



# **Effectiveness of Imagination Stretch Teaching Strategy in Correcting Misconceptions of Students about Particulate Nature of Matter**

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## **ABSTRACT**

This research was carried out to determine the effectiveness of imagination stretch teaching strategy in correcting misconceptions of students about the particulate nature of matter in Senior Secondary Schools in Rivers State. Quasi-experimental design pretest- posttest control group was adopted using ninety-two (92) Secondary School 3 Chemistry Students from intact class as the sample. A four-tier misconception diagnostic test tagged "Particulate Nature of Matter Misconception Diagnostic Test" developed by the researcher was the instrument used for diagnosis of students' misconception on the particulate nature of matter. The reliability coefficient of 0.76 of the instrument was established using alpha Cronbach method. Mean, percentages, standard deviation and ANOVA were statistical tools used for data analysis and hypotheses tested at 0.05 level of significance. Wrong answers by approximately 20% or above were considered as misconceptions. From the results, it was discovered that imagination stretch teaching strategy caused a significant reduction in students' misconceptions about the particulate nature of matter. There was a significant difference in mean score of students' misconceptions about the particulate nature of matter for the experimental

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and control groups confirming the effectiveness of imagination stretch teaching strategy in correcting students' misconceptions. Based on the findings, it was recommended that teachers should adopt conceptual change instructional strategy in teaching abstract chemistry concepts to foster students' understanding and motivate them to the study chemistry as a subject.

*Keywords: Particulate nature of matter; misconceptions; imagination stretch teaching strategy; traditional lecture method.*

## 1. INTRODUCTION

The concept of particulate nature of matter is fundamental in chemistry as it addresses the appearance of substances at the macroscopic and microscopic level and finds its application in many content areas of chemistry which forms the basis for the understanding of other physical and chemical processes. A proper understanding of the concept of particulate nature of matter provides a solid foundation for understanding and interpretation of concepts of atoms and molecules which are the invisible microscopic components of all phenomena in the natural world. This accounts for its relevance in the teaching and learning of chemistry. The outlined importance of particulate nature of matter notwithstanding, the concept is perceived difficult topic by both students and teachers [1]. Concepts are mental tools which facilitate thinking and transformation of a wide range of information into utilisable units which can be easily understood by individuals. They are the building blocks of knowledge necessary for classification and organisation of the information learnt by individuals. Therefore, learning of concepts requires the proper construction of knowledge from their previous experiences with the learned information by the students. Deficiency or inaccuracy in the learning of scientific concepts prevents the correct construction of knowledge on a concrete base and contributes to a misconception in science. One of the important factors that influence learning is what the learner "already knows", as such the preliminary knowledge of an individual plays a significant role in the conceptual learning process [2]. A proper understanding of particulate nature of matter can be achieved only when students can establish the relation between macroscopic structures (which is the holistic appearance of matter), their formula (which is the statement of symbol particles which forms the holistic structure), and microscopic size (which represents the relation between the different states). In line with this, the constructivist recommends revealing of students' prior knowledge or former knowledge before the

commencement of any lesson. Students' proper understanding of chemical concepts can only be achieved when chemical concepts are constructed accurately in their minds.

There are several misconceptions about particulate nature of matter which has been established at different levels of education ranging from the primary to the tertiary institutions. For instance, many researchers [3-8] have identified the following misconceptions about the particulate nature of matter: atom is the smallest and indivisible particle of a substance, it is tiny but visible, it can be crushed, they are colourful, and may be hard. When matter is divided into two their atoms are divided into two, Atoms are undividable since they are too small, they are alive and hard, and are spherical. Atoms are interspersed throughout the substance, and are centralised and surrounded by the substance. Atoms are enclosed by the "wall" of the element. They are the same as cells- chopped bits of the substance. Atoms are like the sun with electrons (planets) revolving around it in definite path, and atoms are spheres having a definite radius but they cannot define the radius. Ayas et al. [9] investigated students' conceptions about particulate nature of matter at secondary and tertiary level and found that students at the tertiary level had a better understanding of the particulate nature of matter than secondary level students. The finding of this study confirms the progression of students' understanding of the particulate nature of matter with educational stage as a result of increases in cognitive abilities from the lower to higher class. Offering explanation to this occurrence, Liu and Lesniak [10] opined that the progression of student's conceptions on matter from lower grades to high school is not automatic but multifaceted process, which suggests that there are other factors involved other than the level of education. Polat et al. [11] explored pre-service science teachers' misconceptions related to particulate nature of matter using one hundred and eighteen (118) 1<sup>st</sup> and 4<sup>th</sup> grade pre-service science teachers and found that pre-service science teachers' misconceptions about the

atomic structure is more than the other concepts. Specifically, it was observed that the teacher candidates had problems in defining concepts like atomic structure and molecular structure. Misconceptions related to the concept of element were minimal and there was no significant difference between the first and fourth grade in their misconceptions about the particulate nature of matter. Misconceptions of science undergraduate who are the future prospective chemistry teachers have adverse effect on conceptual development and understanding of those students they are likely going to teach after graduation. Therefore, there is a need to investigate their misconceptions and correct them to ensure quality teaching of science subjects at the secondary school level which forms the base for acquisition of basic scientific knowledge. Banda et al. [12] investigated the understanding of pre-service science teachers on the concept of particulate nature of matter in Zambia using 30 pre-service science teachers at a training college in Zambia and questionnaire as the instrument. The result of this study showed that most teachers had correct views on the effect of phase change on speed, spaces and number of particles in a substance while other pre-service teachers had poor understanding of the phase change effect, cooling and heating on the particle size of the substance, and they erroneously believed that when a substance is cooled, it contracts because the sizes of the particles decrease, and when a substance is melting the size of its particles increase. Identification of misconceptions is very important in the teaching and learning of the concept of particulate nature of matter and has paved ways for providing solution to the problem.

In an attempt to correct misconceptions about particulate nature of matter, Stojanvska et al. [13] carried out research to address misconceptions about the particulate nature of matter among secondary school and high school students in the Republic of Macedonia using conceptual change intervention programme and group interviews on semi-structured group and found that the intervention programme was efficient in facilitating the understanding of some basic elements of the theory and practice concerning the particulate nature of matter among students of different levels of the study. Seven misconceptions prevalent by more than 20% of students and some additional ones emerged from the in-depth focus group discussion in the study. Furthermore, it was discovered that the analysis of the contents of textbooks indicated

some erroneous chemical concepts formed as a result of the teaching of chemistry from the textbooks and related physics concepts as well. The use of animations and molecular models had a positive effect on students' misconception pointing to the need of introducing more visual materials into the chemistry teaching mostly at the secondary school level. Kezembe [14] used portfolios to correct students' alternative conceptions and enhanced learning in Zimbabwe, and found that portfolio was an effective tool for correcting students' alternative conceptions in chemical bonding and other concepts in chemistry such as atomic structure, matter and particles, and chemical equilibrium. The results further revealed the efficiency of the use of portfolios in enhancing students to develop a sense of ownership of their science learning, nurture students, foster a positive self-concept of learning, and involve students in self-reflection and in determining and setting individual goals. Most of the studies considered in literature stem from the conceptual change approach. This study intends to use imagination stretch teaching strategy to correct students' misconception in line with related studies in the available literature. Imagination stretch instructional strategy is a conceptual change based teaching approach which is rooted constructivist theory and was proposed by Alamina [4]. The strategy involves the systematic presentation of a known phenomenon to the students starting from the concrete or macroscopic level which is within the learners' observable physical state and progressively moving from the concrete to the abstract level by providing clues where it is necessary for the learners to imagine the possible end product and offer an explanation to the phenomenon. The learners' imagination is then properly and carefully guided to extend beyond reasoning in the concrete or macroscopic horizon to reasoning in the abstract or sub-microscopic horizon in which the particles exist. At this stage, the learner can creatively and subjectively engage in critical thinking which enables them to relate and integrate the process to what happens in the abstract level. This process is called "stretching" as the learners reasoning is elongated giving him a clearer picture of what happens to the particles and its existence at the atomic level as one tries to establish a relationship between the different states of matter. This is a process of scaffolding. At this stage, the teacher is exposed to the learners' ideas or conceptions from the responses to questions at the "stretching stage" and the

source of the misconceived ideas from the reasons the learners give to their answers.

### 1.1 Statement of Problem

The problem of misconceptions has been a major source of concern in the teaching and learning chemistry because of its adverse effect on the understanding of students about various chemical concepts. This informs the classification of chemistry as a difficult subject by many students and associated poor performance in examinations despite the relevance of the subject in engineering, medicine and related science course at the secondary and tertiary levels of education. Good knowledge about the particulate nature of matter is required for proper understanding of related concepts such as chemical reactions, reaction rates, and chemical equilibrium among others. In an attempt to address this problem, many researchers [9,12,15,11] have identified several students' misconceptions about particulate nature of matter while Stojanvska et al. [13] and Kezembe et al. [14] went further to correct student's identified misconceptions. Unfortunately, despite these discoveries, students' still hold diverse misconceptions about the particulate nature of matter as reported in the studies above. There is therefore urgent need to utilise the information from these studies which provides essential and indispensable clues to provide a solution to the problem. Many instructional strategies have been adopted for teaching different concepts in chemistry, each having specific application and suitability for the concept in consideration. The issue then rests on discovering appropriate and effective teaching strategy(s) to correct identified misconceptions and enhance students' understanding of abstract concepts such as particulate nature of matter which is the main focus of this study.

### 1.2 Significance of the Study

This study will not only reveal the possible misconceptions of students about the particulate nature of matter but will provide a suitable strategy for correcting and addressing these misconceptions. Consequently, this study will be of great importance to chemistry teachers and students as the application of this strategy will enhance the teaching- learning process leading to the improvement in students' understanding. Since misconception is a worldwide issue, the results of this study will not only be beneficial to Nigerian students but other nations of the world.

Findings of this study are therefore expected to have implications for the teachers and students of science as well as for curriculum developers at both the secondary and teacher education level where the results of this study are applicable.

### 1.3 Purpose of the Study

This study was carried out to evaluate the effectiveness of Imagination Stretch Teaching Strategy (ISTS) in correcting misconceptions of students about the particulate nature of matter in senior secondary schools in Rivers State. Specifically, the study tends to:

- Find out if there is any difference in misconceptions of students about the particulate nature of matter after lessons using imagination stretch teaching strategy and traditional lecture method

### 1.4 Research Question

- What difference exists in students' misconceptions about the particulate nature of matter after lessons using imagination stretch teaching strategy and traditional lecture method?

### 1.5 The Hypotheses

- **HO:** There is no significant difference in mean misconceptions score of students about the particulate nature of matter before and after lessons using imagination stretch teaching strategy and traditional lecture method.

## 2. METHODOLOGY

This study adopted quasi-experimental design using non- randomised pretest- posttest control group. Quasi- experimental research design is used where there is no randomisation because of ease access to the sample group which allows the use of the intact class. This study was carried out in Port Harcourt Metropolis using four schools purposely selected out of convenience from all secondary schools within the metropolis based on the availability of chemistry students to form experimental and control groups. Using this method, four out of fifteen schools that met the conditions above were selected. The two classes in each of the selected school were assigned the experimental and control group using random sampling. The sample size was ninety-two (92) Senior Secondary 3 chemistry students representing 45 and 47 students in experimental and control groups respectively. SS3 students

were considered for this study because they have background knowledge of the particulate nature of matter having been exposed to the teaching in several related topics in the lower classes of senior secondary school. Students in the experimental group were exposed to the treatment using conceptual change intervention programme called ISTS. The treatment administered to the experimental group followed the conceptual change approach based on the basic features of constructivist theory which include identification of students' prior knowledge or preconceptions, discussion and evaluation of the identified preconceptions, creating conceptual conflict using the discrepant event, and finally encouraging and guiding students for conceptual change accomplishment. A discrepant event is a phenomenon or situation that cannot be explained by students' current conception but can be explained by the concept in the instruction. This teaching was based on 'Activity, Student-centered, Experiments, Improvisation – Plan, Do, See, Improve' (ASEI-PDSI) lesson plan prepared from the module developed by the researcher from using the Senior Secondary School Chemistry Curriculum. The students in the control group were not given the above treatment but rather taught using traditional lecture method and the Teaching Knowledge Test (TKT) lesson plan based on the approved textbooks. The teaching procedure lasted for one week with a total of three double periods of 50 minutes in each period. The instrument was administered to the experimental and control groups before exposure of the experimental group to the intervention programme as a pretest. Thereafter, it was administered to both groups after the lesson as a posttest.

The instrument was a four- tier misconception diagnostic test tagged "Particulate Nature of Matter Misconception Diagnostic Test" (PNMMDT) developed by the researcher. The first tier of the diagnostic test contains an ordinary multiple choice tests with only one correct option and the other, distracters selected from predetermined misconceptions about the particulate nature of matter in literature. The second- tier indicates the confidence level of the option chosen, and third tier reasons for the selected option in the first tier with only one correct reason and distracters from predetermined misconception and finally, the fourth- tier which contains confidence level for the reason in the third- tier. When a student chooses the correct option in the first- tier with a

high level of confidence and correct reason in the third- tier and high level of confidence it is referred to as scientific conception (SC). On the other hand, when a student chooses the wrong option with a high level of confidence and wrong reason with a high level of confidence, then it is considered misconception (MC). When a student chooses the correct answer in the first or 3<sup>rd</sup> tier with a low level of confidence in any one or both, it is considered Lack of Knowledge (LK), When a student chooses the correct option in the first tier with a high level of confidence and wrong answer in the 2<sup>nd</sup> tier with a high level of confidence, then it is considered as False Positive (FP). When a student chooses the wrong answer in the first- tier with high level of confidence and correct reason in the 3<sup>rd</sup> tier with a high level of confidence, then it is considered False Negative (FN). Since the focus of this study is on the correction of misconceptions, the different types of misconceptions LK, FP, FN and MC are collapsed and referred to as MC in this study for clarity in data presentation. Wrong answers selected by approximately 20% or and above of the students were considered as misconceptions. According to Dhindsa and, Treagust [16] and Stojanvska et al. [13], in a four- distractors- item test, incorrect responses (distractors) selected by more than 20% of the students indicates the presence of misconception of the tested concepts and correct answers given by a minimum of 75% of the students confirms satisfactory understanding of the tested concept. The four- tier misconception diagnostic test was preferred in this study because of its advantage over the two- tier and three- tier multiple choice test. It removes errors due to overestimation of students' misconception scores and the correct scores, underestimation of lack of knowledge proportion, and guessing [17]. The instrument was subjected to face and content validation by two lecturers from the Department of Science Education and one lecturer from Measurement and Evaluation and the reliability coefficient of 0.76 established using alpha Cronbach method considered appropriate. Mean, percentages, standard deviation and ANOVA were statistical tools used for data analysis at 0.05 level of significance.

### 3. RESULTS

#### 3.1 Research Question

What differences exist in students' misconceptions about the particulate nature of matter before and after lessons using imagination

stretch teaching strategy and traditional lecture method?

Table 1 shows, before treatment, six (6) students' misconceptions about the particulate nature of matter with 20% and above of the students selecting the misconception as an option were identified in both experimental and control groups similar to the predetermined misconceptions in literature. The misconceptions and their percentages on atoms are interspersed throughout the substance 31.3% and 25%. Atoms are enclosed by "wall" of the element 25.0% and 31.3%, atoms are the same as cells 31.3% and 18.8%, atoms are chopped bits of the substance 31.3% and 25.0%, atom is the smallest particle and cannot be divided 87.5% and 81.3%, electrons, protons and neutrons are found everywhere in the atom 62.5% and 50%. Furthermore, there was no remarkable difference in scientific conception in both of the experimental and control groups before the exposure of the treatment as follows. Atoms are found everywhere in the substance 31.3% and 25%, atoms contain smaller particles 31.3% and 43.8%, atoms of the same substance have the same sub-atomic particles 6.3% and 12.5%, an atom is electrically neutral 12.5% and 18.8% respectively for experimental and control groups.

After treatment there was drastic and remarkable reduction in students' misconception in the experimental group but minimal reduction in the control group as follows. Atoms are interspersed throughout the substance 31.3% to 0.0% and 25.0% to 19.6%, atoms are enclosed by the "wall" of the element 25.0% to 12.5% and 31.3%, to 26.1%, atoms are the same as cells 31.3% to 0.0% and 18.8%, to 13.1% atoms are chopped bits of the substance 31.3% to 25.0% and 25.0% to 19.6%, atom is the smallest particle of an element and cannot be divided 87.5% to 50.0% and 81.3%, to 65.3%, electrons, protons and neutrons are found everywhere in the atom 62.5% to 18.8% and 50.0% to 45.7% (Table 1). On the other hand, after treatment there was a remarkable increase in students' scientific conceptions in the experimental group but no meaningful reduction in control group as follows:- Atoms are found everywhere in the substance 31.3% to 87.5% and 25.0%, to 39.2%, atoms contain smaller particle and as such they are not the smallest particle 31.3% to 75.0% and 43.8% to 65.3%, atoms of the same substance have the

same sub-atomic particles 6.3% to 25.0% and 12.5% to 19.6, an atom is electrically neutral 12.5% to 37.5% and 18.8% to 26.1% respectively for experimental and control groups (Table 2).

The difference in mean score and standard deviations of the misconceptions of students about the particulate nature of matter before and after lessons using imagination stretch teaching strategy and traditional lecture method was also used to establish the difference between the two groups as shown in Table 3.

The results in Table 3 shows that the mean and standard deviations of students' misconception score in the pretest control and experimental was 15.29 and 15.00 with the mean difference of 0.29 and standard deviations of 3.86 and 3.10 with a difference of 0.76 respectively. Also, the posttest experimental and control group mean scores was 14.43 and 9.31 with a mean difference of 5.11 and standard deviations of 2.43 and 5.62 with a mean difference of 3.19 respectively. From Table 3, it was discovered that the control group had a higher posttest students' misconception mean score (14.43) than the experimental group (9.31) indicating a reduction in a misconception of the treatment group. Also, the higher mean difference in the posttest (5.11) than the pretest (0.29) confirms the effect of treatment on the experimental group.

### 3.2 Research Hypothesis

**HO:** There is no significant difference in mean students' misconceptions about particulate nature of matter after lessons using imagination stretch strategy and traditional lecture method.

From Table 4, the calculated value of F-ratio ( $F = 5.257$ ,  $p = .05$ ) is greater than the table value, therefore the null hypothesis which states that there is no significant difference in students' misconceptions about particulate nature of matter after lessons using imagination stretch strategy and traditional lecture method is rejected indicating that there is a significant difference in students' misconceptions about particulate nature of matter after lessons using imagination stretch strategy and traditional lecture method.

**Table 1. Percentages of students' misconceptions about particulate nature of matter before and after treatment in the experimental and control groups**

S/N	Item statement	Before treatment (pretest)		After treatment (posttest)	
		Experimental (%)	Control (%)	Experimental (%)	Control (%)
1.	Atoms are interspersed throughout the substance	31.3	25.0	0.0	19.6
3.	Atoms are enclosed by the "wall" of the element	25.0	31.3	12.5	26.1
5.	Atoms are the same as cells	31.3	18.8	0.0	13.1
8.	Atoms are chopped bits of the substance	31.3	25.0	25.0	19.6
12.	Atom is the smallest particle of an element and cannot be divided	87.5	81.3	50.0	65.3
16.	Electrons, protons, and neutrons are found everywhere in the atom	62.5	50.0	18.8	45.7

**Table 2. Percentages of students' scientific conceptions about the particulate nature of matter before and after treatment in the experimental and control groups**

S/N	Item Statement	Before treatment (pretest)		After treatment (posttest)	
		Experimental (%)	Control (%)	Experimental (%)	Control (%)
4.	Atoms are found everywhere in the substance	<b>31.3</b>	<b>25.0</b>	<b>87.5</b>	<b>39.2</b>
7.	Atoms contain smaller particles and as such they are not the smallest particle	31.3	43.8	75.0	65.3
11.	Atoms of the same substance have the same sub-atomic particles	<b>6.3</b>	<b>12.5</b>	<b>25.0</b>	<b>19.6</b>
13.	An atom is electrically neutral	12.5	18.8	37.5	26.1

**Table 3. Mean and standard deviation of students' misconception about the particulate nature of matter in the experimental and control groups**

Mean		Standard deviation				
Group	N	Pretest	Posttest	Difference	Pretest	Posttest
Control	47	15.29	14.43	0.58	3.86	2.43
Experimental	45	15.00	9.31	5.69	3.10	5.62
Difference between		0.29	5.11	5.13	0.76	3.19

**Table 4. Results of ANOVA analysis of posttest experimental and control group students' misconception score about particulate nature of matter**

Source of variance	Sum of squares	df	Mean square	F	Sig.
Between Groups	127.457	1	127.457	5.257	.032
Within Groups	509.152	21	24.245		
Total	636.609	22			

**Table 5. Results of ANOVA analysis of mean students' misconception score about particulate nature of matter in the pretest control and experimental group**

Source of variance	Sum of squares	df	Mean square	F	Sig.
Between Groups	.398	1	.398	.036	.852
Within Groups	233.429	21	11.116		
Total	233.826	22			

From Table 5, the calculated value of F-ratio ( $F = 0.036$ ,  $p = .05$ ) is less than the table value indicating that there was no significant difference between the mean misconception scores of students in the pretest experimental and control group on particulate nature of matter which confirms the group equivalence. Therefore, any observed difference indicates the effect of treatment not by chance.

#### 4. DISCUSSION

The emergent outcome of this study revealed six (6) identified misconceptions held by students about particulate nature of matter before treatment which include: atoms are interspersed throughout the substance, atoms are enclosed by the wall of element, atoms are the same as cells, atoms are chopped bits of the substance, atom is smallest and indivisible particle, and electrons, protons are found everywhere in the atom. The identified students' misconceptions were similar to the predetermined misconceptions in literature [9,12,15,11] where several misconceptions about particulate nature were found to be prevalent among students. After exposure to the students using imagination stretch teaching strategy, there was a remarkable reduction in percentage of identified misconceptions of students about particulate nature of matter from very high percentage of 31.3% to 0.0 % or very minimal percentage and

corresponding remarkable increase in scientific conceptions of the students from 6.0% to 87.5 % except the misconception that atom is the smallest particle and cannot be divided which persisted after treatment showing a minimal reduction from 87.5% to 50% after treatment (Table2). The reduction in the percentage of misconception and corresponding increase in scientific conception of students taught that using imagination stretch teaching strategy could be attributed to the fact that this strategy enhanced students' understanding of concepts as a result of their active involvement in the process of knowledge making which enable them to construct new ideas or replace the existing ones with the new (scientific conceptions) resulting in conceptual change. Students' prior conception was elicited and built into the actual teaching process in the experimental group and used to simplify the abstract concepts to enhance students understanding and construction of new knowledge which is same as scientific conception. This observation is in marked contrast to the students in the traditional lecture class where there was no reduction in students' misconception and no remarkable change in scientific conceptions because then they played the role of passive listeners having nothing to contribute to knowledge in the teaching process since they are seen as an empty slate waiting for the transfer of knowledge. Furthermore, the higher mean students' misconception score in



the control group at posttest points to the fact that the misconceptions still persist despite lessons with traditional lecture method while the reverse was the case in experimental group where students were exposed to imagination stretch teaching strategy, and a lower mean misconceptions score obtained. It was further observed that the results of the test of hypothesis at 0.05 level of significance revealed a statically significant difference in students' misconceptions about particulate nature of matter after lessons using imagination stretch teaching strategy and the traditional lecture method. This implies the effectiveness of imagination stretch teaching strategy in correcting students' misconceptions about particulate nature of matter. The results of this study supports the findings of Kezembe [14] where portfolio, a conceptual change instructional strategy was found to be an effective tool for correcting students' alternative conceptions in chemical bonding and other concepts in chemistry such as atomic structure, matter and particles, and chemical equilibrium. It further corroborates the findings of Stojanvska [13] on addressing misconceptions about the particulate nature of matter among secondary school and high school students in the Republic of Macedonia using conceptual change intervention programme where the effectiveness of conceptual change intervention programme in facilitating the understanding of some basic elements of the theory and practice concerning the particulate nature of matter among students of different levels was established. Furthermore, in line with this, Ayas et al. [9] reported progression of students' understanding of the particulate nature of matter with educational level as a result of increases in cognitive abilities from the lower to higher class. Liu and Lesniak [10] argued that there are other factors involved other than the level of education because progression of student's conceptions on matter from lower grades to high school is not automatic but multifaceted process.

Imagination stretch teaching strategy enhanced students' understanding of scientific concepts in particulate nature of matter and enables them to relate the microscopic properties of atom to their daily experiences for conceptual change. This support Stojanvska et al. [13] assertion that, students should be able to establish the relation between macroscopic structures which is the holistic appearance of matter, their formula which is the statement of symbol, particles which forms the holistic structure, and microscopic size which represents the relation between particles for

proper understanding of particulate nature of matter to be achieved. Conceptual change involves replacement of students' existing conceptions and adding new knowledge to what already exist with the goal of adopting more meaningful conceptions while discarding the misconceptions they bring to the learning environment. To accomplish this conceptual change, a learner should actively and rationally replace existing non-scientific conceptions with scientifically accepted explanations or conceptions as new prepositional linkages are formed in his conceptual framework. It promotes students' conceptual understanding and has the unique feature of allowing learners to make their conceptions explicit so that they become aware of their ideas and thinking while assisting in revising their conceptions. To be able to correct misconceptions in chemistry, there must be replacement of students' prior conception or preconceived ideas with the scientific conceptions. According to constructivist teaching theory, for construction of idea to occur, students must be dissatisfied with the existing idea, and the new idea or concept must be meaningful and plausible. Learners must not only be aware of the misconceptions but also dissatisfied with it, and the new concept must be intelligible, plausible and applicable. Teaching of chemistry from the traditional perspective involves knowledge transmission from the teacher who is the expert to the passive learner who has nothing to contribute to the learning process. Assessment is based on the ability of students to remember and reproduce knowledge without any alteration.

## 5. EDUCATIONAL IMPLICATION

The evidence of the findings of this study confirms the effectiveness of imagination stretch teaching strategy in correcting misconceptions of students about the particulate nature of matter. This implies that chemistry teachers need to adopt the conceptual change approach in teaching abstract concepts in chemistry to minimise the problem of misconception. Since this strategy involves the process of knowledge construction, It encourages active participation of students in the lesson which enhances their understanding of abstract concepts.

## 6. CONCLUSION

The results of the findings of this study revealed that imagination stretch teaching strategy is an effective strategy for correcting students' misconceptions about the particulate nature of

matter. This is substantiated in the drastic and remarkable reduction of students' misconceptions and a corresponding increase in scientific conceptions about the particulate nature of matter after exposure to lesson using imagination stretch teaching strategy. All identified students' misconceptions were corrected except misconception about indivisible nature of atoms which persisted after treatment. A significant difference in mean students' misconception score between the experimental and control groups were established confirming the effectiveness of imagination stretch teaching strategy in correcting students' misconceptions.

## 7. RECOMMENDATIONS

Based on the findings of this study the following recommendations were made.

- Chemistry teachers should be trained to use conceptual change based on instructional strategies in teaching secondary school chemistry.
- Chemistry teachers should motivate students toward the learning of chemistry as a subject.
- The government should provide basic facilities and a supportive learning environment to the teachers and students.

## CONSENT

As per international standard or university standard students' written consent has been collected and preserved by authors

## COMPETING INTERESTS

Authors have declared that no competing interest exist

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