

# Analysis of students' critical thinking skills on social arithmetics with jumping task

Hobri<sup>1</sup>, R Oktavianingtyas<sup>1</sup>, D Trapsilasiwi<sup>1</sup>, R P Murtikusuma<sup>1</sup> and QA'yun<sup>1</sup>

<sup>1</sup>Mathematics Educational Study Program, University of Jember, Jember, Indonesia

E-mail : ayunquro@gmail.com

**Abstract.** This study describes critical thinking skills of students at MTsN Banyuwangi in solving social arithmetic problems based on jumping tasks. The critical thinking indicators used in this study are focus, reason, inference, situation, clarity, and overview. The data collection methods used are tests and interviews. The subjects studied further in this study were 6 students. The six students consisted of two students from each category of high, medium and low ability. This study used a qualitative approach with a type of descriptive research. The results show that students with high category critical thinking skills can fulfill 6 criteria of critical thinking, medium category students can meet focus, reason, inference, and situation criteria, while students of low category critical thinking can meet focus and situation criteria. Thus, it can be concluded that learning using the jumping task method helps the students' critical thinking skills become better.

## 1. Introduction

Education is very important for human survival [1]. The importance of education in building the nation's generation, and the progress of a country is to be able to develop intellectual abilities in humans. According to the National Education System Law Number. 20 of 2003, education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, noble character, and the skills needed by themselves, society, nation and state.

Mathematics is one of the educational sciences that has an important role in everyday life [2]. Mathematics as the foundation for building reasoning needs to be given to all students at all levels [3]. Learning mathematics is one of the ways to scientific and logical thinking and has an important role in efforts to improve the quality of human resources [4]. The purpose of mathematics learning is to train and foster ways of thinking systematically, logically, critically, creatively, and consistent, as well as persistent and confident nature in solving problems. Good quality education can be seen from the coherent teaching and learning process and in accordance with the character of students. Soedjadi states that learning mathematics in schools so far generally uses the order of presentation as follows: (1) taught theory/definition/ theorem, (2) given examples, (3) given practice or problems. This kind of learning is commonly called conventional learning which causes the teacher to dominate more learning while students are only good listeners and note takers.

Critical thinking is one of the thinking abilities that must be possessed by students because it can be used by students to further explore the concept of mathematics itself. The ability to think critically is an important thing, but the reality in schools is not as good as what has been expected. The Indonesian students' critical thinking ability is still relatively low. That fact is based on a study of Trends in International Mathematics and Science Study (TIMSS) conducted in junior high school



students using high cognitive level questions that can measure students' critical thinking skills. The result showed that Indonesian students consistently slumped below the level [5]. The educators are responsible to provide learning methods or models that can support students to think critically. The ability to think critically has several indicators. According to Ennis that in critical thinking there are six criteria namely Focus, Reason, Inference, Situation, Clarity, and Overview [6]. These six criteria will be used to determine students' critical thinking skills in solving problems. Ennis describes these criteria into several indicators which can be seen in the following table.

**Table 1.** Indicators of Critical Thinking

No.	Critical Thinking Criteria	Indicators of Critical Thinking
1.	Focus	a. Students are able to understand and write information in the form of what is known and what is asked b. Students are able to focus questions, and identify or formulate questions
2.	Reason	a. Students are able to find ways or patterns to solve problems by giving reasons based on facts or relevant evidence from each step in decision making. b. Students are able to work on problems according to a predetermined pattern by expressing clear reasons.
3.	Inference	a. Students are able to make conclusions from reasons that have been stated correctly b. Students are able to give reasons in making conclusions that have been made
4.	Situation	Students can relate prior knowledge in solving problems.
5.	Clarity	Students are able to explain step by step the methods used in problem solving
6.	Overview	a. Students can thoroughly examine the answers. b. Students can find other ways to solve the problem.

The success of students in learning mathematics is not only influenced by the ability of students themselves but influenced by other factors such as teacher and learning models used in the classroom [7]. One method that can be used is the jumping task method. Jumping task is a way to train and improve students' critical thinking skills to solve problems with their own methods. Therefore, this study used a method of learning jumping tasks. Jumping Task is the provision of questions or tasks that are challenging or above the curriculum level. By applying jumping tasks, students are expected to think critically in solving problems [8].

Topic in mathematics that has never been taught with jumping task-based problems is social arithmetic. Social arithmetic materials are related to story problems, so to be able to solve these problems requires a high critical thinking ability to be able to understand, analyze, and determine solutions systematically and correctly. Thus, social arithmetic material has aspects that support students to think critically.

## 2. Research method

This is a qualitative descriptive research. The data obtained were in the form of oral or written word from an object that had been observed. The data were original which had not modified yet and used a systematic way and could be justified [9]. The subjects of this research were 6 junior high school students in MTsN Banyuwangi.

The research instruments used were test questions and interview guidelines. The instrument that was made was then validated by the validators, who were two lecturers of the Mathematics Education Study Program of UNEJ. The instrument was declared valid because  $2.5 \leq V_a < 3$ . The value of the observation sheet validation results obtained was  $V_a=2,68$ , while for the interview guide value obtained was  $V_a=2,71$ . Analysis of the data was the analysis of students' work and interviews. Data obtained from test results were analyzed to describe the students' critical thinking skills. The results of the interview also been analyzed to obtain the descriptive data as a complement to the test result data. The next was an assessment of the relationship between test results and interviews. This connection was used to draw conclusions about students' critical thinking processes. The data obtained from the results of the test were analyzed to describe the students' creative thinking skill. The results of the interview were also analyzed to get the data descriptively as the supporting data of the result of the test. Then, a study about the relationship between the result of the test and interview was conducted. This relationship was used to draw conclusion about the students' critical thinking.

**Table 2.** Criteria and Indicators for Critical Thinking Research Reference

No.	Critical Thinking Criteria	Indicators of Critical Thinking
1.	Focus	<ol style="list-style-type: none"> <li>1. Students can write information that is known in the problem</li> <li>2. Student can write information that is asked on the problem</li> <li>3. Students can tell in their own language the problems that exist in the problem.</li> </ol>
2.	Reason	<ol style="list-style-type: none"> <li>1. Students can explain (verbally and in writing) strategies in solving mathematical problems by expressing reasons</li> <li>2. Students can work on problems in accordance with the way or strategy that has been determined by revealing the reasons.</li> </ol>
3.	Inference	Students can make solutions to problems that have been worked on.
4.	Situation	Students can connect prior knowledge in solving problems.
5.	Clarity	Students are able to explain step by step the methods used in problem solving.
6.	Overview	<ol style="list-style-type: none"> <li>1. Students can thoroughly review the answers</li> <li>2. Students can find other ways to solve the problem.</li> </ol>

## 3. Result and discussion

The data analyzed in this study were the result data about the description of social arithmetic materials based on jumping tasks and interview guidelines. The subjects of the study were six students of VII B class of MTsN Banyuwangi. Those students consisted of 4 female students and 2 male students. The research subjects were chosen based on the level of students' thinking ability which is divided into

three levels, namely high, medium and low abilities taken from the work of students. The level of critical thinking is obtained through the achievement of critical thinking criteria. Students are considered in high level if they reach 5 or 6 criteria for critical thinking. They are considered at a moderate level if they reach 3 or 4 criteria for critical thinking and at a low level if they reach 1 or 2 criteria for critical thinking.

Based on the analysis of critical thinking skills tests and interviews, S1 and S2 were categorized in high-level of critical thinking because they met 5 or 6 criteria of critical thinking namely focus, reason, inference, situation, clarity and overview. In question number 1, S1 student did not write the alternative ways on the answer sheet. The reason was that S1 student wanted to save time to work on the next problem. However, during interviews, S1 could explain smoothly. S2 was able to write all the answers correctly. According to the indicators on the critical thinking skills test and during the interview, S2 could explain in a coherent and fluent manner. This can be seen in the work of S2 students below. The following was one of the students work:

No Soal	Tahap Penyelesaian
1.	<p>Diketahui : (Tuliskan apa yang diketahui pada soal)            1. peti duku = Berat = 50 kg                Tara = 4%                Laba = 20%            Duku besar &amp; manis = 28 kg = 14.500 / kg            - " - kecil &amp; manis = 13 kg = 12.000 / kg            - " - kecil &amp; manis = ? = 13.500 / kg</p> <p>Ditanya : (Tuliskan apa yang ditanya pada soal)            Harga pembelian duku &amp; keuntungan pedagang duku?</p> <p>(Tuliskan rencana/strategi penyelesaian soal)            Rencana/strategi yang dilakukan untuk menyelesaikan soal ini yaitu:  <math>Netto = \frac{1}{100} \times 50 \text{ kg}</math>  <math>berat \text{ duku kecil \&amp; manis} = Netto - 28 + 13 = \dots</math>  <math>HB \text{ duku} = H_{manis} + laba = \dots / \text{kg}</math>  <math>Keuntungan = HJ - HB</math></p> <p>(Selesaikan penyelesaian soal sesuai dengan apa yang telah direncanakan)  <math>Netto = \frac{1}{100} \times 50 \text{ kg} = \frac{20}{10} = 2 \text{ kg}</math>  <math>= 48 \text{ kg}</math>  <math>Berat \text{ duku kecil \&amp; manis} = 48 - 28 + 13 = 7 \text{ kg}</math>  <math>HB \text{ duku} = Besar \&amp; manis = 28 \times 14.500</math>  <math>= 406.000</math></p>

Focus  
Criteria

Reason  
Criteria

**Reason Criteria**

- Feil & masam =  $15 \times 12.000 = 156.000$   
 - Fecil & manir =  $7 \times 13.500 = 94.500$   
 Jumlah total harga jual =  $106.000 + 156.000 + 94.500 = 656.500$   
 Untung =  $\frac{20}{100} \times 656.500 = 20 \times 6.565 = 131.300$   
 HB =  $HJ - \text{Untung} = 656.500 - 131.300 = 525.200$

**Inference Criteria**

(Tuliskan kesimpulan penyelesaian soal disertai alasan yang logis)  
 Harga beli = 525.200  
 Untung = 131.300

**Overview Criteria**

(Tuliskan cara atau alternatif lain dalam menyelesaikan soal)  
 -  $\frac{1}{100} \times 50 = \frac{20}{10} = 2\text{kg}$ ,  $50 - 2 = 48\text{ kg}$   
 - Total harga jual = 656.500  
 - Harga beli =  $\text{Harga jual} - \text{Untung} = 656.500 - 131.300 = 525.200$

Figure 1. The students' work result no 1

S3 and S4 were categorized in the category of moderate critical thinking because they met 4 criteria of critical thinking namely, focus, reason, inference, clarity. On average, S3 and S4 had difficulty with the second indicator which is reason. This was because S3 and S4 did not finish answering the questions. Thus, no proper solution is obtained.

The next subject is S5 and S6. Both students were categorized in low ability level. Students with low ability tend to meet the first and second indicators. They can write things that are known and can write things that are asked. S5 and S6 were only able to meet the criteria of critical thinking focus and situation. This can occur due to several factors such as the level of difficulty in the problem, students' lack of knowledge in translating the problem, and students with low ability need more direction to understand the problem.

Based on the analysis of critical thinking skills performed by using the jumping task method, the results showed that the subject of high-level critical thinking could meet all the criteria of critical thinking. Subjects who are in high level of critical thinking are able to meet the criteria of focus, reason, inference, and situation while subjects that are classified as low only meet the criteria of critical thinking focus and situation. According to students with moderate to high critical thinking skills are able to analyze, focus, and identify assumptions properly and can write steps in a coherent and correct way [14]. Students with low critical thinking skills are less able to analyze, focus and identify assumptions well. They tend to write unclear steps and write incorrect answers. The following is a summary of the fulfillment of the criteria of the subjects' critical thinking skill based on the results of the jumping task-based test questions.

Table 3. Summary of fullness of indicators of creative thinking

Subject	Focus	Reason	Inference	Situation	Clarity	Overview
S1	√	√	√	√	√	√
S2	√	√	√	√	√	√
S3	√	√	√	√	-	-
S4	√	√	√	√	-	-
S5	√	-	-	√	-	-
S6	√	-	-	√	-	-

From the results of student work that have been analyzed, there were some differences in solving the social arithmetic problems between high, medium and low category students. High category

students tend to work on problems by prioritizing correct answers, mainly on reason and overview criteria. On these criteria, students do not fill in the answer sheets but during interviews students can express answers verbally correctly. Medium category students tend to solve problems with only half of the steps. Thus, they find difficulty in concluding and finding alternative ways to find the right answer. Low category students only focus on things that are known and asked on questions. Low category students tend to be afraid of trying to solve problems because they lack understanding in the concept of problem-solving so that they need guidance in working on the given problem.

Based on the analysis of critical thinking skills on jumping task-based in social arithmetic material, there are two students with high-level critical thinking abilities category, 2 students with medium-level critical thinking abilities category, and two students with low-level critical thinking abilities. Problem description of jumping task-based in social arithmetic can improve student activities well. This result is in line with who argues that student learning activities and student learning outcomes can be improved by giving jumping tasks exercises [10]. According to Anwar in research conducted on learning based on jumping task, there is a significant change in the results of student learning as well [11]-[12]. This shows that the method of jumping tasks can improve students' thinking abilities, one of which is critical thinking skills.

#### 4. Conclusion and suggestion

The conclusion can be drawn based on the research findings and the discussions. Students with a high level of critical thinking skills can meet critical thinking criteria (focus, reason, inference, situation, clarity, and overview) when they are asked to complete jumping tasks based questions. In completing jumping tasks based questions, students with a moderate level of critical thinking can meet critical thinking criteria such as focus (in the first and second indicators), reason (in the first indicator) and inference and situation. Students with a low ability are only able to meet two criteria of critical thinking, namely focus and situation, in completing the same tasks. The conclusions obtained from the results of the analysis and discussion of critical thinking was each student had advantages and disadvantages in solving problems. Each student had his own way of developing concepts of answers and arguments that made sense in order to solve the problem. Students answered briefly or in a long way it depended on how critical the student was, but the weakness of students was in finding other alternatives to solve these problems.

Suggestions for teachers from the results of this study are that students must be accustomed to solving material arithmetic social with jumping task problems not only in the form of answers, but by using ways that can develop students' critical thinking skills. This method is also possible to facilitate students in practicing critical thinking. In addition, this research can be used as an additional reference for similar research.

#### Acknowledgement

We would like to thank the University of Jember, Jember. Indonesia, which offers grants and opportunities to disseminate intellectual results from our research.

#### References

- [1] R R Saputri, T Sugiarti, R P Murtikusuma, D Trapsilasiwi, E Yudianto 2018 *Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Materi Fungsi Berdasarkan Kriteria Watson Ditinjau Dari Perbedaan Gender Siswa Smp Kelas VIII Kadikma* **9** 2 59-68
- [2] Z Arifin, D Trapsilasiwi, A Fatahillah, 2016 *Analisis Kemampuan Komunikasi Matematika Dalam Menyelesaikan Masalah Pada Pokok Bahasan Sistem Persamaan Linier Dua Variabel Siswa Kelas VIII-C SMP Nuris Jember* JURNAL EDUKASI UNEJ 2016 III **2** 9-12
- [3] A Fatahillah, Y F Wati, and Susanto 2017 *Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Matematika Berdasarkan Tahapan Newman Beserta Bentuk Scaffolding yang Diberikan* Kadikma **8** 1 40-51

- [4] Hobri, RP Murtikusuma, LI Hermawan 2019 *Development of e-comic using pixton and kelase web on linear program of two variables assisted by geogebra* 1265 1 Journal of Physics: Conference Series
- [5] Karim and Normaya 2015 *Kemampuan Berpikir Kritis Siswa dalam Pembelajaran Matematika dengan Menggunakan Model Jucama di Sekolah Menengah Pertama* Jurnal Pendidikan Matematika **3** 1 92-10
- [6] R H Ennis 1996 *Critical Thinking*
- [7] R Purwati, Hobri, A Fatahillah 2016 *Analisis Kemampuan Berpikir Kritis Siswa Dalam Menyelesaikan Masalah Persamaan Kuadrat Pada Pembelajaran Model Creative Problem Solving* Kadikma **7** 1 84-93
- [8] Hobri and Susanto 2016 *Collaborative Learning, Caring Community, dan Jumping Task Berbantuan Lembar Kerja Siswa Berbasis Scientific Approach: Salah satu Alternatif Pembelajaran Matematika di Era MEA*
- [9] T A Irawan, S B Rahardjo, Sarwanto 2017 *Analisis Kemampuan Berpikir Kritis Siswa Kelas VII-A SMP Negeri 1 Jaten Prosiding Seminar Nasional Pendidikan Sains (SNPS)* 232-236
- [10] S Umala 2016 *Profil Kemampuan Berpikir Kritis dalam Menyelesaikan Soal Lingkaran Siswa Kelas VII-A SMP Negeri 11 Jember*
- [11] Nofrion 2017 *Peningkatan Aktivitas Belajar Siswa Melalui Penerapan Metode "Jumping Task" Pada Pembelajaran Geografi* Jurnal Geografi **9**(1): 11-20.
- [12] B Anwar 2017 *Pengaruh Collaborative Learning dengan Teknik Jumping Task terhadap Keterampilan Berpikir Kritis dan Hasil Belajar IPA Siswa SMP.*