Representation of Elementary School Teachers on Concept of Heat Transfer

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Abstract. The purpose of this study is to get a description of how elementary teachers represent the understanding on the concept of heat transfer both conduction and convection to their students. This is a descriptive research, data collect by asking teacher to give their picture and explanation about the heat transfer concept. Subjects in this study there are six teachers who already have experience teaching over five years. Based on the analysis results obtained that the representation of teachers in the concept of heat transfer there are many alternative conceptions and in the description of the given phenomenon is less able to provide optimal explanation for students. The impact of teacher representation that is not in accordance with scientific rules will cause the learners not optimal for students to understand the concepts. Therefore to produce a better and tangible learning for students the teacher needs to improve his understanding that will support his representation in explaining the concept to the students more better.

1. Introduction
Heat transfer is a concept of science that often appears in every level of education in Indonesia. Although this concept can be found in everyday life. However, it is difficult to connect with the science learning process in the classroom [1]. The term heat is very familiar in everyday vocabulary. The concept of heat may have existed in the minds of children since the early age, but unfortunately this concept often encountered errors including Students think of heat as a flowing substance or made of 'hot particles', students think also that cold as the opposite of heat, and think of cold as something Which flows also [2]. In addition the alternative misconceptions or conceptions that occur in students are 1). Cold transfer is done to make an object cool or freeze; 2). Heat is something that is always warm or hot; 3) jackets, blankets, and socks generate heat; 4) the heat always rises; and 5) dark objects attract heat [3]. If alternative conceptions are not discussed in school and if the student does not experience a way to change or discard the alternative conception, then the error will survive until adulthood [4].

In order to remedy the abstract concept it is necessary to represent a concept of heat transfer and be understood by the students. Representation can help conceptual change students need a representation that can aid the processes that are in the students' thinking to according with scientific conception [5]. Representations can connote as providing information configuration. Representations can realize meaningful learning, since representations are contributing to students' cognitive configurations and allow for information mapping [6]. Research on representation is done more referring to the use of multiple representations on learning and refers to students [7]. However, the research about the
representation of teachers on the learning process has not been done. Whereas the teacher who has a big part in making science lessons more real.

Therefore the purpose of this study is to get an idea of how teachers represent their understanding of the concept of microscopic heat transfer both by conduction and convection. Descriptive method is the method used in this research by analyze the picture and explanation given by six teachers studied. The result of this study is the teacher's representation of the concept of heat transfer has not shown on scientific representation. The impact of the teacher's representation will lead to misconceptions that the students and misconceptions will continue if there is no attempt to improve teachers' understanding changes in a more scientific direction to make students better understand the concepts they are studying.

2. Research Method

This research is a descriptive research. The subjects were six class teachers (teachers who teach all the lessons) in elementary school with a teaching experience over five years and the teachers were continuing their studies in post graduate master's program. The instruments used in this study are written tests and interviews. In a written test the instrument asks the teacher to describe and explain how the process of conducting heat conduction conducts on a metal and wooden spoon in a water heated place for a certain time. While the conduction is to describe how the movement patterns of pieces of paper (which represents the movement of the water flow) when the water is heated to boiling. The results of the written test are then asked to be clarified in the interview to obtain more in-depth data from the teachers. The results of the instrument are then analyzed to see if the representation of the teacher's understanding is appropriate or not to the scientific rule.

3. Result and Discussion

The result of teachers' representation on the concept of heat transfer in this study is divided into two namely conduction and convection. For the heat conduction the teacher is asked to draw and explain what happens to the ends of conductor objects (metal spoons) and insulators (wooden spoons) when the other end is inserted into the heated water. Figures 1 and 2 are illustrative of the teacher's representation of heat transfer in metal and wooden spoons.

![Figure 1. Representation Teacher 1 on the phenomenon of heat transfer in the conductor.](image1)

![Figure 2. Representation Teacher 4 on the phenomenon of heat transfer in the insulator](image2)
Figure 1 according to teacher 1 explanation about the phenomenon of the conductor before heated particles in a still state has not changed form and separated from one another, then after heated the particles will experience changes in the form becomes denser so as to deliver the heat very quickly from the source fire. Figure 2 according to explanation teacher 4 before heated the particles do not move, then after heated the particles will remain not moving and the particles do not changes form, for this explanation all teachers have almost the same representation. However, for the phenomenon of the representative matter the teacher's representation tends to be more variable as in figures 3 and 4.

Figure 3. Representation Teacher 5 on heat transfer phenomena on the object conductor

Figure 4. Representasi Teacher 6 on heat transfer phenomena on the object conductor

Figure 3 according to teacher 5 explanation before heated the particles of the spoon spread evenly, then after heated the particles will expand and cause the particle will be raised and spread in all directions. Figure 4 according to teacher 6 explanation before heated the particles on silent metal spoons in their respective places. Then after heated the particles on the spoon will rise to the top so that the temperature becomes all hot.

Based on excerpts from the explanations of these teachers we can get some alternative conception that that causes the conductor object (metal spoon) occurs heat propagation (conduction) due to expansion of particles after heated; because expanding the particles jostle and spread evenly; and the heated spoon particles will move upwards so that the other end will feel hot.

In the concept of heat convection the teacher gives a representation of the phenomenon of heated water and the teacher describes what happens to the water particles when heated to boiling by looking at the movement of the paper powder inside. Figures 5, 6, and 7 representations given by the teacher about the concept.

Figure 5. Representation of Teacher 1 on hot convection phenomena

Figure 6. Representation of Teacher 2 on hot convection phenomena
Figure 7. Representation of Teacher 6 on hot convection phenomena

Figure 5 according to teacher 1 explanation that initially the paper powder is below then when heated the paper powder will upward as the water boils and the movement forms a spiral. Figure 6 according to explanation teacher’s 2 that initially the paper powder is below, after boiling the paper powder will move upwards then back down again in accordance with the movement of hot water particles. Figure 7 water particles after heated will be lighter than paper, thus resulting in paper that was at the surface to be down.

Based on a snippet of three teacher’s answers we can see that there is an alternative conception on the representation result that is the movement of the boiling water moves the spiral; Movement of water flow not centralized from existing heat sources; and the cause of moving paper powder is due to the weight difference between water and paper powder. More hotter water more lighter the weight.

The consequences of teacher representation that is less appropriate or not in accordance with scientific rules will delivery of a misconception about a concept that will impact on the learning process and students include: 1) students bring a conception of objects or phenomena that are not in accordance with scientific concepts; 2) the alternative of this conception will be difficult to avoid because it is very diverse; 3) the difficulty of accepting the correct concept because it has embedded an alternative conception on the students; And 4) Teachers have a considerable role in the occurrence of alternative conceptions [8].

Student representation is the result of its decision from the observation done on a phenomenon, this representation is influenced by two factors such as internal factors that is the level of student development that form mental model which is displayed through their representation and external factor either directly or indirectly, qualitatively or quantitatively [9]. External factors one of them is certainly from how the teacher's learning in the classroom through an explanation of understanding and representation. Representation of the teacher will also greatly affect the students' understanding and will be a representation of the concept he or she has learned. If the student's representation can be visual, verbal, and mathematical. This process will continue to be modified in the mind of the student [10]. In this process there is a process of assimilation and accommodation, assimilation when students use earlier concepts to adapt to new phenomena and accommodation if the initial understanding change becomes a new understanding [11]; [12].

Representation of teachers in science teaching will make abstract concepts can be visualized, of course in accordance with the understanding of teachers in providing representation in certain concepts. If the teacher understands a concept then it will easily represent the concept in accordance with the needs of students. But if the teacher just does not understand the concept he teaches how he can visualize or make it visible and make students understand what it says. Representations are used to describe and explain a science phenomenon and can facilitate the delivery of students [13].

In learning both teacher and student learning will have various representations of target concepts and construct knowledge seen as a process of making and transforming different representational modes. Skilled teachers will have various repertory treasures of appropriate representation and can be
used to elaborate on their learning in response to student statements and questions or to provide an alternative explanation for students unable to follow the learning process [14].

Representation greatly affects how students solve problems, because problem solving will rely heavily on the construction and mental model manipulation (internal representation) in mind [15]. Thus in the learning process it is necessary to straighten the representation of the students so that their initial representation that has been formed will turn into a corresponding representation of the scientific representation.

The use of representations in accordance with scientific rules and the level of student development will make the learning process will be more optimal because 1) improve the building of student knowledge; 2) increasing student involvement and achievement; 3) the availability of windows linking to student thinking, thus providing an opportunity for productive assessment of diagnostic and formative assessments; 4) learning becomes richer because of opportunities for different representations and choices; 5) provide a meaningful learning experience through the potential of connecting lessons with daily experience; And 6) allow students to study the form and function of representation appropriately [7].

4. Conclusion
Based on the analysis data can be concluded that the teacher who made the subject of research has not been optimal in providing a representation that after the scientific rules. The teachers still use alternative conceptions in representing his understanding to explain a concept relating to a phenomenon in the student. Because the representation is strongly related to the understanding of the teacher need to improve their understanding in accordance with the scientific principles of the concepts discussed in the learning, therefore it is necessary in the process of prospective teachers should be given understanding not only a big phenomenon and symbolic but must also be given a sub-Microscopic as well so later when they become teachers it can make science lessons more visual and tangible for their students.

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