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IMPLEMENTATION OF SIMULATION METHOD TO IMPROVE STUDENT'S LEARNING OUTCOME OF SOLAR SYSTEM IN JUNIOR HIGH SCHOOL

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Abstract

This classroom action research aimed to find out the application of simulation method in improving students' comprehension about the solar system in Junior High School Equivalency Program Class VII at Community Learning Center (CLC) Ash-Shoddiq conducted three learning improvement cycles. The research method used in this research is design-based research with classroom action research. The subjects of this study were students of the equivalence education program class VII as many as 33 students at CLC Ash-Shoddiq West Bandung. We did the pretest and posttest to determine the level of understanding of students. The results showed that student learning outcomes which were presented in the form of student scores could be seen from the results of the pre and post-tests which experienced an increase in the average grade value in cycle 2 as an improvement from cycle 1, and in cycle 3, as an improvement from the previous cycle (cycles 1 and 2), while the results of observations of the activities carried out by students when viewed from the smallest percentage range showed the number was above half especially for the question indicator in cycle 1, while the highest percentage was almost close to one hundred percent is indicated by indicators of doing tasks that occur in cycles 2 and 3, for indicators answering and expressing opinions, from cycle 1 to cycle 3, showing a fairly high percentage. The results of peer observations obtained data that the learning process carried out by the teacher when viewed from the ten aspects observed as indicators of competence and learning skills above, showed a very good condition, where the ten aspects the teacher had carried out in each cycle, except in cycle 1, the teacher's efforts in providing reinforcement have not yet emerged, but in cycles 2 and 3, the teacher has been able to consistently correct these deficiencies. This is because teacher intervention through learning facilitation through simulation methods is effective in improving learning outcomes. Furthermore, the simulation method has an impact on improving the learning outcomes of learning residents in understanding the material of the solar system in the science subjects of the equality education program.

Keywords: Learning outcome, Simulation method, Solar system.

1. Introduction

Technically, teachers were demanded to have abilities a good and quality teacher related to their main job as teacher and educator [1]. The ability to teach and educate is the main factor to reach the educators in schools, facilitating the teacher's role and trying to develop their professionalism in a very important position [2, 3]. For their significant position, teachers are required to perform their best. In addition, successful and successful teachers are those who can simplify the learning system so that it is easily understood by students [4].

Teachers' performances can be seen from the success rate of transforming the knowledge to the students [5]. This can be successful if the teacher applied an effective method in the learning process related to the material. One of the required competencies for a teacher was the ability to teach and educate students as a professional teacher, this is under the professional competence of a teacher where he must be willing to participate and be actively involved in learning both cognitively, affectively, and emotionally [6, 7].

In the teaching process, many researchers technically as teacher frequently meet some problems to help students comprehend the concept of the material, especially science. In this research, the researcher focused on material reinforcement with the basic competency about the sun as the center of the solar system and Earth in a solar system. In the main material, students could not comprehend the material well by applying the lecturing method and showing some related pictures, when in fact teachers find meaningful activities in their learning as a professional work process [8-10].

Based on cognitive theory, students use their prior knowledge and reflect on the situation actively, learn from it, and think differently in a different situation. In social theory, simulation is social interaction. Interaction among students by observing others' work, competency, and behavior [11]. In realistic theory, students' perspective about knowledge, skill, and behavior based on reality was highlighted in the simulation. Realizing the mentioned problems, we tried to improve in a science subject, especially on the main topic: the solar system. This improvement plan was simulated by students completed with some pictures about the solar system. Based on conceptual consideration about the real problem faced by the researcher as a teacher of class VII, the problem solving was conducted through Classroom Action Research (CAR). Specifically, the formulation of the problem posed in the form of research questions about:

(i) How are students' learning outcomes after treatment, especially regarding the understanding of the solar system in science subjects?

(ii) What are the results of observations about student activities during the learning process in the form of an improvement framework?

(iii) How are the results of observations by colleagues as evaluation material for researchers to make improvements in the learning process?

(iv) How do you reflect on the results of cycles 1, 2, and 3?

This classroom action research aimed to find out the application of the simulation method in improving students' comprehension of the solar system in Junior High School Equivalency Program Class VII at Community Learning Center (CLC) Ash-Shoddiq. The research method used in this research is design-based research with classroom action research. Novelties of this study were.

(i) Simulation as one of the learning methods that used props can be applied in various subjects especially exact subjects (Math and Science) especially in nonformal education institutions (CLC).

(ii) Simulation was effective to describe the material and it can give symbolic images similar to the real ones.

(iii) The use of learning media in the simulation method becomes a supporting medium in achieving effective learning goals for equivalence education students.

2. Literature Review

2.1. Solar system concept

Scientists believe that the universe was created after the Big Bang. This hot explosion occurred nearly 14 billion years ago. In an instant, the universe grew from a very small size, even smaller than a single atom, into a galaxy and is still growing today [12]. The solar system is very interesting to be studied by residents studying equivalence education level package B, it was formed 4.6 billion years ago and consists of planets that orbit the sun. Apart from planets, the solar system also has natural satellites or moons, asteroids, comets, dwarf planets, dust, gas, and other interesting objects. The discovery of relatively large and widespread variations in oxygen isotopic composition has cast doubt on this assumption [13]. Figure 1 shows the names of the planets presented in this lesson are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto, an explanation of the position of the planets with the sun.

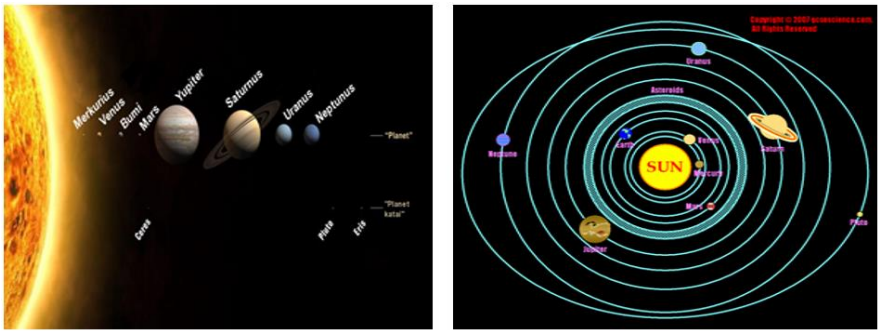

Fig. 1. Position of the planet with the sun.

2.2. Simulation method concept

The teaching method is part of the teaching strategy as a tool to achieve the expected goals [14]. This implies that a teacher must understand the position of the method that can be used as an extrinsic motivational tool that can arouse students' enthusiasm for learning to create an active and participatory learning atmosphere [15]. Talking about the types of methods, there are many types of learning methods, there are education experts identify the number of learning methods between 40 and 60 types of learning methods, but the most frequently and widely used in learning in elementary schools, at least the types of learning methods can be identified. as follows: discussion method, group work method, discovery method (discovery), simulation method, micro-teaching method, brainstorming method,

field trip method, experimental method, demonstration method, fieldwork presentation method, simulation method, method inquiry, socio drama method, case presentation method, team teaching method, question and answer method, recitation method, lecture method, story method, and writing method.

In this study, the concept or literature review used is the simulation method. There is a consensus that the simulation method in learning Natural Sciences (IPA) stimulates students to take lessons seriously and interestingly which allows students to develop a deeper understanding of the subject matter in discussing the solar system [15-18]. They have also identified unique advantages of the simulation method when compared to other forms of active learning. It is hoped that the simulation method used in equivalence education learning can organize student-centered learning, of course, equipped with teacher training and collaboration with students.

3.Method

As one of the research methods, Classroom Action Research (CAR) has very distinctive criteria when compared to other types of research methods. At least two salient characteristics of classroom action research can be identified, namely:

(i) The implementation of collaborative learning improvements.

(ii) There is a cycle in a series of learning improvements. Researchers describe the nature of action research as requiring collaboration between parties, either with colleagues, students, parents or with university faculty, or a combination of partners.

This classroom action research is carried out according to a cycle that focuses on collaborative research between researchers. For this research, a collaborative action research cycle has been carried out, the researcher together with peer teachers received support from their supervisors or principals as instructors for the subjects they took. This research was conducted in the equivalence education program in CLC Ash-Shoddiq West Bandung with the field setting of class VII. The number of student respondents who took part in this study was 33 people consisting of 14 men and 19 women. The main topic of discussion in improving science learning is the solar system. Improvements in learning are carried out to achieve students' basic competencies, namely, describing the solar system and the position of the constituents of the solar system. The competency standard to be achieved is to understand the sun as the center of the solar system and the interaction of the earth in the solar system.

4. Results

4.1. Learning Outcome

It needs to be highlighted that one aspect of the research focus in this molecular analysis toward the application of simulation method by using pictures (to improve students' comprehension about the solar system in science subject class VII) was the test indicator developed in a form of learning outcome. Learning outcome as the benchmark of the improvement success during the process was seen through students' scores.

The learning outcome in a form of students' scores was the result of pre-test and post-test. A pre-test is a test given by a teacher before starting the learning

process. A post-test is a test given by the teacher after the treatment. Pre-test and post-test were performed in every cycle (cycles 1, 2, and 3), especially in the improvement framework through the simulation method with pictures as the props.

Firstly, there is a need to describe the characteristic of students as respondents in form of an improvement framework table through this research. The improvement or treatment will conduct by the researcher where they teach as a classroom teacher, that is class VII. This performed as the first semester ran. Figure 2 shows the condition of class VII student improvement target by gender, the number of students in class VII was 33 people., with 14 men (42.42%) and 19 women (57.58%).

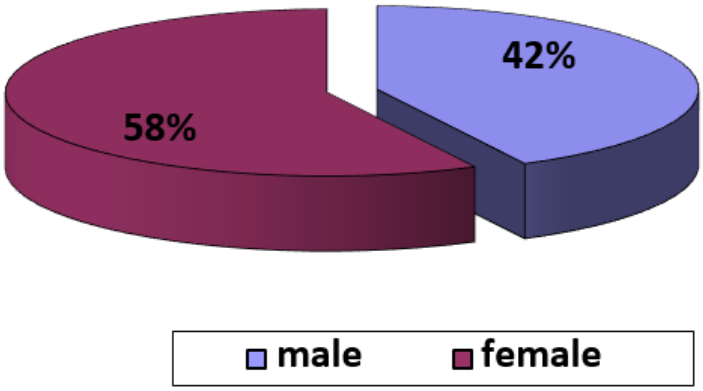

Fig. 2. Condition of class vii students.

Figure 3 shows the condition of class VII student improvement target by age, not only by gender but also can be categorized by the group of age. The age of the class is relatively homogeny. The students of class VII were in one interval group of age (12-14 years old). By age, it was 12 years old as the youngest students and 14 years old as the oldest ones. To be more specific, refer to Fig. 3:

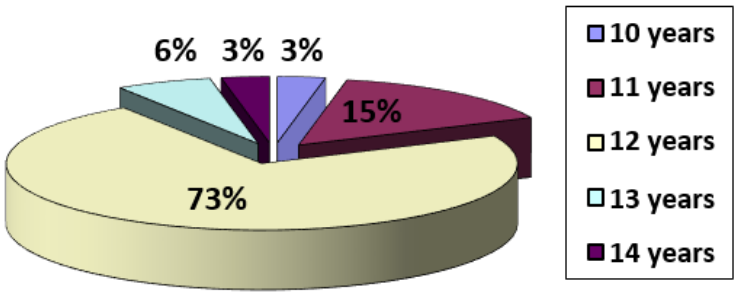

Fig. 3. Condition of class vii student improvement target by age.

Furthermore, Table 1 shows the data of students' scores were presented in 0-100, as the result of pre-test and post-test in cycles 1, 2, and 3. It not only represented the students' scores generally but also the lowest, the highest, and score average.

Table 1. Pre-test and post-test score of class vii students cycle 1, 2, and 3 in science improvement process.

No.	Students' Name	Cycle 1		Cycle 2		Cycle 3	
		Pretest	Postest	Pretest	Postest	Pretest	Postest
1	AM	60	65	65	70	70	75
2	An	63	68	70	75	75	78
3	AB	68	70	70	70	70	72
4	DF	60	63	65	70	65	70
5	AH	65	70	67	72	70	75
6	AF	58	60	65	70	70	73
7	AFI	56	60	54	56	54	64
8	DS	56	57	54	60	66	70
9	FRM	54	60	56	59	64	69
10	FL	70	76	71	75	70	76
11	FH	75	78	78	80	62	70
12	HM	54	60	70	78	63	70
13	FST	50	55	65	69	66	70
14	JI	56	60	64	68	75	78
15	MAR	52	57	70	78	66	70
16	RM	60	65	64	68	60	65
17	KS	70	78	60	70	68	70
18	IHN	70	72	70	75	72	75
19	KK	58	60	70	72	73	75
20	NW	56	62	64	68	78	80
21	MA	54	58	58	60	72	80
22	NA	72	78	64	68	73	75
23	KF	70	72	65	70	70	70
24	NA	70	74	73	76	70	75
25	NIA	68	70	70	75	74	75
26	RP	65	65	71	75	70	72
27	SAP	58	60	52	56	54	58
28	SS	68	70	70	75	70	75
29	SH	60	64	65	70	76	77
30	MA	62	68	76	72	65	70
31	TA	75	80	74	80	75	80
32	TAA	50	58	78	84	75	85
33	RTS	65	69	64	68	70	75
Total		2048	2182	2192	2332	2271	2412
Average		62	66	66	70	68	73
Highest Score		75	80	78	84	78	85
Lowest Score		50	55	52	56	54	58

Based on the previous table, it showed that there was an improvement in every cycle, (means cycle 2 is better than cycle 1, cycle 3 was better than cycle 2). It implied that the strategy in every treatment was quite effective.

To give a more specific description of the improvement in every cycle as in Table 1, it showed that the average score in cycle 2 pre-test (66) was higher than the previous cycle (62). The average of cycle 3 (6) was also higher than the previous cycles. The average pre-test scores were 62, 66, and 68. The range of the score was not significant but it showed a few improvements by the teacher in learning quality. It means the treatment was potential and became a dominant factor for the improvement. For the students' aspect, they can improve their learning ability sustainably with systematic guidance. Moreover, Fig. 4 shows the pre-test average score of class VII student cycle 1,2, and 3 in the science improvement process, the following graphic will give more description about the improvement of the average pre-test score in every cycle.

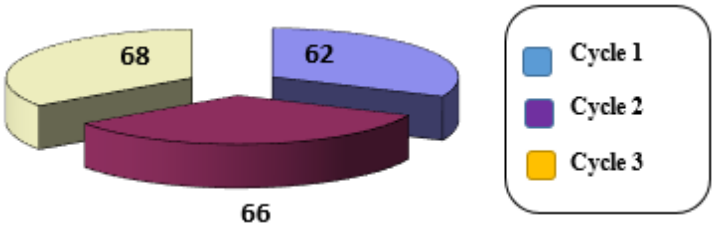

Fig. 4. Pre-test average score of class vii students cycle 1, 2, and 3 in science improvement process.

Figure 5 shows the average score of the post-test showed relatively the same result as the pre-test. There was also improvement in the average score of cycle 2 (70) which was higher than cycle 1 (66), and the average in cycle 3 (73) was higher than the two previous cycles. The improvement of the average test was not significant if it seemed from the gap between the scores.

The interesting thing from the whole cycle was the significant improvement of the first pre-test (66) to the latest post-test (77). It improved 11%.

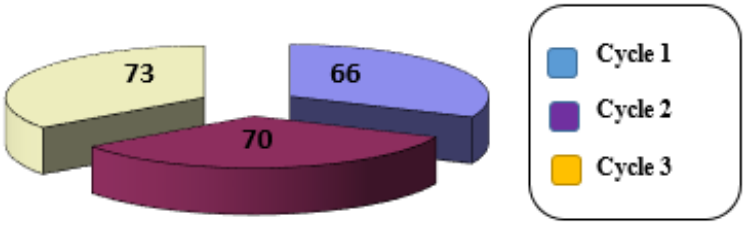

Fig. 5. Post-test average score of class vii students cycle 1, 2, and 3 in science improvement process.

4.2. The observation result of student activity during the treatment

Table 2 shows the observation result of student activities in cycles 1, 2, and 3 in the science improvement process, the essential qualitative aspect related to the treatment in this research was the students' activity. This was important because learning was not only seen from the score result, but also from the qualitative process that can encourage students to be real learners. The observation was

focused on students' activity in asking, answering the question, finishing the task, and expressing an opinion.

Table 2. The observation result of students'' activities in cycles 1, 2, and 3 in science improvement process.

No.	Students' Name	Cycle 1				Cycle 2				Cycle 3			
		As	An	T	O	As	An	T	O	As	An	T	O
1	AM	X		X	X	X	X	X	X	X		X	X
2	An	X		X	X	X	X	X			X	X	X
3	AB			X	X	X		X	X	X	X	X	X
4	DF	X		X	X		X	X	X	X		X	X
5	AH	X	X	X	X		X	X			X	X	X
6	AF	X	X		X		X	X	X	X	X		
7	AFI		X		X	X	X	X	X		X	X	X
8	DS		X	X		X	X		X	X	X	X	X
9	FRM		X	X		X	X	X	X	X		X	X
10	FL		X	X	X		X	X	X	X	X		X
11	FH	X	X		X	X	X	X		X	X	X	X
12	HM	X	X		X	X		X	X	X	X	X	
13	FST		X	X	X	X		X	X		X	X	X
14	JI	X		X	X	X	X	X	X	X	X	X	X
15	MAR	X		X		X	X	X	X	X		X	X
16	RM		X	X	X	X	X		X	X	X	X	X
17	KS	X	X		X		X	X	X	X	X	X	X
18	IHN	X	X	X		X	X		X		X	X	X
19	KK		X	X	X	X	X	X	X	X	X	X	
20	NW		X	X	X	X	X	X		X	X	X	X
21	MA	X	X	X	X		X	X		X	X	X	X
22	NA	X	X				X	X	X	X	X	X	X
23	KF		X	X	X	X	X	X	X		X	X	X
24	NA		X	X	X	X		X	X	X		X	X
25	NIA		X	X		X		X	X	X	X		X
26	RP		X	X	X	X	X	X		X	X	X	X
27	SAP	X	X		X	X	X	X	X		X	X	X
28	SS	X	X	X			X	X	X	X	X	X	X
29	SH	X	X	X	X	X	X	X	X	X	X	X	X
30	MA	X	X	X		X	X	X	X	X	X	X	X
31	TA	X		X	X	X	X	X	X	X	X	X	X
32	TAA				X	X	X	X	X	X	X	X	X
33	RTS		X	X	X	X		X	X		X	X	
Total		18	25	25	25	25	27	30	25	25	28	30	29
Percentage		55	76	76	76	76	82	91	76	76	85	91	88

The description of the observation result of students' activities during the process above showed a positive trend. The indicators can be studied from four activities: asking the question, answering the question, finishing tasks, and expressing opinions in the next cycle (cycle 2 was after the improvement in cycle 1, cycle 3 was after the two previous cycles). Figure 6 shows the presented observation result of those four students' activities:

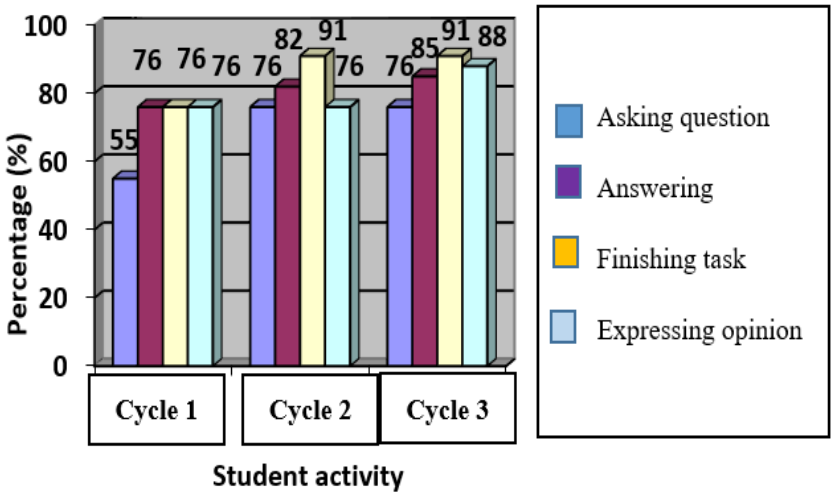

Fig. 6. The observation result of students' activities in cycle 1, 2, and 3 in science improvement process.

Based on the result toward the students' activities, it showed that the improvement reached more than a half (55% (especially for the indicator "Asking Question" in cycle 1. The highest percentage that almost hit 100% (91%) was for the indicator "finishing tasks" in cycles 2 and 3. The indicator "answering the question" and "expressing question" from cycle 1 to cycle 3 also showed high results with a range of 70 until 80%. The description showed that the treatment given by the teacher through Classroom Action Research (CAR) indicated a positive result.

4.3. Observation result by peers toward the treatment in science subject

As the teachers' competency related to the main tasks, functions, and authorities in the learning process, this study developed several aspects as indicators of observation by peers. These indicators were expected to be a direction in teacher efforts to improve science subjects, especially in basic competency about the solar system and its position to understand that the sun is the center of the solar system and Earth interaction.

Table 3 shows the indicators of observation by peers were focused on the ability and competency of the teacher in mastering the subject. This teaching ability was assumed to be correlated with quality improvement in class. The result of the observation would be a direct input for the improvement in every cycle. There were 10 indicators of observation by peers, as follows:

Table 3. The result of observation by peers in cycle 1, 2, and 3 for science subject.

No.	Observed Aspects	Cycle 1		Cycle 2		Cycle 3	
		Yes	No	Yes	No	Yes	No
1	Conditioning students to prepare the class	X		X		X	
2	Apperception	X		X		X	
3	Mentioning the learning objectives	X		X		X	
4	Demonstrating the props	X		X		X	
5	Encouraging the students to try the props	X		X		X	
6	Question and answer	X		X		X	
7	Reinforcement		X	X		X	
8	Teacher movement	X		X		X	
9	Observing and guiding the students in the class	X		X		X	
10	Closing	X		X		X	

Source: Observation result by peers during the treatment in cycles 1, 2, and 3 for science subject class VII.

Based on the data above, it showed that the process ran quite well, and the teacher performed those 10 aspects in every cycle. Except the cycle 1, it was a lack of reinforcement, but the teacher made some improvement consistently in the two next cycles.

The result of the observation above showed that there was a fairly good consistency of teacher's competency in carrying out the learning which included those 10 aspects.

4.4. Observation result by peers toward the treatment in science subject

The implementation of Classroom Action Research (CAR) carried out by the researcher as a classroom teacher in this science subject had been implemented by applying three cycles of treatment (cycles 1, 2, and 3). In general, the result from the students' scores, the observation of students' activities, and observation by peers indicated that this treatment was successful.

The confirmation of the result of these improvements was referred to the data related to three aspects. The improvements occurred from one cycle to another cycle. For the peer's observation, the teacher consistently carried out the 10 aspects of observation from cycles 1 to 3.

This happened for the support between the teacher as a researcher with the peers and superiors in designing learning treatment scenarios. Therefore, the researcher can analyze the advantages and disadvantages of each cycle, which was then used as improvement material for the next cycle.

For cycle 1, which used lecture method, question and answer, and simulation with visual aids, the researcher felt that the method was less than optimal. The teacher did not understand the conditions and characteristics of each student, in the context of the competencies to be developed and achieved.

Basically, the method used in cycle 1 was quite good. However, based on the result of observation of students activates, observation of peers, and reflection; cycle 1 was lack of reinforcement for students in the simulation process. Hence, additional strengthening and reflection were needed in cycle 2.

For cycle 2, the implementation of learning was referred to as the result of observation by peers and superiors, and also the weaknesses and strengths of cycle 1. The learning method used was lecturing question and answer, simulation with visual aids, and individual assignments in form of role-playing. However, there was still room for improvement in the next cycle.

Based on the result of the analysis in cycle 2, students were still unable to reflect on their understanding of the solar system circulatory system despite showing good learning activities. Some students still focused more on playing activities compared to the meaning reflection of the role-playing in the simulation. Therefore, it was necessary to strengthen and confirm the understanding of the concept and meaning for the next cycle.

For cycle 3, the learning implementation was referred to from the analysis of weaknesses and strengths of the previous cycles (cycle 1 and 2). The implementation of cycle 3 was effectively indicated the consistency of improvement in students' scores, observation of students' activities, and observation by peers. However, it still needs optimization for the use of props and the environment. Improvement was also needed for the students' encouragement and emotional relation between student and teacher.

From the reflection, the teacher needed to explore several learning sources and to create a conducive learning scene to support the emotional relation between students and teacher, as well as the peers.

5. Discussion

Reviewing the research objectives that was to determine the effectiveness of simulation method with visual aids in improving the understanding about the solar system in science subject class VII [15]. In this discussion part, we described all the findings related to the several descriptions of the result to analyze and discuss it in several concepts, basic principles, and rules related to the focus of study. In the treatment process in every cycle, starting from cycle 1 to 3, the researcher highlighted the use of the simulation method with visual aids to improve the effectiveness of the learning process [17].

This was done because, in a science subject, especially related to understanding and improving basic competencies in describing the solar system and its position, the competency standard to be achieved was to understand the sun as the center of the solar system and the interaction of Earth in the solar system. Students do not only listen to the teacher's explanation but also understand the concept and to be able to simulate the solar system circulation. Therefore, they will be able to interpret all the concepts.

About the simulation method, in several references, it was explained as a group of participation learning. This was also named role-playing to allow students to be the subject and key role in the learning process. The simulation method means a way to present learning by using imitating the situation to describe the real situation

to get comprehension about a concept, principles, or a certain ability. In simulations, students can be involved as players or simulators and also as spectators who assess and pay attention to the course of the simulation and take lessons from the simulation.

The simulation method was based on constructive learning theory which emphasizes that learning occurs through active, experiential, and social collaboration [11]. The cyclical learning experience can be divided into four separate stages where all the steps are closely interrelated, forming a learning cycle [19]. Learning was found on the subjective and personal experiences of learners related to the topics or experiences encountered and related activities [20]. The learner simultaneously reviews and reflects on different aspects of the subject and thereby builds a new understanding of its application or change in operation. During the next conceptualization stage, students aim to modify their previously acquired knowledge and create new operational models and theories, after which the subject learned can be applied as a practical solution [21].

It is believed that none of the learning methods can directly increase the effectiveness of learning, because each method has advantages and disadvantages, especially if learning is directed at achieving conceptual learning outcomes. On the other hand, it also requires complete student involvement in learning so that the learning held by the teacher really gives meaning to students' lives [22]. This is in accordance with the notion of learning itself, that is the process of building meaning/understanding, by the learner, of experiences and information filtered by perceptions, thoughts (knowledge possessed), and feelings.

The fact is that children persistently want to know as much as possible about the world around them by creating knowledge about what they have experienced. That is very good because scientists are like that too. Children observe, think, formulate, and test the answers to the questions they ask themselves. If nothing gets in the way, they will continue to get better knowledge.

All the hopes and realities that have been achieved are actually in line with the law's reference that the learning process in educational units is held interactively, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for the initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students [23]. To realize the mandate of this law, it is not only learning methods that can create an effective learning atmosphere. Another very important component or aspect is learning tools in the form of media and teaching aids [24, 25]. Students need a tool or object that can help them to concretize the materials they will learn. By using teaching aids in learning, students will more quickly understand the material being taught. In line with this, explains that: teaching aids in learning play an important role as a tool to create an effective learning process [26]. Each learning process is characterized by the presence of several elements including objectives, materials, methods, and tools as well as evaluation. Elements of methods and tools are elements that cannot be separated from other elements that function as ways or techniques to deliver learning materials to reach their goals. In achieving these goals, the role of aids or teaching aids plays an important role because, with these teaching aids, the learning materials will be easily understood by students. In short, a simulation is an event in which interactive learning occurs through doing, experiencing, feeling, and reflecting [9].

As some of the opinions expressed above, we have felt the benefits of using teaching aids to help the effectiveness of science learning in this CAR. Researchers consistently used teaching aids that can help the effectiveness of learning from cycle 1 to 3, without overriding the role of other methods. The effectiveness of these teaching aids can be proven from the results of the CAR implementation which shows positive results, wherein its implementation there are always improvements in each cycle. This can be interpreted that the role of the teacher has a central position in providing instruction and direction. This is in accordance with the opinion of Wotton, *et al*. who stated that "to facilitate a successful and effective learning process, the teacher's ability to provide instructions, guide simulations and feedback is significant" [27-29]. Thus, debriefing, in which students have the opportunity to process the topic being studied, combine the topic with previously acquired knowledge and consider how this can be utilized in the future, forms a very important stage.

6. Conclusion

The implementation of a classroom action research set in the science subject was held in the Junior High School Equivalency Program Community Learning Center (CLC) Ash-Shoddiq Lembang class VII. The topic of discussion in improving science learning is the solar system. Improvements in learning are carried out to achieve students' basic competencies, that was; to describe the solar system and the position of the constituents of the solar system. The competency standard to be achieved is to understand the sun as the center of the solar system and the interaction of the earth in the solar system. The purpose of conducting classroom action research is to obtain improvements in learning quality in three cycles of treatment. This is indicated by the constant improvement from one cycle to the next. The focus of this class action research data study is aimed at three categories of data, namely student score data, student activity data in the process of improving learning, and observation data made by peers on teacher efforts in implementing learning improvements. From those three categories of data, it showed a positive trend in every cycle (cycles 1, 2, and 3).

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