



In-depth Analysis of The Learning Process in Schools: Reviewing The Quality of Students' Actual Mastery of Concepts on Temperature and Heat Material

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Abstract: This research aims to determine students' mastery of concepts regarding temperature and heat in the learning process. Researchers used a quantitative approach with a Quasi-Experimental method in this research. This research was conducted at SMK Negeri 09 Muaro Jambi. The population in this study was all class X at SMK Negeri 09 Muaro Jambi. Sampling used a purposive sampling technique with consideration of teachers who taught in the same class, namely class X TBSM 1 and X TBSM 2, totalling 24 and 26 students. Data was obtained by giving a concept mastery test in 5 essay questions. After being given the test, the data was analyzed, and the results showed that students' mastery of concepts in temperature and heat material was in a low category. This is proven in question number 1, where as many as 60% of students answered with a value of 0; in question number 2, as many as 80% of students responded with a value of 1; in question number 3, as many as 72% of students answered with a value of 1, question number 4 as many as 62% of students answered with a value one, and for question number 5, 52% of students responded with a score of 0. Indikator that more than 50% of students' concept mastery abilities could be higher.

INTRODUCTION

Natural and Social Sciences are subjects taught at senior high school (SMA) and equivalent levels. There are still many students who have not been able to master and understand several concepts in this science subject properly, which makes it difficult for students to understand this science material (Gurcay & Gulbas, 2015). This difficulty is caused because the material in this science subject has a concept that only observes phenomena but does not go directly into observing by conducting experiments and experiments (Baser, 2006). The science material that is still considered difficult for students is temperature and heat. Temperature and heat material is often considered difficult material because many students often misinterpret the concept and connect several existing concepts or students often experience misconceptions in studying temperature and heat material (Ergin & Atasoy, 2013). A conceptual error that often occurs is that students have difficulty distinguishing between temperature and heat. This is clearly shown in many previous studies that analyze temperature and heat, there are students who understand that temperature is the same as heat because they are the same

as heat, and there are also those who have the view that between temperature and heat it is only a matter of saying the name, but meaning it. the same meaning, this certainly shows a misunderstanding in understanding and also the mechanics of temperature and heat. Misconceptions occur because students' initial concepts do not match the actual concepts or students incorrectly connect several concepts they are studying (De Berg, 2008). This means that students have not mastered the concepts of temperature and heat properly, so that the entire learning process becomes fragmented information which results in students not understanding (Foroushani, 2019; Yuliana et al., 2019). Students' complete lack of understanding of the concepts of temperature and heat provided can make it very difficult for the transfer of knowledge from teachers to students to produce learning with a comprehensive understanding.

Basically, in the learning process, students who have not mastered the concepts in temperature and heat material are due to problems in the system or the learning process itself which causes students to have difficulty mastering the concepts correctly, one of which is because there is no appropriate learning method or model used. From several observations and analyzes carried out by researchers, several important factors were obtained, namely: First, students' mastery of concepts is still relatively minimal or low, this is because students more often just memorize formulas rather than understanding them well, especially regarding temperature and heat. (Docktor & Mestre, 2014 ; Mahavidyalay et al., 2017). This problem is in accordance with previous research which stated that students' concept mastery was in the low category, namely only 64% (De Berg, 2008). Second, in the learning process, learning is only focused on the teacher (teacher centered) not on the students (Thomaz et al., 1995). Mastery of concepts should be the most important factor in providing good learning outcomes. Students who have good concept mastery will have good learning outcomes (Chu et al., 2012). To build good concept mastery, especially in studying temperature and heat material, students focus more on understanding concepts by connecting existing concepts with phenomena that occur and carrying out experiments, not just memorizing formulas or systematic calculations (Bapat et al., 2013; Sundari, 2019). With indications that cause low understanding of concepts, teachers should look for an appropriate strategy or learning model to overcome problems that occur with students, especially in temperature and heat material.

The issue of understanding concepts is a special concern in the learning process, because referring to the main goal of the learning process is how to improve the quality of students in understanding the material presented, in this case the level of student understanding can be seen from how much understanding of the concepts they have. Understanding the concept will be able to encourage students to think more critically and analyze a phenomenon more deeply in a problem that is being sought or is a source of discussion (Meiliani et al., 2021; Sulman, Yuliati, Purnama, et al., 2022). A good understanding of concepts can indirectly build and at the same time encourage students to deepen the material being taught. The encouragement that students have in learning can become the main capital for students in studying their understanding more deeply (Alwan, 2011; Sulman, 2019; Sulman et al., 2021). If the learning process or knowledge

possessed by students is interconnected with their initial knowledge, it is believed that students will be able to carry out the learning process easily. Students should carry out a learning process that is not new knowledge, but is knowledge that they have had from the start and are related to the new knowledge they have or are currently studying so that students' abilities are better. Mastery of concepts becomes a strength for students to understand learning material better and with better quality.

Based on the understanding presented above, it is an indication that students' mastery of concepts in learning Natural and Social Sciences (IPAS), especially regarding temperature and heat, is something that teachers or educators need to pay attention to in carrying out the learning process. Good mastery of concepts can develop problem-solving abilities and critical thinking abilities in solving problems that are usually measured and seen in a problem (Thomaz et al., 1995; Musa'adah & Kusairi, 2020). From several studies that researchers have highlighted, there are many indications regarding the important role that teachers must play in the learning process so that mastery of concepts can increase completely. The role of students' mastery of concepts is a very important benchmark in knowing students' capacity in learning, especially physics learning on temperature and heat. This makes researchers interested in analyzing students' mastery of concepts in temperature and heat material at SMK Negeri 09 Muaro Jambi, so that it can be used as input as well as an indication of students' initial abilities, which can be used as input to shape better learning quality in the future.

METHOD

This research aims to see students' mastery of concepts in temperature and heat material, where the research was conducted at SMK Negeri 09 Muaro Jambi. In this research, researchers used quantitative research with descriptive methods. Quantitative descriptive quantitative research is research where the results of the analysis are mostly in the form of numbers (Lodico, 2010; Njie & Asimiran, 2014). The population used in this research were all class X students, both non-multimedia classes and also multimedia classes. The sample in this research was taken using purposive sampling technique. The purposive sampling technique is a sampling technique based on predetermined criteria, namely based on teachers who teach in the same class, so that researchers choose or have the consideration that if teachers teach in the same class, the research data will be better and will reduce the occurrence of research bias. So the samples used in this research were class X TBSM 1, totaling 24 people and X TBSM 2, totaling 26 students. Different numbers of students will be analyzed first, namely normality and homogeneity tests, so that it is clear how the students' actual abilities compare.

The instrument used to collect data is a concept mastery test in the form of 5 description questions, where the questions have been validated by experts and empirically. This 5-question essay test was given to classes X TSM 1 and X TSM 2 to see students' mastery of concepts in temperature and heat. After being given the test and obtaining the answer results, the student's answers will be calculated and analyzed carefully and accurately to obtain the percentage of student mastery of concepts on each question indicator. Each indicator analysis result will be used as a reference for

researchers to determine the actual level of student mastery of concepts, and will be further clarified based on each question score analyzed. In other words, mastery of the concept will be seen from the question score on each question given. This is intended so that there is an increase or the actual abilities possessed by students can be described comprehensively and completely. As for the Indicators and Distribution of Concept Mastery Test Questions for the 5 questions can be seen in Table 1.

Table 1. Indicators and Distribution of Concept Mastery Test Questions

Question Item Indicators	Question Number	Cognition Level			
		C1	C2	C3	C4
Analyzing changes in temperature of a substance	1	-	-	-	x√
Analyzing the total heat required by a substance	2	-	-	-	x√
Analyze changes in temperature of an object when it experiences expansion	3	-	-	-	x√
Analyzing the expansion of an object	4	-	-	-	x√
Analyze the concept of Black's Principle on the mixture of two different substances	5	-	-	-	x√

From table 1, it is clearly explained that the actual question data given is in the question indicators C4. The questions are directed at a level that is slightly more difficult for students, so that the learning outcomes obtained are truly able to measure students' abilities. Meanwhile, to determine the level of student mastery of concepts using a description test, an assessment rubric is used according to the categories specified in table 2.

Table 2. Concept Mastery Assessment Rubric

Score	Category
3	Understand the whole thing
2	Partially understand
1	Misconceptions
0	Do not understand

Table 2 shows that there are 4 categories that are used as references for researchers in measuring students' concept mastery, so that in the process the concept mastery that will be observed is only based on these 4 categories. The ability to master concepts from these 4 categories will provide data findings regarding students' more precise understanding of concepts.

RESULT AND DISCUSSION

This research aims to find out how students actually master the concept of temperature and heat which actually occurs in the learning process in physics subjects. In the analysis of students' concept mastery, the process of observing is carried out by using test questions in the form of essay questions totaling 5 questions. After carrying out the analysis, the results of students' mastery of concepts in temperature and heat material were obtained. The data measured only looked at the 5 questions or problems given, where the 5 questions were questions that the researcher was able to measure students'

better understanding of concepts. Below are presented the results of 5 questions used in the research as a research instrument to determine students' mastery of concepts in temperature and heat material. Where the questions or research data findings provided will be described based on the order of the questions. Question number 1 is a question about changes in temperature of a substance, which is still related to the big theme, namely temperature and heat, which can be seen in table 3:

Table 3. Percentage of Assessment for Question Number 1

Indicator	Assessment Rubric	Number of Students	Percentage
Analyzing changes in temperature of a substance (C4)	3	0	0%
	2	2	4%
	1	18	36%
	0	30	60%

From table 3, it can be seen that there are differences in students' conceptual understanding in the Analyzing changes in temperature of a substance (C4) section, where based on the data obtained from question number 1 it is known that 0% of students answered with a value of 3, then 4% of students answered with a value of 2, then 36% of students answered with a value of 1, and around 60% of students answered with a value of 0. This means that there are still many students who don't understand it. concept well. This process is an indication that students' mastery in analyzing changes in temperature of a substance is still not good. Then, if you look at question number 2, which is a question of analyzing changes in the temperature of an object when it experiences expansion (C4), you also experience almost the same data, where for more details, see Table 4.

Table 4. Percentage of Assessment for Question Number 2

Indicator	Assessment rubric	Number of Students	Percentage
Analyzing the heat of a substance (C4)	3	0	%
	2	0	%
	1	40	80%
	0	10	20%

In table 4 it is clear that there is a decrease or difficulty for students in answering questions better. This can be seen. Based on question number 2, it is known that 0% of students answered with a value of 3, then 0% of students also answered with a value of 2, and as many as 80% of students answered with a value of 1, and 20% of students answered with a value of 0. This means that it clearly provides information that there are still many students who misunderstood question number 2, namely Analyzing the heat of a substance (C4). This is certainly very important information for teachers to improve the quality of student learning. The learning process will run well if the entire learning system can be implemented in accordance with expectations, so that learning can run effectively and with quality. Then in terms of analyzing changes in temperature of an

object when it experiences expansion (C4), which is measured by Question number 3 which is about long expansion, it also shows almost the same data, namely that students' abilities are still not good and according to expectations. For more details, see table 5.

Table 5. Percentage of Assessment for Question Number 3

Indicator	Assessment Rubric	Number of Students	Percentage
Analyzing changes in temperature of an object when it experiences expansion (C4)	3	0	0%
	2	2	0%
	1	36	72%
	0	14	28%

The research data also produces slightly the same information, where in table 5 it is clear that there are weaknesses in the process of understanding the materials experienced by students or students' difficulties in answering questions better and more accurately. This can be seen. Based on question number 3, it is known that 0% of students answered with a value of 3, then 0% of students also answered with a value of 2, and as many as 72% of students answered with a value of 1, and as many as 28% of students answered with a value of 0. This means that it clearly provides information that a improvements in the learning process and also students' answers are still not correct and there are still many students who misunderstand question number 3, namely Analyzing changes in temperature of an object when it experiences expansion (C4). This is certainly very important information for teachers to improve the quality of student learning. The learning process will run well if the entire learning system can be implemented in accordance with expectations, so that learning can run effectively and with quality. Then in terms of analyzing the expansion of an object (C4) as measured by Question number 4, namely about length expansion, it also shows almost the same data, namely that the students' abilities are still not good and according to expectations. For more details see table 6.

Table 6. Percentage of Assessment for Question Number 4

Indicator	Assessment Rubric	Number of Students	Percentage
Analyzing the expansion of an object (C4)	3	0	0%
	2	2	0%
	1	31	62%
	0	19	38%

In table 6 it is clear that there is a decrease or difficulty for students in answering questions better. This can be seen. Based on question number 4, it is known that 0% of students answered with a value of 3, then 0% of students also answered with a value of 2, and as many as 62 % of students answered with a value of 1, and 38% of students answered with a value of 0. This means that it clearly provides information that there are still many students who misunderstood question number 3, namely Analyzing the expansion of an object (C4). This is certainly very important information for teachers to

improve the quality of student learning. The learning process will run well if the entire learning system can be implemented in accordance with expectations, so that learning can run effectively and with quality. Then in terms of Analyzing the concept of Black's Principle on the mixture of two different substances (C4), which is measured by Question number 4 which is about long expansion, it also shows almost the same data, namely that students' abilities are still not good and according to expectations. For more details, see table 7.

Table 7. Percentage of Assessment for Question Number 5

Indicator	Assessment Rubric	Number of Students	Percentage
Analyzing the concept of Black's Principle on the mixture of two different substances (C4)	3	0	0%
	2	2	0%
	1	24	48%
	0	26	52%

The research results also reveal data as in table 7, where there are differences in the processing of student data provided in the process of understanding the learning material provided. Based on question number 5, it is known that 0% of students answered and got a score with a score of 3, then there were also no students or 0% of students answered with a score of 2, then only 48% of students answered with a score of 1, and the data is not much different, namely 52% of students answered with a score of 0. This data clearly shows that students' conceptual understanding of learning outcomes is still very low on average and needs to be improved so that children's learning or abilities will become better and can be guaranteed by changing times, in other words skin quality. Children are an important factor that must always be maintained and improved in the learning process.

Analysis of The Quality of Students' Understanding of Concepts

In this study, the data that researchers want to answer more comprehensively is how students actually understand the concepts of temperature and heat in physics lessons. After the data was calculated and analyzed, the students' concept mastery data was obtained, which was slightly distributed, showing almost the same scores. The results of the analysis show that students' mastery of concepts is still relatively low, so it can be stated that improvements are still needed in the physics learning process, especially in temperature and heat. For example, if we analyze the data that has been submitted and also in this, it can be seen in table 3 that the students' ability to answer questions in question number 1, many students got a score of 0, as many as 30 students with a percentage of 60%, where it can be said that there are still students who do not understand question number. 1 or the student does not understand the material presented. Students in this section are clearly still not ready and unable to analyze the material on changes in temperature of substances. Meanwhile, 18 students got a score of 1 with a percentage of 36%. This means that students still experience misconceptions or conceptual errors regarding the analysis indicators for changes in temperature of a

substance. In this case, it can make the process of understanding the material a little hampered, because the students' initial understanding is still not good. This can be caused by students still not mastering the concept of temperature changes in temperature and heat material. Students' understanding should be really good, so that they can encourage better quality of students in the future (Alwan, 2011; Baser, 2006; Suryadi et al., 2021).

The temperature and heat learning process should be able to provide opportunities for students to express their opinions and understanding more in analyzing better learning, so that the learning process should really be able to deepen and improve students' understanding to be better and of higher quality (Chu et al., 2012; Thees et al., 2020). Understanding does not mean only understanding the matter of temperature and heat, but more than that understanding must be a benchmark for students in describing their personal abilities which are able to encourage themselves to become better individuals in the future, so that the learning process can run according to what to expect (Alwan, 2011; Baser, 2006; Musa'adah & Kusairi, 2020). All learning systems must be able to reflect good learning processes and outcomes. In the research process, data also shows that can almost conclude that student learning outcomes are low, in this case students' understanding of concepts in learning. Where in table 4, namely in the analysis or students' answers to question number 2, many students got a score of 1, namely 40 students with a percentage of 80%, where it can be said that students also still experience misconceptions or conceptual errors regarding the heat analysis indicators of a substance. Meanwhile, there were 10 students who got a score of 0 with a percentage of 20%. This means that there are still many students who are not able to answer question number 2 or students are not able to analyze the heat of a substance. This can be caused by students still not mastering the concept of heat in temperature and heat material. The important role of mastering concepts is actually to help students think critically about the problems they are facing so that the problems that arise can be overcome easily.

Students' weak mastery of concepts in the process of understanding questions is clearly a problem that must and must be found for a solution, where both teachers and students must have ways or alternatives to improve students' answers to make them better. The low student learning outcomes can also be seen in table 5, namely in question number 3, many students got a score of 1, namely 36 students with a percentage of 72%, where it can be said that students also still experience misconceptions or conceptual errors in the change analysis indicators, this all has to be The main concern that must be found is a solution so that a truly good understanding of the child's concepts emerges, especially in the material of temperature and heat, in this case the child's weakness is when studying the occurrence of an object or an object when it experiences expansion (Putra et al., 2021; Reyza et al., 2022). Meanwhile, 14 students got a score of 0 with a percentage of 28%. This means that there are still many students who are not able to answer question number 3 or students are not able to analyze changes in the temperature of an object when it experiences expansion. This can be caused by students still not mastering the concept of linear expansion at temperature and heat of a material. Students' weaknesses in understanding expansion problems well and precisely should be an early

warning for students in carrying out the learning process so as to create truly good and high-quality students.

If students' understanding is not good and accurate, if left unchecked, it can cause students to experience more and more misconceptions, so students' understanding must be straightened out and corrected as soon as possible. What can be done in physics learning is to increase students' interest and motivation to learn better (Rozal et al., 2021; Sulman, Yuliati, Kusairi, et al., 2022; Zb et al., 2021). Interest and motivation can provide encouragement for students to become better quality individuals, especially in understanding concepts or material in physics learning better. When students are motivated to study temperature and heat, an understanding or strength will emerge from within them that can encourage them to become individuals who want to change and at the same time become enthusiastic in the learning process (Beerse et al., 2019; Savinainen et al., 2013; Tan et al., 2014). The enthusiasm that arises from an individual's interest in learning can cause the individual to become a quality person who is ready to carry out his activities as a student. Children have different initial understandings and abilities depending on the initial understanding obtained so that the individual learning process must be facilitated by the teacher by taking into account the students' initial abilities so that the quality of the students becomes even and equally good (Ennis, 1991; McBeth & Volk, 2009; Wu & Liu, 2021). Making students' lives smarter or providing students with an understanding of how important the material taught is and is able to encourage students to become better and more qualified individuals.

Research results always show a decline in the quality and learning outcomes of students, this is something that is worrying. for example, in table 6, namely question number 4, many students got a score of 1, namely 31 students with a percentage of 62%, where it can be said that students also still experience misconceptions or conceptual errors in the indicator of analyzing the volume expansion of an object. Meanwhile, 19 students got a score of 0 with a percentage of 38%. This means that there are still many students who are not able to answer question number 4 or students are not able to analyze the expansion of the volume of an object. This can be caused by students still not mastering the concept of volume expansion in temperature and heat material. This is also in line with table 7 where question number 5, many students got a score of 0 as many as 26 students with a percentage of 52% where it can be said that there are still many students who have not been able to answer question number 5 or students have not been able to analyze the concept of the Black Principle in the mixture of two substances. different. Meanwhile, there were 24 students who got a score of 1 with a percentage of 48%. This means that students still experience misconceptions or conceptual errors in the indicator of analyzing the Black Principle concept in the mixture of two different substances. This can be caused by students still not mastering the concept of black principles in temperature and heat material. also shows that students' learning scores have a very low level of conceptual understanding and have not been able to demonstrate success in providing students with an understanding of temperature and heat material.

From several discussions regarding students' understanding of their ability to master temperature and heat material, there is still a need for a learning model that is

truly appropriate and capable of leading students to a better and better quality understanding of temperature and heat learning. Learning changes must be made immediately and it is the teacher's obligation to make good preparations, starting from observing students' initial abilities, investigating factors of low student learning outcomes and also analyzing the teacher's ability to provide the best solutions, be it learning approaches, learning strategies. or appropriate learning models and methods for students, so that the learning process becomes more effective and better.

CONCLUSION

Based on the research and data analysis results, students' mastery of concepts in temperature and heat material is still relatively low. This is proven by the results of the analysis of each question item indicator; as many as 60% of students answered with a value of 0; this means that many students did not understand question number 1, as many as 80% of students responded with a value of 1, this means that many students experienced misconceptions about number 2, as many as 72% of students responded with a value of 1, this means that many students participated misconceptions on number 3, as many as 62% of students answered with a value of 1, this means that many students participated misconceptions on number 4, as many as 52% of students responded with a value of 0, this means that many students experience misconceptions in number 5. states that students still often need clarification or conceptual errors; in other words, students' understanding of temperature and heat material still needs to improve. Thus, it is necessary to enhance students' concepts so that students no longer experience misconceptions, especially regarding temperature and heat material, by improving the learning process, which can provide enthusiasm for students in the learning process. It is recommended that future researchers use question instruments with international standards/high standards so that the conclusions obtained can immediately be used as general input and as a measuring tool for research in other conditions.

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