IJOLAE Indonesian Journal on Learning and Advanced Education

http://journals.ums.ac.id/index.php/ijolae

Learning Social Arithmetic of Low-Ability Student through the Context of Snacks and Money

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DOI: 10.23917/ijolae.v4i1.14308
Received: May 6th, 2021. Revised: September 1st, 2021. Accepted: September 11st, 2021
Available Online: December 24th, 2021. Published Regularly: January 1st, 2022

Abstract

Low-ability students are evidenced to have difficulties in understanding the concept of abstraction in mathematics, such as social arithmetic problems. It is because low-ability students have an IQ below the average of 70 to 90. Most teachers find it challenging to discover what kind of learning approaches that may be suitable for improving their mathematical understanding. An alternative approach that can be used to improve the understanding of low-ability students is the Indonesian Realistic Mathematics Education (IRME) approach by using real contexts as a starting point for learning to make it easier for students to study the abstract material. This study aims to determine the learning process and the role of IRME in improving low-ability student's mathematical cognitive abilities regarding the concept of social arithmetic. This study used the Single Subject Research (SSR) method with a single subject, and a seventh-grade student at one of the Junior High Schools in Depok, Yogyakarta. The research data collected in this study are audio and video recordings, photos, and student worksheets. The data collected was then analyzed using in and between analysis with A-B research design. The results showed that the IRME approach with snack and money contexts could improve a low-ability student's mathematical understanding of the social arithmetic concept. This context could be a starting point for teachers in teaching social arithmetic problems and be a reference for finding other contexts that can make mathematics learning more easy and joyful for low-ability students.

Keywords: indonesian realistic mathematics education approach, low-ability student, single subject research, social arithmetic

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1. Introduction

There are several differences in students' abilities in teaching and learning activities, one of which is related to students' cognitive skills. Every student is born with unique, memorable, and different skills, including students' cognitive skills to learn something (Khabibah, 2017; Qois, 2017; Othman et al., 2016; Shahrill et al., 2013). At school, the teacher will find other children with different cognitive abilities, some are slow, and some are fast. Students with slow cognitive abilities are usually referred to in previous literature as slow learners or students (Borah, 2013; Khabibah, 2017; Larrivee & Horne, 1991).

However, in this study specifically, we will be referring to them as low ability students.

When cognitive abilities are measured, students who are classified as low ability have IQ scores below the average between 70 and 90, but they are not classified as disabled students (Borah, 2013). These students only have problems with their interests in educational learning who may be traditional and are taught materials within the classroom settings (Borah, 2013; Ramlaksmi, 2013; Mupputadathi, 2014). Students who are categorised as low ability leaners do not typically need special education, but they need extra support from teachers who are not aware of their learning difficulties; and usually, low ability students have difficulties understanding something abstract and they are more likely to comprehend concrete things easily (Abdul Latif et al., 2017; Brennan, 2018, Borah, 2013, Williamson & Field, 2016). Therefore, these students need special treatment to solve their difficulties in the learning process.

In the field of mathematics, low ability students have difficulties to understand abstract materials (Abdul Latif et al., 2017; Othman et al., 2016; Rofiah & Rofiana, 2017; Shahrill et al., 2013; Vasudevan, 2017), such as social arithmetic problems. This is because the characteristics of low ability students are that they tend to understand something concrete better and can be easily imagined (Warnemeuende, 2008; Martin & Martin, 1965; Muppudathi, 2014; Vasudevan, 2017). Consequently, to teach abstract materials to low ability students, a specific approach to mathematics is needed.

One approach that can be used is *Pendidikan Matematika Realistik Indonesia* (PMRI) or Indonesian Realistic Mathematics Education (IRME). IRME uses an authentic context as the starting point for learning mathematics. The actual context can bridge students' understanding by using tangible objects to understand abstract mathematics (Jannah & Prahmana, 2019; Risdiyanti, Prahmana, & Shahrill, 2019; Karaca & Ozkaya, 2017). IRME has been adapted in Indonesia from Hans Freudhental in the Netherlands, namely Realistic Mathematics Education (RME). Subsequently, IRME has been adapted to the existing culture in Indonesian society (Prahmana et al., 2012; Gravemeijer, 2008; Zulkardi et al., 2020; Zulkardi, 2020).

One of the materials that are difficult to be implemented by low ability student is the social arithmetic material in particular. These issues were initially found during an earlier observation and subsequent interview result with a teacher regarding a particular student. In line with these problems, the IRME approach that uses real contexts as a starting point in learning can be used to improve the abilities of the low ability student at one of the junior high schools in Depok, Yogyakarta. Therefore, the researchers of this present study are interested in conducting Single Subject Research with the subject from the low ability class from the previous mentioned school with the learning approach used, namely IRME.

In social arithmetic material, one of the contexts that can be used is snacks and money. This context was chosen because it is familiar to students and often encountered in their daily lives. Also, snacks and money are concrete objects that can be readily accepted and imagined by students and, by their tendency to understand concrete or real things easily. A previous study by Wanabuliandari and Purwaningrum (2018) has proven that the use of *Gusjigang Kudus* can improve the mathematics capabilities of low ability students. Meanwhile, the research of Musyani and Nurhastuti (2019) showed that IRME could improve the mathematics skills of low ability students, which in turn solve their learning difficulties.

This Single Subject Research (SSR) study was designed for mathematics learning using the IRME approach with snacks and money context. This activity determines the role and learning process as well as the role of IRME to improve the low ability student's mathematical cognitive abilities regarding the concept of social arithmetic. This study explores the mathematics learning process for low ability student in understanding the concept of social arithmetic problems.

2. Method

The Single Subject Research (SSR) was chosen as a research method because it has an important role in developing specific practices for inclusive education (Horner et al., 2005; Cook et al., 2008). The sample for this present study is a seventh-grade student who has difficulty understanding mathematics in one of the classes at the junior high school in Depok. The student experienced difficulties in participating in-class learning, such as when the teacher explained in front of the class the student was less able to understand the materials presented, so the teacher had to repeat the materials that were shown in order for the student to participate in learning mathematics. According to Firdausy, Setyaningsih, and Waluyo, (2019), the students' facilities and activities contribute to their learning independence and outcomes.

The research design used in this study is the A-B design, the first condition is called the baseline (A), and the second condition is called the intervention (B). In this design, there is no repeated measurement where the baseline phase (A) and the intervention phase (B) are each carried out only once for the same subject, hence it cannot be concluded that the independent variables (intervention) are solely responsible for changes in target behavior (Sunarto et al., 2005). On the other hand, Gast (2014) explained that in applied research, there are two fundamental requirements for evaluating the relationship between a study participant's behavior and independent variable. First, precise, reliable, and frequent behavioral measurements are required. Second, researchers should use the measurement system in conjunction with a single-case study design. Furthermore, at the baseline conditions (A), the subject is assessed in several sessions in order for it to look secure without intervention, then stabilized with the intervention condition (B), which is applied for a certain period of time so that the data is stable (Fraenkel & Wallen, 2009; Jemes, 2016). The behavior measured in this study is only the level of mathematical understanding, which depicts only one behavior.

This study used the context of snacks and money applied with the IRME approach as the treatment to explore the role of this context in increasing the low ability student's understanding of social arithmetic concepts. The SSR was conducted during the school year 2019/2020. This research was conducted for eight sessions with a single material. The first of the four meetings, namely the baseline phase, the first author gave several problems related to the concept of the social arithmetic. At each meeting, the first author explained how the question could be asked to the student without assistance to solve it. After the first of four meetings, the data from the student's evaluations showed that it was in a stable condition, hence the research process continued to the intervention phase. The results of the initial phase were then used as the basis for researchers to learn and analyze, which are carried out in the next four phases of the intervention phase. At the intervention phase, learning activities that were designed by using the IRME approach and using the context of snacks and money were subsequently conducted. At the end of the learning process of each meeting, the first author provided an

evaluation that must be done by the student. During the intervention phase, when the data from the student evaluations showed that it was in a stable condition after four meetings, the research process was then stopped. The results were then used as bases for analyzing and describing the student's understanding of social arithmetic concepts.

The research data collected was in the form of audio, photo, and video documentations, and written documentations (student worksheets) were also collected (Fraenkel & Wallen, 2009; Neuman & Cormick, 1995). The videos were to document and describe the learning activities, both at the baseline, the intervention and activity phases, when the student worked on the given questions. The academic lecturers validated the student evaluation sheets containing the questions. The validation processes began with the creation of a form containing indicators of social arithmetic understanding. Each question was created and developed based on textbooks used in schools and indicators designed by the first author. Next, the questions that have been validated by the validators were then used to see the effects that occurred after the research was done.

The data analysis used in this study is a in condition and between condition analyses (Fraenkel & Wallen, 2009) with six phase analyses that are firstly, the length of condition which stated the number of sessions or meetings conducted during the study in the baseline or intervention phase; secondly, the tendency of direction to see the description of the behavior of the subjects; thirdly, the stability tendency is used to see the stability of each phase, in this research the stability tendency is used by 10% if the data is clustered at the top and 15% if the data is clustered at middle or bottom; fourthly, trace data or trace tendencies, in each measurement condition used to see whether the data can be said to decrease (-), increase (+), or flat (=); fifthly, the levels of stability and ranges were used to observe the range of data groups in the baseline and intervention conditions; and finally, the level change that indicates the number of data changes in a condition (Sunarto et al., 2005; Gast & Ledford, 2014; Prahmana, 2021).

Analysis between conditions is almost the same as analysis in condition. However, analysis between conditions has five principles, such as first, the number of variables changes that are the number of variables approved in the research; second, the direct tendency and the influence can take data on in condition analysis, changes in both conditions can have a good effect marked by a positive sign and can have a harmful impact marked by a negative symbol; third, the difference in the stability tendency from baseline to intervention is to see changes in post-intervention conditions based on in condition analysis; four, level changes are used to see the changes that occur based on the point difference, the data is the data of the last session baseline conditions and the first session data on the intervention conditions then the difference between the two is calculated, a positive sign (+) indicates improvement and a negative sign (-) indicates worsening; and fifth, the percentage of overlap done by checking again the upper and lower limits of the baseline phase and calculate the number of data points in the intervention phase which is in the range of baseline phase, if the percentage of overlap is getting more minor than the effect of the intervention on target behavior which also becomes smaller (Fraenkel & Wallen, 2009).

3. Result and Discussion

This research was conducted in eight sessions with a single subject seventh-grade student. In the baseline phase, there were four sessions (one 45-minute session per day) in

order to observe the initial ability of the research subject regarding social arithmetic concepts before being treated in the intervention phase. Then, the intervention phase was carried out for four sessions (one 90-minute session per day). In this phase, the student was treated with implementing the IRME approach to understand the social arithmetic material. The treatment was carried out to evaluate the subject's ability before and after being given the treatment. The results of the evaluation of the research subject are given in Table 1.

Table 1. Subject Evaluation Results

Phase	Date	Score
Baseline	5 February 2020	12
	6 February 2020	13
	7 February 2020	14
	11 February 2020	13
Intervention	12 February 2020	70
	13 February 2020	74
	19 February 2020	72
	20 February 2020	72

Table 1 shows the scores obtained by the subject in solving evaluation questions about the concept of social arithmetic. As can be seen the conditions before treatment (or in the baseline phase), the scores obtained were very low, starting from the first to the fourth session, which were 12, 13, 14, and 13 respectively. Meanwhile, after being given treatment (or in the intervention phase), the obtained scores increased, starting from the fourth to eighth session (70, 74, 72, and 72 respectively).

Furthermore, the data that has been obtained was analyzed with in conditions and between conditions, as follows:

1. In Condition Analysis

a. Length of Conditions

The length of the session in the baseline phase (A) is four sessions, and the long phase of the intervention (B) is four sessions.

b. Direction Tendency

The direction tendency is obtained from the intersection of the vertical line, which divides the parts equally in each phase with the graph (split middle). Direction Tendency can be seen in Figure 1.

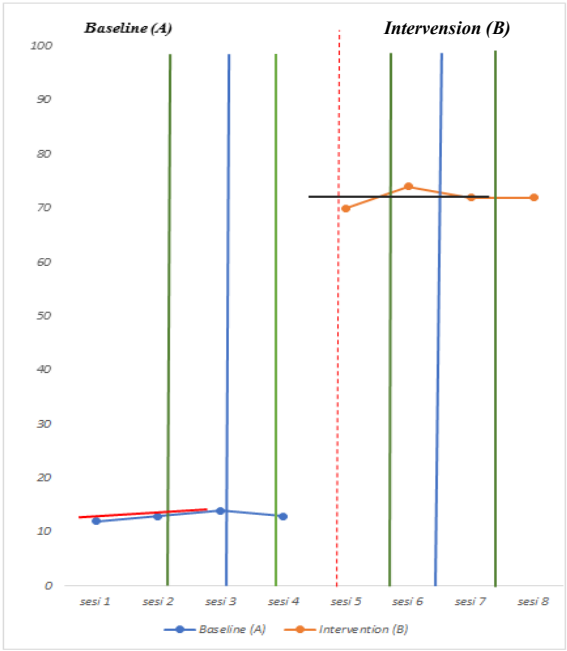


Figure 1. Estimated Direction Tendency Toward Subject

c. Stability Tendency

Determine the trend of stability in the baseline phase and the intervention phase, which is 15%. Figure 2 shows that the data at the baseline phase points are in the range of the upper limit (red color) and the lower limit (green color).

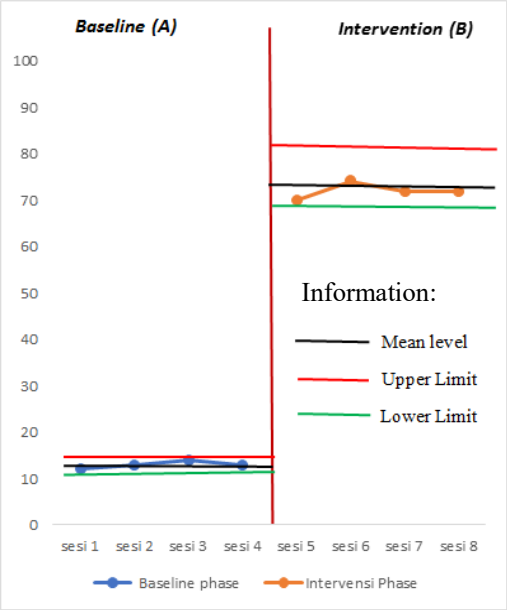


Figure 2. Estimated Stability Tendency Toward Subject

d. Trace Tendency

Trace Tendency in the baseline phase is increasing, and in the intervention, phase is flattening so that changes occur that are improving but less visible.

e. Level Stability

The level of stability data calculation can be seen in the disturbance tendency calculation. In the baseline phase the data is stable with a range of 12-14. Whereas in the intervention phase the data was stable with a range of 70-74.

f. Level Change

In the baseline phase, a difference of 1 means that there is a change, and a difference of 2 in the intervention phase indicates that the change is getting better. All components that have been calculated can be summarized as in Table 2.

Table 2. Visual Analysis Results in Conditions

Condition	A	B
Length of Conditions	4	4
Direction Tendency	↗	—
Stability Tendency	Stabil (100%)	Stabil (100%)
Trace Tendency	—	—
Stability Level	Stable	Stable
	12-14	70-74
Change Level	13-12	72-70
	(+1)	(+2)

2. Between Condition Analysis

a. Number of Variables

The variable that is changed here is the slow learning student learning outcomes on social arithmetic material. In Table 3, the number 1 is written, which means that only one variable is changed.

b. Change in Direction Tendency

Changes in the direction of the condition analysis can be determined by taking data from the condition analysis. Writing the change in trend direction is the same as the analysis under conditions, causing a good impact (+).

c. Change in Stability Tendency

Changes in the stability trend in the analysis between conditions can be determined by looking at the data on the analysis stability trend under conditions. In this study, the changes that occurred from the baseline phase to the intervention phase were stable to stable.

d. Level Change

The last session point data for the baseline phase is 13, and the data points for the first session of the intervention phase are 70. Then they are set aside so that they reach 57 for comparison of conditions B : A. The (+) sign is experiencing an increase from the previous data.

e. Percentage of Overlap

The overlap percentage is 0%, the smaller the overlap percentage, the better the effect of intervention on target behavior. All components of data analysis between conditions can be summarized as in Table 3.

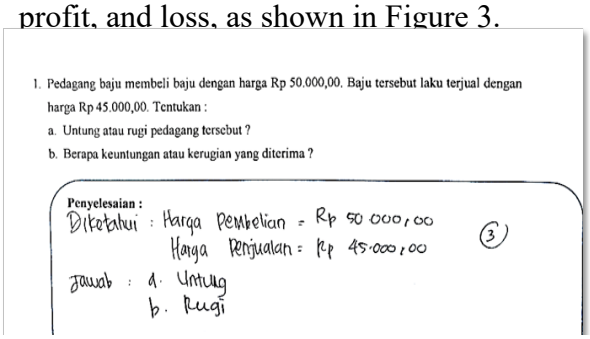
Table 3. Summary of Visual Analysis Results between Conditions

Comparison of Condition	B : A (2 : 1)
Number of variables changed	1
Change in direction tendency and the influence	(=) (=)
Change in stability tendency	Stable to stable
Level change	(13-70) (+) 57
Percentage of overlap	0%

Based on the results of this study, there is an increase in the learning outcomes of the low ability students on social arithmetic material with the use of the IRME approach. The changes that occur can be observed in graphic images and summary analysis in Table 2 and Table 3, which include visual analysis, analysis in conditions, and analysis between conditions in Figure 1 and Figure 2. The results in each phase are presented below.

1. Baseline Phase

In the first session, the first author gave instructions to the student to work on the evaluation questions. At first, the student was not confident and hesitated to do the questions. However, the first author provided the extra encouragement and a sense of confidence that made the student work on the evaluation questions that were given, and only then the student started working on them. The student did not understand the concept of social arithmetic related to selling price, purchase price, profit, and loss, as shown in Figure 3.


1. Pedagang baju membeli baju dengan harga Rp 50.000,00. Baju tersebut laku terjual dengan harga Rp 45.000,00. Tentukan :
a. Untung atau rugi pedagang tersebut ?
b. Berapa keuntungan atau kerugian yang diterima ?

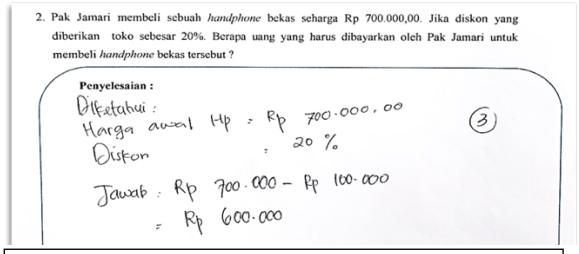
Penyelesaian :
Diketahui : Harga Pembelian = Rp 50.000,00
Harga Penjualan = Rp 45.000,00 (3)
Jawab : a. Untung
b. Rugi

1. A clothing trader buys clothes for Rp. 50.000,-. He sold the clothes for Rp. 45.000,-
a. Is the trader's profit or loss?
b. How much profit or loss did he receive?

Solution:
Information: Purchase Price = Rp. 50.000, Selling Price = Rp. 45.000,-
Answer: a. Profit b. Loss

Figure 3. Results of Student's Work in the Baseline Phase 1

Instructions were given to the student to work on further on the questions. In this session, the student could still work on social arithmetic material questions related to discount, gross, net, and taxes This is because the student did not understand the material, as shown in Figure 4.

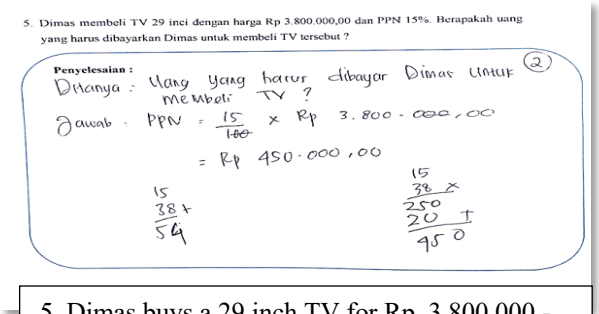


2. Mr. Jamari buys a used handphone for Rp. 700.000,- If the store gives a discount for 20%, how much money that he gives to buy this used phone?

Solution:
Information: Original Price = Rp. 700.000,
Discount = 20%
Answer: Rp. 700.000 - Rp. 100.000
Rp. 600.000,-

Figure 4. Results of the Student's Work in the Baseline Phase 2

In the third session, the scores obtained by the student increased by only 1-2 points only. Even though the student's scores increased in the arithmetic material related to single interest, in this phase, the student did not seem to have mastered multiplication well. In addition, the student still had errors in calculating multiplication, as seen in Figure 5.

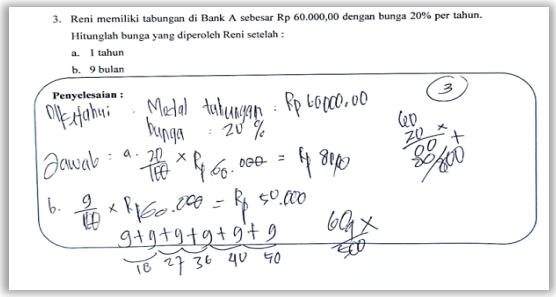


5. Dimas buys a 29 inch TV for Rp. 3.800.000,- with tax 15%. How much money that he pays to buy this TV?

Solution:
Information: The money that Dimas payed to buy this TV?
Answer: Tax = 15% x Rp. 3.8700.000
= Rp. 450.000,-

Figure 5. Results of the Student's Work in the Baseline Phase 3

In the fourth phase, the scores obtained by the student decreased. The student had not mastered social arithmetic material about taxes. The location of the error in this phase indicated that the student was not able to do the multiplication questions well, as shown in Figure 6.



3. Reni has saving at the Bank A for Rp. 60.000,- each year. Calculate the interest earned by Rani after:
a. one year
b. nine months

Figure 6. Results of the Student's Work in the Baseline Phase 4

2. Intervention Phase

In the first session of the intervention phase, material to be studied was briefly described, namely, social arithmetic related to sales prices, purchase prices, profits, and losses. Furthermore, the first author asked the student whether there was already a description of the material. The student answered doubtfully and did not display confidence. Then the first author explained a little about the sales price, purchase price, profit, and loss. In this case, the context of buying and selling was used to make it easier for the student to understand the material being taught. The student was given some snacks (tango) and money, and then enacted the role of a seller and a buyer. The use of snacks (tango) and money context is a mathematical model to bridge the student's mathematical understanding from real to abstract setting. Furthermore, the first author also asked the student to provide examples of sales prices, purchase prices, advantages and disadvantages of using

snacks (tango), and money, as shown in Figure 7.

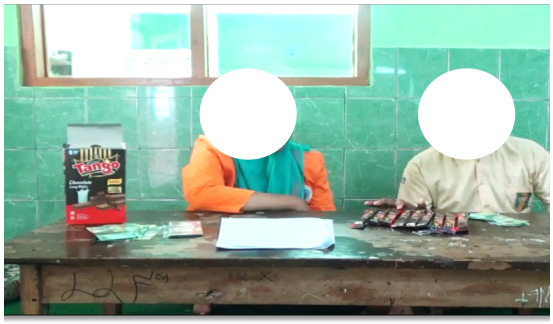
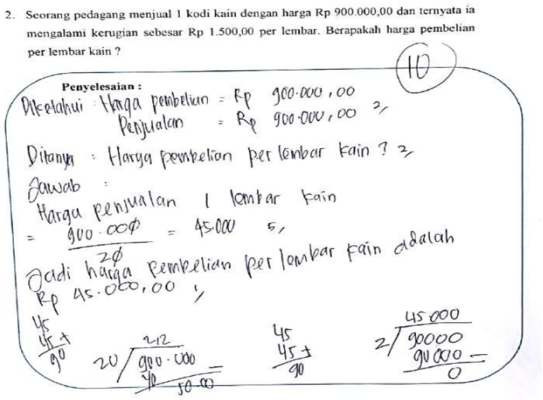


Figure 7. The Use of IRME Approach using the Context of Snack and Money

During the intervention phase, the first author instructed the student to work on the evaluation test sheet that has been prepared to determine learning outcomes. In the first session, the student was able to do the questions well. It can be said that the student began to master the concept of social arithmetic regarding sales prices, purchase prices, profits, and losses, as seen in Figure 8.



2. A trader sells twenty clothing (1 *kodi* = 20 pieces) for Rp. 900.000 and he got loss for Rp. 1.500.000 each piece. What is the purchase price per piece of cloth?

Solution:
Selling price each cloth
= 900.000 : 20 = 45.000
So, the purchase price for each cloth is Rp. 45.000

Figure 8. Results of the Student's Work in the Intervention Phase 1

In the second session, the first author used snack mediums such as green bean extract, the 'Indomilk' milk brand, twisters and money. The student was instructed to use these mediums that were brought by the first author to bridge social arithmetic concepts related to discount, gross, net, and taxes. Additionally, it can build the discount concept with the context of buying and selling. After the student understood the idea of discounts, the first author then discussed social arithmetic materials related to discounts. Christidamayani and Kristanto (2020) explained that the problem-posing ability has a negligible effect on student's learning achievement. The discussion process is needed in this meeting, as shown in Figure 9.

Figure 9. Discussion about Discount

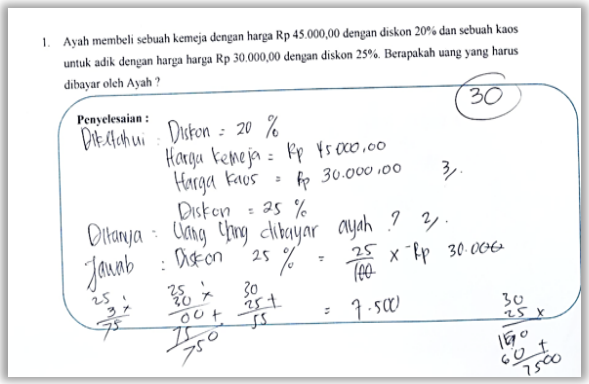
Next, the first author instructed the student to mention which parts are meant by net gross using juice snacks, as shown in Figure 10.

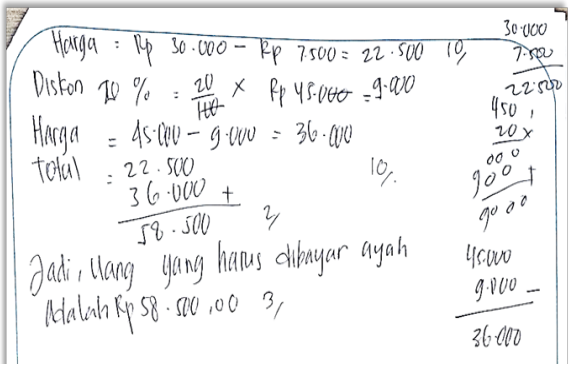
Figure 10. Student Mentioned the Shares of the Net Gross

The student was able to follow the instructions by using several mediums. He was able to solve several problems given in the student worksheet. The actual context can bridge the student's understanding by using

tangible things to understand abstract mathematics material (Jannah & Prahmana, 2019; Risdiyanti, Prahmana, & Shahrill, 2019; Karaca & Ozkaya, 2017).

The evaluation test sheet was then provided to determine the extent to which the student understood the social arithmetic material related to discount, gross, net, and taxes. There were improvements in the results obtained by the student, as displayed in Figure 11.



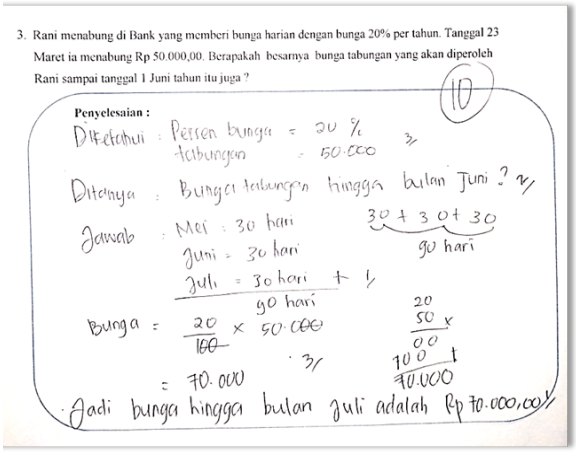


1. Father buys a shirt for Rp. 45.000 with the discount is 20% and a cloth for his son for Rp. 30.000 with the discount 25%. How much money does dad have to pay?

Solution:
So, the money that dad must pay is Rp. 58.500,-

Figure 11. Results of the Student's Work in the Intervention Phase 2

Savings books and money were then used in the third session as social arithmetic materials related to a single interest. The context in this phase is savings and loans. Furthermore, the first author instructed the student to find the amount of someone's savings after depositing money at a bank, with a predetermined time, and knowing the capital and interest per year. The student then proceeded to work on the evaluation question sheets, similar to the previous session. The results obtained by the student decreased because there were errors in calculations related to multiplication, as shown in Figure 12.



3. Rani saves at the Bank which give her daily interest for 20% each month. She save for Rp. 50.000 on March 23. How much interest will Rani receive until the first June in this year?

Solution:
So, the interest in July is Rp. 70.000,-

Figure 12. Results of the Student's Work in the Intervention Phase 3

In the fourth session, snack media (wafers) and money were used for social arithmetic materials about taxes. The context for this material is buying and selling, which is then taxed. The student also worked on the evaluation question sheets.

The results obtained by the student in the intervention phase showed an increase in social arithmetic learning outcomes after providing the context of buying and selling, snacks, savings, and loans based on the IRME approach in social arithmetic learning. Thus, the IRME approach was able to improve the student's learning outcomes. It should be noted that previous researchers have also stated that using the IRME approach can

improve students' learning outcomes (Maulidia, 2017; Musyani & Nurhastuti, 2019; Jannah & Prahmana, 2019; Risdiyanti, Prahmana, & Shahrill, 2019; Prahmana et al., 2020).

4. Conclusion

The findings of this study indicated that the low ability student was able to follow the learning processes well in order to solve the problems given in the form of social arithmetic material using the Indonesian Realistic Mathematics Education (IRME) approach. The results showed the learning outcomes of the student, before being given the treatment was an average score of 13 (based on a scale of 100). Evidently, after the treatment using the IRME approach with buying and selling, snacks and savings, and loans, the results showed an average score of 72. Therefore, learning social arithmetic using the IRME approach, with buying and selling, snacks and savings, and loans contexts for low ability student produces a learning process that can improve student learning outcomes.

5. Acknowledgement

We would like to express our gratitude to Universitas Ahmad Dahlan for providing the facilities and opportunities to develop this research until completion, especially to Syariful Fahmi, M.Pd. and Fariz Setyawan, M.Pd., as the validators for our research instruments, and also to Uswatun Khasanah, S.Si., M.Sc., as the Head of Mathematics Education Department who supported this research until completion. We also express our thanks to the junior high school and the teachers in this study for allowing us to conduct this study.

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