An analysis of the ability to apply student problem solving concepts and algorithms in online and offline learning systems based on realistic mathematical approaches

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Abstract. In the problem solving requires the ability to apply concepts and algorithms. Problems of particular concern in this regard are math problems related to everyday life. The abilities of each student are different and need to be analyzed. Therefore, a qualitative study with descriptive methods was carried out to determine the students' problem-solving abilities in applying concepts and algorithms. But in this case, the research subjects were selected randomly and divided into two parts, namely students who applied offline and online learning with 5 discussion groups each. The research subjects were VII students of SMP RK Serdang Murni and SMP HKBP Lubuk Pakam. Based on problem solving on the student worksheet on the material of addition and subtraction of integers based on a realistic mathematics approach, it was obtained data that the ability to apply problem-solving concepts and algorithms in groups of students who applied offline learning tended to be better than the group of students who applied online learning. This was concluded based on results of problem solving carried out by the group of students. Therefore, it is hoped that the ability of teachers to design online learning will be further improved regarding the use of technology so that the results obtained are as good as the implementation of offline learning.

1. Introduction
Mathematics as the basis of relationships related to other fields. Mathematics can train the ability to think rationally so that it becomes a good problem solver, because mathematics is a tool that can help in problem solving, communication, reasoning thinking patterns, and connectedness with other aspects [1]. However, many students feel afraid and find it difficult to learn mathematics. This is usually because the math problems created for students are very complicated to solve [2]. In the solving a problem requires a solution. The answer does not appear immediately, it takes an algorithm or steps/ways to solve it. The alternative ways of solving the problem can vary. But the process and the end result must be correct. Troubleshooting can take a variety of ways and can be recognized as a question history [3]. In solving problems with alternative methods, it takes the ability to think and think for each person differently.
Thinking skills which are the basic skills needed to solve problems are the ability to understand concepts. Several questions arise, why are students’ mathematics learning outcomes not as expected? Why don’t Indonesian students rank sufficiently or well in terms of math ability on PISA? Why can’t the average UN math score show something to be proud of? Why do most students think of mathematics as a scary and confusing subject? So, to answer some of these questions, of course, it can be connected with the ability to understand students’ mathematical concepts.

Kilpatrick J, Swafford J, and Findell B (2011) stated that understanding concepts is the basis for meaningful mathematics learning because understanding concepts makes it easier for students to learn and solve math problems [4]. Basically, mathematics demands students’ high conceptual understanding and mathematics involves procedures that may appear abstract and unrelated to life [5].

One indicator of the ability to understand mathematical concepts is being able to apply concepts or algorithms in problem solving. Juwita (2017) argued that the low ability of students to solve mathematical problems is closely related to the low understanding of students’ mathematical problems and the lack of skills in finding various solutions of non-routine mathematical problems [6]. Non-routine problems involve problem situations that students are unfamiliar with and are not expected to have previously solved or have not encountered regularly in the curriculum [7]. Mathematics teachers should strive to continually think of ways to improve their teaching and help students understand mathematical concepts [8]. One of the problems in mathematics arises from its nature. One of the goals when learning mathematics is for students to solve problems by making procedures and getting the correct answers [5]. Therefore, teachers or educators, especially in mathematics, need to analyze students’ abilities in understanding mathematical concepts. This can be analyzed by providing a test of the ability to understand mathematical concepts. The test given must meet the indicators of the ability to understand mathematical concepts, one of which is applying concepts or algorithms in problem solving. Thus, it is expected that valid concept understanding ability data will be obtained. Kesumawati, N. (2012: 2) states that students are said to understand a concept mathematics among other things when they build relationships between new knowledge ones acquired with prior knowledge [9]. The indicators of understanding the concept are: (1) restate a concept; (2) classifying objects according to certain properties (according to the concept); (3). provide examples and non-examples of concepts; (4). presenting concepts in various forms of mathematical representation; (5) apply the concept or algorithm to solving; and (6) using, utilizing, and selecting certain procedures or operations [10].

In this regard, teachers can also apply a realistic mathematics approach. Realistic mathematics-based learning design is able to answer mathematical problems using real-world contexts and is close to students. Thus it is expected that the understanding of the data understanding a valid concept.

Bray and Tangney (2015) stated that RME is an approach that addresses problems caused by traditional and abstract mathematics learning [2]. In RME, the problems presented to students can come from the real world and can also come from fantasy or the formal world of mathematics, as long as the problem concerns real experiences in the minds of students [11]. RME has the characteristic that in the learning process students must be given the opportunity to rediscover mathematics through teacher guidance and find mathematical ideas. The concept must start from exploring various situations and issues in the real world [12].

During the 4.0 revolution, an online-based learning system was needed. Therefore, in addition to implementing offline-based learning (face-to-face), teachers need to design online-based learning. In addition, the teacher needs to evaluate the learning applied to the two systems. Therefore, an analysis of students’ ability to apply concepts or algorithms was conducted in problem based on a realistic mathematics approach which was analyzed in two groups of learning systems, namely online and offline.

2. Research Method

This research is a qualitative research with descriptive methods. This qualitative research is applied with the aim of explaining things experienced by research subjects related to the students’ ability to apply
concepts and algorithms in solving problems. This research was conducted at SMP HKBP and SMP RK Serdang Murni Lubuk Pakam. Research implementation at SMP HKBP Lubuk Pakam was carried out online in the 2020/2021 academic year while at SMP RK Serdang Murni Lubuk Pakam was carried out offline in the 2019/2020 Academic year.

The subjects of this study were groups of students who applied online learning at SMP HKBP Lubuk Pakam and offline at SMP RK Serdang Murni Lubuk Pakam. Online learning that is implemented at SMP HKBP Lubuk Pakam uses social media, namely WhatsApp. Meanwhile, SMP RK Serdang Murni Lubuk Pakam students through face to face in class. In this case, each school is divided into 5 groups of students in solving problems in the Student Activity Sheet, especially the material for the operation of addition and subtraction of integers. The instrument in this research is the Student Activity Sheet for the material of addition and subtraction of integers.

The data collection technique in this study was carried out by using a test technique in the form of giving problems to the exercises in the Student Activity Sheet, especially the material for the operation of addition and subtraction of integers. Guidelines for assessing the ability to apply concepts and algorithms in problem solving are presented in the following table:

Table 1. Criteria and indicators of scoring of ability to apply concepts or algorithms in problem solving.

| Concepts Understanding Indicators | Information                                                                 | Score |
|-----------------------------------|-----------------------------------------------------------------------------|-------|
| Apply concepts or algorithms in problem solving | Students do not answer or mathematical ideas emerge                          | 0     |
|                                    | Students' mathematical ideas have emerged, but students have not been able to apply concepts or algorithms in problem solving        | 1     |
|                                    | Students can apply concepts or algorithms in problem solving but do not understand the concept or algorithm in problem solving     | 2     |
|                                    | Students can apply concepts or algorithms in problem solving but still make some mistakes                                     | 3     |
|                                    | Students can apply concepts or algorithms in problem solving appropriately                                                                 | 4     |

3. Results and Discussion
In the online learning system implemented at SMP RK Serdang Murni Lubuk Pakam obtained data on the ability to apply concepts and or algorithms in problem solving with a realistic mathematics approach based on comic modules can be seen in the following data table explanation:

Table 2. Offline learning system group score data in SMP RK Serdang Murni Lubuk Pakam.

| Group Name | Score of Each Question Item | Average |
|------------|-----------------------------|---------|
|            | 1   | 2   | 3   | 4   | 5   | 6   | 7   |         |
| 1          | 4   | 4   | 2   | 4   | 3   | 0   | 4   | 3       |
| 2          | 4   | 4   | 4   | 4   | 3   | 4   | 4   | 3,86    |
| 3          | 2   | 4   | 2   | 1   | 1   | 1   | 2   | 1,86    |
| 4          | 4   | 4   | 3   | 1   | 3   | 3   | 4   | 3,14    |
| 5          | 4   | 2   | 3   | 4   | 3   | 4   | 3   | 3,29    |
| Average    | 3,6 | 3,6 | 2,8 | 2,8 | 2,6 | 2,4 | 3,4 | 3,03    |

Based on the data in the table above, the group data of students who can apply concepts and or algorithms appropriately are: (a) in solving problem number 1 it is known that there are 4 groups of
students, namely groups 1, 2, 4, and 5; (b) in problem solving number 2, there are 4 groups, namely groups 1, 2, 3, and 4; (c) in problem solving number 3 there is 1 group, namely group 2; (d) in problem solving number 4, there are 3 groups, namely groups 1, 2, and 4; (e) there is no single group in problem solving number 5; (f) in problem solving number 6 there are 2 groups of students, namely groups 2 and 5; (g) in solving problems number 7, there are 3 groups, namely 1, 2, and 4.

The group data of students who can apply concepts and algorithms but there are several errors, namely: (a) there is no single group on solving problems number 1, number 2, and number 4; (b) in problem solving number 3, there are 2 groups, namely groups 4 and 5; (c) in problem solving number 5, there are 4 groups, namely groups 1, 2, 4, and 5; (d) in solving the problem number 6, there is 1 group, namely group 4; (e) in solving problem number 7, there is 1 group, namely group 5.

The group data of students who can apply concepts and algorithms but do not understand concepts or algorithms in problem solving are: (a) in problem solving number 1, there is 1 group, namely group 3; (b) in solving problem number 2, there is 1 group, namely group 5; (c) in problem solving number 3, there are 2 groups, namely groups 1 and 3; (d) there is no single group on problem solving number 4, 5, and 6; (e) in solving problems number 7, there is 1 group, namely group 3.

The group data of students who came up with mathematical ideas but were not able to apply concepts or algorithms in solving problems are: (a) none in groups 1, 2, 3, and 7; (b) in problem solving number 4, there are 2 groups, namely groups 3 and 4; (c) in solving problems number 5 and 6, there is 1 group, namely group 3.

Data on groups of students who did not answer or ideas did not appear are: (a) none in solving problems number 1, 2, 3, 4, 5, and 7; (b) in solving problem number 6, there is 1 group, namely group 1.

In addition to the implementation of face-to-face (offline) learning, online learning is also carried out but at different schools. The online learning system is applied at SMP HKBP Lubuk Pakam by using a realistic mathematics approach based on comic module. The data can be seen in the following table:

| Group Name | Score of Each Question Item | Average |
|------------|-----------------------------|---------|
|            | 1  | 2  | 3  | 4  | 5  | 6  | 7  |       |
| A          | 4  | 4  | 4  | 4  | 3  | 4  | 4  | 3.86  |
| B          | 1  | 3  | 3  | 2  | 3  | 2  | 4  | 2.57  |
| C          | 4  | 4  | 2  | 0  | 0  | 0  | 0  | 1.43  |
| D          | 4  | 4  | 1  | 4  | 3  | 4  | 0  | 2.86  |
| E          | 4  | 4  | 2  | 0  | 3  | 4  | 0  | 2.43  |
| Average    | 3.4| 3.8| 2.4| 2.4| 2  | 2.8| 1.6| 2.63  |

Based on the data in the table above, the data for groups of students who can apply concepts or algorithms, are: (a) in problem solving number 1, there are 4 groups, namely groups A, B, C, D, and E; (b) in problem solving number 2, there are 4 groups, namely groups A, C, D, and E; (c) in problem solving number 3 there is 1 group, namely group A; (d) in problem solving number 4, there are 2 groups, namely groups A and D; (e) there is no single group in problem solving number 5; (f) in problem solving number 6, there are 3 groups, namely groups A, D, and E; (g) in solving problem number 7, there are 2 groups, namely groups A and B.

The group data of students who can apply concepts and algorithms, but there are several errors are: (a) there is no single group in solving problems number 1, 4, 6, and 7; (b) in solving problems number 2 and number 3, there is 1 group, namely group B; (c) in problem solving number 5, there are 4 groups, namely groups A, B, D, and E.
The group data of students who can apply concepts and or algorithms but do not understand concepts or algorithms in problem solving are: (a) none of them in solving problems number 1, 2, 5, and 7; (b) in problem solving number 3, there are 2 groups, namely groups C and E; (c) in solving problems number 4 and 6, there is 1 group, namely group B.

The group data of students who came up with mathematical ideas but were not able to apply concepts or algorithms in solving problems are: (a) in problem solving number 1, there was 1 group, namely group B; (b) there is no single group on problem solving 2, 4, 5, 6, and 7; (c) in problem solving number 3, there is 1 group, namely group D.

Data on groups of students who did not answer or ideas did not appear are: (a) there was no single group on problem solving 1, 2, and 3; (b) in problem solving number 4, there are 2 groups, namely groups C and E; (c) in solving problem number 5 and 6, there is 1 group, namely group C; (d) in problem solving number 7, there are 3 groups, namely groups C, D, and E.

When compared to the ability of applying concepts or algorithms in problem solving based on data from the ability of the group of students who are taught in 2 learning systems that apply a realistic mathematics approach based on comic modules, it is better that the group of students who are taught with face-to-face learning systems (offline) is better than the system online learning. This is because students’ in direct face-to-face (offline) learning are easier to interact in group (discuss) and teachers can more accurately observe the activities carried out during learning, if group learning is applied. Meanwhile students in online learning via WhatsApp do not interact with students in their groups because some students do not have their own cellphones, quotas and internet networks are not supported, and teachers find it difficult to monitor student interactions in their groups more accurately because teachers do not join predetermined student groups. However, there is a positive side to the online leaning system rather than the offline learning system. In the online learning system students can listen repeatedly to the video explanation of material that the teacher share during the learning process on WhatsApp. Which has the offline learning system is not.

The statements above are concluded based on the results of interviews and observations with groups of students in both schools, namely SMP RK Serdang Murni Lubuk Pakam and SMP HKBP Lubuk Pakam. The offline and online learning systems each have a positive side and a negative side in their implementation.

So, based on the results obtained, it is known that the group of students who were taught with an offline learning system with a realistic mathematics approach based on comic module had an average ability to apply concepts or algorithms in solving problems that were better that the group of students who were taught using the online learning system.

4. Conclusion
Based on the research results above, it is concluded that:

1. Analysis of students' abilities in applying concepts or algorithms in solving problems in online and offline learning systems with a realistic mathematical approach to produce data:
   a. The groups of students who did not answer or did not have detailed mathematical ideas were (i) there was no group of students who answered problems 1, 2, and 3; (ii) two groups answered problem number 4; (iii) one group answered problem number 5; (iv) two groups answered problem number 6; (v) there were three groups that answered question number 7.
   b. Groups of students who come up with ideas but students have not been able to apply concepts and algorithms in solving problems in detail, namely: (i) there is one group for each of the problems number 1, 3, 5, and 6, (ii) there is no single group in problem number 2 and 7, (iii) there are two groups on problem number 4.
   c. Groups of students who are able to apply concepts and algorithms in solving problems, but do not yet understand the concepts or algorithms in solving problems in detail, namely: (i) there is one group in each of the problems number 1, 2, 6, and 7; (ii) there are four groups in problem number 3; (iii) there are two groups in problem number 4; (iv) there is no single group in problem number 5.
d. Groups of students who can apply concepts and algorithms in solving problems but still make mistakes with details: (i) there is no single group on problems number 1 and 4; (ii) there is one group for each of problems 2, 6 and 7; (iii) there are three groups for problem number 3; (iv) there are eight groups for problem number 5.

e. Groups of students who are able to apply concepts or algorithms to problems with the details, namely: (a) all groups for problems number 1 and 2; (b) there are two groups for problem number 3; (c) there are three groups for problem number 4; (d) there is no single group for problem number 5; (e) there are five groups for problems 6 and 7.

2. The average group of students who apply online learning has the ability to apply concepts or algorithms better in solving problems than the group of students who apply online learning.

Based on the conclusions of this study, it is recommended that teachers who implement online learning monitor and dialogue more frequently with students in solving problems if they apply group discussion learning to solve problems. Given the two applications of learning also have good and bad sides.

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