guess but did not write them down on the answer sheet for fear of running out of time, resulting in a score of 3. PA students can also solve problems by translating sentence-form questions into complete mathematical forms. PA students receive a score of 4 for the indication of mathematical manipulation. They also properly conclude the answer sheet, so PA students receive a score of 4 for the indicator of concluding. As a result, PA receives an 11-point total.

Figure 14. ZR's Answer from the question number 2

When ZR was interviewed, it was clear that they understood and could answer the issue. Student ZR raises an indicator of proposing a guess even though it is not perfect because he misreads the problem so that what is written in the section it is known that there is a slight error, so he gets a score of 3. ZR can also solve the problem by translating the problem in sentence form into a complete and correct mathematical form because ZR students receive a score of 4 for the indicator of mathematical manipulation. As a result, ZR pupils' total score on test number one is 11.

Table 4. The emergence of indicators of mathematical reasoning skills

Indicator	Total Eligible Students	
	Question test number 1	Question test number 2
Submit a Conjecture	23	20
Mathematical Manipulation	21	21
Drawing Conclusion	18	16

According to table 4, the indicator that emerges the most frequently from the two test questions is submit a conjecture, which received responses from 23 people for question one and 20 people for question two. The results of all of the students' responses were then added together and arranged in table 5 below.

Table 5. The qualitative value of mathematical reasoning skills

Score	f_1	f_2	f_{tot}
81-100	11	5	16
61-80	9	9	18
41-60	1	6	7
21-40	2	2	4
0-20	-	1	1

Note:

f_1: Number of students in test question number 1

f_2: Number of students in test question number 2

f_{tot}: $f_1 + f_2$

According to table 5, the top eleven students on question one have the highest score, while the top five students have the highest score on question two. The most people are in question two, which has the lowest score, one person.

Table 6. Average students' mathematical reasoning skills

Score	f_{tot}	x_i	$f_{tot}. x_i$	Average
81-100	16	90.5	1448	**69.61**
61-80	18	70.5	1269	
41-60	7	50.5	353.5	
21-40	4	30.5	122	
0-20	1	10	10	
Total	**46**		**3202.5**	

According to table 6, students' average ability to reason mathematically. After implementing the PMRI approach and collaborative learning on integer content, an SMP Srijaya Negara Palembang demonstrates that the category of mathematical reasoning abilities is defined as good.

Discussion

The learning procedure in this study used video media while changing the principles and characteristics of PMRI to assist students in understanding the learning material better (Meitrilova & Putri, 2020). PMRI's principles: guided reinvention or progressive mathematizing, didactical phenomenology, and self-developed (Zulkardi & Putri, 2010). Rahayu and Putri (2021) that a student's knowledge will be relevant if the learning process is carried out in the context of solving the problem. To make learning more exciting, what is offered begins with a real background (Putri, 2015). This also refers to PMRI's characteristics, such as using real-world problems (temperature and cake problems), using mathematical models (in solving problems given to students), and student contributions (in learning, students as group representatives will be asked to explain the results of the answer), interactivity (during the learning process, students will collaborate and teach each other), and integration with other learning topics (Zulkardi & Putri, 2010). Students are separated into six groups with four students in each group during the learning process, and the teacher encourages students to collaborate; when there are group friends who do not understand, the teacher advises students to question a group friend who does. Until his friend understands, a friend must teach his friend who does not understand from him (Sato, 2014). According to Zulkardi and Putri (2010), the challenges mentioned include problems with sharing duties and jumping tasks. The difficulty of sharing duties and jumping tasks will be demonstrated through the video medium. Students will absorb the content more easily if the video is used, and the information communicated will be clearer. According to Hidayati et al. (2019), video media uses two senses: hearing and sight, and students will be able to receive and retain information more quickly when employing more than one sense.

Students are asked questions about their mathematical reasoning ability at the next meeting following the learning process. The following are more detailed explanations of the indications after learning with video media through PMRI and collaborative learning.

Submit a conjecture
Submit a conjecture is an indicator that occurs the most frequently based on the outcomes of the answers to the test questions presented. For test item number one, 23 students raised this sign, and for test item number two, 20 students raised this indicator. Because pupils are still not focused on participating in learning, they cannot bring up this indicator. As a result, they do not understand the information supplied on the problem. Students can understand or identify the answer to a given problem based on the information provided in the problem and make a conjecture about the solution or completion of the problem by submitting conjectures (Romadhina et al., 2019).

Mathematical manipulation

Students' responses to the test questions reveal many signs of mathematical manipulation. Students displayed up to 21 indicators for test item number one, and for test item number two, students displayed up to 21 indicators. Some pupils do not appear to be the cause of this indicator since they are still unable to generate solution ideas and thus opt not to answer the question. Students need mathematical manipulation to strengthen their thinking skills, mathematical manipulation in steps to solve a problem, and students will solve the problem using a mathematical model (Jannah et al., 2020).

Drawing conclusion

Based on the results of student exams, the indication of concluding is the one that appears the least, with 18 students showing signs on test number 1 and 16 students showing indicators on test number 2. One student can bring up this indicator during the interview, especially a PA student, but the student does not write it down on the answer sheet since, based on the interview findings, the student has run out of time and cannot write his conclusion. Based on this, the student is considered not to bring up indicators of concluding because it contradicts the theory that concluding is a new statement produced following existing statements, in which case students make logical statements so that they can conclude response to the questions given (Afandi, 2016).

Conclusion

The mathematical reasoning skills of an integer using video media through the PMRI approach and collaborative learning applied to class VII A of SMP Srijaya Negara Palembang, resulting in these students' reasoning skills becoming good with indicators that most often appear as conjectures and which rarely appear as interesting. The lowest indicator appears because the student neglected to write the conclusion on the answer sheet. It appears the least because the time permitted has run out, leaving pupils with no opportunity to jot down their conclusions. This study also has flaws, such as a lack of time for students to focus on test questions, which results in less-than-ideal student responses to test problems.

Conflicts of Interest

The authors state that there are no conflicts of interest in the publishing of this work. Furthermore, plagiarism, misconduct, data fabrication and/or falsification, multiple publication and/or submission, and redundancy have all been thoroughly addressed by the authors.

References

Afandi, A. (2016). Penalaran deduktif dalam menyelesaikan masalah geometri berdasarkan perbedaan gender. [In order to solve geometric issues based on gender inequalities, deductive reasoning is used]. *Education and Human Development Journal*, *1*(1), 9-21. https://doi.org/10.33086/ehdj.v1i1.284

Ariyanti, P. L., Dantes, N., & Marhaeni, A. A. I. N. (2020). Pengembangan RPP tema keluargaku pada siswa kelas 1 berbasis kecakapan belajar dan berinovasi abad 21 [My family and I developed theme lesson plans for grade 1 pupils that were centered on 21st century learning and innovative skills]. *Jurnal Pendidikan Dasar Indonesia*, *4*(1), 147-158.

Asari, S. (2017). Sharing and jumping task in collaborative teaching and learning process. *Jurnal Didaktika*, *23*(2), 183-188. https://doi.org/10.30587/didaktika.v23i2.28

Febriani, C. (2017). Pengaruh media video terhadap motivasi belajar dan hasil belajar kognitif pembelajaran IPA kelas V [In science class V the impact of video media on learning motivation and cognitive learning outcomes]. *Jurnal Prima Edukasia*, *5*(1), 11-21. https://doi.org/10.21831/jpe.v5i1.8461

Firmadani, F. (2020). Media pembelajaran berbasis teknologi sebagai inovasi pembelajaran era revolusi industri 4.0. [In the era of the fourth industrial revolution, technology-based learning material can be used as a learning innovation]. Konferensi Pendidikan Nasional, *2*(1), 93-97. https://ejurnal.mercubuanayogya.ac.id/index.php/Prosiding_KoPeN/article/ download/1084/660

Furi, U. L. & Mustaji. (2017). Pengembangan media video mata pelajaran komposisi foto digital bagi siswa kelas XI multimedia di sekolah menengah kejuruan [Video media development for photo composition subjects multimedia in vocational high school for kids in class XI digital media]. *Jurnal Kwangsaan, 5*(2), 91-100. https://doi.org/10.31800/jtp.kw.v5n2.p91--100

Hidayati, A. S., Eka, P. A., & Henry, P. (2019). Pengembangan media video pembelajaran untuk meningkatkan pemahaman materi gaya kelas IV di SDN Sukoiber 1 Jombang [SDN Sukoiber 1 Jombang developed learning video media to help students better understand class IV level subject]. *Jurnal Inovasi dan Teknologi Pembelajaran, 6*(1), 45-50. http://dx.doi.org/10.17977/um031v6i12019p045

Inah, E. N. & Utami, A. P. (2017). Penerapan collaborative learning melalui permainan mencari gambar untuk meningkatkan hasil belajar ipa kelas v di SDN Tabanggele kecamatan Anggalomoare kabupaten Konawe [Application of collaborative learning through games looking for pictures to improve science learning outcomes for class v at Tabanggele Elementary School Anggalomoare sub-district, Konawe district]. *Jurnal Al Tadib*, *10*(1), 19-36.

Jannah, R., Zubainur, C. M., & Syahjuzar. (2020). Kemampuan siswa dalam mengajukan dugaan dan manipulasi matematika melalui discovery learning di sekolah menengah Aceh [The ability of students to make assumptions and to manipulate mathematics through the discovery learning model in Aceh middle school]. *Jurnal Ilmiah*

Mahasiswa Pendidikan Matematika, *5*(1), 70-78. https://doi.org/10.32672/si.v21i1.1893

Juliawati, E., Sugiatno, & Astuti, D. (2016). Pola penalaran matematis siswa dalam materi bilangan bulat di sekolah menengah pertama [In junior high school, students' mathematical reasoning patterns in the material integers]. . *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*, *5*(5), 1-10. https://jurnal.untan.ac.id/index.php/jpdpb /article/view/15175

Kurniawan, O. & Putri, R. I. I. (2020). Pemecahan masalah matematis siswa kelas VIII menggunakan PMRI dan LSLC pada materi gradien [Using PMRI and LSLC on gradient material to solve mathematics problems for class VII students]. *Jurnal Elemen*, *6*(2), 346-356. https://doi.org/10.29408/jel.v6i2.2214

Lestari, D. & Sardin. (2020). Efektifitas model pembelajaran Knisley terhadap penalaran matematis siswa [The Knisley learning model's usefulness in improving student math reasoning]. *Academic Journal of Mathematics Education*, *6*(1), 49-52. https://ejournal.lppmunidayan.ac.id/index.php/matematika/article/view/195

Lestariningsih & Trismawati, A. (2020). Penerapan pendekatan PMRI pada sistem persamaan linier tiga variabel [The PMRI method is used to solve a three-variable linear equation problem]. *Jurnal Pendidikan Matematika, 11*(1), 117-125. https://doi.org/10.36709/jpm.v11i1.10078

Liu, A. (2019). Hipotesis lintasan belajar matematika siswa pendekatan pendidikan matematika realistik indonesia pada siswa kelas VII SMP Negeri Maubeli tahun ajaran 2019/2020 [The educational approach's premise about the student's mathematical learning trajectory for the academic year 2019/2020, Indonesian realistic mathematics will be taught to students in class VII at SMP Negeri Maubeli]. *Jurnal Ilmu Pendidikan Matematika*, *4*(1), 9-15. https://jurnal.unimor.ac.id/JIPM/article/view/706

Mairing, J. P. (2016). Kemampuan mahasiswa pendidikan matematika dalam memecahkan masalah [Students' capacity to solve problems in mathematics education]. *Jurnal Edumatica*, *6*(2), 11-30.

Maulidah, E. (2021). Keterampilan 4C dalam pembelajaran untuk anak usia dini [4C learning skills for early childhood]. *Jurnal Pendidikan Anak Usia Dini, 2*(1), 52-68.

Meitrilova, A. & Putri, R. I. I. (2020). Learning design using PMRI to teach central tendency materials. *Journal of Physics*: *Conf. Series*, *1470*(1), 012086. https://doi.org/10.1088/1742-6596/1470/1/012086

Munawaroh, S., Surahmat, & Fathani, A. H. (2019). Kemampuan penalaran dan pemecahan masalah matematis melalui model pembelajaran (air) menggunakan media mind mapping pada materi bilangan bulat kelas VII SMP Shalahuddin Malang [For class VII SMP Salahuddin Malang, the capacity to reason and solve mathematical issues utilizing a learning model (water) and mind mapping media on integer material]. *Jurnal Pendidikan dan Profesi Pendidik, 14*(8), 91-99. http://riset.unisma.ac.id/index.php/jp3/article/view/4936

Muthy, A. N. & Pujiastuti, H. (2020). Analisis media pembelajaran e-learning melalui pemanfaatan teknologi dalam pembelajaran matematika di rumah sebagai dampak 2019 N-Covid [As a result of the 2019 N-Covid, an analysis of e-learning learning media through the use of technology in learning mathematics at home was conducted]. *Jurnal Math Educator Nusantara*, *6*(1), 94-103. https://doi.org/10.29407/jmen.v6i1.14356

NCTM. (2000). *Principles and standars for school mathematics.* NCTM. https://www.nctm.org/uploadedFiles/Standards_and_Positions/PSSM_ExecutiveSumm ary.pdf

Nisa, H., Disman, & Dahlan, D. (2018). Pengaruh penerapan model pembelajaran kolaboratif teknik group investigation terhadap kemampuan berpikir analisis peserta didik [The impact of using the group inquiry technique's collaborative learning model on students' analytical thinking skills]. *Jurnal Manajerial, 3*(5), 157-166. https://doi.org/10.17509/manajerial.v17i2.10277

OECD. (2019). *PISA 2018 Mathematics Framework in PISA 2018 assessment and analytical framework*. OECD Publishing. https://www.oecd.org/education/pisa-2018-assesment-and-analytical-framework-b25efab8-en.htm

Octriana, I., Putri, R. I. I., & Nurjannah. (2019). Penalaran matematis siswa dalam pembelajaran pola bilangan menggunakan PMRI dan LSLC [Students' mathematical reasoning in learning number patterns uses PMRI and LSLC. *Jurnal Ilmiah Pendidikan Matematika*, *13*(2), 131-142. https://doi.org/10.22342/jpm.13.2.6714.131-142

Permendikbud. (2016). *Permendikbud No 21 Tahun 2016 tentang standar isi pendidikan dasar dan sekolah menengah [Regulation No. 21 of 2016 of the Minister of Education and Culture on content standards for primary and secondary education]*. https://bsnpindonesia.org/wpcontent/uploads/2009/06/Permendikbud_Tahun2016_Nomor021_Lampiran.pdf

Permendikbud. (2016). *Permendikbud No 22 Tahun 2016 tentang standar isi pendidikan dasar dan sekolah menengah [Regulation No. 22 of 2016 of the Minister of Education and Culture on educational content standards for elementary and intermediate schools]*. https://bsnpindonesia.org/wpcontent/uploads/2009/06/Permendikbud_Tahun2016_Nomor022_Lampiran.pdf

Purwanti, S., Mardiyah, S., & Risnanosanti. (2020). Soal tentang bilangan bulat untuk mengukur kemampuan penalaran matematis [Integer questions are used to assess mathematical reasoning skills]. *Jurnal Pendidikan Matematika Raflesia*, *5*(2), 145-152.

Putri, D. K., Sulianto, J., & Azizah, M. (2019). Kemampuan penalaran matematis ditinjau dari kemampuan pemecahan masalah [In terms of problem-solving skill, mathematical reasoning]. *International Jurnal Of Elementari Education, 3*(3), 351-357. https://doi.org/10.23887/ijee.v3i3.19497

Putri, R. I. I. (2015). Pengaruh interaksi pendekatan pembelajaran dan bentuk tes formatif terhadap hasil belajar matematika [The impact of combining learning modalities and different types of formative testing on arithmetic learning outcomes]. *Jurnal Pendidikan dan Pembelajaran*, *22*(1), 69-75. http://journal.um.ac.id/index.php/pendidikandan pembelajaran/article/view /7723

Rahayu, P. T. & Putri, R. I. I. (2021). The data package in learning mean using LSLC and PMRI, *Jurnal Pendidikan Matematika*, *15*(1), 61–70. https://doi.org/10.22342/jpm.15.1.9431.61-70

Ramadania, F., Wulandari, N. I., & Nahlini. (2017). Peranan komunikasi bahasa dalam pembelajaran matematika pada siswa kelas V SDN Keraton 3 Martapura [The role of language communication in Mathematics learning in class V SDN Keraton 3 Martapura]. *Jurnal Pendidikan Matematika, 3*(1), 23-32. https://doi.org/10.33654/math.v3i1.52

Sato, M. (2014). I*n junior high schools, dialogue and collaboration are used to create a "learning community"*. JICA.

Sofyana, U. M. & Kusuma, A. B. (2018). Upaya meningkatkan kemampuan penalaran matematis siswa menggunakan pembelajaran generative pada kelas VII SMP Muhammadiyah Kaliwiro [Efforts in class VII SMP Muhammadiyah Kaliwiro to improve pupils' mathematical thinking skills through generative learning]. *Jurnal*

Penelitian Didaktik Matematika, *2*(2), 11-23. http://dx.doi.org/10.30659/kontinu.2.1.1429

Suciati, I. (2020). Penggunaan metode "perang mental matematika" dengan menggunakan media kartu pecahan pada materi penjumlahan bilangan pecahan. [The use of fraction cards in the material for adding fractions as a medium for the "mathematical mental war" method]. *Jurnal Pendidikan dan Pembelajaran*, *3*(1), 35-42. https://doi.org/10.31970/gurutua.v3i1.44

Trisnawati, D., Putri, R. I. I. & Santoso, B. (2015). Desain pembelajaran materi luas permukaan prisma menggunakan pendekatan PMRI bagi siswa kelas VIII [For class VIII students, learning design for prismatic surface area utilizing the PMRI technique]. *Jurnal Matematika Kreatif-Inovatif, 6*(1), 76-85. https://doi.org/10.15294/kreano.v6i1.4504

Zulkardi & Putri, R. I. I. (2010). Pengembangan blog support untuk membantu siswa dan guru matematika indonesia belajar pendidikan matematika realistik indonesia (PMRI). [Support blog for siswa and guru matematika indonesia to learn real-world matematika indonesia (PMRI)]. *Jurnal Penelitian Inovasi dan Perekayasaan Pendidikan*, *2*(1), 1-24, https://repository.unsri.ac.id/id/eprint/6777