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Educationists all over the world view education as a very crucial factor in raising the standard of living of common people. It undoubtedly serves as the main agent and component of overall social, economic and political development of a nation. Therefore, every nation wedded to democracy now a day wants to stress on raising the standard of education and streamlining it at all levels. Educational system presently gives much importance to the study of science. The student achievement in science depends a great deal upon the correct formation of concepts. The present system of education is graded to produce citizens who can deal with the words, concepts and scientific symbols that are necessary for success in a technological society. Hence, a widely accepted perspective on the nature of learning is that it is a process of conceptual change (Kyle & Shymansky, 1989; Linder, 1993). Learning is a process in which a student changes conceptions through capturing new ideas and knowledge and replacing the old with the new (Hewson & Hewson, 1991).

Science education aims at increasing common knowledge about science and widening social awareness of scientific findings and issues. Learning science requires learning its language, which often differs from colloquial languages. The language used to communicate science is rife with terms pertaining to concepts, phenomena and processes, which are initially alien to children. Learning science goes beyond scientific facts, principles and theories. One of its aims is to attain conceptual understanding about science.

Children develop ideas about natural phenomena before they are taught science in school. In some instance, these ideas get along with the science that is taught. In many cases, however, there are significant differences between children’s notions and school science. Effective science teaching takes account of these ideas and provides activities that enable pupils to make the journey from their current understandings to a more scientific view. Learning of concepts is the main outcome of an educational process.
Students can have misconceptions about scientific facts, models, laws and theories (Brown & Clement, 1987). Misconceptions have a variety of labels in the research literature such as alternative conceptions, alternative frameworks, naïve conceptions, intuitive or spontaneous concepts or alternative interpretations (Linder, 1993; Metere & Tonger, 1989).

Misconceptions are more prone to occur in abstract concepts than in more life related and concrete concepts. Physics is one area in science where students have to learn many concepts that are not tangible. Recent researches in physics education report that students enter physics classes with many preconceived ideas (Brown & Clement, 1987; Marioni, 1989). These preconceptions are often misconceptions in that they do not provide a correct description of the behavior of the physical world, which is consistent with the laws of physics. Whenever these ideas are misconceptions, teachers should try to challenge and discuss them immediately, otherwise students will find it very difficult to model, understand and process the physical world completely.

In a learning process, it is undoubtedly established that students’ misconceptions often pose strong barriers to understand physics. Students have many misconceptions related to their own previous experiences or knowledge. The traditional teaching methods often fail to rectify those misconceptions. Arguably, various instructional strategies, instead of traditional lecturing can dispel student misconceptions in physics.

**Need and Significance of the Study**

The complex and abstract nature of many a concept in science makes them difficult to understand. Nevertheless, complexities are not the only barrier to our understanding science concepts. The subject seems much more difficult due to the presence of numerous misconceptions.

From the developmental view of science education, children do not come to school for the first time at “zero” in science learning. They might have already
reacted to gravity, energy, lightning, thunder, darkness, light, weather and a host of other scientific phenomena. However, many of their experiences could be misconceptions, superstitions and fear. Students bring into school a good attitude for learning and readiness for the development of intelligent and resourceful behavior. Twenty-first century science teaching emphasizes upon the conceptual structure of science in order to enable the pupil to recognize and understand the rapid changes in scientific knowledge. To cope well with the rapidly changing industrial and digital world, pupils must develop and master the essential concepts.

A concept is an abstract idea based on grouping objects or events according to their common properties in order to think and communicate about endless objects, living things and events in the world. A person simplifies them by mentally grouping and organizing based on relationships and features they have in common. The process of constructing rules about how things go together is called concept formation. According to Ausubel (1968) “Concept formation is an act of discovery in which the active role of the learner is emphasized.”

Many of the educationists and psychologists have stressed the importance of concept formation in learning. According to Gagne if the child does not learn concepts and principles that are lower in hierarchy, the learning of those higher in the hierarchy becomes difficult or impossible. Attaining a concept is beneficial to the individual in several ways- in identifying objects around him, in reducing necessity of constant learning and in reducing the complexity of the environment.

The literature study indicated that there exist severe misconceptions among students. For example, students believe that air is not a form of matter, and that heavier objects sink in water irrespective of their densities. Studies in the area of misconceptions show that misconceptions can occur due to various reasons; whatever may be the reason it needs special attention.
Early misconceptions can haunt a student's science learning until the misconception is confronted (Brown & Clement, 1987; Hewson & Hewson, 1983). Students can become confused in physics and mis-learn because of a number of factors. Language usage, everyday experiences, metaphors and textbooks can cause difficulty in students forming acceptable understanding of physics concepts, theories and laws (Brown & Clement, 1987; Ivowi & Oludotun, 1987; Maloney, 1990).

Considering the above given facts, the investigator realized that a study on misconception in physics is as important as a study of concept formation. Misconception may hinder the exact and smooth learning of physics and thereby influence related fields. It makes obstacles in the way of science learning because science is a chain of connected concepts and phenomena. Keeping this in view, the investigator tries to identify major concept areas where misconceptions occur frequently. The investigator also feels that the knowledge of these misconceptions will be useful for science teachers to take up the necessary remedial and compensatory measures for improving the performance in physics.

Studies on misconception can help remove misconceptions by relevant methods and thereby it can contribute to the national development by eradicating superstitions, developing objectivity, open mindedness, critical thinking and by adopting scientific method in solving problems. Therefore, it will be worthwhile to investigate the misconceptions in physics concepts among the secondary schools students in Kerala. Hence, the investigator strongly felt to conduct a study of this kind.

**Statement of the Problem**

The problem selected for study is stated as “Identification of Misconceptions in Physics and Testing of Effectiveness of Certain Instructional Programmes on Remediation of the Misconcepts among VIII Standard Students in Kerala ".
Introduction

Definition of Key Terms

Definitions of corresponding terms related to the study are given below:

Misconceptions in Physics

Misconceptions in physics as used here means students’ non-scientific knowledge about areas such as false concept about scientific terms, definitions and phenomena. Inadequate or lack of acquisition of the most important and indispensable ideas covering important content areas should be mastered at a particular stage in order to get a clear idea of the discipline. Misconceptions are concepts developed in students about scientific processes and beliefs that run counter to the beliefs and theories held by scientists.

Certain Instructional Programmes

Certain instructional programmes stand for the methods other than traditional, which can be used effectively to minimize misconceptions and enhance understanding of important concepts. The proposed strategy is an eclectic one, developed by adopting strategies i.e., strategies of teachers and researchers whose students have relatively less misconceptions of the identified areas of misconceptions. Specifically, this study employed a combination of conceptual change, concept mapping, and participative approaches advocated by previous researchers, which is in tune with present constructivist paradigm being practiced in schools of Kerala.

Eighth Standard Students

Eighth standard students are operationally defined as the students studying in eighth standard of secondary schools affiliated to the Department of General Education, Government of Kerala.
Objectives of the Study

Present study as indicated in the title is “Identification of misconceptions in physics and testing of effectiveness of certain instructional programmes on remediation of the misconceptions among VIII standard students in Kerala”. This involves identifying frequently occurring misconceptions in physics among secondary school students, and verifying the effectiveness of selected instructional strategies in correcting the identified misconceptions among standard VIII students of Kerala. With these broad objectives, the following specific objectives were set for this study.


3. To identify the major concepts in physics and the minor concepts involved with each of them in which there exists significant difference in the percentage of error between boys and girls among VIII standard students of Kerala.

4. To identify the major concepts in physics and the minor concepts involved with each of them in which there exists significant difference in the percentage of error between rural and urban VIII standard students of Kerala.
5. To find out the effectiveness of a range of selected experimental instructional strategies in remediation of the identified misconceptions in physics among VIII standard students of Kerala.

**Hypotheses of the Study**

1. There will be significant difference in extent of misconception among girls and boys of VIII standard students of Kerala.

2. There will be significant difference in extent of misconception among VIII standard students in rural and urban secondary schools of Kerala.

3. There will be significant decrease in misconceptions after the implementation of selected experimental instructional strategies in remediating the identified misconceptions in physics.

4. The extent of misconception in physics after remedial instruction will be less in the experimental group than in the control group.

**Methodology**

This study adopts a mixed method approach. The study was completed in two phases, a survey phase leading to an experimental phase.

**Variables in the Survey Phase**

Survey phase of the study explored the misconceptions in physics among secondary school students, in the total sample and subsamples based on gender of students and locale of schools.

**Attribute variables.**

Survey phase has the following attribute variables, viz.

1) Gender

2) Locale of schools
**Criterion variables.**

The criterion variables in the survey phase are misconception in physics. This variable is explored in terms of misconceptions in fourteen major conceptual areas of physics viz.,

i. Matter
ii. Solar system
iii. Density
iv. Pressure
v. Velocity
vi. Mass
vii. Force
viii. Gravity
ix. Work
x. Energy
xi. Light
xii. Sound
xiii. Magnetism
xiv. Electricity

Misconceptions in each of these fourteen areas are further analyzed in terms of the minor concepts involved in each of the major concepts.

**Variables in the Experimental Phase**

The experimental phase of the study constitutes independent variable and dependent variable. This phase involves testing the effectiveness of select interventions for remedying the misconceptions identified during the survey phase. Hence, this phase has identified independent and dependent variables.
Independent variable.

The independent variable of the study is instructional method for remediation of misconception referred to as remedial instruction programme. This variable has two levels, the remedial instruction programme, and a no treatment control. This programme is constituted as an eclectic set of instructional strategies chosen from previous researches, subject to the judgment that such strategies fit to the paradigm of education and infrastructural facilities in schools of Kerala. Specifically, three conceptual change strategies were employed as instructional programmes for remediying misconceptions in physics. They were conceptual change strategy, concept mapping, and participative approach.

Thus, in addition to the effect of total instructional programmes on total concept attainment in physics, the effect of the three strategies individually and in combination on the concept attainment in select areas of physics were studied as follows.

i. The effect of Conceptual change strategy on Concept attainment in Pressure
ii. The effect of Concept mapping strategy on Concept attainment in Motion
iii. The effect of Participative approach on Concept attainment in Sound
iv. The effect of Conceptual change cum concept mapping strategy on Concept attainment in Force, Density, Magnetism, Light, and Electricity

Hence, the independent variable, remedial instructional programme has four sub-independent variables viz.,

i. Conceptual change strategy (vs. no treatment control)
ii. Concept mapping strategy (vs. no treatment control)
iii. Participative approach (vs. no treatment control)
iv. Conceptual change cum concept mapping strategy (vs. no treatment control)

Dependent variable.

The dependent variable of the study is concept attainment in physics. This variable is quantified as the inverse of misconception in physics. The
concept attainment in physics in total and concept attainment in four broad areas of physics were analyzed for the studying the effectiveness of select set of instructional strategies. The four subset of dependent variables thus studied were:

i. Concept attainment in Pressure,
ii. Concept attainment Sound,
iii. Concept attainment Motion, and
iv. Concept attainment in Force, Density, Magnetism, Light, and Electricity.

These variables, as mentioned earlier, were quantified as inverse of misconception in these areas.

**Sample Used for the Study**

There were two sets of samples used in this study. One sample was used in survey phase and the other in the experimental phase.

**Survey sample.**

The present study was conducted on a representative sample of 476 secondary school students from eight schools of Kozhikode, Malappuram and Kasaragod revenue districts. Stratified random sampling techniques was used, giving due representation to factors including gender of the pupils and locality of the schools.

**Sample for experimental phase.**

A sample of 104 standard eight students from a secondary school randomly selected from the eight schools used in survey phase constitute the sample in the experimental phase. Forty-seven students each in experimental and control groups constitute these 104 students. An intact classroom to which an experimental conceptual change programme was imparted is the experimental group. Forty-seven students, formed by individual-to-individual matching with the experimental group on the pretest scores of conceptual attainment in physics and gender is the control group.
Introduction

Tools Used in the Study

For the present study the following tools are employed.

1) Test of Concept Attainment in Physics - Longer Version (TCAP) (Gafoor and Akhilesh, 2010)
2) Instructional Programmes on Remediation of the Misconcepts (Gafoor and Akhilesh, 2012)
3) Test of concept attainment in physics–Abridged Parallel Versions (TCAP) (Gafoor and Akhilesh, 2012)

Test of concept attainment in physics - Longer Version was employed in survey phase of the study, which was constructed by the investigator with the guidance of the supervising teacher. The objective of the study is to identify the extent of misconception regarding the major areas in physics among secondary school students. The Test of Concept Attainment in Physics composed of 98 items. After tryout, the items were reduced to 80 in number that come under 14 major concepts in physics.

The experimental phase was conducted with the administration of test of concept attainment in physics–abridged version, which included 40 test items covering seven major concepts in physics of which the secondary school pupils of eighth standard are familiar.

In addition to the measuring tools mentioned above, this study employed lessons based on conceptual change strategies viz., conceptual change, concept mapping, and participative approach to remediate the misconceptions among students in the experimental phase.

Scope and Limitations of the Study

The aim of the present study was to find out the extent of misconception in the selected concepts in physics in relation to gender and locality, and to verify the effectiveness of selected instructional strategies in correcting the identified misconceptions among standard VIII students of Kerala. The concepts are
selected based on a thorough analysis of physics concepts present in the Basic science being taught up to standard VIII in schools of Kerala. The concept areas selected to find out the extent of misconception in physics were chosen from interviews with teachers, literature review, and discussion with students. Tests of Concept attainment in physics was constructed, one for survey phase and two parallel versions for experimental phase.

The study was conducted on a sample of 476 pupils of VIII standard of secondary Schools of Kozhikode, Malapuram and Kasaragod districts, drawn by stratified random sampling technique.

The present study tries to test whether there is any difference in the concept attainment in physics and thereby tackle misconceptions persistent in Physics between boys and girls, urban and rural pupils. It also finds out the major concept areas where misconceptions occur frequently in minor concepts.

Three strategies for conceptual change viz., conceptual change, concept mapping, and participative approach were chosen based on the topics to be taught in schools and the curricular paradigm being followed in schools, plus, facilities in the school where the experimental sample was situated.

The effects of these strategies on remediation of the identified misconcepts were studied using a quasi-experimental design. Effects of individual strategies on the specific conceptual areas of physics were also explored.

The following are the limitations of the study

1. The study has been restricted to standard VIII which is taken as representatives of secondary school students.

2. Due to practical difficulty, the sample was restricted to only Kozhikode, Malappuram and Kasaragod districts of Kerala.

3. Due to the practical difficulties in time of test administration, some of the areas being taught at school level are avoided and restricted to 14 major concept areas of physics in secondary only.