The problems of teaching fractional arithmetic operations for disabled student using Realistic Mathematics Education

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Abstract. This study aims to describe the problems of teaching a blind student using Realistic Mathematics Education (RME) in the arithmetic's operations ability of many fractions. The method of this study was a descriptive analysis of implementation RME for a blind student. The subject of the implementation of the RME was a 15-year-old student in grade VI at the Muhammadiyah Purworejo Special School (SLB) who were randomly selected. The implementation of RME for the blind students has characteristics that are in accordance with the principles of teaching blind students. However, sometimes there are many factors that make RME could not optimize the ability of blind students. These factors are the student itself and external factors. As a teacher, knowing these factors is one way to plan the next learning. Therefore, this study focuses on explaining the problems when the RME has been implemented in the learning of arithmetic operations of many fractions for a blind student.

1. Introduction
All children must learn to use mathematical skills in a practical way to solve problems [1]. Blind students are children with visual impairments included low vision. Eighty percent of human experience be obtained from eyesight [2]. People who lose their vision mean losing the line of visual information so that blind students find it difficult to obtain information or experience. Many factors affect students' mathematical abilities, but it has been observed that the teacher factor is one of the strongest elements impacting student achievement [3–6]. Therefore, in mathematics learning of blind students, the teacher must try to improve other senses that are still functioning.

Educational reforms during the last decade have led to a more inclusive environment for students with different needs and have shed light on teachers’ readiness to teach diverse students in the general classroom [7–13]. This can be interpreted that teachers who teach disabled student must have the teaching competencies of students with special needs. There are three principles of teaching for blind students, such as (1) concrete experience, (2) integration between concepts, and (3) learning by doing [14]. At least a teacher who teaches disable students must be able to do the three principles of teaching.

The characteristics of RME include: (1) using realistic problems, (2) using models, (3) there are many interactions, (4) contains constructivism, and (5) there is an interrelationship between concepts [15]. There are some characters that stand out in the RME, one of which is a "realistic" situation in the
learning process [16]. If viewed carefully, the characteristics of the RME and the principle of teaching blind students have a high synergy. RME will provide concrete experience to blind students while blind students themselves need concrete experience to construct their cognitive structure. The implementation of RME can be seen as one of the real steps to improving the quality of mathematics learning for blind students.

Based on the characteristic of RME, the teacher can easily make a scaffolding to the students to evaluate themselves. However, it always depends on the students’ learning factor, such as their conceptual understanding, procedural ability or computation skills in solving the problem [17]. For example, in the arithmetic's operations especially fraction addition, students must hold the main concepts. One of the main concepts is the condition that the addition of two fractions can be done if the denominator is the same number. However, students often make a mistake that is they add up the numerator numbers without equating the denominator (can be seen in Figure 1). RME can minimize this, but if students still repeat the same mistakes, this means that it is a student factor itself which is one of the obstacles to construct cognitive structures. A study that applying RME to blind students in the discussion of fraction addition showed that the subjects had difficulty when adding the two fractions with different denominators even though they had been given treatment using RME [18]. The study illustrated that even though RME is well implemented and there is an increase in achievement for blind students, there are important issues that need to be inspected by teachers to the continuity of learning for blind students. Furthermore, this study would describe the problems when the RME is applied in learning arithmetic operations of many fractions for a blind student.

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\frac{1}{2} + \frac{2}{3} = \frac{3}{5}
\]

**Figure 1.** An example of student error

2. Methods

In this study, the method used is descriptive analysis. Descriptive research is a research method that is intended to describe existing phenomena that take place at this time or in the past [19]. This research is a description of the problems that occur when the RME is applied to the learning of arithmetic’s operations of many fractions for a blind student. A randomly selected subject was a 15-year-old student in grade VI at Muhammadiyah Purworejo Special School (SLB) that categorized as a totally blind. A-B-A design is the development of the basic design of A-B, this A-B-A design has shown that there is a causal relationship between the dependent variable and the independent variable [14]. The learning that has been done using an A-B-A reversal design which shows a causal relationship between the arithmetic operations ability of many fractions (dependent variable) and the RME (independent variable). The procedures for implementing A-B-A design are as follows: (1) determine the behavior that will be changed as the target behavior that can be observed and measured, namely operation ability of many fractions; (2) make continuous measurements in a certain phase (baseline phase 1); (3) give treatments such as learning and measurement (intervention phase); (4) measurement as a control for the intervention phase so that it can conclude that there is a functional relationship between the independent variable and the dependent variable (baseline phase 2) [14]. This research is a case study of the implementation of RME in arithmetic operations learning on many fractions for a blind student who is analyzed descriptively. Data collected are primary and secondary data obtained through interviews and literature studies. The primary data is interviewed result with the teacher who teaches RME for the blind student while secondary data are research results and theories that some experts present.
3. Result and Discussion

Basically, the characteristics of RME are synergistic with the principles of teaching blind students. However, some factor makes the student achievement not as expected and the implementation of RME not optimized. These factors will be explained after through descriptive analysis of the implementation of RME with the reversal design of A-B-A for blind students. Previously, several theories will be presented about blind students and RME.

3.1. Blind student, RME and the implementation

Psychologically blind students with the totally blind category had the following characteristics: (1) touchy; (2) skeptic; (3) dependency [20]. The blind student feels touchy because less received visual stimulation so that he feels emotional when someone talks about things he cannot do. In addition, the failure experience that makes his emotions more unstable. Actually, everyone has the suspicion of the others. However, a blind person is more suspicious than others as well as the blind student. Sometimes, he is also suspicious of people who want to help him. Someone needs to near him first so that he knows and understands that not everyone is bad so his suspicion will be decreased or disappeared. A blind student must help in doing something, but not all of the activities you helped. These activities such as eat, drink, bath etc. Everyone can watch him when he does that to prevent things that endanger him. One example fell from the bathroom.

In the introduction, the characteristics of RME have been mentioned, namely (1) using realistic problems, (2) using models, (3) there are many interactions, (4) contains constructivism, and (5) there is an interrelationship between concepts [15]. Using realistic problems does not have to be real-world problems but can be in the world of games, props, or other situations as long as they are meaningful and can be imagined in the minds of students. The use of models is a bridge from concrete to formal mathematical knowledge. A person's learning process is not only an individual process but also a social process. Mathematics is not given to students as an object that is ready to be used but as a concept constructed by students, then in RME students as subjects of learning are given the freedom to develop problem-solving strategies. The concepts in mathematics are not partial, but many mathematical concepts are connected. Through this connection, one mathematics learning is expected to be able to construct more than one mathematical concept at the same time (even though there is a dominant concept). RME was applied to the blind student using the A-B-A reversal design. Explanation of the implementation as follows:

3.1.1. Baseline 1 (A1)

Activities in this phase aim to determine the arithmetic operations ability of many fractions before the student given an intervention. This measurement is done repeatedly until it gets a stable result. Measurements are made 4 sessions, and all sessions provide stable results. Stable here is that students give answers with the same score.

3.1.2. Intervention (B)

Activities in this phase are the implementation of RME to the blind student which is a strategy after the A1. In implementing this RME, learning assisted with simple teaching props that made from cardboard and household waste. The intervention was conducted in 8 sessions which continued the previous session. At the end of the session, the measurement of learning achievement was achieved with the same instrument as the A1. In this activity, there are many problems happens, such (1) the student is not familiar with learning using RME; (2) the student difficult to communicate; (3) at the time of review, the concept was not delivered; (4) student need motivation at each session; (5) it takes a long time to understand student about the concept of division. Although there were many obstacles in this phase, overall when measurements were taken, student scores increased and maximum scores were achieved in sessions 9 to 12. The props were used in this activity can be seen in Figure 2-4.
3.1.3. Baseline 2 (A2)
This phase is the control phase of the intervention and a benchmark for the successful implementation of RME. Measurements were made 3 sessions and gave stable results. In addition, the score obtained by the student has increased so that the intervention can be said to be successful. In this activity, there are not too many obstacles because the student already communicates with the teacher and the questions also already usual to the student.

3.2. The discussion of the problems
At this time, the problems that occur when implementing the RME will be explained based on the theory of blind students, RME and its implementation. These problems are caused some factors are the student itself and external factors. Previously mentioned that blind students with the totally blind category had the following characteristics: (1) touchy; (2) skeptic; (3) dependency. While in the intervention phase there are problems as follows: (1) the student is not familiar with learning using RME; (2)
the student difficult to communicate; (3) at the time of review, the concept was not delivered; (4) student need motivation at each session; (5) it takes a long time to understand student about the concept of division. Let's discuss them one by one.

3.2.1. The student is not familiar with learning using RME
Please note that before the implementation of the RME, observations, and interviews are conducted first with the mathematics teacher. Observations and interviews were conducted to determine the initial conditions of learning that had been applied to SLB. The observations and interviews produced the following: (1) students often confusion when changing fractions to decimal; (2) there are props that are not suitable; (3) it is difficult to find ways to make students say their difficulties; (4) there needs to be a more intense approach between teachers and students so that student confidence can be fully given to the teacher; (5) students are accustomed to receiving knowledge from the teacher rather than constructing their own knowledge. In the fifth result, it provides an overview of learning that has been applied to blind students, namely teachers as learning centers. This is not in accordance with the teaching principles of blind students, namely learning by doing [2]. It is not appropriate because when students only receive knowledge from the teacher it means that students are not given the opportunity to arrange their cognitive structures so that students can only work on or solve problems but do not understand the concepts and absorb their knowledge. Therefore, when the implementation of the RME during the intervention phase this also occurs. Students only listen to the teacher's instructions and are very stiff when given props in learning arithmetic operations on many fractions. Mentioned that if we want students to reinvent mathematics by doing mathematics, teachers have to adapt to how their students reason and help them build on their own thinking [21, 22]. Therefore, as a teacher, at least they should be able to apply to learn by doing according to the principles of teaching blind students.

3.2.2. The student difficult to communicate and need motivation at each session
On this issue is related to the factors of blind student itself, there are touchy, skeptic and dependency. Why is this related? Because when someone is touchy and skeptic, they will be more difficult to interact with other people. For example, if we remember Helen Keller, we will better understand how the psychological approach between students and teachers really determines the success of learning [22]. Learning that is done slowly through a personal approach will make an impression on students and motivations are indeed inseparable from blind students because basically there are blind students who still not confident.

3.2.3. The problems related to the concepts
Previously it was mentioned that the problems related to the concept were (1) there were concepts that not delivered in the review; (2) it takes a long time to understand student about the concept of division. One concept that is difficult for the student to understand is the concept of division and solving story problems. Some sessions in the intervention phase, students were still not smooth in explaining the concept of division. Between that, at the time of measurement in all sessions, students could not solve one of the story problems in Figure 5.

![Figure 5](image_url). The story problem that is given in the measurement instrument.
In this problem, it can be understood that the problems given are relatively easy and very common. But in fact, for 15 sessions that have been done students still cannot solve the problem. Whereas in concept, the student has held the fractional arithmetic operation.

The most fundamental mistake of this is the absence of related learning to solve story problems as in the matter. On the implementation of the RME with the A-B-A reversal design that has been done, the real problems given are more inclined to the concept. This is certainly not wrong at all, but if we relate to the students' skills in solving the story problems it does not support it.

Basically, the RME learning provided can provide at least a picture of how to solve this problem. Basically, RME learning can give an idea of how to solve this problem. When the RME is given in the intervention phase, there are obstacles that make it difficult for students to understand the division. However, in the final intervention phase, the basic concept of division can be understood by students. Based on this, it can be said that habituation in conducting learning is very important for the development of the ability to arithmetic operations of many fractions. Therefore, the teacher must be able to condition learning that is in accordance with student needs and learning that gives the habit of students 'doing' not just accepting. Another study said that because children with learning disabilities must contend with academic failures, their self-image is particularly at risk [23–26]. Based on these studies, it can be understood that disabled students have a higher risk of their self-image. That is, academic failures that have occurred will have a major influence on their self-image or personality so that they are more likely to not be confident. Because of this self-distrust, there is a doubt in answering the problem. This certainly needs to be used as a discussion for teachers to better prepare learning that can directly increase the self-confidence of the disabled student so that they can influence their mathematical abilities.

4. Conclusion
Based on the explanation that has been submitted previously, it can be understood that the implementation of RME with A-B-A reversal design in learning arithmetic operations of many fractions has several obstacles, namely: 1) students are not used to carrying out learning using RME (session 5); (2) students are very difficult to communicate; (3) at the time of the review, the concept was not achieved (session 5); (4) students need motivation in each session; (5) it takes a long time to understand students about the concept of division. However, some of these obstacles can be solved by learning itself. In fact, there is a major problem, namely the inability of students to solve story problems given by the teacher for 15 times. By paying attention to the phase of the intervention that is carried out, then with longer habitation, the mass can be used as an alternative learning that optimizes the students' ability to solve the story of the arithmetic operations of many fractions.

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References
[1] Krebs C S 2001 Learning To Solve Word Problems in a Middle School Vision Class. J. Vis. Impair. Blind. 95 757
[2] Sunanto J 2005 Mengembangkan Potensi Anak Berkelainan Penglihatan Jakarta Dep. Pendidik. Nas.
[3] Buddin R and Zamarro G 2009 Teacher qualifications and student achievement in urban elementary schools J. Urban Econ. 66 103
[4] Clotfelter C T, Ladd H F and Vigdor J L 2007 Teacher credentials and student achievement: Longitudinal analysis with student fixed effects Econ. Educ. Rev. 26 673
[5] Hattie J 2012 Visible learning for teachers: Maximi...
[7] Boyd B and Bargerhuff M E 2009 Mathematics education and special education: Searching for common ground and the implications for teacher education. *Math. Teach. Educ. Dev.* 11 54

[8] Brownell M T, Sindelar P T, Kiely M T and Danielson L C 2010 Special education teacher quality and preparation: Exposing foundations, constructing a new model *Except. Child.* 76 357

[9] DeSimone J R and Parmar R S 2006 Middle school mathematics teachers’ beliefs about inclusion of students with learning disabilities *Learn. Disabil. Res. Pract.* 21 98

[10] DeSimone J R and Parmar R S 2006 Issues and challenges for middle school mathematics teachers in inclusion classrooms *Sch. Sci. Math.* 106 338

[11] Rosas C and Campbell L 2010 Who’s teaching math to our most needy students? A descriptive study *Teach. Educ. Spec. Educ.* 33 102

[12] Kintz T 2012 The effect of the No Child Left behind accountability mechanisms on middle school mathematics teaching and student performance *Learning and Doing Policy Analysis in Education* (Springer) pp 117

[13] Yeo L S, Ang R P, Chong W H, Huan V S and Quek C L 2008 Teacher efficacy in the context of teaching low achieving students *Curr. Psychol.* 27 192

[14] Sunanto J, Takeuchi K and Nakata H 2006 Penelitian dengan subjek tunggal *Bandung UPI Press*

[15] Treffers A 2012 *Three dimensions: A model of goal and theory description in mathematics instruction—The Wiskobas Project* vol 3 (Springer Science & Business Media)

[16] Van den Heuvel-Panhuizen M 2003 The didactical use of models in realistic mathematics education: An example from a longitudinal trajectory on percentage *Educ. Stud. Math.* 54 9

[17] Lestiana H T, Rejeki S and Setyawan F 2017 Identifying Students’ Errors on Fractions *J. Res. Adv. Math. Educ.* 1 131

[18] Septika L C 2013 Pendekatan Matematika Realistik Terhadap Hasil Belajar Penjumlahan Pecahan Anak Tunanetra *J. Pendidik. Khusus* 3

[19] Hamdi A S and Bahruddin E 2015 *Metode penelitian kuantitatif aplikasi dalam pendidikan* (Deepublish)

[20] Smart A 2010 Anak cacat bukan kiamat: metode pembelajaran & terapi untuk anak berkebutuhan khusus *Yogyakarta Kata Hatı*

[21] Gravemeijer K P E 1994 *Developing realistic mathematics education: Ontwikkelen van Realistisch Reken/wiskundeonderwijs* (CD-[beta] Press)

[22] Wahyu K, Amin S M and Lukito A 2017 Motivation Cards to Support Students’ Understanding on Fraction Division *Int. J. Emerg. Math. Educ.* 1 99

[23] Bloom B S 1976 *Human characteristics and school learning.* (McGraw-Hill)

[24] Bryan T H and Pearl R A 1981 Self-concepts and locus of control of learning disabled children *Educ. Horizons* 59 91

[25] Serafica F C and Harway N I 1979 Social relations and self-esteem of children with learning disabilities *J. Clin. Child Adolesc. Psychol.* 8 227

[26] McWhirter J J, McWhirter R J and McWhirter M C 1985 The learning disabled child: A retrospective review *J. Learn. Disabil.* 18 315