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The Implementation of Dialogic Teaching Through Concept Cartoon Worksheets to Improve High School Students' Science Process Skills

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Abstract: Science learning should focus on cognitive processes that lead to the development of scientific processes, scientific products, and scientific attitudes. However, field facts show that students' science process skills are still low. One possible solution that can train and improve students' science process skills is dialogic teaching facilitated by concept cartoon worksheets. This study aims to identify the implementation of dialogic teaching through concept cartoon worksheets to improve students' science process skills. This research method is quasi-experimental with 2 sample classes, namely the experimental class and the control class which were taken by purposive sampling. The research instrument is science process skills test, concept cartoon worksheets, learning implementation observation sheet, and student response questionnaires. Data analysis used independent t-test and n-gain. The results showed that students' science process skills in control class and experimental class were significantly different. The n-gain test results also showed a higher increase in the experimental class than the control class with an average n-gain result of 0.65 (moderate) in the experimental class and 0,31 (moderate) in the control class. Based on these results it can be concluded that the application of dialogic teaching through the concept cartoon student worksheet can improve students' science process skills.

Keywords: Concept cartoon worksheets; Dialogic teaching; Science process skills

Introduction

Science education reform over the past decade has emphasized teaching implementation that encourages students' understanding on principles, concepts and practices of science (Aranda et al., 2020). The science learning process should focus on cognitive processes that involve students actively in forming knowledge, reflecting on the process of acquiring knowledge, and scientific practice. Hadjicosti et al. (2021) stated that students must have the opportunity to learn science more than memorizing and confirming. In this case, the teacher must always be able to create a learning process that encourages students to be able to develop their understanding through scientific practice including asking questions, conducting experiments, designing models, sharing opinions, and understanding data through arguments and reflection. This is in accordance with the nature of learning Biology which leads to the development of scientific processes, scientific products, and scientific attitudes (Carin & Sund, 1964) .

Scientific process is one of the skills that students really need to think logically in solving problems in daily life (Anggraini et al., 2019). Kurikulum merdeka which is a new policy in the Indonesian education system, also carries the concept of learning outcomes which consist of 2 elements, namely understanding biology and process skills. In other words, science process skills are one of the skills that need to trained in learning process to face the reform era of science education and the demands of new policies on the Indonesian education system.

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However, there are demands for science education reform and new policies for the Indonesian education system, which are reversed by the fact that students' science process skills in the field. This is proven through field facts which show that students' scientific process skills are still relatively low. Several studies that analyzed the profiles of students' science process skills also showed that high school students' science process skills in Bandung were still relatively low (Mahmudah et al., 2019). Another study by Wahyuni et al. (2020) also shows that the profile of the science process skills of class X high school students is still in the low category. One causes of the low science process skills is the learning process has not facilitated students' science process skills. In addition, Mahmudah et al. (2019) also explained that the low SPS is because the teacher has not habituate students with science process skills based test. In other words, the learning process has not integrated science process skills as a learning approach or as an evaluation tool.

The results of an interview with one of the teachers at SMA Negeri Cimahi also stated that the teacher had used approaches and teaching materials that trained students' science process skills such as student worksheets in class. However, student worksheet used by teacher has not practice science process skills like predicting, planning an experiment, applying concept, making a question, and communicating. Teacher also find it difficult to come up with student ideas that can expand interaction in the class. Such conditions found in the field become an important illustration of the need for a learning approach facilitated by certain teaching materials to train students' science process skills. There are several ways that can potentially train and develop students' science process skills, including the guided inquiry model (Dewi et al., 2017; Juhji, 2016), experiental learning (Ridyah & Sriyati, 2019), practicum method (Royani et al., 2018; Suryaningsih, 2017), the use of teaching materials and worksheets based on science process skills (Hidayati et al., 2019; Nuha et al., 2023; Wazni & Fatmawati, 2022), and various other ways. In this study, one solution that can be applied in the learning process to train and improve students' science process skills is dialogic teaching facilitated by concept cartoon worksheets.

Dialogic teaching is a teaching approach that maximizes learning through interactive dialogue where students exchange ideas by reasoning, discussing, critical thinking, and voicing their ideas (Grinath & Southerland, 2019; Hadjicosti et al., 2021; Kumpulainen & Rajala, 2017). Dialogue that occurs in the classroom also actively engages students in inquiry which empowers various science process skills, such as asking questions, conducting experiments, hypothesizing, understanding and analyzing data through argumentation, explaining their thoughts, communicating, and enabling students to build knowledge and meaning together (Aranda et al., 2020; Hadjicosti et al., 2021; Hiltunen et al., 2020). Implementation of dialogic teaching can maximized through teaching materials, strategies, or certain media, such as concept cartoon worksheets, modelling, and workstation strategies (Bermudez et al., 2020; Chin & Teou, 2010; Hiltunen et al., 2020). In this study, dialogic teaching will be implemented and facilitated by concept cartoon worksheets.

Concept cartoon worksheet is a worksheet that integrates scientific problems about everyday life in the form of dialogue accompanied by visual stimulus (Keogh & Naylor, 1999). Previous research indicate that the concept cartoon worksheets can improve students' science process skills, such research by Hidayati et al. (2019) which indicate that concept cartoon worksheets can improve students' science process skills. Balim et al. (2016) also state that concept cartoon worksheets can affect cognitive skills, including inquiry skills and science process skills. The increase in science process skills is due to the stimulus questions at the beginning of the worksheets using a cartoon format that discusses a problem regarding a particular concept or topic followed by various tasks that allow students to make predictions, plan and carry out independent investigations which train students' diverse science process skills (Keogh & Naylor, 1999; Van den Berg & Kruit, 2017). This is what distinguishes concept cartoon worksheets from general worksheets which can train students' science process skills. Seeing the opportunities from dialogic teaching through concept cartoon worksheets to train students' science process skills, this study aims to determine the implementation of dialogic teaching facilitated by concept cartoon worksheets to improve students' science process skills.The results of this study are expected to be used as a reference and consideration for teachers in implementing dialogic teaching in the classroom which can be practically beneficial for students and teachers, especially for training students' science process skills as well as in efforts to improve the quality of the learning process.

Method

The research method used in this study was a quasi-experimental design with a pretest-posttest nonequivalent control group design. The design aims to determine science process skills before and after implementing dialogic teaching using concept cartoon worksheets. The difference score between pre-test and post-test is assumed as the effect of treatment. The

nonequivalent control group pretest-posttest design is presented in Table 1.

Table 1. Research Design Pretest-Posttest Nonequivalent Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	X_1	Y_1	X_2
Control	X_1	Y_2	X_2

Description:

X_1 = pre-test score before treatment

X_2 = post-test score after treatment

Y_1 = implementation dialogic teaching through concept cartoon

Y_2 = implementation dialogic teaching with common worksheet

This study was conducted at a senior high school in Cimahi, West Java from February to March 2023. The population in this study were all students of class X IPA at one of the senior high schools at Cimahi for the 2022-2023 academic year. Sampling was carried out by purposive sampling with the criteria of 2 classes having almost the same pre-test average score of the entire population. It is intended that the students' initial abilities before being given treatment are same. In this study, the sample used was 2 classes, namely the experimental class consisting of 34 students who were taught by implementing dialogic teaching through concept cartoon worksheets and the control class consisting of 34 students who were taught by dialogic teaching using common practicum worksheets

The stages of dialogic teaching in the experimental class use the concept cartoon worksheets, namely:

Figure 1. Introductory section in concept cartoon worksheets

Introduction from the teacher uses the concept cartoon worksheets which acts as a stimulus in the form of dialogue between 2-3 cartoon-illustrated people. The cartoon dialogue tells a problem related to environmental change with the opinions of the two being inversely proportional to each other. Then, the teacher invites students to give their views on the opinion that he thinks is true from the cartoon along with the reasons (dialogic teaching indicators: interactions, questions, scaffolding; SPS indicators: applying concept).

Predictions related to problems in the surrounding environment (dialogic teaching indicators: interactions, questions; SPS indicators: predicting).

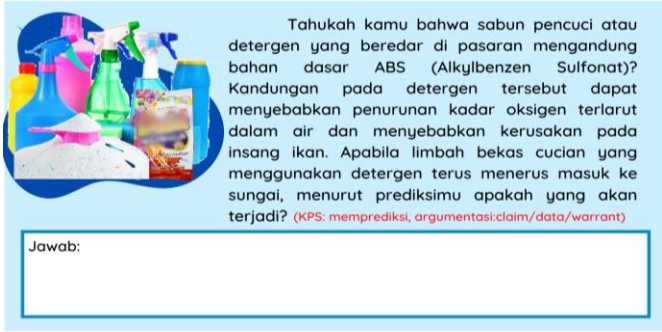


Figure 2. Prediction section in concept cartoon worksheets

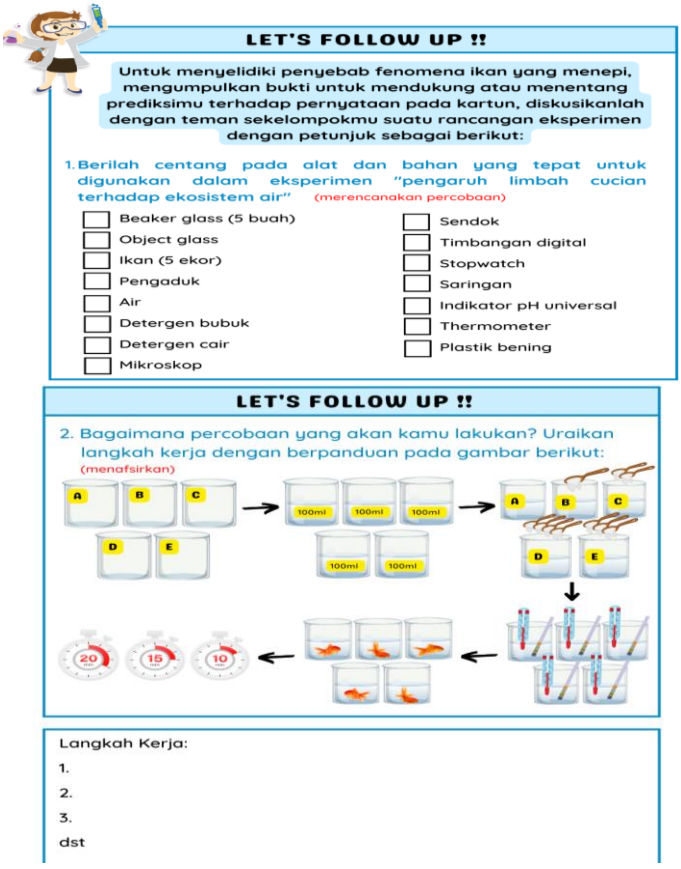
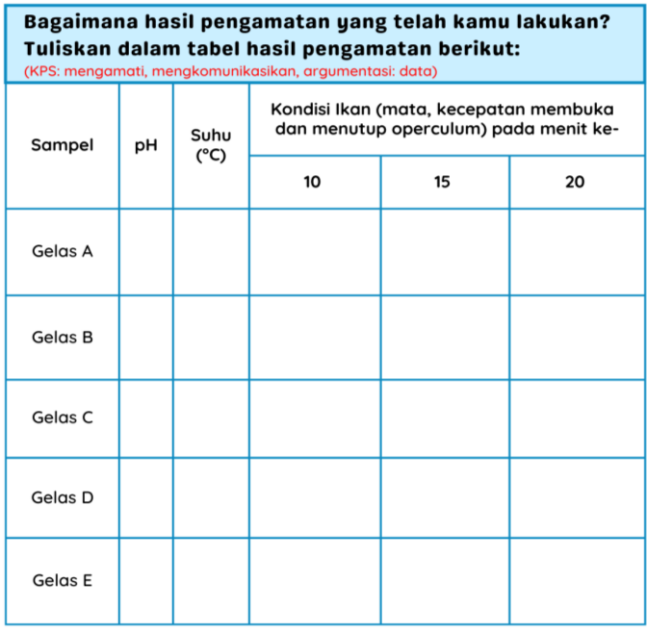


Figure 3. Experimental planning section in concept cartoon worksheets

Plan independent investigations assisted by instructions on worksheets (dialogic teaching indicators: discussion and argumentation; SPS indicators: planning an experiment).

Investigation and collecting evidence to prove predictions and answers in the previous introductory section. Observational data is written in the observation result table (dialogic teaching indicators: discussion and argumentation, scaffolding; SPS indicators: communicating).

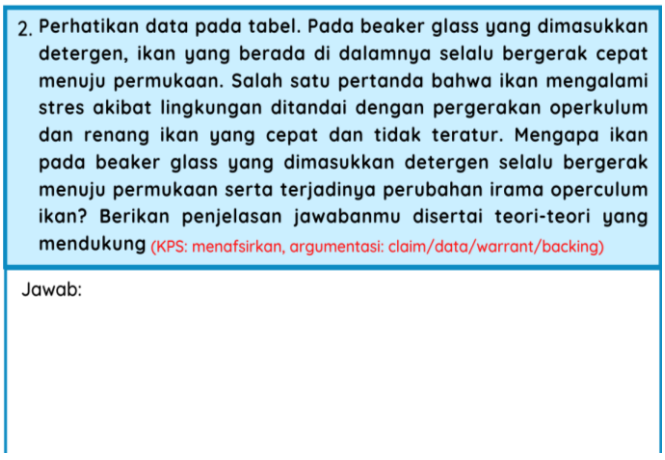


Bagaimana hasil pengamatan yang telah kamu lakukan? Tuliskan dalam tabel hasil pengamatan berikut:
(KPS: mengamati, mengkomunikasikan, argumentasi: data)

Sampel	pH	Suhu (°C)	Kondisi Ikan (mata, kecepatan membuka dan menutup operculum) pada menit ke-		
			10	15	20
Gelas A					
Gelas B					
Gelas C					
Gelas D					
Gelas E					

Figure 4. Observational result collection section in concept cartoon worksheets

Data analysis guided by questions on worksheets in groups (dialogic teaching indicators: interactions, answers, feedback, exchanges, discussion and argumentation, scaffolding; SPS indicators: interpreting).

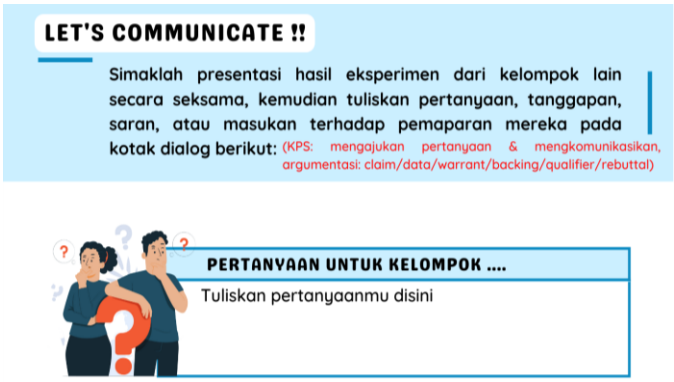


2. Perhatikan data pada tabel. Pada beaker glass yang dimasukkan detergen, ikan yang berada di dalamnya selalu bergerak cepat menuju permukaan. Salah satu pertanda bahwa ikan mengalami stres akibat lingkungan ditandai dengan pergerakan operkulum dan renang ikan yang cepat dan tidak teratur. Mengapa ikan pada beaker glass yang dimasukkan detergen selalu bergerak menuju permukaan serta terjadinya perubahan irama operculum ikan? Berikan penjelasan jawabanmu disertai teori-teori yang mendukung (KPS: menafsirkan, argumentasi: claim/data/warrant/backing)

Jawab:

Figure 5. Data analysis section in concept cartoon worksheets

Presentation of experimental results and data analysis accompanied by discussion and questions and answers. Each group must write their questions to other groups on the questioning template on the worksheets. In this case, the teacher acts as a facilitator who guides and elaborates on students answers so that a process of continuous dialogical interaction occurs (dialogic teaching indicators: interactions, answers, feedback, contributions, exchanges, discussion and argumentation, professional mastery of subject matter; SPS indicators: asking for question & communicating).



LET'S COMMUNICATE !!

Simaklah presentasi hasil eksperimen dari kelompok lain secara seksama, kemudian tuliskan pertanyaan, tanggapan, saran, atau masukan terhadap pemaparan mereka pada kotak dialog berikut: (KPS: mengajukan pertanyaan & mengkomunikasikan, argumentasi: claim/data/warrant/backing/qualifier/rebuttal)

PERTANYAAN UNTUK KELOMPOK ....

Tuliskan pertanyaanmu disini

Figure 6. The question-answer section in concept cartoon worksheets

The instruments used in this study included science process skills test instruments, concept cartoon worksheets, learning implementation observation sheets, and student response questionnaires. The science process skills test instrument consists of 15 questions with 7 indicators according to Rustaman (2003), that is observing, predicting, interpreting, planning an experiments, applying concepts, communicating, and asking for questions. The concept cartoon worksheet was designed by adapting the framework according to Keogh & Naylor (1999). An overview of the compiled concept cartoon worksheets framework can be seen in Figures 1 – 6.

The learning implementation observation sheet was designed by adapting the dialogic teaching indicators according to Alexander (2018). Then the linkages of each dialogic teaching indicator with the science process skills indicator are formulated, so that it appears that the implemented dialogic teaching learning activities can train students science process skills. The observation sheet used in the study is as presented in Table 2.

The data obtained were analyzed statistically using independent t-tests and n-gain tests to see the increase in students' science process skills after learning. Then, the n-gain results are categorized into three categories according to Hake (1999), which is shown in Table 3.

Table 2. Dialogic Teaching Indicators According to Alexander (2018) and Their Relationship With The SPS Indicators

Indicators	Description	SPS indicators
Interactions	Encourage students to think, and to think in different ways	Predicting, apllying concept, interpreting
Questions	Questions from teacher which invite more than simple recall	Predicting, interpreting
Answers	Justified, followed up and built upon rather than merely received	Interpreting, communicating
Feedback	Feedback which leads thingking forward	Interpreting, communicating, asking for question
Contributions	Contributions which are extended rather than fragmented or prematurely closed	Communicating, asking for question
Exchanges	Exchanges which chain together into coherent and deepening lines of enquiry	Interpreting, communicating, asking for question
Discussion and argumentation	Probe and challenge rather than unquestioningly accept	Planning an experiment, interpreting, communicating, asking for question
Scaffolding	Provides appropriate linguistic and conceptual tools to bridge the gap between present and intended understanding	Applying concept, planning an experiment, interpreting, communicating, asking for question
Professional mastery of subject matter	Liberate classroom talk from the safe and conventional	-
Time, space, organisation and relationships	Disposed and orchestrated as to make conducive learning process this possible	-

Table 3. N-Gain Category

Description	Category
G > 0.7	High
0.3 ≤ G ≤ 0.7	Moderate
G < 0.3	Low

Result and Discussion

Data on students' science process skills were obtained through pre-test and post-test. The results of the pre-test and post-test were analyzed using the independent t-test statistic. The results of the statistical test data on the science process skills of students who were taught using dialogic teaching through concept cartoon worksheets and dialogic teaching with ordinary practicum worksheets in the control class are presented in Table 4.

Table 4. Results of Statistical Test Data on Science Process Skills

Data	Pre-test		Post-test	
	Cont	Exp	Cont	Exp
N	34	34	34	34
Mean	59.22	55.50	78.68	85.50
Normality	0.31 (normal)	0.41 (normal)	0.051 (normal)	0.062 (normal)
Homogenity	0.060 (Homogen)		0.47 (Homogen)	
Independent t-test	0.383 (Not significant)		0.005 (Significant)	

Based on Table 4 it can be seen that the data on students' science process skills before being treated (pre-test) has a significance value of 0.383 (> 0.05). This shows that there is no significant difference in students' science process skills before learning. In other words, students' initial science process skills are the same. Furthermore, students were given treatment in the form of a learning process applying dialogic teaching through concept cartoon worksheets in the experimental class and dialogic teaching with ordinary practicum worksheets in the control class. The results of the independent t-test post-test data obtained a significance value of 0.005 (<0.05). So, it can be interpreted that the science process skills of students in the control class and the experimental class are not the same or significantly different. After the test results obtained the mean difference between the experimental class and the control class which differed significantly, then the n-gain calculation was carried out to determine the magnitude of the increase in student scores in the experimental class and the control class. The results of the n-gain calculation recapitulation are presented in Table 5.

Based on the data in Table 5, it can be seen that the average n-gain results in the two study sample classes fall into the moderate category with a value of 0.31 in the control class and 0.65 in the experimental class. However, the increase in the experimental class was higher than the control class. In addition, if viewed from each science process skills indicator, the experimental class experienced an increase which was included in the high category on 4 indicators, namely interpreting, applying concepts, predicting, and asking questions, and 2 indicators including the moderate category,

namely communicating and planning experiments. Meanwhile, the control class experienced an increase which was included in the moderate category in almost all science process skills indicators. The results of the n-gain calculations show that the application of dialogic teaching through concept cartoon worksheets is more effective for improving students' science process skills than learning dialogic teaching using ordinary practicum worksheets.

Table 5. N-Gain Results of Science Process Skills of Experiment Class and Control Class Students

SPS indicators	Control	Inter-pretation	Expe-riment	Inter-pretation
Interpreting	0.1	Low	0.7	High
Applying concept	0.5	Moderate	0.8	High
Predicting	0.3	Moderate	0.7	High
Communicating	0.3	Moderate	0.6	Moderate
Asking for question	0.4	Moderate	0.7	High
Planning an experiment	0.4	Moderate	0.6	Moderate
Overall N-gain	0.31	Moderate	0.65	Moderate

The difference in the results of this increase is that in the experimental class, there are investigative activities that allow students to explore and discuss together to develop their knowledge. This is supported by previous research that the process of discussion and dialogic interaction that occurs in dialogic teaching can train students' science process skills because they actively involve students in inquiry activities that empower various science process skills, such as asking questions, conducting experiments, hypothesizing, analytical skills, and critical understanding, communicate and enable students to build knowledge and meaning together (Aranda et al., 2020; Hadjicosti et al., 2021; Hiltunen et al., 2020; Muhonen et al., 2018). Hidayati et al. (2019) also stated that the use of concept cartoon worksheets in the learning process could encourage student activity and improve students' science process skills.

The observation results also show that the use of concept cartoon worksheets in dialogic teaching can attract students' attention and encourage active and sustainable dialogic interactions. This is supported by the statement of Atasoy et al. (2017) that concept cartoon worksheets can attract students' attention to scientific knowledge, and act as an initial stimulus to experience hands-on and minds-on activities that allow students to explore, investigate, discuss, and evaluate concepts or problems presented until students can apply new knowledge to real situations. The existence of learning activities that require students to carry out investigations assisted by concept cartoon worksheets makes students already have an understanding from their point of view. So that he can bring up arguments or ask questions about a problem. This is the opinion of Kim et al. (2019) that to maximize the dialogue process a balance is needed between inquiry (looking for evidence, asking questions,) and advocacy (expressing their point of view). So this concept cartoon worksheet is designed to facilitate these activities so that the learning process can be carried out properly.

The differences in the science process skills of students in the control class and the experimental class based on indicators of science process skills can be seen in Figure 7.

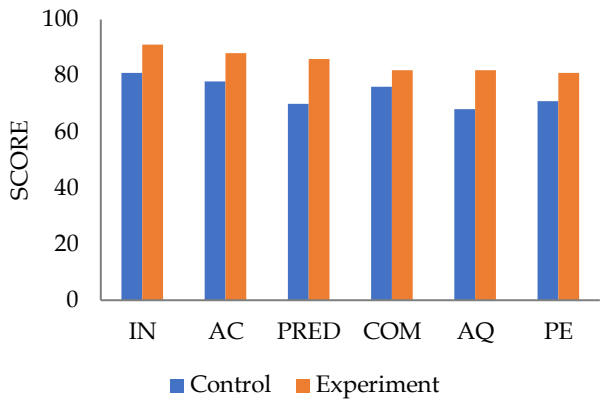


Figure 7. Differences in science process skills of control class and experiment class students on each indicator (IN: interpreting, AC: applying concept, PRED: predicting, COM: communicating, AQ: asking for question, PE: planning an experiment)

Based on Figure 7. it can be seen that the highest science process skills indicator in the experimental class is interpreting skills with an average value of 91. Likewise in the control class, the highest science process skills indicator is interpreting skills with an average value of 81. A description of each indicator of science process skills is explained in the following discussion.

Observing

Student achievement in observing skills is not measured using a test instrument, but using questions on the concept cartoon worksheets. This is because observing skills involve students' ability to use their senses to collect relevant facts (Rustaman, 2003). So that in measuring observing skills it cannot be measured using ordinary cognitive questions but must be with questions based on observational data. Based on the results of the analysis of student's answers on observing skills in the concept cartoon worksheets, it can be seen that as many as 94% of the experimental class students were able to provide answers that match the results of

observations along with the observational evidence obtained. While the control class reached 84% of students able to provide answers accompanied by data or observational evidence. The difference in results was due to the different types of questions in the concept cartoon worksheets and the worksheets in the control class. The questions in the concept cartoon worksheets ask students to write down their answers accompanied by observational data, such as "How is the condition of the fish operculum in each beaker glass that you observe? In which beaker glass is the condition of the fish worst? Explain your answer with data or observational evidence.

The command to write answers accompanied by supporting data encourages students to write answers accompanied by data. This was evident from the answer of one student, such as "In the beaker glass that we have observed, the worst condition of the fish was the fish in beaker glass C, because the fish were the first to die, and secreted more clear mucus than the others, the condition of his eyes bulging. Then the condition of the second fish that was the worst was the fish in glass E because it reacted the shortest among the other fish (except the fish in glass C) and secreted a lot of mucus and was slightly gray in color." Whereas, in the control class, the questions presented were not accompanied by instructions to write down the answers accompanied by observational data, such as "based on the experimental results you obtained, in which glass was the worst condition of the fish?". So, there are still some students who tend to only give answers without being accompanied by observational data. Observing skill is a skill that has the highest achievement score of other science process skills. This is because observing skills are one of the first or most basic or first process skills that are often used in almost all daily activities and scientific activities (Ango, 2002). The results of Hidayati's research et al. (2019) also show that observing skills have the highest average score because these skills are basic skills that are easy and often performed by students.

Interpreting

In interpreting skills, students in the experimental group obtained an average post-test score higher than the control class, which was 91, while the control class was 81. The results of the n-gain analysis also showed that experimental class students experienced higher interpretive skills than the control class with a value of 0.7 (high), while the control class is 0.1 (low). This shows that students who are taught using dialogic teaching through concept cartoon worksheets are already able to connect observational data and find patterns from an observation in obtaining new information and knowledge. This can also be seen from the percentage of filling out the questionnaire in one of the statements, namely "Learning activities can train me to interpret the results of observations or investigations". In this statement, 84% of the experimental class students answered strongly agree and agree.

When the learning process took place, experimental class students analyzed observational data guided by questions in concept cartoon worksheets. The questions in the concept cartoon student worksheet play a role in directing students to connect observations and find patterns in concluding. This activity seems to train science process skills, namely interpreting skills. This is the opinion of Kurniawati (2021) that interpreting skills can be trained through activities to recognize and relate patterns from observation and draw a conclusion from the observed data. The observation results also show that the learning process that occurs in the experimental class is by the indicators of dialogic teaching, namely interactions that encourage students to think, and think in different ways; questions that invite more than just recall; and discussion and argumentation that investigates and challenges rather than simply accepting opinions or answers without hesitation. However, this situation is inversely proportional to students who are taught using dialogic teaching with ordinary practicum worksheets which generally only provide cognitive questions and do not train students' science process skills, especially interpreting skills. Thus students who are taught using dialogic teaching through concept cartoon worksheets can improve students interpreting skills.

Applying Concept

In the skill of applying the concept, the experimental group students obtained an average post-test score higher than the control class, which was 88, while the control class was 78. The results of the n-gain analysis also showed that the experimental class students experienced an increase in skills applying concepts that were higher than the control class with a value of 0.8 (high), while the control class was 0.5 (moderate). This shows that dialogic teaching-learning through concept cartoon worksheets can train students' ability to use existing concepts to explain new events that they have observed. This can also be seen from the percentage of completing the questionnaire in one of the statements, namely "learning activities can train me to apply the concepts I already have to a phenomenon" obtaining results as much as 88% of experimental class students answered strongly agree and agree.

When the learning process was taking place, students in the experimental class were given a stimulus in the form of a dialogue between 2-3 cartoon-illustrated people on the concept cartoon worksheets who gave

their opinion on a particular problem. Then, students are asked to provide answers about the opinion that they think is true from the cartoon along with the reasons. These activities can train students to use their previous knowledge of new concepts or situations. This is in line with the statement of Balim et al. (2016) that questions on concept cartoon worksheets that ask their opinion about a problem act as an initial stimulus for students to use reasoning and apply known concepts in expressing their arguments against a concept or problem. However, this situation is inversely proportional to students who are taught using dialogic teaching with ordinary practicum worksheets which are generally only in the form of practical activity instructions without any questions that encourage students to express their personal opinion about a concept or problem. Thus, students who are taught to use dialogic teaching through concept cartoon worksheets can improve students' skills in applying concepts.

Predicting

This skill involves a person's ability to predict or propose an estimate of things that have not been observed. In the predicting skills of the experimental group, students obtained an average post-test score higher than the control class, which was 86, while the control class was 70. The results of the n-gain analysis also showed that the experimental class students experienced an increase in predictive skills that were higher than the control class. with a value of 0.7 (high), while the control class is 0.3 (moderate). The difference in the increase was due to the experimental class having a dialogic teaching-learning process that invited students to reflect on a phenomenon written in the concept cartoon worksheets accompanied by predictive questions, such as "What do you think will happen if soap waste continues to enter the water environment?". The open questions contained in the concept cartoon worksheet can motivate students to be actively involved in the learning process and encourage students' thinking processes to assess the causes and effects of a problem presented.

In addition, experimental class students were also invited to predict based on the data obtained from the lab results the conditions that would occur if the treatment was changed or the variables were added. This activity seems to train students to find patterns of observations and predict conditions that have not yet occurred based on the patterns they find. This is to the statement of Wiwin et al. (2018) that predictive skills require skills to predict a consequence of pre-existing patterns and observations. Whereas in the control class, students are not invited to reflect on or predict a phenomenon. Students only focus on doing practicum according to the instructions provided in the worksheets without any questions that encourage students to predict the results of their observations. Thus, students who are taught using dialogic teaching through the concept cartoon worksheets can train students predictive skills. This is also supported by the percentage of completing the questionnaire in one of the statements, namely "learning activities can train me to make predictions about a problem or phenomenon" obtaining results as much as 83% of experimental class students answered strongly agree and agree.

Planning an Experiment

In the experiment planning skills, the students in the experimental group obtained an average post-test score higher than the control class, which was 81, while the control class was 71. The results of the n-gain analysis also showed that the experimental class students experienced an increase in predictive skills, which was higher than the experimental class. control with a value of 0.6 (high), while the control class is 0.4 (moderate). The difference in this increase is due to the experimental class having a dialogic teaching-learning process that invites students to investigate and collect evidence to support or oppose predictions and answers at the previous stage in groups. The investigation process was assisted by concept cartoon worksheets in which there were instructions to check the appropriate tools and materials for the experiment, as well as design work steps by the flowchart available in the concept cartoon worksheets. This activity seems to train students to design the tools and materials needed and design work steps for their experiments independently.

Whereas in the control class, the tools and materials as well as the experimental work steps have been listed on the worksheets. Students are not accustomed to determining tools and materials as well as experimental steps independently. Rustaman (2003) states that the skill of planning an experiment involves a person's ability to determine the tools, materials or sources to be used, the variables to be measured and observed, and to determine work steps to test and solve a problem. Thus students who are taught using dialogic teaching through the concept cartoon worksheets can train students predictive skills. This was also supported by the percentage of completing the questionnaire in one of the statements, namely "learning activities can train me to plan and carry out experiments well" obtaining results as much as 89% of experimental class students answered strongly agree and agree.

Communicating

In the communication skills of the experimental group, students obtained an average post-test score higher than the control class, which was 82, while the

control class was 76. The results of the n-gain analysis also showed that experimental class students experienced higher communication skills than the control class with a value of 0.6 (moderate), while the control class is 0.3 (moderate).

The difference in the increase was due to the experimental class having learning activities in which they carried out practical work and wrote down the group's observational data in the table provided in the concept cartoon worksheets and converted the research data into graphical form accompanied by an explanation regarding the graph. After the practical activities were completed, students in each group made a presentation in front of the class to explain the data and results of their experimental analysis. During the presentation, each student is given the opportunity freely to express, share ideas, and consider their point of view. In this case, the teacher acts as a facilitator who develops ideas and connects students' opinions through a process of thought and investigation to form shared knowledge. The activities that occurred in the experimental class seemed to develop students' communication skills and were appropriate.

Kurniawati (2021) states that communication skills can be trained by presenting the results of observations in the form of graphs, tables, diagrams, or posters and presenting the results of observations. Whereas in the control class students' communication skills were only trained during post-practicum group discussion activities. In the worksheets provided, there are no tasks that ask students to convert their observed data into graphs or diagrams. Thus, students who are taught to use dialogic teaching through the concept cartoon worksheets can train students' communication skills. This was also supported by the percentage of completing the questionnaire on one of the statements, namely "learning activities can train me to express opinions and argue" obtaining results as much as 89% of experimental class students answered strongly agree and agree. Yildirim et al. (2021) also stated that dialogic teaching can improve students' talking activities in class, communication skills, and students questioning skills.

Asking for Question

This skill involves a person's ability to ask questions regarding what, how, and why to ask for an explanation regarding a matter or condition. In the skill of asking questions, students in the experimental group obtained an average post-test score higher than the control class, which was 82, while the control class was 62. The results of the n-gain analysis also showed that experimental class students experienced an increase in their skills in asking questions that were higher than the control class with a value of 0.7 (high), while the control class was 0.4 (moderate).

The difference in the increase was due to the experimental class having a dialogic teaching-learning process that invited students to write down questions from the analysis results and presentations of other groups on the templates available in the concept cartoon worksheets. In this case, the teacher acts as a guide who elaborates on students' answers to extend the dialogic interaction. Then, students are required to record the answers to each student's question on the template provided in the concept cartoon worksheets. Apart from being able to practice the skills of asking questions, this activity can also be used as material for the teacher's evaluation of student understanding, because the answers from each student are recorded in the concept cartoon worksheets.

Meanwhile, in the control class that applied dialogic teaching without the concept cartoon worksheet, there were no instructions to write down the questions regarding the what, how, and why of a phenomenon. Teachers play a deeper role in giving questions to students to form a concept or knowledge together. But, when the teacher asked several questions to students to encourage active interaction in class, there were still many students who were confused and had difficulty giving answers. Thus, interaction in the classroom tends to be passive and one-way. This is because, during the learning process, students are only invited to conduct experiments without any instructions that help students to interpret, predict, and apply the concepts they already have to new situations. Almuntasheri (2020) states that strategies that ask students to predict, collect observational data, interpret observations, discuss ideas or opinions with each other, and compare explanations from other groups can support teachers in encouraging dialogue and dialogic interaction in class.

Conclusion

Based on the results of the research, it can be seen that the average value of students' science process skills in the experimental class is higher than the control class, namely 85.50 (experiment) and 78.68 (control). So, it can be concluded that the application of dialogic teaching through concept cartoon worksheets can improve students' science process skills better than using common worksheets. The highest indicator of science process skills is interpreting with score of 91 and the lowest indicator is planning an experiment with a score of 81.

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