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TEACHING HIGH SCHOOL STUDENTS WITH/WITHOUT SPECIAL NEEDS AND THEIR MISCONCEPTION ON CORROSION

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Abstract

This study aims to investigate teaching strategies for improving students' comprehension and their misconception of corrosion. The subjects in this study were senior high school students with/without special needs. Different from other teaching methods, we implemented experimental demonstration activities equipped with experimental video to facilitate the delivery of material to offline and online activities. We also analyzed data on misconceptions during the teaching process. The results showed that the level of understanding of students with special needs and students in general in high school had increased after students took part in the learning using the experimental demonstration method equipped with video as learning media. In addition, the present teaching strategies are also effective to decrease misconceptions on each item of the problem. The main ideas for the improvement of students understanding are because of several reasons: (1) implementation of experiments that can easily be understandable compared to conventional teaching, (2) the use of video as a learning media that is repeatable by students, (3) experiments are one of the concrete media to improve students' comprehension, (4) specifically for special needs students, they need visual learning to understand the subject matter, and (5) experiments using daily products that can be imaged by students, and students can do by themselves.

Keywords: Corrosion, High school students, Identification, Misconception, Teaching.

1. Introduction

Corrosion is an event of damage to an object (metal) caused by environmental influences. Corrosion occurs when a metal surface comes in contact with a gas or chemical liquid [1]. Corrosion causes the metal to become hollow, brittle, and turn brown. The corrosion process is influenced by several factors, including water and humidity, uneven metal surfaces, the formation of electrochemical cells, and electrolytes [2].

In the curriculum in Indonesia, corrosion material is found in the curriculum at the educational unit level in class XII. This material is important to be taught to students because corrosion phenomena often occur in everyday life [1]. When learning corrosion, the media and methods used must be considered. Media and methods affect students' learning outcomes [3]. This is so that students do not have misconceptions about the material being taught.

The misconception is a concept that is not following the concept recognized by experts [4]. Misconception or misconception refers to a concept that is incompatible with the scientific understanding or understanding accepted by experts in the field. The misconceptions experienced by students must be understood and discovered by teachers to help students correct the misconceptions they experience so that they are effective [4].

Currently, there are several studies on misconceptions including identification of student misconceptions using a four-tier diagnostic test on geometric optical material [4], identification of misconceptions and causes of student misconceptions with a three-tier diagnostic test on rotational dynamics material [5], identification of student misconceptions in completing the algebraic content TIMSS questions in terms of the level of mathematics anxiety [6], identifying misconceptions and causes of students 'misconceptions using a four-tier diagnostic test on dynamic fluid sub-material: the principle of continuity [7], A review and comparison of diagnostic instruments to identify students' misconceptions in science [8]. However, until now no research explains the identification of misconceptions in the learning process of corrosion material in high school students plus the comparison of learning outcomes with students with special needs. So that it becomes the originality of this research.

Students with special needs are children who experience obstacles both due to internal and external factors that have an impact on the emergence of problems in the learning process [9]. Both students with special needs and students in general in high school need media and learning methods that are in accordance with the needs of students. It is not uncommon for students to experience difficulties in understanding the material being taught, especially about corrosion. To ensure students' understanding, the activity of analyzing data from the identification of misconceptions is also very important.

Therefore, the objective of this study was to investigate teaching strategies for improving students' comprehension and their misconception of corrosion. In this study, a mixed-method was used to obtain data. In practice, learning activities are carried out online and offline. In addition, we also carry out experimental demonstration activities equipped with experimental video videos to facilitate the delivery of material to students. The pretest and posttest were carried out to determine the level of understanding of students at the beginning and end of the

learning process. Although students with special needs and high school students have different abilities and are not worth comparing, this study was conducted to determine the effectiveness of the learning process and its effect on student learning outcomes. As a differentiator, data analysis of misconceptions that occur in high school students is carried out to find out the misconceptions that occur. This is done as a follow-up to analyze the abilities of high school students more deeply when working on questions. The results showed that the level of understanding of students with special needs and students in general in high school had increased after students took part in the learning by using the experimental demonstration method which was equipped with video media. The results of this study are expected to be an inspiration for educators in carrying out the learning process.

2. Theoretical Frameworks

2.1. Corrosion

Corrosion occurs when a metal surface comes in contact with a gas or chemical liquid [10]. Corrosion causes an object to rust. The environment affects the destruction of metals in the corrosion process [11]. Anything made from metal can rust over time due to contact with water, oxygen, air, warm temperatures, acids, and salts. Corrosion causes the metal to become hollow, brittle, and turn brown.

The process of corrosion is an electrochemical process. The formation of electrochemical cells is one of the factors that affect the acceleration of corrosion [12]. Electrochemistry is the process of spontaneous redox reactions (oxidation-reduction process) [13]. For example, corrosion of iron will form iron oxide (i.e. Fe_2O_3 and Fe_3O_4). Iron is oxidized by oxygen from the air and will corrode.

The occurrence of corrosion can take place quickly or slowly. This is influenced by the following factors [13].

(i) Water and humidity. This factor plays an important role in the process of corrosion. The higher moisture content around the metal affects the easier metal to get experience in corrosion. If the metal is in an area that has low water content, the corrosion process will run more slowly, and iron does not rust easily. Thus, we need to keep the iron in a dry and not damp place.

(ii) Electrolyte. The electrolyte is the place or medium where the charge transfer takes place. This makes it easier for oxygen in the air to bind to electrons. For example, rainwater (which is acidic) and seawater (which is salty) can act as a medium for accelerating corrosion. NaCl solution is an electrolyte solution that can accelerate the corrosion process [14].

(iii) Metal surface. The corrosion rate is also influenced by the shape of the metal surface. Metals with uneven surfaces corrode easily. The reason is that the charge poles are formed on the metal surface. The charge poles act as anode and cathode.

(iv) The formation of electrochemical cells. The formation of an electrochemical cell is motivated by the presence of two metal surfaces that touch each other. If the metal surfaces that touch have different electrode potentials, an electrochemical cell is formed. When an electrochemical cell is formed, metals with a lower electron potential will release electrons, causing oxidation. This oxidation is the main cause of corrosion.

2.2. Misconception

Misconception refers to a concept that is not in accordance with the scientific understanding or understanding accepted by experts in the field [4]. Misconception can be described when the condition is the wrong understanding from the theory. The concept built in one's mind is incorrect compared to the realistic theory, and mostly the concept is from one's idea, perception, and experiences [5]. So, it is concluded that the misconception of an understanding of the concept received by students from a teacher or a teacher is not in accordance with the concepts of experts.

The misconceptions experienced by students must be understood and discovered by teachers to help students correct the misconceptions they experience so that they are effective [4]. Several factors influence the factors, including students, teachers or teachers, textbooks, context, and teaching methods.

Identification of misconceptions is very important to locate the location of misconceptions and their causes [8]. Identification of student misconceptions is very important for the student learning process going forward. If misconceptions are allowed to continue, it can affect student learning outcomes and further student learning processes. It is necessary to hold a diagnostic test to identify student misconceptions so that they can be found and resolved effectively so that student learning outcomes are better and students do not experience misconceptions when working on questions.

Various misconceptions that are often carried out by students will result in errors in solving problems and of course result in student learning outcomes being less good. Therefore, misconceptions that are often done by students should not be left too long because it will affect understanding of the concepts in other material [7].

The ways to identify misconceptions include the Certainty of Response Index (CRI) and diagnostic tests. One of the latest developments in the diagnostic test is the four-tier diagnostic test, which is a diagnostic test with four levels. This four-tier diagnostic test can be said to be a combination of multiple-choice tests with open reasoning and the Certainty Response Index (CRI) because the level of the diagnostic test is accompanied by a level of confidence [4].

CRI is indeed powerful enough to be used to differentiate between students who experience misconceptions and students who do not know the concept, as well as to identify misconceptions that occur [4]. The student's confidence level is said to be low if the student fills the CRI scale 0, 1, or 2. The student's confidence level is said to be high if the student fills the CRI scale 3, 4, or 5 [4]. The CRI scale and criteria are shown in Table 1.

Table 1. CRI scale and criteria.

CRI Score	Criteria	Description
0	Totally guessed answer	100% guessing
1	Almost a guess	75-99% guessing
2	Not sure	50-74% guessing
3	Sure	25-49% guessing
4	Almost certain	1-24% guessing
5	Certain	0% guessing

Students experience misconceptions or misconceptions if the concept of student understanding is not in accordance with the scientific understanding received by experts in that field [15]. Misconceptions need to be overcome, activities to correct students' misconceptions are carried out so that student concepts that are initially not in accordance with the scientist's conception can become appropriate. One of the ways that can be done is by remedial activities [15]. The remedial process is carried out to improve student learning outcomes. The use of methods, models, strategies, and media makes students interested in the lesson so that they are willing to be actively involved in the learning process [16]. One of the media used to reduce the level of misconceptions in students is through the use of learning video media. The provision of learning videos aims as a means to attract students' attention in the learning process [17]. In general, learning videos are favored by students because visualization learning can stimulate students' attention and concentration to remember the material presented. In science material, there are so many phenomena that will be easier to understand if students conduct experiments directly using laboratory equipment [15]. However, due to the limitations of available tools and materials, this study used learning videos that contained experiments or experiments related to the material. Thus, students can observe directly the phenomena or experimental activities that are displayed through learning videos [15]. This can reduce the level of misconceptions that occur.

2.3. Students with special needs

Children with special needs are children who have obstacles and problems due to both internal and external factors which have an impact on the emergence of problems in the learning process in everyday life. Children with special needs are categorized into children with special needs, permanent and temporary [18]. There are several children with special needs according to the obstacles they have, including [19]:

(i) Children with visual impairments (blind). Children with visual impairments are children who have visual impairments so they need special education services in their education and life. Children with visual impairments are divided into two categories, namely children with low vision (low vision) and blind children (blind) [9].

(ii) Children with hearing impairments (deaf). Children with hearing impairments are children who lose part or all of their hearing power so they experience problems communicating verbally. They have difficulty understanding the complex and abstract information [20]. They are visual learners [21].

(iii) Children with intellectual disabilities (mental retardation). Children with intellectual disabilities are children who have below-average intelligence, have problems in adaptive behavior, so they have difficulty completing tasks in everyday life. They need concrete and interesting media in the learning process [3].

(iv) Children with mobility / physical disabilities (disabled). Children with limb / physical impairments are children who have permanent disabilities or disabilities in the limbs or neurological disorders in the brain.

(v) Children with emotional and behavioral disorders. Children with emotional and behavioral disorders are children who show deviant behavior at moderate, severe, or very severe levels that occur at the age of children and adolescents that occur due to disruption of emotional and social development.

Every child with special needs has different development, learning barriers, and needs. Factors that cause learning barriers experienced by each child, namely environmental factors, factors within the child, and a combination of the two.

3. Method

3.1. Research subject and student demographics

In this study, we involved 14 students with special needs (students with intellectual disabilities and students with hearing impairments) from special schools (SLB) and 14 students in general from high schools (SMA), Indonesia.

In this study, we involved 28 subjects consisting of students with special needs and students in general. There are 14 students with special needs, consisting of 6 students with hearing impairments and 8 students with intellectual disabilities. While the other 14 students are students in general.

Figure 1 describes the presentation of the number of research subjects. As many as 50% are students in general (normal) from high school. Students are generally students who have an average level of intelligence. They do not need special education and teaching services [22]. As many as 28.57% are students with special needs with intellectual barriers. Students with intellectual disabilities are students who have intelligence below average (IQ less than 70), have adaptive behavior problems, and have problems experienced during development [23]. Meanwhile, 21.43% are students with special needs with hearing impairments. Students with hearing impairment have characteristic problems in the aspect of communication caused by dysfunction of the hearing or speech organs [24]. Students with hearing impairment generally have the same level of intelligence as students in general (average). But, because of the characteristics of communication barriers, they have caused them to experience problems understanding information. With various characteristics possessed, students with special needs have problems in the learning process. They find it difficult to understand abstract and complex information. So they need special education and teaching services [18]. Media and methods must be considered and adapted to the needs of students so that the learning process runs effectively.

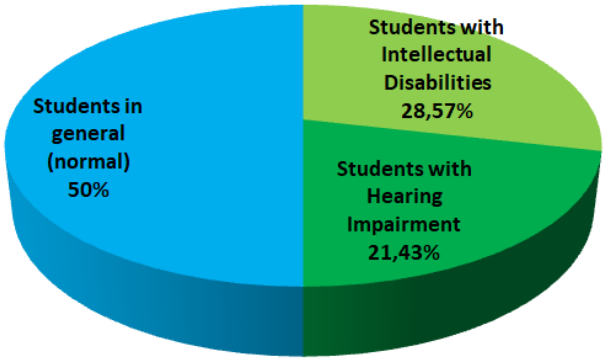

Fig. 1. The percentage of total data on students with special needs and students in general.

3.2. Research procedure

Figure 2 shows the stages of research starting from the stages of preparation, implementation, and evaluation.

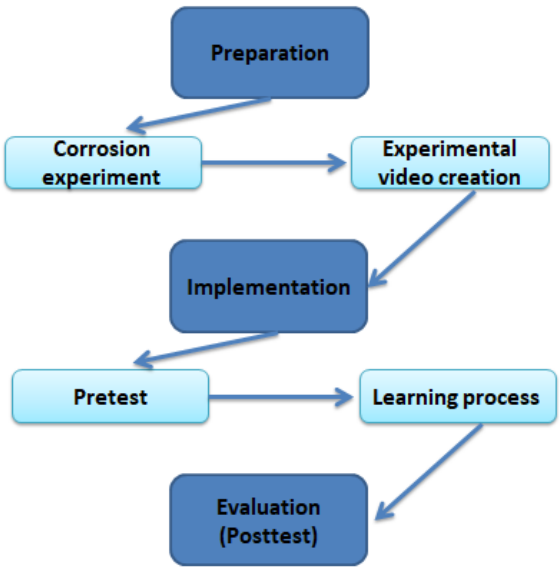

Fig. 2. The research procedure.

The corrosion learning process is carried out by offline and online activities. Offline activities are carried out on students with special needs. This is because the demographic conditions where students with special needs live do not allow them to carry out the learning process offline. While online activities are carried out for students in general.

There are several stages of the learning process, namely preparation, implementation, and evaluation. At the preparatory stage, we carried out experimental activities of corrosion phenomenon using iron, salt, and water particles as media. This was done to make it easier for students to observe the process of corrosion [1]. The results of the experimental activities were documented and a learning video was made. At the implementation stage, the activities were divided into several activities, namely posttest (for 20 minutes), material explanation, experiments with video playback, and learning activities (for 50 minutes). Students also carried out a demonstration experiment using the media provided. Meanwhile, at the evaluation stage, the posttest was carried out for 20 minutes.

3.3. Learning process stages

Figure 3 describes the procedure for implementing the corrosion learning process. The first stage is the preparation activity. There are three activities at this stage, namely conducting experimentation of corrosion phenomena, making experimental videos of the results, and making learning implementation plans. The next stage is the implementation stage, at this stage, the learning process is carried out online

and offline. The learning process begins with a pretest activity after which it is continued with the delivery of material about corrosion by displaying experimental videos of the results. Students also carry out a demonstration experiment using the media provided. The evaluation stage is carried out by giving a posttest to students.

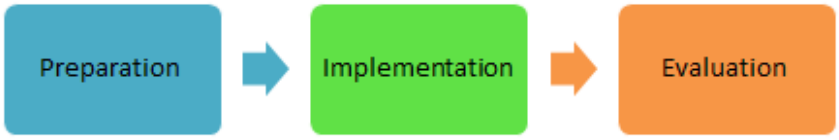

Fig. 3. Learning procedure.

We gave 15 questions on the activities before and after the learning process (pretest and posttest). This activity aimed to determine the level of students' understanding of corrosion material. We made 15 short answer questions, with a choice of answers and a score analysis of 1 (yes) and 0 (no) with a total score if answered yes of 100. The calculation method is the answer score (yes) multiplied by ten, then divided by thirty-five. In addition, we supplemented each question with an identification question for misconceptions. We ask the question "How confident is the answer to Problem Number 'X?". X is the question number. This question has a scored assessment with its criteria.

The calculation method is the score of yes answers multiplied by ten, then divided by thirty five.

$$\frac{schorus\ obtained \times 100}{15} = student\ final\ score$$

Table 1 shows a description of the answer choices to identify any misconceptions in students. The choice of answer 0 when the student answered the question was 100% of guessing, point 1 is if the student answered the question the percentage of the guessing element was between 75 and 99% of guessing, point 2 is f the student answered the question the percentage of the guessing element was between 50% -74% guessed, point 3 is if the student answered the question element percentage guesses between 25 and 49% were guessed, point 4 is if the student answered questions, the percentage of the guessing element was between 1% -24% being guessed, and point 5 is if the student answered the question there was no element of guessing at all. All these calculations we can refer to references regarding misconceptions [4].

4. Results and Discussion

4.1. Learning outcome data analysis

Table 2 describes the comparison of data on the pretest and posttest results of students with special needs and students in general in high school. At the time of the pretest, the average score for students with special needs was 17.30, while general students were 74.28. They both have an average score of below 75. At the time of the posttest, the mean score of students with special needs was 78.56 while students in general were 98.57. They both have average scores above 75.

Students with special needs have pretest and posttest scores of below students in general (normal). This is due to problems with student characteristics that have an impact on the process of understanding information. Students with special needs have difficulty understanding abstract and complicated information resulting in low student learning outcomes [18]. In contrast to students in general who do not have communication barriers and have a level of intelligence above average. Even so, students with special needs and students generally had a pretest score below 75. However, after using the experimental demonstration method and experimental video media in the learning process, the students' scores increased. This shows that there is an influence from the learning methods and media used [25-27]. For getting an effective learning process, educators must use media and learning methods that are in accordance with the needs of students [9].

Table 2. Pretest and Posttest results.

No.	Students with Special Needs	Pretest (X0)	Postest (X)	Students in general (normal)	Pretest (X0)	Postest (X)
1	B1	60	100	A	73.33	100
2	B2	20	100	B	73.33	100
3	B3	20	100	C	73.33	93.33
4	B4	20	100	D	73.33	100
5	B5	20	100	E	86.66	100
6	B6	20	93.33	F	86.66	93.33
7	C7	20	73.33	G	86.66	100
8	C8	20	73.33	H	66.66	100
9	C9	20	73.33	I	66.66	100
10	C10	20	66.66	J	66.66	100
11	C11	13.33	60	K	66.66	93.33
12	C12	13.33	53.33	L	73.33	100
13	C13	13.33	53.33	M	73.33	100
14	C14	13.33	53.33	N	73.33	100
Average		17.30417	78.56929	Average	74.28071	98.57071

In addition to comparing the results of the pretest and posttest students with special needs with students in general in high school. We also analyzed the identification of misconceptions on student learning outcomes in general in SMA. This is done to identify and identify whether or not there are misconceptions from the corrosion learning process given. This is important for the student learning process in the future [1]. If misconceptions are allowed to continue, it can affect student learning outcomes and further student learning processes.

Table 3 describes the average identification results of the pre-test and post-test results of learning corrosion in high school students. At the time of the pretest, the percentage of misconceptions was 46.18%. And, 27.13% of the misconceptions occurred in the students' posttest results.

The results showed that the corrosion learning process with the experimental demonstration method equipped with experimental videos on the corrosion affects the improvement of students' learning outcomes. This is confirmed by the increases in students' learning outcomes during the posttest. In addition, comparative data on

student learning outcomes with special needs and students, in general, showed that the pretest and posttest scores of students with special needs are smaller. This is because students with special needs have various characteristics of problems that cause them to have problems in the learning process. Students with special needs find it difficult to understand the information or material presented [3]. In contrast to students in general, they have an average level of intelligence and do not have problems in the learning process [22]. The main thing in this study is that the experimental video has effectiveness in improving student learning outcomes. In addition, learning videos can reduce the level of misconceptions in students [15].

Table 3. Identification of misconception.

No.	.Question	Mean value of misconceptions	
		Pretest (X0)	**Posttest (X)**
1	Do you know what a solution is?	14.28	7.14
2	Did you know NaCl is another name for salt?	21.42	14.28
3	Did you know that the salt solution is an electrolyte?	21.42	21.42
4	Did you know the salt solution has a salty taste?	42.85	21.42
5	Do you know the difference between the taste of mineral water and salt solution?	42.85	21.42
6	Did you know that corrosion is another name for rusting?	42.85	28.57
7	Do you know that the corrosion process has discolored?	50.00	28.57
8	Do you know the corrosion process affects weight loss?	50.00	28.57
9	Do you know the corrosion process affects the deformation of objects?	50.00	28.57
10	Do you know objects that are prone to corrosion?	50.00	28.57
11	Did you know that iron is an object that is prone to corrosion?	50.00	35.71
12	Do you know the factors that cause corrosion?	64.28	35.71
13	Did you know that saline solution speeds up the corrosion process?	64.28	35.71
14	Do you know that the corrosion process of objects in mineral water is slower than in saline solutions?	64.28	35.71
15	Do you know the corrosion process changes the color of the solution?	64.28	35.71
	total	46.19	27.14

The use of methods and media that are in accordance with the needs of students also affects the decrease in the level of students' misconceptions in answering questions. It can be seen that there is a decrease of 19.04% in the mean value of the results of the identification of misconceptions on the posttest. Methods and media in accordance with the needs of students affect the continuation of the effective learning process [9].

There are some lacks and limitations in the pretest and posttest. However, this study can distinguish the importance of additional experimental demonstration and

video to improve students' comprehension. It is also not possible to do additional pretest and posttest to the same subjects. Thus, for getting more understanding regarding the effectiveness of this study for improving students' comprehension, we must revise and improve the pretest and posttest to other subjects, and it will be done in our future work. Indeed, the improvements must be supported by understanding and searching more literature, in which this will be conducted based on previous studies [28-32].

5. Conclusion

In this study, we tested special needs students with offline teaching and learning processes, while that to regular students with online processes. Quality of the research work should be done equally in the same teaching and learning process. However, there are limitations in the CoVid-19 pandemic that makes us difficult to do experiments in the offline process. Thus, all experiments done in the offline process will be done in our future work. We use both quantitative and qualitative methods in collecting research data. The corrosion learning process is carried out in several stages. The experimental demonstration method and video experimental media were used in the learning process. Student learning outcomes are seen from the pretest and posttest activities. The results showed an increase in the learning outcomes of students with special needs and students in general in high school. In addition, the results of the comparison of student scores show that students, in general, have higher average pretest and posttest scores than students with special needs. Methods and media affect increasing student grades. In addition, methods and media also affect the reduction in the level of misconceptions. This can be seen from the average value of the identification results of misconceptions on the students' pretest and posttest. The significant impact of this study was (1) find a method to improve student learning outcomes (2) find out how to find out misconceptions in high school students (3) find out the difference in improving student learning outcomes (4) find out the effectiveness of experimental videos used in corrosion learning.

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