

A Study on the Relation between HOTS Awareness and Achievement in Physics of Secondary School Students of Kerala

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Abstract: *Higher order thinking skills should be developed in students in a proper way so that abstract reasoning, critical and creative thinking and problem solving ability develop in an appropriate way which is very essential in science learning. So the higher order thinking skills is a need of the hour for budding science students to grow their potentials to the maximum and to contribute effectively to the world as future scientists. This will clearly result in better achievement in physics. The present article tries to find out the relationship between HOTS awareness of secondary school students and Achievement in Physics of Secondary school students. The study also tries to find out the relationship between HOTS awareness level and Achievement in Physics of Secondary school students based on the subsample Gender.*

Keywords: HOTS awareness level, HOTS oriented achievement, Secondary school students

1. Introduction

Based on the different levels of the cognitive skills, the educational reformers are trying for enhancing the higher order thinking skills. This enhancement is meant for leading students to be more critical and creative; in a way that they can use the content of knowledge in a thorough comprehension which may assist them to research information, analyze, evaluate and to be critical and creative in responding to questions and in solving their problems [5]. Therefore, the inclusion of higher order thinking skills (HOTS) in education has become one of the reform step that has been conducted to develop students critical and creative thinking [6].

The cognitive domain of Revised Blooms taxonomy can be categorized into lower order and higher order thinking skill. remembering, understanding applying are considered as the lower order thinking skills and analyzing, evaluating, creating skills are considered to be higher order thinking skills. The other forms of higher order thinking skills are mainly;

- Creative thinking
- Critical thinking
- Decision making
- Logical thinking
- Met cognitive thinking
- Problem solving
- Reflective thinking
- Scientific experimentation
- Scientific inquiry (inquiring skills)
- System analysis
- Visualization
- Reasoning skills
- Communicating skills
- Conceptualizing skills.

All these higher mental abilities are very crucial for learners for their academic wellbeing. In close observation it can be seen that the skills such as reasoning, creative thinking, problem solving, critical thinking are very essential for science students especially for physics learning. Critical thinking and reflective thinking are often used synonymously or reflective thinking is a part of critical thinking. Higher – order thinking basically means thinking that is taking place in the higher levels of the hierarchy of cognitive processing. Higher order thinking by students involves the transformation of information and ideas. This transformation occurs when students combine facts and ideas and synthesis generalize explain, hypothesis or arrive at some conclusions or interpretations [7].

To develop students' high - order thinking skills there are five stages [8], namely: (1) determining learning objectives, (2) teaching through questioning, (3) practicing before assessment, (4) review, refine, improve, as well as (5) providing feedback and assessment learning. This indicates that giving HOTS question is not the only way to develop high - level thinking skills in an integrated way. HOTS questions are measuring instruments used to measure higher order thinking skills, i. e. unexpected capabilities (recall), restatement (repetition), or attempt without using processing (reading). HOTS questions in the assessment context measure abilities such as; 1) transferring one concept to another, 2) processing and applying knowledge in real life, 3) looking for links from different information, 4) using information to solve problems, and 5) examining ideas and information critically.

1.1 Need and Significance of the Study

Physics is a school subject that involves complex scientific concepts that requires proper development of higher order thinking to grasp the inner concepts. Barak and Dori [3]

defines higher order thinking as a complete mode of thinking that often generate multiple solutions without reliance on the application of specific sets of procedures. Miri, Ben – Chaim and Zoller [4] explained that HOTS involve complex thinking, multiple solutions, uncertainty, application of multiple criteria, reflection and self regulation. Valentino and Andre [11] argued for a move away from the use of lower - order thinking skills (LOTS) in e - assessment in favor of higher - order thinking skills (HOTS), in line with Bloom's Revised Taxonomy delivered via a Learning Management System (LMS) in a chemistry course which enhanced higher - order learning outcomes.

Allan A [10] revealed that the use of the supportive graphical intervention in the construction and extraction of graphs improved the graphing skills and conceptual understanding of students. Yasemin and et. al [9] found that the gender differences in conceptual post - test performance were mediated by the model variables like students' prior physics knowledge and skill differences, and self - efficacy also had the strongest total gender effect on conceptual learning.

From the studies Investigator realized that practicing higher order thinking skills effectively reflect in the Achievement of students. So the investigator tried to find out the significant relationship between HOTS Awareness level and Achievement in Physics of secondary school students and whether Gender plays any significant role in this relationship.

1.2 Objectives of the Study

- To find out whether there exists any significant difference in the HOTS awareness level of Secondary school students based on subsample Gender
- To find out whether there exist any significant difference in the Achievement in Physics of Secondary school students based on the Subsample Gender
- To find out whether there exist any significant relationship between HOTS awareness level and Achievement in Physics of Secondary school students for the total sample and subsample based on Gender

1.3 Hypotheses of the Study

- There will be significant difference in the HOTS Awareness level of secondary school students based on the subsample Gender
- There will be significant difference in the Achievement in Physics of secondary school students based on the subsample Gender
- There will be significant relationship between HOTS awareness level and Achievement in Physics of Secondary school students for the total sample and subsample based on Gender

1.4 Sample Selected for the Study

The sample selected for the study consists of 150 secondary school students studying in standard VIII and IX from various schools of Thrissur District. Out of the 150 Secondary School students, 90 were Boys and 60 were Girls.

The sample was selected using Stratified Random sampling Technique.

1.5 Methodology of the Study

The Investigators adopted Survey Method for collecting the data of HOTS Awareness level scale. The Investigators administered HOTS Awareness level scale and HOTS oriented Achievement test in Physics among Secondary school students of the selected sample. The answer sheets were collected; tabulated and suitable statistical techniques were used for analyzing the data obtained.

1.6 Tools used for the Study

1.6.1 HOTS Awareness level scale: - The HOTS level awareness scale was prepared in the form of a Likert type Rating Scale. It was prepared in the form of a five point scale. It consists of 25 items based on the dimensions General awareness, reasoning skills, Problem solving skills, critical thinking skills and creative thinking skills. Reliability of HOTS level awareness scale was ensured using Test – re test reliability and correlation coefficients for various components of HOTS level awareness scale are General awareness (0.60), Reasoning skills (0.47), Problem solving skills (0.54), Critical thinking skills (0.56) and Creative thinking skills (0.57). content validity and Intrinsic validity were also established for the scale

1.6.2 HOTS oriented Achievement test in Physics: - The test consists of 60 multiple choice test items with 1 mark for each and a total of 60 marks. It consists of the dimensions namely Reasoning skills, Problem solving skills, Critical thinking skills and Creative thinking skills. Test – retest method was used for finding the reliability of HOTS oriented achievement test and the reliability coefficients obtained for various domains of HOTS test includes; 0.80 for Reasoning skills, 0.74 for Problem solving skills, 0.83 for Critical thinking skills and 0.8 for Creative thinking skills which are all significant at.01 level of significance. Content validity and Intrinsic validity were also established for the test.

1.7 Statistical techniques used for the Study

- Descriptive Statistics
- Significance of difference between Means
- Call Pearson Product moment Correlation

2. Analysis and Discussion

2.1 Descriptive statistics for HOTS Awareness level and Achievement in Physics for the Total sample and subsample based on Gender

The Investigators collected the scores of students on HOTS Awareness level scale and HOTS Oriented Achievement test in Physics. The Mean and Standard Deviation obtained for the Total sample and Subsample Boys and Girls on HOTS Awareness level and Achievement in Physics were given in Table 1.

Table 1: Descriptive Statistics for the Total sample and Relevant Subsamples on HOTS Awareness level and Achievement in Physics

Variables	Total Sample		Boys		Girls	
	Mean	S. D	Mean	S. D	Mean	S. D
Achievement in Physics	32.49	13.502	32.71	13.382	32.15	13.78
HOTS Awareness level	94.97	13.482	95.39	13.6	94.33	13.44

Table 1 show that the Mean scores obtained by Boys on variables Achievement in Physics and HOTS awareness level are slightly higher than Girls. This implies that Boys have more HOTS awareness level than Girls which led to more Achievement for Boys than Girls.

2.2 Comparison of HOTS Awareness level and Achievement in Physics of Secondary school students based on Subsample Gender

The Mean and Standard deviation were calculated for the Subsamples Boys and Girls. Significance of difference between the Mean Scores of Boys and Girls were found out for the variables Achievement in Physics and HOTS awareness level. The results obtained were given in Table 2.

Table 2: Comparison of Boys and Girls on HOTS Awareness level and Achievement in Physics

Variables	Gender	N	Mean	S. D	t - value
Achievement in Physics	Boys	90	32.71	13.4	0.469
	Girls	60	32.15	13.78	
Scientific Interest	Boys	90	95.39	13.6	0.249
	Girls	60	94.33	13.44	

Table 2 shows there is no significant difference between the Boys and Girls on Achievement in Physics and HOTS awareness level of Secondary school students. The Mean scores however show that Boys are slightly higher than Girls in Achievement in Physics and HOTS awareness level.

2.3 Relationship between Scientific Interest and Achievement in Chemistry of Secondary School Students for the Total Sample and for the Subsample based on Gender

The correlation between Achievement in Physics and HOTS awareness level were found out for the Total Sample and the Subsample Gender using Pearson Product moment Correlation. The results obtained are given in Table 3.

Table 3: Correlation between Achievement in Physics and HOTS awareness level for the Total Sample and Subsample Gender

No.	Variables Correlated	'r' value		
		Total Sample (N = 150)	Boys (N = 90)	Girls (N = 60)
1	Achievement in Physics and HOTS awareness level	0.913**	0.059	0.045

** - Significant at.01 level

Table 3 shows that the correlation coefficients obtained for the Total Sample, Boys and Girls are all positive. This reveals that there exists a significant positive correlation

between Achievement in Physics and HOTS awareness level for the Total sample and to a small extent for the subsamples Boys and Girls.

2.4 Major Findings of the Study

- There exists significant positive Correlation between Achievement in Physics and HOTS awareness level of Secondary school students for the Total Sample and to a small extent for Subsample Gender
- There is no significant difference in HOTS awareness level of Secondary school students based on Subsample Gender
- There is no significant difference on Achievement in Physics of Secondary school students based on Gender.

3. Conclusion

From the analysis and discussions, it was clear that the factor HOTS awareness level is influencing achievement in physics to a greater extent. Moreover skill related practices are necessary for achievement in science subjects, especially in physics learning.

4. Future Scope from the Study

The variables HOTS awareness level and Achievement in Physics are positively correlated. This implies that the Teaching and learning activities in Science classrooms should focus on the ways for enhancing Higher order thinking skills among students who are the budding scientists for the future scenario. The concepts and principles learning in the class rooms must be properly interconnected with the practical life situations in daily life.

- The Science curriculum should be restructured for giving ample space for the learning activities that will cater to the needs of students and thereby promoting Higher order thinking skills
- The result which shows no significant difference between Boys and Girls in HOTS Awareness level and Achievement in Physics is a merit of the present Educational system. It is a good sign that Gender disparity does not exist in the Achievement level and level of HOTS awareness. But the Teaching - learning process must be made more strengthened by developing creative and efficient ways of Teaching Methods and Techniques to reduce the disparity based on gender to the minimum level possible.

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