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A study of primary school teachers' conceptual understanding on states of matter and their changes based on their job locations (case study at Ambon island in Moluccas-Indonesia)

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A study of primary school teachers' conceptual understanding on states of matter and their changes based on their job locations (case study at Ambon island in Moluccas-Indonesia)

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Abstract. The research aims to describe primary school teachers' conceptual understandings about states of matter and their changes. The method was descriptive which involved 15 primary school teachers from three different school locations. They were from urban school (CS1), sub-urban school (CS2), and rular school (CS3) at Ambon Island on 2016/2017 academic year. The research instrument was a multiple-choice test combined with both essay and confidence level of their answers. The test was used to measure teachers' understanding levels about states of matter and their changes. They were macroscopic, sub-microscopic and symbolic levels. Teachers' understanding levels were classified into following categorization, they were *understand, partly understand, misconception,* and *do not understand*. The results show that primary school teachers' conceptual understanding is varied based on their job locations and primary school teachers' level understanding. Generally, primary school teachers' conceptual understandings at sub-urban location (CS2) are better than those of both of urban (CS1) and rular locations (CS3). The results suggest that teachers need improvement to make better primary school teachers' conceptual understanding. It can be *on the job training* and *in service training* activities. We also need a further research in order to investigate the program effectiveness.

1. Introduction
Many factors can influence the attitude and action inividu and groups, one of which is the geographical location. The geographical location or location of a person's residence, whether direct or indirect, may affect the attitudes and actions of the person concerned. People living and living in urban areas differ from people living and living in rural areas. Similarly, both are different from those living in the suburban [1,2]. Students living in rural areas tend to have low results in terms of performance levels and academic performance of urban students [3]. In addition to the motor skills of elementary school students in urban areas better than those in rural primary schools [4].

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The main differences in location of residence, i.e. in terms of cultural habits, mindset, attitude, and everyday behavior. Differences inherent in human residing in the residential location as mentioned above, is no exception science teacher primary school. Thus differences in mindset, attitudes, and behaviors that apply also to elementary school science teachers who live or job in the urban, suburban, and rural [5].

In order for students to have a good understanding of objects, substances, and particles, the teacher must first understand and be able to teach the topic or concept well and correctly. The key factor in developing students' thinking skills in schools is teachers but that does not mean ignoring other factors such as textbooks and other teaching aids as well as attitude and interest in learning [6-8].

There has been prior research on understanding the concept of science in primary schools and understanding of the concept of prospective teachers on material topics and their changes [9-11]. The results of this study provide an overview of the conceptual understanding of prospective teachers on the topic of states of matter and their changes to the characteristics of a particular subject. However, information on conceptual understanding on the same topic in primary school teachers has not been widely reported.

The teacher's understanding of the concept needs to be specifically studied based on the geographic location of the school in this case the teacher's job location. Therefore, this paper tries to describe teachers' conceptual understanding about states of matter and their changes based on their job location, ie in the urban, suburban, and rural. It is hoped that this paper can enrich the data of science teachers' conception of objects and their properties that can be the inspiration to take corrective action and further research.

2. Methods

The research aims to describe primary school teachers' conceptual understandings about states of matter and their changes. The method was descriptive which involved 15 primary school teachers from three different school locations. They were from urban school (CS1), sub-urban school (CS2), and rular school (CS3) at Ambon Island on 2016/2017 academic year. The research instrument was a multiple-choice test that was combined with both essay and confidence level of their answers. The test was used to measure teachers' understanding levels about states of matter and their changes. They were macroscopic, submicroscopic and symbolic levels. Teachers' understanding levels were classified into following categorization, they were Understand (U), Partial Understanding (PU), Misconception (M), and Do not understand (DNU) [12].

3. Results and Discussions

3.1. Primary school science teachers' understanding on the discontinuous nature of matter

Table 1 shows that the understanding of primary school science teachers based on their job locations were varied. The percentage of understanding of particle existence (solid, liquid, gas) by CS1 teachers (urban) and CS2 teachers (suburban) is the same and is good while CS3 teachers (rural) 20% do not understand solid particle existence.

Table 1. Primary school teachers' understanding on the existence of particles of matter

Levels of Understanding	Solid (%)				Liquid (%)				Gas (%)			
	CS1	CS2	CS3	Tot	CS1	CS2	CS3	Tot	CS1	CS2	CS3	Tot
Understand	100	100	80	93,33	100	100	100	100	100	100	100	100
P. Understand	0	0	0	0	0	0	0	0	0	0	0	0
Misconception	0	0	0	0	0	0	0	0	0	0	0	0
Do Not U.	0	0	20	6,67	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

Table 2 shows that the understanding of particle-free space (solid, liquid, gas) by teachers from CS3 is better than CS1 teachers and CS2 teachers.

Table 2. Primary school science teachers' understanding on the existence of "particle-free space" between particles of matter

Levels of Understanding	Solid (%)				Liquid (%)				Gas (%)			
	CS1	CS2	CS3	Tot	CS1	CS2	CS3	Tot	CS1	CS2	CS3	Tot
Understand	20	20	100	46,67	60	0	80	46,67	0	0	80	26,67
P. Understand	0	0	0	0	0	0	0	0	0	0	0	0
Misconception	0	0	0	0	0	0	0	0	0	0	0	0
Do Not U.	80	80	0	53,33	40	100	20	53,33	100	100	20	73,33
Total	100	100	100	100	100	100	100	100	100	100	100	100

3.2. Primary school science teachers' understanding on states of matter and their changes at macroscopic level

Table 3 shows that the percentage of teachers' understanding from CS2 is generally better than the other two categories (CS1 and CS3).

Table 3. Primary school science teachers' understanding on states of matter and their changes at macroscopic level

School	CS1				CS2				CS3				Total			
Understand (%)	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU
Expansion	40	0	40	20	40	0	0	60	40	0	0	60	40	0	13,3	46,7
Evaporation	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Condensation	80	20	0	0	100	0	0	0	0	0	0	100	60	6,67	0	33,33
Melting	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Freezing	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Sublimation	80	20	0	0	100	0	0	0	100	0	0	0	93,33	6,67	0	0
Deposition	0	0	0	100	20	20	0	60	20	0	0	80	13,33	6,67	0	80

3.3. Primary school science teachers' understanding on states of matter and their changes at submicroscopic level

Table 4 shows that the percentage of teachers' understanding from CS1 is generally better than the other two categories (CS2 and CS3).

Table 4. Primary school science teachers' understanding on states of matter and their changes at submicroscopic level verbally

School	CS1				CS2				CS3				Total			
Understand (%)	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU
Expansion	20	0	0	80	40	0	0	60	0	0	0	100	20	0	0	80
Evaporation	40	0	60	0	20	0	80	0	40	0	40	20	33,33	0	60	6,67
Condensation	60	40	0	0	40	40	0	20	0	0	40	60	33,33	26,67	13,33	26,67
Melting	40	40	20	0	40	20	20	20	0	80	0	20	26,67	46,67	13,33	13,33
Freezing	60	40	0	0	20	40	0	40	20	0	60	20	33,33	26,67	20	20
Sublimation	20	20	60	0	40	20	0	40	0	20	20	60	20	20	26,67	33,33
Deposition	20	40	0	40	40	40	0	20	0	0	0	100	20	26,67	0	53,33

Table 5 above shows the misconceptions of primary school science teachers in explaining the phenomenon at the level of submicroscopic.

Table 5. Primary School Science Teachers' Misconceptionson States of Matter and Their Changes

Expansion/ Changes in states of matter	Primary School Science Teachers' Misconceptions
Expansion	-
Evaporation	Water particles do not move due to evaporate. Water particles disappear when water evaporate
Condensation	Water particles swell when it turns into dew. Water particles do not have movement when water condense
Melting	Water particles are smaller when water melt. Water particles do not have movement when water melt
Freezing	Water particles do not move due to frozen
Sublimation	Particle of mothballs shrink and disappear
Deposition	-

Table 6 shows that teacher CS2 understands 4 concepts (expanding, condensing, melting, and freezing) more than the other two categories of schools (CS1 and CS3).

Table 6. Primary School Science Teachers' Understanding on States of Matter and Their Changes at Submicroscopic Level Visually

School	CS1				CS2				CS3				Total			
Understand (%)	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU
Expansion	20	0	0	80	40	0	0	60	0	0	0	100	20	0	0	80
Evaporation	40	0	60	0	20	0	80	0	40	0	40	20	33,33	0	60	6,67
Condensation	60	40	0	0	40	40	0	20	0	0	40	60	33,33	26,67	13,33	26,67
Melting	40	40	20	0	40	20	20	20	0	80	0	20	26,67	46,67	13,33	13,33
Freezing	60	40	0	0	20	40	0	40	20	0	60	20	33,33	26,67	20	20
Sublimation	20	20	60	0	40	20	0	40	0	20	20	60	20	20	26,67	33,33
Deposition	20	40	0	40	40	40	0	20	0	0	0	100	20	26,67	0	53,33

3.4. Primary school science teachers' understanding on states of matter and their changes at symbolic level

Table 7 shows that teachers from CS2 understand 2 concepts (melt and freeze) more than the other two categories of schools (CS1 and CS3).

Table 7. Primary school science teachers' understanding on changes states of matter at symbolic level

School	CS1				CS2				CS3				Total			
Understand (%)	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU	U	PU	M	DNU
Expansion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Evaporation	0	20	0	80	0	0	0	100	0	20	0	80	0	13,33	0	86,67
Condensation	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100
Melting	0	20	0	80	60	0	0	40	0	20	0	80	20	13,33	0	66,67
Freezing	0	20	0	80	60	0	0	40	0	40	0	60	20	20	0	60
Sublimation	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100
Deposition	0	0	0	100	0	20	0	80	0	0	0	100	0	6,67	0	93,33

Based on the findings, it seems that the concept of matter and its changes is not an easy concept and simple but elusive because at the macroscopic level there are still primary school science teachers who do not understand; at the submicroscopic level (verbal and visual) and the symbolic understanding of primary school science teachers in general and the category of job location is not good; still misconception and percentage of misconception more than 50%. "The nature of matter particles" is one of the concepts in which learners have the most alternative concepts [13]. One of the reasons why learners have difficulty understanding this is that learners are unable to relate the concept of science to the situations they face. Another reason is the interest and motivation of learners low in learning the concept.

Teacher' conceptual understanding on states of matter and their changes based on their job locations was varied. In general CS2 (suburban) is better than the other two categories of schools (CS1 and CS3). The results obtained are only limited to see the percentage of understanding of teachers have not used statistical tests. So the possibility of understanding the context of suburban teachers better than the other two categories may exist. The power of understanding the context can arise as a result of the ability to relate learned materials to the situation of the environment or job location (or meaningful learning according from Ausubel). In addition, teachers in CS (suburban) have a tendency of better interest among the other two categories. Teachers in this category of schools are more devoted to their job, time, and mind to their teacher's job. Although in general CS2 teachers showed better results from the other two categories, but the variation in the concept of teacher understanding based on the results of this study indicates that the location of the teacher's job location does not affect the conceptual understanding of teachers. The setting of the school location did not show a significant influence on the success rate of English teachers [14].

By looking at these results, educator or educational researchers can look at it as an educational study results can be used as a starting point in order to practice or study of education and further education [15]. Therefore misunderstandings of primary school science teachers need to be studied and sought by reflective solutions by educators and/or educational researchers [16]. Furthermore, there is a need metamorphosis for new corrective actions and means not just memory suppression and problem solving alone, so that teachers can be better in the future [17].

In order for the understanding of the concept of the atom to be well received by the teacher, needs to eliminate the continuous concept of matter through a number of experiments that can bridge learners to cross from continuous to discontinuous concepts [18,19]. To be able to bridge learners, the lessons given should be contextual in order to attract their attention [20]. Therefore, the design of the learning unit needs to be compiled by including three fundamental concepts, namely: model aspect of particle physics, linguistic accuracy, and typographic illustrations [21].

Many possible ways can be tested to improve the mastery of the concept of primary school science teachers. One strategy that can be tried is a strategy *Predict-Observe-Explain* (POE) or its variants, for example PDEODE [22]. This strategy is deemed better to enhance students 'understanding and may improve prospective teachers or teachers' misconceptions [23-26]. In addition, a laboratory based activities *Predict-Observe-Explain* (POE) is able to remediate and improve the understanding and attitudes of prospective teachers compared to traditional learning [5,27].

Furthermore, a concept change approach is needed. One strategy is the concept of change approach *Conceptual Change Text* (CCT). The text used to introduce theories will convince students that they have misconceptions about scientific facts [28,29]. In the text of conceptual change, students are explicitly asked to provide predictions for a situation and then misconceptions and scientific explanations of the situation presented [30-32]. Therefore CCT can be integrated with *Predict-Observe-Explain* (POE) [33]. By using POE, students have the opportunity to use their knowledge in the laboratory [34].

Teachers' teaching experience and job location have less impact on understanding the concept of substances and their changes. Therefore, science teachers in primary schools need to attend trainings that can improve conceptual understanding. the teacher improvement can be done by way of *on the job training* and *in service training* [35].

4. Conclusions

Teacher' conceptual understanding on states of matter and their changes based on their job locations was varied. Generally, primary school teachers' conceptual understandings at sub-urban location (CS2) are better than those of both of urban (CS1) and rular locations (CS3). However, data analysis performed using percentages has not used statistical tests. Based on the school category and level of understanding, results were obtained: at the macroscopic level there were still elementary school science teachers who did not understand; at submicroscopic level (verbal and visual) and symbolic on the basis of, generally not good, still misconception and percentage of misconception more than 50%. Therefore it is necessary to repair efforts. The results suggest that teachers need improvement to make better primary school teachers' conceptual understanding (by POE Strategies and CCT). It can be *on the job training* and *in service training* activities. We also need a further research in order to investigate the program effectiveness.

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anas14

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