Analysis of Teacher Interpretation of the Depth and Breadth of Middle School Level Global Warming Material using "Content Representation" (CoRe)

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Abstract

Global warming is a material presented at the VII grade junior high school level. This material is very complex so it causes different interpretations by everyone when teaching it. Therefore, this research aims to analyze teachers' interpretations of the depth and breadth of global warming material contained in KD 3.9 of the 2013 Curriculum. This research was conducted descriptively using the Content Representation instrument to obtain information about teachers' interpretations. Participants in this study were junior high school 11 science teachers who are members of the MGMP community in Majene Regency, West Sulawesi. The results of this study indicate that teachers interpret KD 3.9 quite completely. This was obtained from the CoRe instrument where teachers fill in essential concepts to teach global warming material. The results show that teachers with more than 10 years of teaching experience have a greater variety of teaching methods and assessments in teaching global warming material. In addition, global warming materials were also obtained based on their depth and breadth.

Keywords: Content Representation, Global warming, Science Teacher, Content Analysis

INTRODUCTION

One of the substances in middle school level subjects to obtain graduation at that level is Natural Sciences. Just like other subjects, science material is also formulated in learning outcomes in the 2013 curriculum in the form of Basic Competency (KD). Basic Competency contains descriptions of skills that must be achieved in a material related to cognitive, affective, and psychomotor and contains operational verbs as indicators of achieving these competencies (Suradi et al., 2022; Zulfa & Pristiwati, 2020)

In this level, One of the KDs that must be passed is KD 3.9, namely "Analyzing climate change and its impact on ecosystems" (Kementrian Pendidikan dan Kebudayaan, 2017). This KD discusses Global Warming which is one of the important materials for students to learn. The importance of knowledge about Global Warming must be introduced to society from the start by providing knowledge in schools. The aim of providing this material is to increase competence related to Global Warming in the learning process because this knowledge can gradually make people aware that the cause of Global Warming is due to human actions themselves (Abbass et al., 2022; Santos et al., 2022)

Global warming and climate change have not only been experienced by one country but globally, including Indonesia. This has been researched about 10 years ago if Indonesia has an effect on global warming and climate change (Mariah, 2010; Prinz, 2009). Indonesia has also

experienced quite rapid changes. These changes occur because of lifestyles and human needs that are instantaneous and the massive use of technology. Lifestyle and activities that damage the environment by humans can cause an increase in temperature (Ainurrohmah & Sudarti, 2022). Because of the importance of this to be realized from an early age, the science subjects chosen are related to Global Warming material

In science subjects, Global Warming is difficult material because it studies processes that occur in nature that cannot be observed directly (they are abstract). Apart from that, this material is also very complex because there are many sub-materials in it. This complex Global Warming material causes different perceptions to emerge between science teachers. Previous research conducted by Yanti (2020) as the lead proponent regarding teachers' ability to determine essential concepts related to the theme of Global warming reported that 3 junior high school science teachers (Teacher A, Teacher B, and Teacher C) from different schools with different teaching experiences (less than 5 years, more than years, and more than 10 years) participated in the study (Yanti et al., 2020). The research results showed that the three science teachers each wrote different essential concepts. Teacher B chose to convey the concepts of global warming, greenhouse gases, the process of ERK, the impact of global warming and efforts to overcome it. Meanwhile, Teacher C explained the same concept but did not include the process of occurrence and efforts to overcome it. Teacher A started by explaining the essential concepts in the Global warming material. The concepts chosen include: (1) The concept of atmospheric layers, (2) The concept of heat transfer, (3) The concept of black body radiation, (4) The concept of electromagnetic wavelengths, (5) The concept of scattering and reflection, (6) impact global warming, and (7) Mitigation concept.

This condition illustrates that teachers' understanding of a KD is different even though the three teachers are at the same school. It is likely that teachers' perceptions of KD are even more varied if analyzed on a larger scale. Therefore, the problem formulation in this research is: What is the teacher's perception of the depth and breadth of KD Global Warming material?

Teachers' perceptions of KD 3.9 need to be analyzed using an instrument which can include the selection of sub-material and its considerations. Where the instrument that meets these criteria is Content Representation (CoRe). This instrument is able to describe a holistic picture of teacher understanding regarding teaching on a particular topic. Each CoRe is accompanied by Pedagogical and Professional-experience Repertoires (PaP-eRs), which are descriptions of how certain aspects of the topic align with the CoRe have been taught by the teacher (Mulyani & Hermayani, 2021; Mweshi, 2019). CoRe provides an overview of how a group of teachers conceptualizes the content of a particular subject matter or topic. CoRe was developed by asking teachers to think about what they consider to be "essential concepts" related to a particular topic for a given grade level based on their experiences teaching that topic. (Loughran et al., 2013).

Much research has been carried out regarding teachers' interpretations of the curriculum, especially (Ahmad & Mardiana, 2014; Dirneti, Fitria Meilina, 2021; Kabiba et al., 2018; Kustijono & Wiwin HM, 2014). However, research regarding teachers' interpretations regarding the depth and breadth of material on certain topics, especially those related to global warming, is still lacking. Research related to teacher interpretation of the depth and breadth of material, especially global warnings, is important so that the global warming material taught by teachers can cover uniform sub-material so that students get the same knowledge even though they come from different schools. The teacher's interpretation of the depth and breadth of material, especially global warnings, can be known using CoRe. This instrument is able to explore teachers' considerations in including sub-material that supports the achievement of the main material, namely global warming. Apart from that, CoRe can also analyze how learning is delivered by paying attention to student character. Based on this description, this research was conducted to analyze teachers' interpretations of the depth and breadth of Global warming material using the CoRe instrument.

The research question is: What is the teacher's perception of the depth and breadth of global warming material? And what are the essential concepts in Global Warming material?

METHOD

This research is descriptive research which is in line with the research objective, namely analyzing teacher perceptions of the depth and breadth of KD material about Global Warming. The descriptive method does not provide any treatment or manipulation, but describes the conditions as they are (Cresswell & Clark, 2007).

11 Participants in this research were science teachers who taught at junior high school level in the city of Majene, West Sulawesi. The sampling method uses purposive sampling. Purposive sampling is a sampling method with a grid or boundary criteria determined by the researcher. The criteria determined were (1) the research sample was a science teacher at the junior high school level, (2) included in a certain length of teaching category. In this study, teachers were screened and grouped into two groups, namely teachers with less than 10 years of experience and teachers with more than 10 years of teaching experience. Clustering of these teachers was carried out to see differences in tendencies in conducting depth and breadth analysis based on teaching experience and experience in participating in professional training.

The instrument used is Content Representation (CoRe) which was developed by John Loughran in 2007. This instrument is often used to measure teacher knowledge in designing learning (Yanti, Riandi & Suhandi, 2020). Apart from that, this instrument has an Intraclass Correlation Coefficient (ICC) and Kendall's Coefficient of Concordance W index at moderate to very high levels (Erwin et al., 2019) This instrument is a table format where the top row is an essential concept. These essential concepts are the selected sub-materials in teaching Global Warming material and in the left column there are several questions from CoRe that must be answered for each essential concept. The points asked in the CoRe Instrument are described in Table 1.

Table 1. CoRe (Content Representation) questions list

Content Representation Questions	Essential concept 1	Essential concept 2	Essential concept 3
1. 1. What would you teach students about this concept?			
2. 2. Why is this concept important for students to learn?			
3. What related ideas/concepts do you think are not yet time to be known by students			
4. What difficulties/limitations might you experience in teaching this concept?			
5. What/what conditions of students (initial knowledge/ways of thinking/interests) are taken into consideration when teaching this concept?			
6. What factors do you consider in teaching the concept?			
7. What order/plot do you choose to teach the concept?			
8. How do you know whether students understand or not?			

The research stage starts from clustering teacher categories based on teaching experience and experience participating in the Teacher Professional Program. After obtaining samples based on these categories, they were then given socialization regarding examples of filling in

CoRe. The socialization is intended to equalize perceptions regarding how to fill out the instrument according to each person's understanding of the KD material on Global Warming. After the data is obtained, analysis is carried out in the form of identifying the most frequently proposed essential concepts along with the reasons. The more essential concepts the teacher provides, the wider the scope of material to be taught and the more detailed the answers to each question point, the deeper the material provided by the teacher regarding Global Warming material. The findings targeted in this research are data and information regarding the depth and breadth related to the KD of Global Warming material which will later be used as primary data to formulate models or guidelines related to the depth and breadth of Global Warming material.

RESULTS AND DISCUSSION

Teacher's Perception Of The Depth And Breadth Of Global Warming Material

The similarity of perception between teachers in interpreting Basic Competency (KD) in the curriculum is important in creating uniformity of material in learning. This is considered important because the graduation exam system in Indonesia uses a Computer-Based National Examination (UTBK) scheme with uniform questions. If teachers have their own versions, it will be detrimental to students who receive material that is not too broad or in explanation. In addition, the selection of Global Warming material was carried out taking into account that this material is quite complex in terms of concepts, because it combines several basic concepts, namely related to radiation, wavelength, heat transfer and others. This material also often creates misconceptions related to the causes of Global Warming itself, especially in the use of the term greenhouse effect. Therefore, this study analyzes how the teacher's interpretation of global warming material is deep in how the teacher describes the material to be taught.

When filling in the data, socialization is first carried out to science teachers regarding how to fill out the instrument. As explained in the previous section, this instrument is a CoRe instrument which consists of several questions. This question explores the teacher's reasons or considerations regarding his decision to include a concept in teaching Global Warming material. The concept in question is an essential concept, which supports achievement in teaching Global Warming material. After the socialization was carried out, then clustering of teachers was carried out based on the duration of teaching. The clusterization results can be seen in Table 2.

Table 2. Teacher's clustrisation based on teaching experience

Teacher's Group	Teachers code	Amount of teacher
Teaching experience more than 10 years	A1, A2, A3, A4, A5, A6,	6 people
Teaching experience less than 10 years	B1, B2, B3, B4, B5	5 people

Table 2 shows the clustering of teachers based on length of teaching experience. There are 6 teachers with teaching experience of more than 10 years, with each teaching experience of 14 years (A1), 20 years (A2), 12 years (A3), 18 years (A4), 20 years (A5), and 18 year (A6). Meanwhile, there are 5 teachers with a teaching experience of less than 10 years. This clustering was carried out to see trends in how teachers in the two clusters organize their learning.

After clustering was carried out, the teachers then filled in the list of questions in Table 2. The teachers answered these questions according to the conditions when teaching Global Warming material. The answers written by the teacher are then assessed using a rubric developed by Anwar (2014). The results of this assessment are shown in Figure 1.
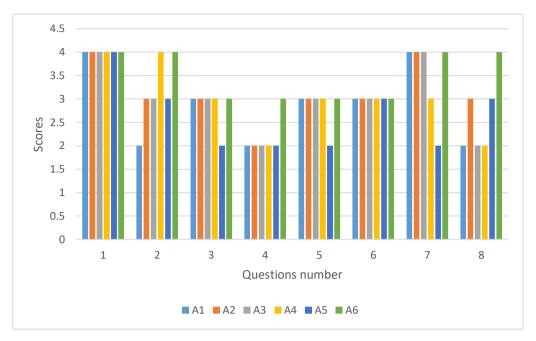
Figure 1. Results of Teachers CoRe answers in First Cluster

Figure 1 shows the scores obtained by teachers based on the rubric used, where the highest score is 4 and the lowest score is 1. In this study, it is assumed that the higher the score obtained by the teacher, the broader and deeper the interpretation of Global Warming material. Because the instrument used is a Content Representation instrument which is usually used to capture teachers' PCK abilities. Study of Yanti et al. (2019) shows that teachers have their own interpretations regarding how to teach global warming material, which is influenced by the length of teaching experience and the type of professional training they have received.

In general, Figure 1 shows the interpretation of teachers with clusters of more than 10 years of teaching experience. In the first question, regarding what concepts do all teachers in this cluster want to teach, they have a maximum score of 4, because they write about 4 to 5 essential concepts that are still in accordance with curriculum standards. Determining this essential concept is the first step and is important enough to determine subsequent processes in learning. Essential concepts can also be represented in other forms, not just as points, to make it easier to see the connection between these essential concepts. Research conducted by Dwi (2023) processed essential concepts into an infographic, apart from making the direction more interesting and the connections between concepts also more visible. If it is related to the teacher's interpretation, then the choice of this essential concept shows that the teacher is correct in designing learning.

The second question is related to the reasons these concepts are taught to students. The answers written by the teachers varied, but only two teachers got a perfect score. This is due to the fact that the two teachers consider the important value of concepts associated with students' daily lives. The remaining teachers gave reasons related to how important it is to study this concept in order to fully understand the Global Warming material. Teachers who are able to see the importance of a concept to relate it to everyday life are assumed to have a good breadth of Global Warming material, because they can directly explain the implications of this material in students' lives. Study from Sakila et al. (2023) shows that by understanding science material and its implications in everyday life students can realize that it is important to protect the environment. This is reflected in several students' attitudes, namely reducing the use of plastic bags, recycling used goods, saving on water use and so on.

In the third question, regarding concepts that students had not yet learned, the results were almost the same for each teacher. The scores obtained show that teachers write down concepts that are not yet known but do not provide an explanation of the student's condition so

that the concept cannot yet be learned. However, the answer to this question also provides an overview regarding the depth of the Global Warming material that the teacher has. So that the more concepts that are explained, the deeper the teacher's understanding will be. The difficulties faced by the teacher are described in the answers to the fourth question. On this question, most teachers received a score of 2 because they expressed difficulties based on a review of the concept without explaining possible solutions that could resolve these difficulties.

Meanwhile, in questions five to eight, teachers were asked to explain how to teach and how to assess students during learning. The data in Figure 1 shows that the question in point seven regarding the flow of teaching carried out has quite high points because based on the answers written by the teachers, they are quite varied in choosing learning models or methods. In addition, the learning flow chosen is based on the results of the analysis of the material and the conditions of the students. An example of a teacher's learning flow from code A2 is by making students understand about the gases in the atmosphere and their function in trapping heat reflected from the surface, then making students understand about solar radiation, then explaining the impact of global warming and the mitigation actions that can be taken. can be done. A continuous flow of material like this can make it easier for students to understand global warming material. This is in accordance with the modules developed in research that the global warming material presented starts from an introduction to the greenhouse effect, causes of global warming, impacts to solutions to preventing global warming. (Imamora et al., 2020; Putri et al., 2021)**.** Furthermore, in the eighth question the teachers got a moderate score, because this question is related to how the teacher assesses whether students understand or not. Most teachers still use written tests or oral tests, so there is less variety in terms of the assessments used. Meanwhile, variations of assessments in this material have quite a big opportunity to develop student skills such as scientific literacy (Setiawani et al., 2021)**.** Next is an explanation of the interpretation of the depth and breadth of global warming material for teachers who are members of the second cluster, namely teachers with less than 10 years of teaching experience. This information can be seen in Figure 2.
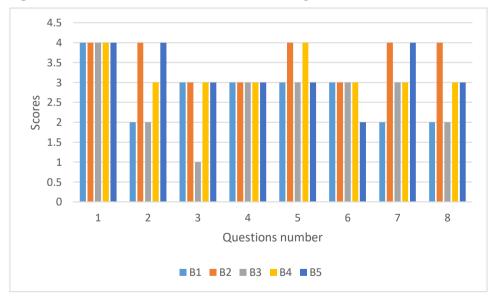

Figure 2. Results of Teachers CoRe answers in second Cluster

Figure 2 shows results that are more or less the same as obtaining the information in Figure 1. Where the ability of the second cluster teacher to interpret is in a fairly good category compared to the teacher in the first cluster. Teachers in the second cluster have a higher average score than teachers in the first cluster. The selection of essential concepts for the first cluster teachers, even though they took part in KD on global warming material, was also equipped with other supporting materials. This is in line with research conducted by Sutamrin et al. (2022), that teachers with good academic skills, in the sense of having teaching experience,

will have a good interpretation of the content in the curriculum. If related to the two categories, namely categories with less than 10 years and more than 10 years of learning experience, then these results are also supported by research Lestari et al. (2015), which also shows that there are two categories, namely prospective teachers and teachers. Judging from the results of working on the CoRe instrument, prospective teachers appear to write more detailed answers than teachers. This is because prospective teachers have fresher content knowledge than teachers.Furthermore, all the teachers in this cluster had higher scores than the first cluster teachers in answer to question 4 regarding the difficulties encountered in teaching the concept. Because the teacher in the second cluster presented solutions related to the problems experienced by students.

Essential Concepts In Global Warming Material

The data obtained from both teachers in the first cluster and teachers in the second cluster provide an illustration of how varied the teachers are in teaching. However, these variations lead to material non-uniformity between teacher 1 and other teachers. As happened to the teachers who were participants in this study. Even though they come from the MGMP IPA community, differences in presenting the material still occur. Diversity in representing a concept has been stated previously by Robin et al. (2017) that there is indicators of consistency principles that have been include namely material balance, breadh of material and material presentation. And in this paper, the non-uniformty occurred in the aspect of breadh material. Therefore, based on the answers from all the science teachers who were research participants, it can be concluded that the depth and breadth of the material on KD global warming is shown in Table 3.

Table 3. Essential Concept based on teachers answer

Basic Competencies	Breadth	Depth
KD 3.9 Analyze climate change and its impact on ecosystems	Atmosphere	- Atmosphere layer - Height in each layer of the atmosphere - Characteristics of each layer of the atmosphere
	Greenhouse effect	- Heat transfer - Sun radiation - Greenhouse gasses - Source of greenhouse gas - The process of the greenhouse effect
	Global warming	- The process of global warming - Evidence of global warming based on data - Places experiencing global warming
	Global warming effect	- The relationship between global warming and the carbon cycle - Drought disaster

Basic Competencies	Breadth	Depth
		- The phenomenon of melting icebergsBanjir rob - Extreme weather - Diseases caused by global warming
	Global warming mitigation	- Fuel efficiency - Greening - Solutions to prevent the impact of global warming

The table shows the depth and breadth of global warming material based on the interpretation of the science teachers who were participants in this research. So it can be said that science teachers interpret KD not only based on the text book but are able to include other supporting materials outside the textbook. The depth and breadth of material produced during research indirectly reveals the character of each material. This is because the material is prepared by different teachers and the guideline for preparing this material is the curriculum and it is developed into a syllabus (Ayu & Syarifuddin, 2016). Apart from that, the suitability or correctness of the sequence of material is important to pay attention to in the learning process, because when students want to build new knowledge or concepts, they need the initial information needed to build it (Rikizaputra, 2016). The more information or material presented, the more complete the students will gain an understanding of the Global Warming material.

CONCLUSION

The analysis in this paper is based on two research questions, namely What is the teacher's perception of the depth and breadth of global warming material? And what are the essential concepts in Global Warming material?

From the first research question it can be concluded that based on the answers given by teachers on the CoRe Instrument, it can be seen that teachers interpret the KD quite complexly. This is influenced by the teacher's teaching experience where in this research the teachers were divided into two clusters, namely teachers with more than 10 years and less than 10 years of teaching experience.

In the second research question, a material formulation based on global warming was obtained.Global warming materials were also obtained based on their depth and breadth. In the future, the formulation of this material will be used as a reference for developing global warming teaching materials that are in accordance with the curriculum and characteristics of students

RECOMMENDATION

Recommendations for further research are to compile or develop a Global Warming learning module based on the depth and breadth produced in this research. So a module will be created with a more complete discussion because it comes from the thoughts of several teachers which of course has been adapted to the characteristics of the students.

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