

Higher Order Thinking Skills A Study of Junior Secondary Level Students

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ABSTRACT

Higher Order Thinking Skill (HOTS) is an idea that has been derived from Bloom's taxonomy of educational objectives. The HOTS are the cognitive processes that require higher level of thinking. They are the thought processes that encompass analysing, creating and evaluating. The ultimate aim of our educational process is to develop quality thinking in students. Thus, this paper aims to study the development of HOTS of junior secondary level students Jawaharlal Navodaya Vidyalaya (JNV). The study is empirical and quantitative in approach. For the collection of data, a standardized tool named HOTS constructed by S.K. Bawa and Neeraj Sharma has been used. Descriptive survey method is being employed for primary data collection. Descriptive statistics like Mean, Percentage and Bar diagram have been used for analysis the data. The result of the study discloses that male and female students do not show noteworthy difference in their HOTS.

[Key words: HOTS, Junior Secondary Students of JNV, Chirang District of Assam]

Introduction

He was B.S. Bloom who propounded taxonomy of educational objectives for the first time in 1956 which consists of three domains: cognitive, affective and psychomotor. He again classified cognitive aspect into six categories hierarchically organized from concrete to abstract, from easiest to the most difficult. These comprise knowledge, comprehension, application, analysis, synthesis, and evaluation. The transition in cognitive aspect distinguishes lower to higher levels of cognitive processing. The first three categories of Bloom's taxonomy, i.e., knowledge, comprehension & application assess the students' lower order thinking skills (LOTS), but the remaining three categories i.e. analysis, synthesis and evaluation assess the higher order thinking skills (HOTS) (Chang & Mao, 1999)

Later, a prior disciple of Bloom named Lorin Anderson and his associates published an updated version of Bloom's taxonomy. The original categories of Bloom's cognitive domain i.e. knowledge, comprehension, application, analysis, synthesis and evaluation were referred to as nouns whereas, in the updated version, Anderson and his associates replaced the nouns with verbs to reflect thinking as an active process. The noun 'Analysis' placed in Bloom's forth category was replaced by the verb 'Analysing' in the updated version. The term 'Analysing' is used to mean breaking information into parts and making evaluation between a text and prior knowledge. The verbs like compare, examine, arrange, discriminate, recognize, separate, compute, assume, select, amalgamate and inspect etc. have been applied to analysing activities. To apply the analytical thinking process, the students must possess the ability to make connections and make inferences. The noun 'Synthesis' placed in fifth category in Boom's taxonomy was substituted by the verb 'Creating' and placed in the sixth category by Anderson in the updated version. Anderson defined the process of creating as mixing things or elements to form a previously unknown pattern. The verbs like organize, choose, devise, combine, generate, predict, compose, construct, invent, design, initiate, assume, advance, articulate, design, generate etc. have been used for creating activities. To achieve at this category, the students must be able to combine their thoughts and make predictions based on information. The last category of Bloom's taxonomy is 'Evaluation'. Bloom placed this skill at the highest level. In the new version, it is placed in fifth category and renamed it by Andrson as 'Evaluating'. According to him, the verb 'evaluating' means making decisions based on in-depth reflections, criticism and assessment by checking, hypothesizing, critiquing, judging, testing,

detecting and monitoring. The verbs like judge, assess, check, compare, conclude, criticise, compile, justify, detect, test, monitor etc. are applied in evaluating activities.

Review of Related Literature

In the midst of developing this paper, a number of literatures having national and international reputations have been reviewed. Thomas and Thorne (2009) stated that HOTS possess a higher thinking level than remembering facts or reiterating anything that is perceived. Remembering facts or reiterating is included in lower order thinking skills because students are comparable with robots who only repeat what is found and perform what they are instructed in order to avoid the high level of thought process.

A representative study was conducted by **Saido et al. (2015)** on higher order thinking skills of 7th grade 349 students in Kurdistan, Malaysia using a Bloom-based HOTLT test. Findings showed that only 20% (16% of male, 24% of female) of the students showed higher order level of thinking skills, whereas 80% of students (84% of male, 76% of female) at the lower-order level. It is also observed that gender differences were observed, but the chi-square results indicated that there was no significant difference between the levels of thinking skills according to gender.

Wandia (2017) examined teachers' understanding of Higher Order Thinking Skills (HOTS) assessment and aims to enhance their capacity to design effective HOTS-based tasks. Drawing on literature reviews, documentation, and observations, it identifies the essential characteristics of HOTS assessments, particularly their focus on non-routine items that measure analysis, evaluation, and creation. The study also outlines clear procedures for developing such items and emphasizes their benefits, including increased student motivation and improved learning outcomes. Overall, it highlights the critical role of well-designed HOTS assessments in inspiring instructional quality.

Tanujaya et al. (2017) conducted a study on the relationship between students' higher-order thinking skills (HOTS) and grade point averages (GPAs) of their academic performance in mathematics instruction. The study uses descriptive statistics, correlation, and regression analysis to examine the relationship between students' Higher Order Thinking Skills (HOTS) and GPAs. Results of the study showed a strong positive correlation ($r = 0.814$, $p < .001$), which indicates that HOTS are associated with higher GPAs. Regression findings further confirm this relationship, showing that HOTS significantly predict GPAs. Overall, the analysis demonstrates a clear linear link between students' HOTS and academic performance.

Yuliati and Lestari (2018) studied to examine the higher-order thinking skills of Elementary School Teacher Education students in responding to HOTS-oriented questions. Using qualitative method supported by descriptive statistics, the research reveals that students' analytical, evaluative, and creative abilities remain limited, especially among those with moderate and low learning skills. High-ability students perform better but still struggle with creating HOTS-based tasks. The study highlights the need for improved instructional strategies and specialized learning modules to strengthen HOTS competence in future elementary teachers. The study highlights the essential need for Elementary School Teacher Education students to develop strong Higher-Order Thinking Skills (HOTS), as these competencies directly influence their future ability to design and implement HOTS-oriented learning activities in classrooms.

Pillay et al. (2018) conducted a review on the implementation of higher-order thinking skills for teaching and learning in Malaysia. He saw a number of issues that allied with the implementation of higher-order thinking skills from different aspects, such as teachers' lack of knowledge, inadequate understanding of the strategies to inculcate HOTS amongst teachers, insufficient materials and references to teach HOTS, and improper environmental settings to instil the learning of HOTS in the education classrooms. The paper emphasized that fostering students' critical and creative thinking requires well-prepared teachers, supportive resources, and strategic teaching methods. Strengthening teacher competence remains essential for achieving national goals in HOTS development.

The study of **Tsaparlis (2020)** offers a detailed re-examination of higher- and lower-order thinking skills in the Greek Nationwide Chemistry Examinations, focusing on performance patterns from 2018 and 2019. Analysis reveals that while students performed consistently well in LOTs-oriented sections, a sharp decline occurred in 2019 due to Section B, which contained a high proportion of HOTS questions requiring conceptual understanding and reasoning in unfamiliar contexts. Teacher feedback confirmed that question style, wording, and contextual novelty increased cognitive demand. The study effectively links poor performance to HOTS-heavy items and highlights misalignment between exam expectations and students' preparation, offering valuable insights for assessment design.

Significance of the Study

The study of higher order thinking skills (HOTS) among secondary students is significant because these skills—analysis, evaluation, and creation—are essential for preparing learners to handle complex academic tasks and real-life problem-solving demands. Understanding students' HOTS levels enables teachers to identify gaps between curriculum expectations and actual learner competencies, thereby guiding more effective instructional strategies. For teachers, the findings can inform classroom practices that move beyond rote

memorization and promote critical and creative thinking. For curriculum developers and school leaders, the study provides evidence for improving assessment methods, teaching materials, and learning environments that support cognitive development. In due course, enhancing HOTS among secondary learners contributes to producing independent thinkers and help them capable of adapting to future academic, technological, and workplace challenges.

Regarding the significance of HOTS, **Tanujaya et al. (2017)** pointed out that higher order thinking skills are the significant attributes in education. Students having high HOTS tends to be more successful in education. There prevails a substantial relationship between students' academic achievement and HOTS.

HOTS are very fundamental to educational process. These help the students adequately to comprehend, analyse and critically assess the knowledges they acquired in life. These are very crucial in learning because they enable students to exercise their minds and draw up with their own findings, ideas, and novel answers to challenging issues. Therefore, the present study considers the higher level of cognitive domain of analysing, creating and evaluating from Anderson and Krathwohl's new version of Bloom Taxonomy.

Secondary stage of education plays a vital role in shaping an individual's future. It gives emphasis on the development of cognitive, affective and psychomotor domain of the students through academic and non-academic activities. In this regard, teachers' active participation plays a significant place in the whole educational process. Due to the advancement of science and technology, the process of education is changing very fast. This changing in educational process help in broadening the learner's mental horizon. As a result, the HOTS of the students begin to develop in a very rapid manner. HOTS are the thought processes of enhancement in the ability of learning, speed and effectiveness in educational process. Thus, there is a great significance of study in regard to HOTS of Junior Secondary level students

The HOTS are very helpful to growing students to solve their numerous problems faced in the teaching-learning process of formal education. The modern world has become very competitive and challenging in every dimension of life. Modern education system has given utmost importance upon the improvement and development of HOTS of the students. Therefore, the students studying in class IX and X has been taken into consideration for studying the development of their HOTS.

Operational Definition of Key Terms

HOTS: It stands for higher order thinking skill. HOTS are mental operations that need more complicated and advanced thinking. Higher order thinking skills are defined as three cognitive skills: **Analysing, Creating and Evaluating**.

Analysing: Analysing is the process of determining motives or causes and interrogating information, breaking it down into its constituent components, drawing conclusions and seeking proof to help generalizations. The sub-skills under this category to be studied include-comparing, discriminating, classifying, computing, structuring, integrating.

Evaluating: The term 'evaluating' is used to mean providing and protecting opinions based on forming assessments about data, the exceptionality of work, or the validity of ideas under given conditions. The sub-skills under this skill to be studied are detecting, assessing value, judging, critiquing and compiling.

Creating: The term 'creating' refers to the process of assembling data into an innovative way by mixing variables into a fresh sample or presenting alternative solutions, such as producing, designing, generating, inventing, and so on. The sub-skills to be studied under this heading are organizing, devising, predicting, generating and planning.

Objectives of the Study

- i. To study the levels of HOTS of the junior secondary level students of JNV, Chirang district of Assam.
- ii. To compare the levels of HOTS between male & female students of the junior secondary level students of JNV, Chirang district of Assam.
- iii. To study the demonstration of HOTS by the junior secondary level students of JNV, Chirang district of Assam.

Null-Hypothesis (H₀) of the Study

- i. Male & female students of junior secondary level of JNV, Chirang district do not differ significantly in HOTS.

Methodology of the Study

The present study is based on empirical data. Descriptive survey method has been employed for the collection of primary data. For the collection of data, a standardized scale named '**Higher Order Thinking Skills (HOTS) Scale**', constructed by **Bawa and Sharma (2023)** which is valid for the age group of 15-18 years has been used. This scale possesses both validity and reliability. The students of class IX and X of JNV are the primary sources here. Secondary sources like books and journals having research articles related to HOTS have been taken for review and references. In the present study, purposive sampling technique has been used for sample selection. Data has been analysed by tabulation and graphical representation of Histogram converting the data into percentage; and for testing hypothesis, Mean, SD and 't' test have also been employed. Thus, the present investigation is quantitative and descriptive in approach.

Table-1 mentioned below describes the population and sample of the present investigation-

Table-1 Population and Sample of the Study

Class	Sex	Population	Sample
Class IX	Male	40	32
	Female	40	31
Class X	Male	46	33
	Female	34	32
Total		160	128

Delimitation of the Study

The study is delimited to class IX and X students of the academic session 2023-24 studying at JNV, Chirang district of Assam, India.

Levels of Data Analysis

The HOTS are categorized into three levels for the purpose of analysing data. Table-2 mentioned below shows the levels data analyses of HOTS –

Table-2 Level of HOTS

Categories	Scores
Low level of HOTS	12 and below
Moderate level of HOTS	Between 13-18
High level of HOTS	19 and above

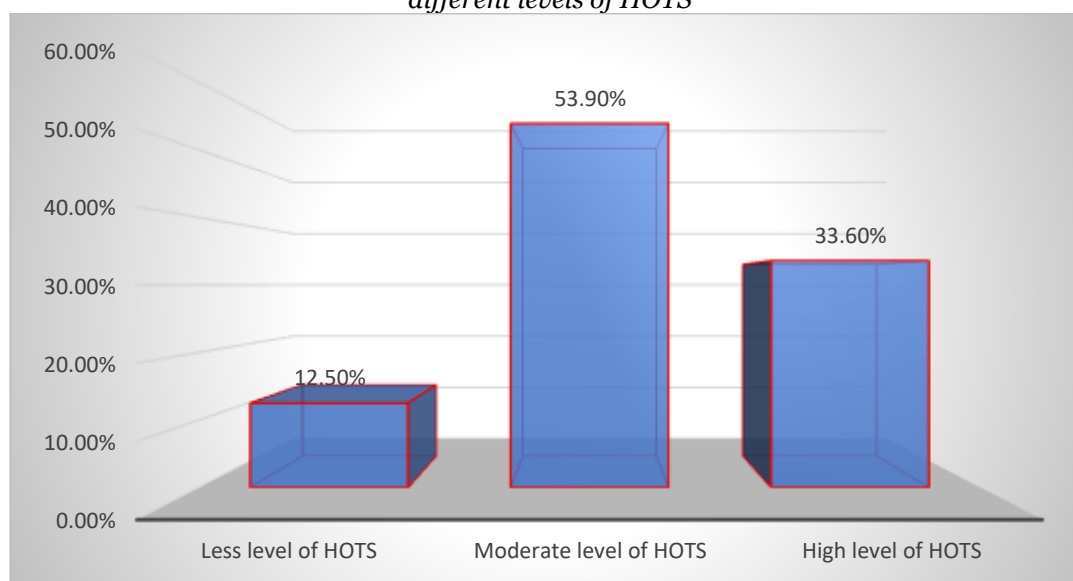
Analysis and Interpretation of Objective No. 1

The study on objective no.1 has been represented by the Table-3 and Fig. 1 mentioned below and is followed by interpretation-

Table-3 Junior secondary level students of JNV, Chirang district showing different levels of HOTS

Levels of HOTS	No. of Students	Percentage
Low level of HOTS	16	12.50%
Moderate level of HOTS	69	53.90%
High level of HOTS	43	33.60%

Fig.-1 Graphical representation of junior secondary level students of JNV, Chirang district showing different levels of HOTS



Interpretation:

The aforementioned **Table-3** and **Fig-1** indicate that the majority of the junior secondary level students of JNV, Chirang district demonstrate satisfactory development of HOTS. Over half of the students (53.90%) possess a **moderate** level of HOTS, while a substantial proportion (33.60%) exhibit a **high** level of HOTS.

Whereas, only a small number of students (12.50%) of junior secondary level of JNV, Chirang district exhibit **low** level of HOTS. This distribution suggests that overall cognitive performance is generally strong, with relatively few students needing significant support to improve their higher-order thinking abilities.

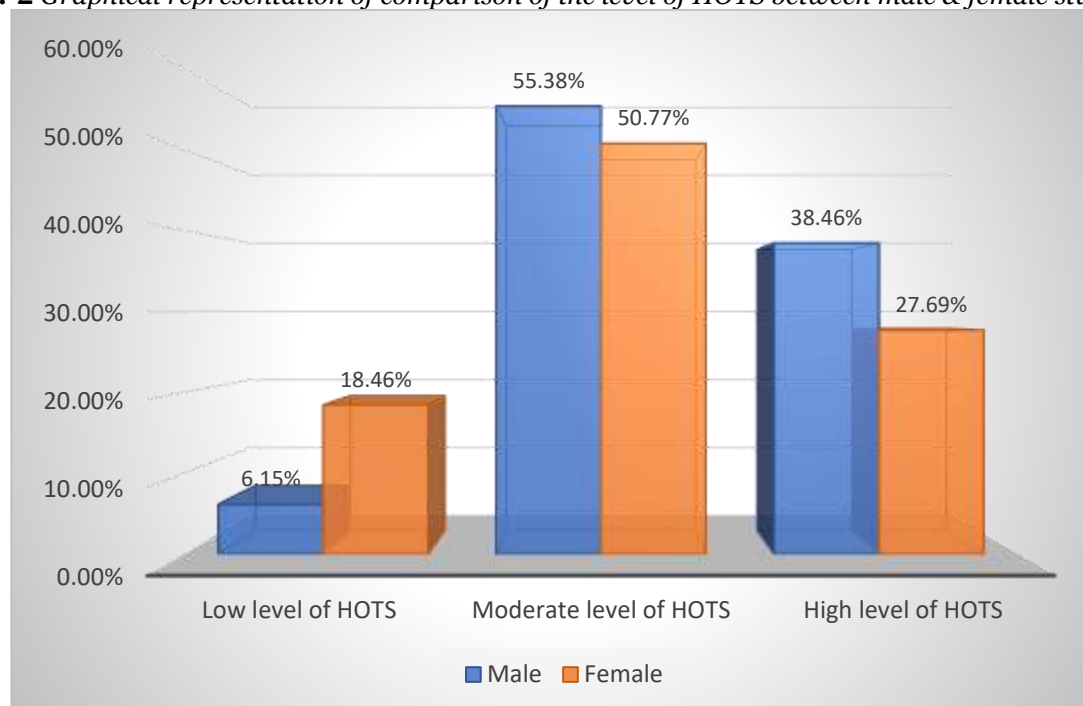
Analysis and Interpretation of Objective No. 2

The study of objective no. 2 has also been denoted by the **Table-4** and **Fig.-2** mentioned below and is followed by interpretation –

Table-4 Showing comparison of the levels of HOTS between male & female students of junior secondary level of JNV, Chirang district

Levels of HOTS	Male		Female	
Low level of HOTS	4	6.15%	12	18.46%
Moderate level of HOTS	36	55.38%	33	50.77%
High level of HOTS	25	38.46%	18	27.69%

Fig.-2 Graphical representation of comparison of the level of HOTS between male & female students



Interpretation

From **Table-4** and **Fig-2**, it is evident that male students have a higher percentage representation in both the **moderate** and **high** levels of HOTS compared to female students. In contrast, a greater percentage of female students fall under the **low** HOTS category. This pattern indicates that male students generally demonstrate stronger higher-order thinking skills than female students in this sample

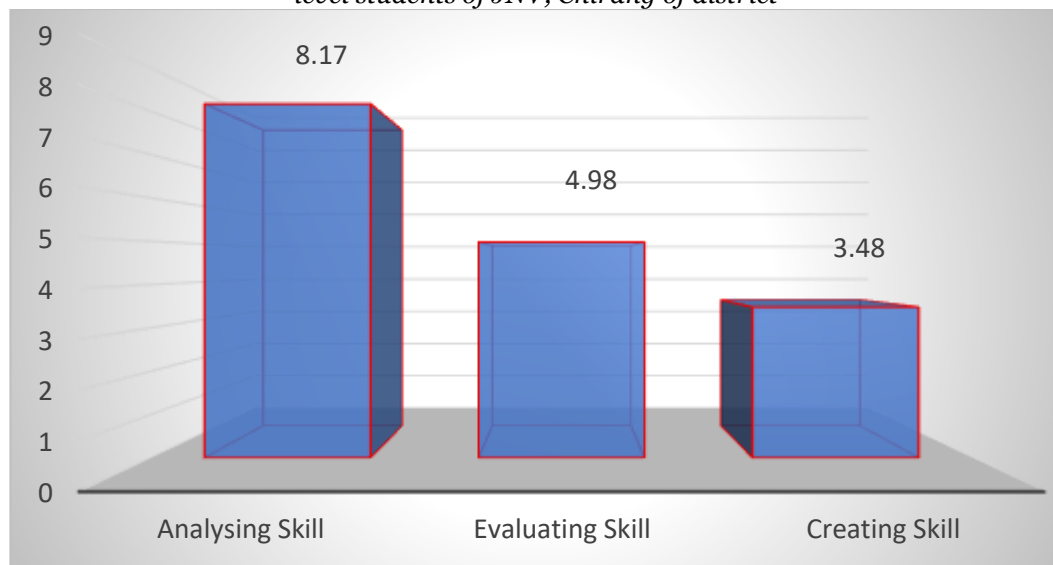
Analysis and Interpretation of Objective No. 3

Table-5 and **Fig.-3** mentioned below indicate the demonstration of HOTS by the junior secondary level of JNV, Chirang district of Assam-

Table-5 Showing Mean values of HOTS demonstrated by the junior secondary level students of JNV, Chirang district

Statistics	Analysing Skill	Evaluating Skill	Creating Skill
Mean	8.17	4.98	3.48

Fig.-3 Graphical representation showing Mean values of HOTS demonstrated by the junior secondary level students of JNV, Chirang of district



Interpretation:

From the aforementioned **Table-5** and **Fig.-3**, it is observed that among the three HOTS, analytical skill has showed more mean value than evaluation and creating skills. In this study, the more the Mean value, the more the demonstration among the HOTS, and the lesser the Mean value, the lesser the demonstration among these HOTS. Thus, it is evident to say that, the junior secondary level students of JNV of Chirang district show more analytical skill as compared to evaluating and creating skills.

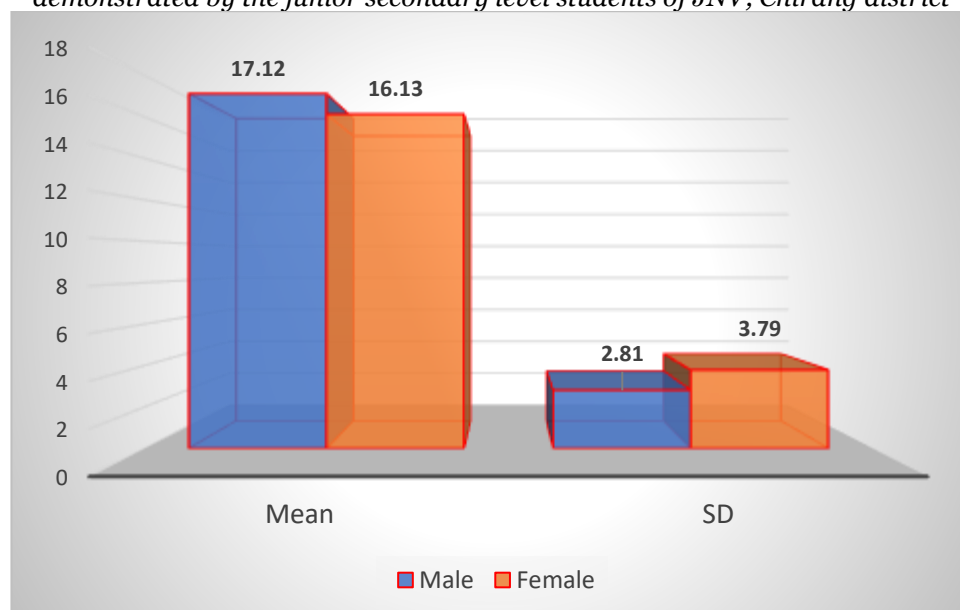
Testing of Null Hypothesis

Table-6 and **Fig. 4** shown below indicate the Mean value and Standard Deviation of male and female students of junior secondary level of JNV, Chirang district along with the 't' value.

Table-6 Showing Mean, Standard Deviation and 't'-value of the male and female students of JNV, Chirang district

Sex	N	Mean	SD	t-value	Level of Significance
Male	65	17.12	2.81	1.68	Not Significant at 0.05 level of significance
Female	63	16.13	3.79		

Fig.-4 Graphical representation showing Mean and SD of male and female students of HOTS demonstrated by the junior secondary level students of JNV, Chirang district



The above **Table-6** and **Fig.-4** indicate that, on average, male students demonstrate slightly stronger higher-order thinking skills than female students. The higher standard deviation among female students suggests greater variability in their HOTS performance, while male students show more consistency in their scores. The 't' value of 1.68 also indicates that there is no significant difference in the exhibition of HOTS between male and female students of the junior secondary level of JNV, Chirang district. Thus, the null hypothesis stated as **“Male & female students of junior secondary level of JNV of Chirang district do not differ significantly in HOTS”** is retained.

Major Findings of the Study

From the above analyses and interpretations of data, the following **major findings** can be drawn out-

- ❖ More than half of the students, i.e., **53.90%** of the students studying in Class IX and X at JNV, Chirang district show **moderate** level of HOTS. However, 33.60% and 12.53% of the students studying in Class IX and X at JNV, Chirang district show **High and Low** level of HOTS, respectively.
- ❖ While comparing different levels of HOTS in-between male and female students of junior secondary level of JNV, Chirang district, it is observed that male students are found to be larger than female students in exhibiting **moderate** and **high** levels of HOTS. It is also noticed that female students are found to be larger than male students at **low** level of HOTS. However, male students are found to be relatively larger to show HOTS as compared to female students.
- ❖ Out of the three levels of HOTS, it is found that the Mean value of analysing skill is higher than the remaining two. It means that students of junior secondary level of JNV of Chirang district possess more analytical skills than creating and evaluating skills.
- ❖ It is also found in the study that the **Mean**-value of male students, i.e., 17.12 is higher than the Mean-value of female students, i.e., 16.13. It means that among the junior secondary level of JNV, Chirang district, male students possess more HOTS than the female students.
- ❖ The test of null hypothesis (H_0) denotes that male and female students do not differ significantly in the level of HOTS at the 0.05 level of significance

Conclusion

Cognitive development occupies a very significant place in our daily life. It helps us not only in solving critical problems of life but also helps in socio-economic advancement from individual level to nation. Our education system gives much emphasis on intellectual development of the students and it is secondary stage, where intellectual development is given much importance. Thus, for secondary level of education, teachers should be competent in such a manner that they can assist students in the progression of HOTS of the growing students. This development is not possible only through the instructions imparted within the four walls. Keeping in view the development of HOTS, the students should be given more experiential learning and conduct interventions. The activities relating to creativity, reasoning, problem solving, field study work, project work etc. should be given to students. Such activities can help the students in enhancing their HOTS.

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