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Implementation of the Concept Attainment learning model to increase independence and reduce misconceptions of MA students on the circulatory system learning material

Citra Nur Anisah, Sigit Saptono [1]✉

[1]Biology Department, FMIPA, Semarang State University, Indonesia

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Abstract

Misconception is an understanding that is not in accordance with the concept conveyed by experts. Misconceptions are still found in student learning outcomes on the Circulatory System material. The Concept Attainment Model is a teaching strategy that helps students strengthen their understanding of the concepts being studied. Learning independence is one of the factors that influence learning outcomes. The purpose of this study was to increase student independence and learning outcomes as well as reduce students' misconceptions about the Circulatory System material. This research is a pre-experimental research with a one group pretest-posttest design. The data in this study were obtained through observation sheets, student response questionnaires, pretest-posttest, and student interviews. The results showed that prior to the implementation of the Concept Attainment learning model, students' learning independence was classified in the medium category. After the implementation of the Concept Attainment learning model, student learning independence increased, belonging to the high category. Student learning outcomes show that prior to the implementation of the Concept Attainment learning model, they had not reached the specified classical mastery. That is, student learning outcomes are low. After implementing the Concept Attainment learning model, student learning outcomes experienced a good increase in the medium and high N-Gain categories. The findings of students' misconceptions prior to the implementation of the Concept Attainment learning model were found in the concept of the mechanism of the clotting process, the link between blood type and blood transfusion, parts of the heart in cardiac anatomy, differences in the systemic and pulmonary circulatory systems, and disorders/abnormalities of the circulatory system. After implementing the Concept Attainment learning model, misconception were found in the concept of blood constituent components, the relationship between blood type and blood transfusion, and disorders/abnormalities of the circulatory system. Thus, it can be concluded that the implementation of the Concept Attainment learning model can increase student independence and learning outcomes and reduce student misconceptions.

✉ Corespondence Addres:
Gedung D6, lantai 1, Jl Raya Sekaran Gunungpati Semarang
E-mail: sigit_biounnes@mail.unnes.ac.id

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INTRODUCTION

Biology is subject that has an important role in supporting science. Biology is a branch of science that deals with how to systematically find out and understand nature, so that biology is not just mastery of a collection of facts, concepts or principles but is also a process of discovery. (Berutu & Muhammad, 2018). The Concepts can be obtained from facts, events, experiences through experiments and critical thinking in accordance with the concepts obtained when discovering new facts or knowledge in real life. (Astuti, 2017). Generally, the aim of learning biology is to achieve a deep understanding of biological concepts (Evi *et al*., 2019).

Independence is the ability possessed by someone to do something and be accountable for it (Fadhillah & Faradiana, 2016). This statement shares the same view with (Egok & Sukenda, 2016) that independence is a condition where somebody has a competitive desire to advance for his own good, is able to make decisions and initiatives to overcome the problems faced, has confidence in carrying out his duties and is responsible for what he does. According to (Diniyah, 2018) stating the attitude of independence that students have can foster self-confidence in students and make them more quickly accept learning material so as to shape their character for the better. The implementation of independence can be done in many ways, one of which is learning independence. According to (Tahar & Enceng, 2006) in Lisa *et al.*,2018) Learning independence is a learning activity carried out by someone with the freedom to determine and manage their own teaching materials, time, place, and use the necessary learning resources.

Learning independence is one thing that is very important in the learning process (Hidayat *et al*., 2020). This is in line with the opinion (Ela et al., 2019) that independence is an important factor in determining student learning success. The independence of student learning can be seen when students are able to face their own problems with confidence and complete assignments with full responsibility without the help of teachers or other people (Rahim *et al.*, 2021). The lack of learning independence from students while at school affects when the learning process takes place. In several cases, there still found students who still lack of confidence in their own abilities when given assignments by the teacher. Even though learning independence greatly affects student learning outcomes. High learning independence will shape students' enthusiasm for learning so that students have the desire to be able to solve problems and obtain satisfying learning outcomes. In line with research conducted by (Kulsum & Djoko, 2017) that learning independence can infulence to the student's learning outcomes.

However, the fact shows that student learning independence is still relatively low. Most students are still reluctant to carry out learning activities independently. There are many students who are still working on assignments at school by copying the work of their friends when given homework by the teacher. There are still students who are caught cheating during exams, sleeping during class session, reading books only after been instructed by their teachers, and students still being found access their cellphones during learning. This of course will have a bad impact on education in Indonesia. According to (Afandi, 2011) in Titin *et al*.,2018) states that one of the causes of low learning independence is a learning system that does not yet require students to play an active role in finding the information needed during the learning process.

Learning outcomes are a measure of student success after taking the learning process (Berutu & Muhammad, 2018). On the other handstates that learning outcomes are achievement that students have as a result of their own experience in interacting with their environment through a process of training, skills, perseverance, and knowledge within the students, according to (Sudjana in Pramika & Merlyn 2018) states that learning outcomes are achievement that students have as a result of their own experience in interacting with their environment through

a process of training, skills, perseverance, and knowledge that is in students. Learning outcomes are a very important part of learning, because they will provide information to teachers about the progress of their students in achieving learning goals.

Misconception is a concept that is not in accordance with the concept presented by the expert (Suparno, 2013). In line with statement by (Muntiani, 2015) reveals that misconception is a discrepancy between the concepts understood by someone and experts. Misconceptions are dangerous because they give wrong thoughts and feelings in knowing the concept so that it limits effort in learning and there is interference between concepts that have been learned (incorrectly) and those that are being studied (correctly). The lack of understanding of biology concepts has resulted in difficulties for teachers and students to continue on the material afterward, because the material is interrelated with one another. So that it will affect the biology learning outcomes that will be obtained by students.

Based on the results of researchers' observations in September 2022, student learning independence is still unclear within students. There are many students who lack confidence when asked by their teacher to present in front of the class. Students also lack confidence in their own abilities, when given assignments by the teacher, both school assignments and homework, there are still many students who do assignments by working together with their friends and copying each other. Student responsibility is also still relatively low, most students do not collect assignments according to the time set by the teacher. The initiative of students to read books or to review material taught by the teacher is also very lacking, as evidenced in the next lesson when the teacher reviews material that has been studied in the previous meeting students cannot answer questions from the teacher. Student discipline is also relatively low, students are often found outside the classroom when the teacher is absent. There are also some students who access their cellphones to play games and check their social media account such as Instagram and TikTok while learning is taking place. Students do not optimally use their cellphones to find information on other learning resources. There are even students who use sandals or take off their shoes when at school.

With the conditions, researchers identified several problems. First, learning in class still uses conventional learning with lecture models. Teachers are more active than their students. Second, the lack of opportunities for students to be able to develop self-learning independence. The dependence of students on the existence of their teacher is very high. In situations and conditions like that, students cannot obtain a possibility t develop their learning skill. Third, students have difficulty solving problems given by the teacher. This difficulty arises, because finding answers is seen as a goal to be achieved, while the level of mastery of student learning is often neglected.

With these problems, it will have a bad impact for students. For instance, student learning outcomes that are less than optimal and student understanding is still low. Therefore, there is a need for new innovations for the learning process of students in schools. One of them is by implementing the Concept Attainment learning model. The purposes of this study are 1) to analyze student learning independence before and after the implementation of the Concept Attainment learning model; 2) analyzing student learning outcomes before and after implementing the Concept Attainment learning model and; 3) analyze students' misconception before and after implementing the Concept Attainment learning model.

RESEARCH METHOD

This research is a pre-experimental study with a quantitative approach. The type of design used is the one group pretest posttest design. This research was conducted at State Senior High School 1 Semarang City in October 2022. The population for this research was all students of class XI MIPA (Science). The sample used was 3 classes consisting of 70 students.

Determination of the sample using purposive sampling method and selected by the biology teacher. The selected class was a class that has finished receiving lessons and fulfilled the KKM (minimum classical completeness) on the previous material test.

The data collection method of this study included the results of observation sheets, pretest-posttest, student response questionnaires, and student interviews. Analysis of student learning independence using the Microsoft Excel program. Student learning outcomes were analyzed using the t-test and the N-Gain test. The concept errors using the four tier multiple choice test were analyzed through the Microsoft Excel application. The results of the interviews were analyzed qualitatively. Based on the data obtained, it can be seen that independence and student learning outcomes from the completeness of the pretest and posttest scores. In addition, the criteria for students' misconception can be identified through the percentage of students who understand concepts, guess, do not understand concepts, and misconception (Fransiska et al, 2018).

RESULT AND DISCUSSION

Student's Learning Independence

Student learning independence data was obtained through observation sheets and student response questionnaires before and after being given treatment. Data were analyzed using Microsoft Excel program. The results of the analysis of observation sheets and student response questionnaires obtained results as in Table 1.

Table 1. The result of Student's learning independence

Before Implementation of *Concept Attainment* Learning Model				
Indicator	**Student's Learning Independence Level Result From**		**Average**	**Category**
	Angket	**Observasi**		
Confident	58	48	53	Medium
Responsible	60,6	52,4	56,5	Medium
Inisiative	61,4	43,7	52,5	Medium
Discpline	62,2	54	58,1	Medium
Overall	**60,5**	**49,5**	**55**	**Medium**
Ater Implementation of *Concept Attainment* Learning Model				
Confident	78,5	70	74,2	High
Responsible	80,4	76	78,2	High
Inisiative	86,9	66	76,4	High
Discpline	85,5	75,2	80,3	High
Overall	**82,8**	**71,8**	**77,3**	**High**

Based on Table 1, it shows that student learning independence after being treated with the Concept Attainment learning model obtained a score of (77.3) higher than before being given treatment with a score of 55. All indicators of student learning independence after being treated showed a higher score. This means that student learning independence after being given treatment is better than before being given treatment. This was also marked by the acquisition of learning outcomes which showed a positive after the implementation of the Concept Attainment learning model and enthusiastic student responses to the application of the learning

model developed. This is in line with research (Titin et al, 2018) that there is a significant positive effect of learning independence on learning outcomes. Agree with the results of the study (Egok, 2017) concluded that there is a positive relationship between learning independence and learning outcomes.

The implementation of the Concept Attainment learning model supports and influences student learning independence. This is because the Concept Attainment model tends to make students more active. Students get a different learning atmosphere, so students will not feel bored and bored when the learning process takes place. Also supported by learning activities outside the class that have been going well. Students are able to study independently, the process of discussion and question and answer also runs smoothly. When the discussion occurs the process of exchanging information and knowledge between students and students and students and teachers. This makes students more independent in their learning.

There are four indicators of learning independence observed in this study, namely self-confidence, responsibility, initiative, and discipline. First, learning independence on the self-confidence indicator, after being given treatment it reached the high category with a score of 74.2 higher than before being given treatment with a score of 53 which was classified in the medium category. These results can be seen from the results of the observation analysis and questionnaire responses to student learning independence. During the learning process, students are trained to express opinions in group discussions and answer questions from between groups. According to (Pratiwi & Laksmiwati, 2016) self-confidence is a very important factor for achieving student learning independence. Students who have self-confidence will have confidence in making decisions and in the end students are able to take steps that must be taken in the future starting from planning, implementing, and evaluating the learning outcomes that have been obtained previously. Therefore, it can be emphasized that indicators of self-confidence must be increased by practicing expressing opinions and having confidence in the decisions or answers taken.

Second, learning independence on the indicator of responsibility, after being given treatment reached the high category with a score (78.2) higher than before being given treatment with a score of 55 which was classified as in the medium category. The attitude of responsibility in this study was seen from several activities, including completing all assignments given by the teacher, being active and serious about participating in learning, and being responsible for every action. This learning model encourages students to have a sense of responsibility. During the learning process students work together with their team groups to exchange thoughts and ideas. That way, students have responsibility for their respective assignments, even though the assignments are carried out in groups. Changes in the attitude of student responsibility can be seen after students are given treatment, students have experience of greater responsibility because they are trained to solve problems in discussions. In research (Elviana, 2017) states that independence and responsibility are influenced by the learning methods used by the teacher during the learning process. Therefore, it can be emphasized that appropriate learning methods can train a sense of responsibility in students.

Third, learning independence on the initiative indicator, after students were given

treatment on this indicator it reached the high category with a score (76.4) higher than before being given treatment with a score of 52.5 which was classified as in the medium category. The implementation of the Concept Attainment model trains students to answer discussion questions which indirectly makes students take the initiative to find the right answer to solve problems in discussion. Indicators of initiative in this study can be seen from various student activities, including learning on their own willing, asking questions when there is an explanation of material that is not understood, trying to find other reference sources for material and taking notes or summarizing material without being instructed by the teacher. According to research (Al Aslamiyah, 2019) states that someone who has a good attitude of initiative, he will be able to create something new, such as coming up with new ideas or solving his own problems. Therefore, it can be emphasized that initiative indicators can be trained by solving problems so that optimism can grow attached to students.

Fourth, learning independence on discipline indicators, after students were given the treatment of disciplinary attitudes students reached the high category with a score (80.3) higher than before students were given treatment with a score of 58.1 which was classified as in the medium category. Discipline in this study can be seen from several student activities, such as collecting assignments on time, not being lazy to study at school or at home, and not being late for class. According to research (Smith, 2011) states that discipline is one of the behaviors that every student must have. Discipline behavior grows in the student's personality through training and awareness of the student himself. The learning process with the Concept Attainment model is very orderly, because during the learning process it follows the syntax of this learning model. Therefore, it can be emphasized that discipline grows through student awareness and can be trained using a systematic learning model and according to student needs. Based on this description, it can be concluded that the Concept Attainment learning model is effective for increasing student learning independence, because the syntax and steps of this learning model are systematic and able to support students to learn independently.

Student Learning Outcomes

Initial ability describes the extent of students' knowledge and insight regarding the material to be studied. This initial ability is very important to be known by researchers or teachers so they can design the learning process so as to create effective learning. In this study, KKM (minimum classical completeness) was used as a reference for student mastery standards to determine the quality of student learning outcomes. The KKM requirement in MAN 1 Semarang City is 75. The minimum classical completeness indicator for students is when students who score above KKM $\geq$ 75 consist of at least 75% of the total students in a research class. Learning outcomes in this study were calculated pretest and posttest scores using the t-test and the N-Gain test. The results of the pretest and posttest values obtained are as shown in Table 2.

Table 2. The results of the pretest and posttest of the research sample students

Details	***Pretest***	***Posttest***
Highest score	75	100
Lowest Score	20	70
Average	49,4	83,7
Complete	1	67
Incomplete	69	3

Based on Table 2, the pretest results obtained the highest score with a score of 75 and the lowest score with a score of 20. Overall the pretest results of 70 students obtained an average of 49.4. Meanwhile, the posttest results obtained the highest score with a score of 100 and the lowest score with a score of 70. The overall average posttest result of 70 students was 83.7. Meanwhile, the number of students who completed KKM after implementing the Concept Attainment learning model was 95.7% (67 students). Then, the pretest and posttest values that have been obtained are analyzed using the t-test. The following results of the t-test analysis are presented in Table 3.

Table 3. Results of the T-Test Analysis

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Before Treatment – After Treatment	-34.28571	12.46112	1.48939	-37.25696	-31.31447	-23.020	69	.000

Based on Table 3, the results of the t-test show the calculation of the sig. (2-tailed) 0.000 < 0.05. So, it can be stated that there are differences in the average pretest and posttest of students using the Concept Attainment learning model. Furthermore, the N-Gain test was carried out to determine the effectiveness of the Concept Attainment learning model to improve student learning outcomes on the Circulatory System material. The N-Gain value that has been obtained is then interpreted by the N-Gain value category. The results of the analysis of the N-Gain test obtained results as shown in Table 4.

Table 4 Results of Students' N-Gain Values

Categories	**XI MIPA 4**	**XI MIPA 5**	**XI MIPA 6**	**Total**	**% Total**
High	14	7	9	30	42,8
Medium	9	14	17	40	57,14
Low	0	0	0	0	0

Based on Table 4, the result of the N-Gain analysis in the research group reached the

high and medium categories. The results of the N-Gain test reached the high category with a percentage of 42.8% and the medium category was 57.14%. So, it can be stated that the Concept Attainment learning model is effective for improving student learning outcomes on the Circulatory System material. In line with research (Risdawati, 2017) states that there is an influence of the Concept Attainment learning model on the activities and learning outcomes of students in biology class XI IPA SMAN 11 Bulukumba. In addition, the results of research (Nainggolan & Derlina, 2017) show that the application of the Concept Attainment model has an effect on student learning outcomes. Research (Sarina, 2021) also states that there is an effect of the Concept Attainment model on student learning outcomes in the Virus material at SMAN 07. Research (Dewi et al., 2021) also concludes that there is an effect of applying the Concept Attainment model to student learning outcomes in structure and plant tissue function.

The completeness of student learning outcomes is high because there is an influence of the treatment of the Concept Attainment learning model. Students play a more active role and are not dependent on the teacher while participating in learning. Students can work together in groups and are able to solve problems given by the teacher. In addition, students are looking for additional information related to learning material, through questions, and examples related to the explanation of the material presented by the teacher. Therefore, the material is easier for students to remember and understand. In line with research (Nainggolan & Derlina, 2021) states that student completeness is high because students are motivated and interested in participating in learning using the Concept Attainment model.

Learning with the Concept Attainment model, students do not just sit quietly and write but students are required to be more active in learning and directly involved in asking questions and finding learning resources to train students to be confident in their ability to solve problems. This learning model encourages students to have a sense of responsibility. During the learning process students work together with their team groups to exchange thoughts and ideas. That way, students have responsibility for their respective assignments, even though the assignments are carried out in groups. Students are also required to think critically in the problem solving process. It is this critical thinking ability that stimulates students' cognitive reasoning in acquiring knowledge. This is done, so that students' ability to understand the material being studied increases. This is in line with research (Muhammad et al., 2014 in djufri muhibbudin 2017) which states that the Concept Attainment model focuses more on developing students' critical thinking. The application of this model trains students to develop thinking strategies and look for links between concepts that have been or are being studied.

In addition, during the learning process the Concept Attainment model can also improve students' psychomotor skills. This can be seen from the students' skills in discussing, presenting the results of their discussions and concluding the subject matter. The average student is very enthusiastic to ask questions and listen to the teacher's and other students' explanations during presentations. Students who are active in the learning process will make it easier for students to understand the material and receive the knowledge taught by the teacher. In accordance with research (Putri, 2017) states that the Concept Attainment model has the advantage of increasing students' understanding of concepts.

Student Misconception Before and After the Implementation of the *Concept Attainment* Learning Model

One of the objectives of this study was to reveal the misconceptions of class XI students on the Circulatory System material at MAN 1 Semarang City. Analysis of students' conceptual errors in this study used the pretest-posttest four tier multiple choice test that had been analyzed previously. This research was conducted offline with a working system on student question sheets and answer sheets. Prior to the test, students were previously given direction and guidance in working on the questions by the researcher. Analysis of students' conceptual errors in this study was classified based on the combination of answers in the four tier multiple choice test. Analysis of students' conceptual errors consisted of four categories, namely understanding the concept (PK), guessing (Me), not understanding (TP), and conceptual errors (MI). Following are the results of the analysis of conceptual errors before and after the implementation of the Concept Attainment learning model as shown in Table 5.

Table 5. Results of Analysis of Student Concept Errors Before and After the Implementation of the Concept Attainment Learning Model.

Sub Konsep	Number	Misconception			
		Before		After	
		Amt	%	Amt	%
Blood Circulatory System Function	7	15	21,4	10	14,3
Blood Constitution Components	6	11	15,7	6	8,6
	9	9	12,8	8	11,4
	13	28	40	25	35,7
Mechanism of the blood clotting process	4	22	31,4	21	30
	17	26	37,1	20	28,6
The relationship between blood group and blood transfusion	8	20	28,6	16	22,8
	12	24	34,3	40	57,1
	15	12	17,1	25	35,7
Parts of the heart in cardiac anatomy	3	14	20	2	2,8
	5	27	38,6	17	24,3
	19	21	30	17	24,3
	20	12	17,1	2	2,8
The difference between veins and arteries	1	15	21,4	7	10
The difference between the systemic circulatory system and the pulmonary circulatory system	10	29	41,4	10	14,3
	16	22	34,4	17	24,3
Lymph circulation	18	16	22,8	5	7,1
Disorders / abnormalities in the circulatory system	2	26	37,1	22	31,4
	11	20	28,6	22	31,4
	14	26	37,1	10	14,3

Based on the results of the analysis in Table 5, the highest misconception prior to the

implementation of the Concept Attainment learning model was found in the moderate category on four indicators, including 1) The indicator on the mechanism of the blood clotting process is found in number 17; 2) Indicators regarding the relationship between blood group and blood transfusion are in question number 12; 3) Indicators about the parts of the heart in cardiac anatomy are in question number 5; 4) Indicators about the difference between the systematic blood circulation system and the pulmonary circulation system are found in questions number 10 and 16; 5) Indicators regarding the relationship between circulatory system technology and types of circulatory system disorders/abnormalities are found in questions number 2, 11, and 14. Concept errors in the pretest, because students have not received and studied the circulatory system material before.

Misconception that were found after the implementation of the Concept Attainment learning model were also included in the moderate category found in three indicators, including 1) Indicators about blood constitution components found in number 13; 2) Indicators regarding the relationship between blood group and blood transfusion are in numbers 12 and 15; 3) Indicators regarding the relationship between circulatory system technology and types of circulatory system disorders/abnormalities are found in numbers 2 and 11. In questions 11, 12, and 15, apart from being classified as questions that experienced the highest misconception, they also included questions that did not experience a decrease in conceptual errors. . Many students faced misconception in these questions, because students are less focused and tend to memorize rather than understand the material. In line with research (Safrida, 2017) that the material that has experienced the least reduction in conceptual errors is the sub-concept of circulatory organs. This is because students do not understand the material well. This material is more complicated and complex compared to other materials because it deals with the anatomy and functions of the circulatory organs.

The misconception in question number 13 shows that students are wrong in understanding the picture. Students could not distinguish between the pictures of lymphocytes, monocytes and basophils, so they only guessed the answers. The conceptual error identified in this problem is monocytes as antibody generators. According to experts, lymphocytes function in immunological (immune) reactions as forming antibodies. Errors in understanding information in pictures or readings also lead to misconception.

In question number 12 students had misconception. The misconception identified in this problem is in the blood clotting process of the recipient antigen which agglutinins the donor. Whereas if the donor's blood group matches the recipient's blood type, the agglutinins in the recipient's blood plasma will agglutinogen the donor. This error occurs because students are not careful in reading the questions.

In question number 15, this misconception is likely to occur because students do not understand the concept properly or students do not pay enough attention to the teacher's explanation during the learning process. The identification results showed that students thought that blood group O could be transfused to blood groups A and B because they did not have agglutinins. Whereas blood type O has α and β agglutinins. If traced from the results of student interviews, that students experience difficulties in answering questions. As for questions number

2 and 11 about the concept of abnormalities/disease in the circulatory system. The finding of this misconception is likely to occur, because students tend to memorize more than understand material concepts.

Based on the findings of students' misconception in this study, it is hoped that the teacher will be able to focus more on explaining the Circulatory System material with a variety of questions, such as questions that are classified as high in the category of misconception. Because during the learning process between teachers and students, many terms are rarely heard by students. This certainly requires the habit of searching for and understanding terms that are rarely found by students. As for the alternative that can be done in helping student learning problems, namely applying remedial teaching or teaching improvement, this serves to improve weak information items in student memory so that student learning outcomes can achieve good grades. Meanwhile, remedial teaching can be done in the form of re-teaching only certain subjects that students do not understand, for example discussing problems together and giving special assignments. In addition, students can increase learning motivation, study skills, and develop good study attitudes and habits.

Obstacles and liablities in this study include 1) lack of focus on students during the learning process, many students are allowed to take part in activities that should be carried out outside class hours so that some data is incomplete; 2) There is no documentation in the form of videos during the learning process, due to limited staff/people during the research process. Attemps to overcome these problems include 1) Students focus on participating in the learning process and schools should provide policies to carry out other activities after the learning process is complete; 2) During the research process it can be documented by video, if there are energy constraints you can use a tripod. The implementation of the Concept Attainment learning model is expected to help students and teachers achieve learning objectives. This research is also expected to be able to help students to be more interested in following the biology learning process.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that after implementing the Concept Attainment learning model, student learning independence has increased in the good category. Student learning outcomes also experienced a high increase in the medium and high N-gain categories. The students' misconceptions before being given treatment were found in the sub-concept of the mechanism of the blood clotting process, the relationship between blood type and blood transfusion, parts of the heart in cardiac anatomy, differences in the circulatory system, and abnormalities/diseases in the circulatory system. After being given the treatment, it was found in the sub-concept of the components of blood constitution, the relationship between groups and blood transfusions, and disorders/diseases in the circulatory system.

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