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MISCONCEPTIONS IN PHYSICS AMONG HIGHER SECONDARY STUDENTS

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ABSTRACT

Physics is one of the important subjects in the school curriculum. Students learn various concepts in physics and apply in their day to day life activities. Concepts are the ideas based on scientific facts. Many students commit errors and form misconceptions while learning. Misconceptions are the incorrect understanding of ideas, objects or events that are constructed based on person's experience. The purpose of the study was to identify the misconceptions committed by higher secondary students in learning Physics. A two-tier diagnostic test was used as a tool to identify their misconceptions committed by students. The tool consisted of 19 items from four selected areas of Physics. Stratified random sampling technique was adopted for the present study. The findings of the study revealed that more than 50% of the students have difficulty in learning Physics. More over male students possessed more misconception than female students in learning physics. The study recommended that the teachers could use two-tier diagnostic test in order to analyze the misconception committed by the students and the appropriate remedial teaching methods could be provided to the particular students. It would help the teacher to achieve the classroom objectives effectively.

KEYWORDS: *Misconception, two-tier diagnostic test, remedial teaching.*

INTRODUCTION

Science has been regarded as the bedrock of modern technology. Without the application of science, it would be difficult for man to explore his knowledge. Science comprises of basis discipline such as Physics, Chemistry and Biology. Physics remains one of the most difficult subjects in the school curriculum. Most of the students perceived Physics as a difficult subject because of its abstract nature. (Ornek, Robinson, &Hangan, 2008) identified three major factors for difficulty in Physics namely student – controlled factors, course- controlled factors and faculty controlled factors. In the student controlled factors, students had to make use of variety of method for understanding the concept such as experiments, formulas and calculations, graphs and conceptual explanation at the same time. On the other hand lack of motivation and interest, not reading textbooks and practicing problems and lack of basic knowledge in Physics make the students feel physics as difficult subject. Faculty related factors such as not providing enough examples and real life applications also make them to feel difficult in learning physics.

Concepts are the ideas that help the students to understand the world around us. Misconceptions are the beliefs that students developed during their interaction with their learning and these beliefs have no basic in actual scientific facts. Some of the sources that make the students to develop misconceptions are daily life experience, interaction with teachers and textbooks, social interactions and experimental conclusions. Teacher plays an important role in the conceptual development of students during school days. The normal lecturing fails to overcome students' misconceptions (Demiric, 2005). Students are coming inside the class with some level of misconception about the subject. The level of misconception is unequal and is

related with the concept to be learned (Taufiq, Hindarto, & Khumaedi, 2011; Thompson, & Logue, 2006). Some misconceptions that transmitted from teachers to the students were also identified (Yates & Marek,2014., Ilyas, & Saeed, 2018.,Saglam-Arslan, &Deveciogli, 2010).

Hence teachers and other educators must understand the various instruments available to identify students' misconceptions. Studies showed that diagnostic instruments were effective in identifying student's misconception (Lin, 2004; Lai, & Chen, 2010; Loh, Subramanian, & Tan,2014; Cil, 2015). Teacher can use the available instruments to assess students' misconceptions and proper remedial teaching measures can be adopted to overcome the misconceptions of students.

OBJECTIVES OF THE STUDY

1. To identify the misconceptions committed by higher secondary students in learning physics.
2. To find out misconception experienced by male and female students in learning physics.

METHODOLOGY

Normative survey method was adopted for the present study. The present study was conducted on a sample of class XI students studying in different higher secondary schools of Kanniyakumari district following state board syllabus during the academic year 2015-16. Size of the sample was 675.Stratified random sampling technique was adopted for selecting the sample for the present study. A two-tier diagnostic test validated by the investigator was used for collecting the data. The tool consists of 19 items from four topics namely significant figures, rules for writing SI units, ray optics and force and its interactions of XI Physics. The statistical technique used for the present study was percentage analysis.

RESULT AND DISCUSSION

The analysis of data revealed the following results.

TABLE – I

STUDENTS RESPONSES ABOUT THE TOPIC SIGNIFICANT FIGURE

Sl. No	Learning Points	Total Correct answer	Total wrong answer	% of correct answer	% of wrong answer	Male	Female
						% of wrong answer	% of wrong answer
1	The number of meaningful digits in a number is called number of significant figures	169	506	25	75	84	69
2	Trailing zeros in a number with a decimal points are significant	131	544	19	81	86	77
3	All non-zero digits in a number is significant	320	355	47	53	66	44
4	All the zeroes between non-zero digits are significant	160	515	24	76	85	71
5	Zeroes at the end without decimal points is not significant	134	541	20	80	86	76

From the above table it is evident that, 81% of students have misconceptions in recalling the trailing zeroes in a number with decimal points are significant. 80% of students have misconception in learning zeroes at the end without decimal points are not significant. 76 % of students have misconception in learning zeroes between non-zero digits are significant.75% of students feel difficult in learning the definition of significant figure and 53% of the students have misconception in learning all non-zero digits in a

number is significant. From the above discussion it is clear that students experience a serious problem to identify the significant and non-significant figures in a digit. Male students possessed more misconceptions than female students on the topic significant figures.

TABLE – II

STUDENTS RESPONSES ABOUT THE TOPIC SI UNITS AND SYMBOLS

Sl. No	Learning Points	Total Correct answer	Total wrong answer	% of correct answer	% of wrong answer	Male	Female
						% of wrong answer	% of wrong answer
1	The unit named after scientists are not written with a capital initial letter	167	508	25	75	80	73
2	When temperature is expressed in Kelvin, the degree sign is omitted	204	471	30	70	77	65
3	Symbol of units named after scientists should be written in capital letter	244	431	36	64	72	59
4	Not more than one solidus is used in symbols	86	589	13	87	89	86
5	Small letters are used as symbols not derived from the proper name	203	472	30	70	77	65

It is evident from the above table II that,87% of students have committed errors in identifying the number of solidus used in symbols.75% of the students have misconception in writing unit named after scientists. 70% of students have committed mistake in identifying the fact that small letters are used in symbols and also degree sign should be avoided when temperature expressed in Kelvin. 64% of students have confusion in writing symbols of unit named after scientists. Also male students have serious problems in understanding the concept of SI units and symbols than female students.

TABLE – III

STUDENTS RESPONSES ABOUT THE TOPIC RAY OPTICS

Sl. No	Learning Points	Total Correct answer	Total wrong answer	% of correct answer	% of wrong answer	Male % of wrong answer	Female % of wrong answer
1	Condition for law of reflection	117	558	17	83	88	79
2	Prism separate white light into its constituent colors	98	577	15	85	86	85
3	Spherical mirror whose reflecting surface is curved inwards is called concave mirror	107	568	16	84	91	80
4	The distance between pole and the principle focus is called focal length	149	526	22	78	81	76

It is evident from the above table III, that most of the students have misconception in the topic ray optics. 85% of the students are not clear about the concept that a prism can separate white light into its constitutions colours. 84% of the students don't know the shape of the concave mirror. 83% of the students have difficulty in recalling the conditions for law of reflection and 78% of students do not know the concept of focal length of a mirror. Also male students have more misconceptions than female students in understanding the concept ray optics.

TABLE – IV
STUDENTS RESPONSES ABOUT THE TOPIC FORCE AND ITS INTERACTION

Sl. No	Learning Points	Total Correct answer	Total wrong answer	% of correct answer	% of wrong answer	Male % of wrong answer	Female % of wrong answer
1	Tensional force is an example for contact force	70	605	10	90	92	88
2	Electromagnetic force is an example for non-contact force	103	572	15	85	90	81
3	Inertia is the property of the body in which the body is unable to change its state by itself	240	435	36	64	79	55
4	Inertia of rest is the inability of the body to change its state of rest by itself	206	469	31	69	76	66
5	Inertia of direction is the inability of the body to change its direction of motion by itself	117	558	17	83	85	81

It is evident from the above table IV that, 90% of students committed errors in identifying the example for contact force. 85% students experience difficulty in understanding the concept non-contact force. 83% of students feel difficulty to identify the examples for inertia of direction. 69% of students are not able to identify the examples for inertia of rest. Moreover 64% of students are not able to recall the definitions of inertia. Also male students possess serious misconception than female students in understanding the concept force and its interaction.

FINDINGS OF THE STUDY

The following were the findings of the study.

1. Analysis of misconception of students (based on learning points) on the topic significant figure, rules for writing SI Units and symbols, ray optics and force and its interaction revealed that more than 50% of students committed errors in all the learning points.
2. Maximum number of students has committed errors in the concept of contact force, usage of solidus in symbols, prism separate white light and examples for non-contact force.
3. Minimum number of students committed errors to identify all non-zero digits is significant, symbols of unit named after scientists and definition of inertia.
4. Male students posses more misconception than female students in learning the four different concepts in physics.

CONCLUSION

From the present study it is revealed that majority of students having difficulty in learning the selected concept in physics. More than 50% of the students committed error in the 19 learning points from the four different areas. 87% of students were not aware about the usage of solidus in the units. 81% of the students were not clear in understanding the concept trailing zeroes in significant figures. 85% of the students were not familiar about prism separate white light into its constituent's colors and 90% of the sample were not clear about the concept contact force. More over male students shows more misconception than female students in all the selected learning points. This shows light to the teachers who provide special attention for male students while the process of teaching and learning takes place.

EDUCATIONAL IMPLICATIONS

It's the duty of the teacher to analyze the student's misconception before the process of teaching. So teachers should be well equipped with preparation of diagnostic test and other related techniques to identify the student's level of misconception. Based on the analysis teacher can adopt proper remediation that can reduce the level of misconception. Innovative strategies can be adopted other than normal classroom teaching in order to create interest among students. Cooperative learning, collaborative learning, multisensory approach can enhance the student to construct physics concept in their own ways their by overcoming the misconception level of the students.

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