
Analysis of High School Students' Preconceptions on the Concept of Climate Change from the Perspective

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ABSTRACT

Preconception is a very important initial understanding for students to have, because preconception can be used as a basis for better learning. One of them is regarding the concept of climate change material, there are still many students who have wrong conceptions. One way to find out students' preconceptions is by using visual representations. The use of visual representation can open students' preconceptions of abstract and complex concepts. This study aims to see and analyze the extent of high school students' understanding of climate change. This study uses qualitative descriptive, with a population and sample consisting of 63 tenth-grade high school students majoring in science at one of the high schools in Indonesia. The data collection technique was carried out by observation and interviews, in this study the researcher used semi-structured interviews. The results of the study revealed that students have a varied understanding of the concept of climate change, there are still many students who experience misconceptions about the concept of climate change. There are three categories of climate change concepts (1) the concept of climate change is correct with a percentage of 37% (23 students), 2) the concept of climate change is based on objects, reviewed from the overall picture that has been visualized by the respondents and 3) the concept of climate change is wrong with a proportion of 63% (40 students). Of the three categories above, based on empirical evidence that has been carried out regarding students' preconceptions of climate change, including at the macroscopic level.

INTRODUCTION

Climate change has become a hotly talked about topic and is increasingly becoming a global concern. How could it not be that in 2020 alone, almost all land areas will experience more heat waves and increasingly hot weather, this is none other than the fact that the impact of climate change has been seen in many aspects of human life (Harmuningsih & Saleky, 2017). One of the biggest causes of climate change is global warming, increasing levels of greenhouse gases, especially CO₂ in the atmosphere. This causes climate change to have a negative impact on human activities on this earth, climate change can be something scary if it continues to occur and is not handled further, of course this handling must be carried out by all elements of the world community, including Indonesia. One of the strategies that can be used is to educate

through educational means, because it is an effective means to understand and teach risk management from the impacts of climate change (Amaliah & Purwaningsih, 2021).

Building students' awareness of environmental problems caused by climate change is certainly not easy. Because environmental education in Indonesia itself is still carried out separately and there has been no curriculum update to improve environmental education. This is reviewed from previous research, that until now students' understanding of the concept of climate change is still minimal (Rosidin & Suyatna, 2017). One of the causes of students' low understanding is from the learning process while at school, which is still not directly taught in the classroom and has not been taught to be used in daily life. In addition, another thing that causes this is that there are many misconceptions among students about climate change, because students think that the discussion of physics learning materials related to climate change is very difficult to understand. Students think that climate change material is abstract and very complex, and too general so that there are often mistakes in understanding the concepts in this material (Asenova¹ & Reiss, 2021; Mayer & Pilegard, 2015).

Therefore, students' initial understanding of a concept is very necessary, because before proceeding to the next level to understand new and sustainable concepts, students' initial understanding is an important basis for students in the learning process (Scribner, 2014). In addition, an initial understanding of the concept of climate change material is very necessary as a way to provide students with a deeper understanding of climate change that is currently occurring. The results of the analysis of previous research on the basic skills that students must have in the 2013 curriculum with science subjects, show that the concept of climate change material is not contained in the basic competencies. This is one of the reasons why students' understanding of the concept of climate change is still low (Nabila, 2022; Weurlander et al., 2012). It is known that students in Indonesia still have low awareness of climate change and still think that climate change is not a serious problem (Sulistiawati, 2024). So, from the various problems above, there are still very few studies that explore students' preconceptions on the concept of climate change. In fact, revealing preconceptions is very important, as one of the efforts to find out students' ideas and ideas in accepting a new material concept.

Preconception itself is an initial understanding that students have before learning about certain material. Each student has different prior knowledge, this understanding can come from experience, knowledge and information received outside of school. One of them is climate change, students have an initial preconception that can be the beginning for knowledge about climate change material. Therefore, it is necessary to make an effort to find out the preconception of students before starting physics learning. One way is by using visual representation, because the use of visual representation can open students' preconceptions of abstract and complex concepts (Prasad & Mkumbachi, 2021; Sari et al., 2017).

The use of visual representation can explore students' understanding of certain concepts, because visual representation can be used as a tool to induce the preconception of Shiva to a certain physics concept, so that the results of this analysis can be used as a foothold for teachers to design better learning with the use of visual representation. Basically, many studies have been conducted related to visual representation, as one example of research conducted by Lasmaria and Kadir (2018), discussing visual representation in physics learning in high school. In this study, it was observed that the use of inappropriate visual representations can result in wrong understanding and difficulties in understanding the material. The results of previous researchers' analyses have shown that the use of visual representation is an attraction for researchers in physics education, because it is very rarely used to explore students' preconceptions about certain concepts in physics.

Previous research highlights the importance of understanding students' preconceptions in science education, particularly on abstract and complex topics such as climate change. For instance, Rosidin and Suyatna (2017) revealed that students often have misconceptions about

climate change, perceiving it merely as seasonal changes rather than a global phenomenon influenced by human activities. Similarly, Nabila (2022) emphasized the role of modeling and virtual laboratories in improving students' understanding of climate change, though significant gaps remain in integrating this topic into school curricula.

The increasing impacts of climate change, including rising global temperatures, extreme weather events, and ecosystem disruptions, necessitate immediate educational interventions to build climate literacy among students. Current curricula fail to adequately address the topic, leaving students unprepared to grasp its complexities or contribute to mitigation efforts. Understanding students' preconceptions is critical to designing effective teaching strategies that combat misconceptions and foster environmental awareness.

While studies have explored students' understanding of specific scientific concepts, limited research has focused on how visual representation can be utilized to uncover students' preconceptions about climate change. Existing studies often neglect the role of macroscopic-level observations and the impact of diverse environmental contexts on students' understanding. This research seeks to fill that gap by analyzing students' visual representations to identify patterns and misconceptions about climate change.

This study introduces a novel approach by combining visual representation techniques with thematic analysis to explore high school students' preconceptions of climate change. By focusing on macroscopic-level observations, the research bridges a critical gap in understanding how students conceptualize this global issue through tangible, everyday experiences.

This study aims to see and analyze the extent of students' initial understanding, especially high school students, regarding the concept of climate change that is happening today. Understanding students' preconceptions of the concept of climate change is very important, in addition to providing for their lives, it is also a demand for the independent curriculum that has been rolled out today. Therefore, the researcher is interested in conducting a study entitled "Preconception Analysis of High School Students on the Concept of Climate Change Reviewed from the Exploration of Visual Representation.

This research offers practical benefits for educators and policymakers. For educators, it provides a framework for assessing students' initial understanding and addressing misconceptions through tailored teaching strategies. For policymakers, it underscores the importance of integrating comprehensive climate education into school curricula, ensuring that students are equipped with the knowledge and skills to address environmental challenges.

The findings of this study have significant implications for educational practice and curriculum development. By highlighting the prevalence of misconceptions about climate change, the research emphasizes the need for more interactive and engaging teaching methods, such as the use of visual representation. It also advocates for curriculum reforms that include climate change as a core topic, fostering a generation of environmentally aware and proactive individuals.

RESEARCH METHOD

The research design used in this study is qualitative descriptive. Qualitative research design has the meaning of understanding and explaining social phenomena and individual experiences through data analysis in the form of words, texts, images and cultural objects. From this, there are several important reasons for the design of this study, namely; (a) focuses on discovering the nature of a particular event or phenomenon being studied; (b) the study is located in a highly factualistic environment to avoid the Hawthorne effect where research participants behave differently knowing that they are being studied; (c) sampling is deliberate with the purpose of obtaining cases that do not have minimal information; (d) data analysis does not need to use pre-existing rules; (e) and the presentation of data involves a direct description

and summary of the information obtained. From this explanation, it is in line with the rhetoric that has been found in previous research which focuses on, (1) analysis of preconception of students' understanding of the concept of climate change with the exploration of visual representation; (2) error analysis on solving the problem of visual representation of geometric optical concepts; (3) data analysis combines several procedures described in existing literature; (4) and implementation in learning visual representation in understanding concepts. So that this research is relevant by using qualitative descriptive to analyze a phenomenon and analyze the preconception of students' understanding of a certain concept.

Data Analysis

The thematic analysis method is the analysis method used in this study after all the data has been collected. This thematic analysis can lead to the process of identification and categorization of preconceptions based on categories generated from codes and the reliability of interpretation is very important. In this study, because the data is in the form of visual representation or in the form of images, there are two analyses, namely: 1). Image data analysis, for the analysis of image data this uses a four-step approach developed by Duncan (2013). The procedural steps are: (a) visual representation annotations are reviewed, and notation is created such as labeling the object/context being drawn. (b) isolate where visual representations are arranged according to the interpreted meaning, detailed descriptions of each individual from visual representations are made. (c) regulates where visual representations are grouped into categories. (d) synthesis in which visual representations according to different categories are made. 2). Interview Data Analysis, on

The analysis of the data from the Wawanvara results is carried out through the Thematic Analysis (TA) stage or commonly referred to as interpretive thematic analysis. TA is defined as a method of identifying, analyzing, and reporting themes or patterns contained in research data. According to (Liamputtong, 2009), in the process there are several main steps that must be taken in thematic analysis. First, the researcher reads and listens to the audio of the entire content or interview transcript repeatedly and carefully to get the meaning of the transcript data. Researchers can underline words that match the relevant meaning of the source to make it easier to get the actual meaning. And in the second step, the researcher provided code to identify the data that could potentially match the question in the study and a brief summary in some of the data. In the third step, the determination of the theme, the determination of this theme is built based on previous codes related to the research phenomenon which will later form several themes, then the relationship between the existing themes is searched for to then become a complete response to the data from the research results. If there is a code or theme that does not match the entire research, it will be replaced with a new theme.

RESULTS AND DISCUSSION

The data described were obtained from the results of the study using observation sheets and interviews that had been filled out by the participants. On the observation sheet, participants were directed to draw according to the preconception of students' visual representation of the concept of climate change. The results of the research were then processed and several data from the research were obtained in the form of: 1) the correct concept of climate change, 2) the concept of climate change based on objects, and 3) the wrong concept of climate change. From the results of the study, there are three categories with the following percentages each.

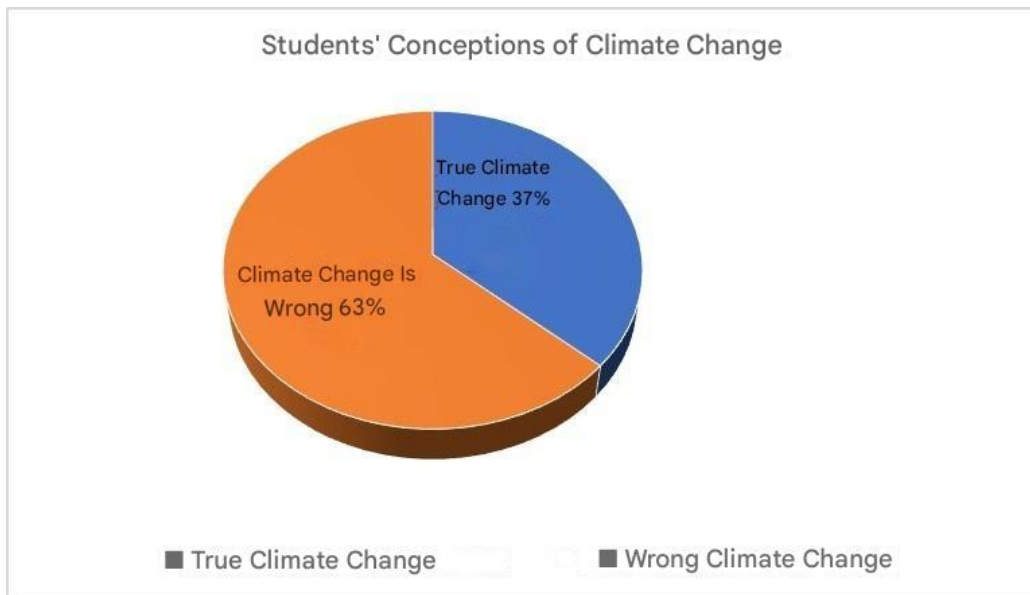


Figure 1 Percentage of Climate Change Concept Data

The Correct Concept of Climate Change

From the results of the data analysis after being categorized into three parts, the first is the correct concept of climate change. From the results of observations and interviews conducted on 63 students, it was found that a total of 23 students or 36.51% of students correctly represented their picture of the concept of climate change. In this category, it is reviewed from the definition of climate change itself, where climate change is a phenomenon of increasing the average temperature of the global atmosphere caused by human activities, especially in the use of fossil fuels and deforestation, resulting in greenhouse gas emissions. As a result, it affects extreme weather changes, sea level lifting, and various other environmental problems. Here are some samples of data from students that represent their initial understanding of the correct concept of climate change.



Figure 2 Visual representation of the correct concept of climate change Respondent One

The results of the interview with one of the students were as follows:

- Researchers* : In your opinion, what is the meaning/meaning of the picture? Try to explain
- Respondents* : Climate warming affects climate change on the earth, and factory pollution is the same as emm mem, naon mem is changing the earth's climate, namely polluting the air, burning forests is the same as air pollution.
- Researchers* : From the pictures you wrote, can this happen or often happens in daily life? Try to explain?"
- Respondents* : Have, which pollutes vehicles, if you are in a place, you don't

The visual conception of climate change itself about warming the weather affecting climate change. This is closely related to the concept of climate change according to physics which explains that human activities such as forest burning, vehicle pollution can increase the concentration of greenhouse gases such as carbon dioxide in the atmosphere. Where from the visual conception that has been drawn (4.2) the respondents show that climate change can occur due to forest burning, so that forests become deforested and oxygen levels on earth decrease (O₂), as well as vehicle pollution and pollution from factories. Where if this continues it will result in the temperature on the earth getting hotter, because the atmospheric layer that should be the protector of the earth will gradually become thin due to the activities of humans who do not pay attention to the environment.

From the results of the interview on the visual meaning (4.2) with the statement "Climate warming affects climate change on the earth, and factory pollution is the same as changing the earth's climate, namely polluting the air, burning forests is the same as air pollution" the statement is stated to be completely true. From this statement, actually warming weather can occur as a result of factory pollution and forest burning, as well as vehicle smoke pollution, due to human activities that are carried out continuously so that carbon dioxide (CO₂) levels increase, as a result of which the layers in the atmosphere are thinning so that the temperature on the earth increases and weather feels getting hotter.

The Concept of Climate Change Based on Objects

Furthermore, the concept of climate change based on objects is reviewed from several objects that can be used as a foothold to understand the concept of climate change. Some objects that can be used as a foothold in the concept of climate change such as the earth, atmosphere, ice sheet, sea, plants and animals, as well as humans and several other objects. After the data was analyzed, the results were obtained that out of a total of 63 students (63 people) described objects that were in accordance with the description at the beginning, while some students described other objects.

Table 1 Percentage of climate change concepts by object

It	Object	Frequency	Percentage $f/63 \times 100$ (%)
1	Earth	24	38,09
2	Cloud	2	3,17
3	Animal	5	7,93
4	Factory	10	15,87
5	Smoke	10	15,87
6	Ice	4	6,34
7	Sea	4	6,34
8	Cloud	37	58,73
9	Plant	38	60,31
10	Thermometer	5	7,93
11	Atmosphere	7	11,11
12	Sun	33	52,38
13	Vehicle	2	3,17
14	Fire	3	4,76
15	Human	1	1,58
16	Gmail	1	1,58
17	Rain	25	39,68
18	House	1	1,58
19	Lake	1	1,58
20	Drought	22	34,92
21	Moon	1	1,58
Total			63

From the results of the analysis of the concept of climate change based on the object, it can be seen from table (1) that basically, students' conception of climate change is widely known from the visual representations that have been drawn by students, where in the results of the research are obtained objects that become a foothold and have a significant influence on the process of climate change. As for the data above, some of the objects that many respondents described were such as plants with the largest percentage, namely 60.31%, clouds at 58.73%, rain at 39.68%, sun at 52.38%, and earth at 38.09%. From this percentage, it can be seen that many students assume that climate change will have an impact on the process of life on this earth. This is because the objects that students describe are all related to the ecosystem of living things on earth.

The Wrong Concept of Climate Change

Basically, the wrong concept of climate change is something that is not in accordance with the existing scientific data. After the observation, the researcher found that as many as 40 students out of 63 students drew the wrong concept of climate change, or about 63.49% of the total respondents. The basis for why the visual representation described is wrong is from the results of interviews with respondents, where the answers of some respondents are not in accordance with theories relevant to scientists related to climate change, the following table of misconceptions about climate change is wrong.

Table 2 Wrong Concept of Climate Change

It	Wrong Conception	Frequency	F/40 x100 % Percentage
1.	Climate change from rain to drought	20	50
2	The sun shines on the earth so it becomes hot and causes plants to dry out and become dry	7	17,5
3	Change nature Originally full of finished trees full the same development so that the impact of clean pollution becomes dirty	2	5
4.	Change weather from bright to cloudy and rainy	7	17,5
5.	Climate change is cold times and hot times	2	5
6.	Weather forecast for one week	2	5
Total			40

Discussion of Research Results

Based on the results of the research that has been carried out, there are three parts in students' understanding of preconceptions of climate change through visual representation. Among them are (1) the correct concept of climate change, (2) the concept of climate change based on objects, and (3) the wrong concept of climate change. Of the three categories, each has a different percentage, for the correct concept category of 37%, and for the wrong concept to get a percentage of 63%. Meanwhile, for the category of climate change concepts based on objects, it was reviewed from the entire image that had been visualized by the respondents. From this percentage, it can be seen that there are still many students who represent the wrong preconception of climate change, so that students' understanding of the concept of climate change is still relatively low. This is in line with the results of previous research by (Rosidin & Suyatna, 2017) stated that until now students' understanding of the concept of climate change is still low, because many students still think that climate change is a change of seasons.

It is also in line with the research of Nur Utami, et al. (2021) who stated that the understanding of Newton's Law III is still low. Most students are disturbed by the difference in mass in the interacting object, and also disturbed by the initial condition in one of the stationary objects. In the concept of climate change, students tend not to understand what the meaning of climate change itself is, so students think that climate change is the same as seasonal change.

In visual representation, students can draw related material that will be conveyed through students' thinking about the concepts to be taught. From the results of the research that has been carried out, that with the visual representation of climate change preconceptions, researchers can find out the extent of students' knowledge and understanding related to the concept of climate change, so that the use of this visual representation test will be very useful to be carried out in learning. The results of the study also show that students' initial understanding through visual representation is still diverse and varied. This is in line with research conducted by (Canlas, 2019), which obtained research results showing that students often associate friction with human activities such as rolling and rolling objects on flat surfaces and are contextual. And there is a limited prejudice evidenced by non-representation of static friction and non-representation of friction at the mesoscopic and microscopic levels. Basically, humans are equipped with the understanding to develop what is in their minds, in this ability they can foster a good understanding of concepts, so that later it will affect the process of students' understanding of a learning material. As revealed by Kriss et al in (Arum & Abdurrahman, 2014) that humans are able to convey, receive, and interpret intentions through various deliveries and communications. From the results of the research, it is evident that with the visual representation of students through images, that students already have a preliminary understanding of the concept of climate change. So that the results of this observation can later be used as a reference to explain more complex material about climate change. This is relevant to Goldzin's opinion, (Mudzakir, 2006) states that representation is a set that can describe, represent, and symbolically represent something in a certain way.

The results of the preconception test with visual representation skills show that most students still have problems in presenting climate change concept material visually through the images they make. Some of the problems faced by students are: (1) students still do not know what climate change is, (2) students themselves know the impact of climate change, but the concept of climate change itself is still unfamiliar, (3) many students think that climate change is a change in weather from the dry season to the rainy season and vice versa. This can be proven from the results of the students' drawings, which mostly illustrate that climate change from the dry season to the rainy season. (4) Some students represent that climate change is a weather forecast for several days or weeks, this is evidenced by the results of pictures by students describing the weather forecast for one week.

From the results of the observations that have been made by the researcher through the analysis of students' preconceptions of climate change with the exploration of visual representations that have been carried out on 63 students, the results were obtained that 63% (as many as 40 people) represented an image that was not appropriate with the concept of climate change, so that there are still many students who have the wrong conception of climate change. And as many as 23 students represented the conception of climate change correctly, from which the researcher can see that the use of visual representation to find out students' initial conception of climate change can be known. Therefore, based on the research that has been conducted, it can be stated that the ability of visual representation to find out students' initial understanding of climate change can be declared to be influential.

CONCLUSION

Referring to the formulation of the problem and based on the results of the analysis of observation data processing and interviews, it can be concluded that students have different understandings of the preconception of the concept of climate change. This can be seen in the visual representations drawn by students and from interviews conducted with students, from the results of pictures and interviews with students there are different images and opinions about climate change. From the results of the analysis of visual representations, the concept of climate change can be divided into three categories, namely: 1) the correct concept of climate

change; 2) the concept of climate change based on objects; 3) the wrong concept of climate change. Of the three categories, and based on empirical evidence that has been carried out regarding students' preconceptions of climate change, including at the macroscopic level, which means that the observation results are reviewed from students' daily experiences, where at this level students often see and involve objects in large sizes that can be seen by humans.

Students experience wrong preconceptions in the concept of climate change which tends to be complex. It is still rare to use visual representation to find out students' understanding is one of the factors. The difficulty of students in explaining and describing the results of visual representation is a supporting factor for students to have difficulty understanding the concept of climate change, and it is still rare for teachers to encourage students to develop their own visual representation based on understanding of a concept is another factor that makes students less understanding of the concept being taught. Thus, teachers can use visual representations as a tool to identify conceptual understanding in certain physics materials; Teachers can consider using visual representations as an evaluation tool for students.

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