Assessing Higher Order Thinking Skills of Elementary School Students

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Abstract

This study explores the level of developed analytical skills in elementary school students and analyzes the level of developed synthesis skills in elementary level students. Moreover, it investigates elementary level students' developed skills related to evaluation by assessing the current level of higher order thinking skills among elementary level students. In order to assess these skills the researchers developed a test consisting upon multiple choice questions (MCQ's) from general science subject prescribed for elementary level students. The final version after pilot test and determination of item analysis contained 18 multiple choice questions (MCQ's).The study was delimited to Islamabad model colleges for girls located in urban area. As per list of Federal Directorate of Education,thirty-four colleges of females are located in urban area. The researchers utilized systematic sampling and selected every fifth college from thelist provided by Federal Directorate of Education (FDE). As double stage sampling is utilized by researchers. At the first stage, female colleges located in urban area of Islamabad were selected. The sample selected for study was 341 students. The data obtainedas a result were analyzed by calculating percentage of students on the basis of scores obtained. The findings of research study showed that most of the students are falling in below average level regarding higher order thinking skills. Students are not capable of applying, analyzing, synthesizing and evaluating the data. The findings provide implications for teachers, heads of the educational institutes and assessment bodies. Teachers need to be encouraged to use student-centered approaches. In order to train teachersseminars, workshops and conferences may be organized at school level on regular basis to guide teachers regarding assessment.

Keywords: Higher Order Thinking Skills, General Science, Critical Thinking, Creative Thinking,

1. Introduction

In the modern education system rote memorization and simple recalling the learned knowledge is not enough. Now the demand ofthe hour is that the students should be able to enhance thinking, broader their vision and cope with the upcoming new challenges of emerging world. According to (Halpern, 2014) higher order thinking is imperative for the students of 21st century. Higher orderthinking is the ability to make interpretations and evaluation. The basics of higher order thinking are rooted to Greeks. Socrates introduced the concept of critical thinking in his approach of questioning method and highlighted its importance. Critical thinking approach was introduced in 19th century. It is related to the generation of new ideas by analyzing and evaluating the thinking patterns. Critical thinking is related to the reorganizing of thoughts as well as increasing the efficiency of thoughts by reflecting on them. In the following century, the approach of reflective thinking proposedby John Dewey was included in the educational programs. Higher order thinking is one of the most essential aspects in education.Learning is incomplete without thinking. When students are trained to think critically they will be able to develop a positive impacton education. As the aim of science is to develop critical thinking among students it contains two basic components including scientific knowledge and its acquisition (King,1997). Scientific knowledge consists of facts, laws, hypothesis and theories. Scientific knowledge is acquired by the application of scientific knowledge to another situation using problem solving skills and encouraging students to develop high order thinking skills. When students are not trained according to higher order learning skills they face problems in understanding different concepts of science and become unable to answer critical questions (Moseley, 2005 and Rasool *et al*., 2023).With the proper use of Bloom's taxonomy students will not only learn the concepts but will also be able to apply that in daily life.

Higher order thinking starts by reflecting on own thinking. It differs exponentially from cognitive thinking as higher order thinkinginvolves the application of concepts to develop reasonable thinking. Critical thinking and science are strongly related to each other. Previous researches highlighted the importance of higher order thinking in education system. According to the researchers science subject is important for the development of analytical and problem solving skills in students that help student in making future evaluations. Various approaches to critical thinking are also discussed in studies. These approaches include psychological, philosophical and educational approaches. Studies found that in Pakistan rote memorization is more emphasized as compared to the development of higher order thinking in students as a result students lack behind in many aspects of life. Among them Bloom'smodel is more useful for classification of educational objectives. One of the previous studies related to assessment of higher order thinking in grade 7 science students in Malaysian context highlighted these skills among male and females students to find out the difference in both genders' skills (Mohammed, Siraj & Sadallah, 2015).

In Pakistan there is need to conduct research on assessment of higher order thinking skills developed by science subject in students because limited work has been done (Khatti *et al.,* 2023), and there is need to conduct such study at elementary level that is pre-entry grade to secondary level. In order to fulfill the gap researcher has selected the elementary level. The objective of this study is to assess the present level of higher order thinking skills among elementary level students in general science subject using Bloom's model for higher order

thinking. This study specifically considered the levels of higher order thinking i-e analyzing, synthesizing and creating.Probing critical thinking will help in; investigating students‟ critical approach towards problem solving.

Moreover, it will improve science learning with respect to the goal, enhancing real life competencies of science students, upliftingteachers' awareness of higher order thinking in science teaching, emphasizing importance in developing habits to take critical attitude. The researcher considered the elementary grade students because elementary grade is a foundation class for choosing anyof major science disciplines. Elementary level is grooming age for developing higher order thinking skills. This teen age group is highly motivated in seeking teen age new knowledge and easily accessible grade for research study.

In Pakistan curriculum of science aims the development of higher order thinking skills including analytical and problem-solving skills. As science demands critical and analytical skills so it is very important for the education system to 5 inculcate problem- solving skills in the students. In order to assess the level of higher order thinking skills developed in students, researcher administered a test based on the analysis, synthesis and evaluation aspect on elementary level students. It provided the informationabout the level of higher order thinking skills in students related to science. The test also indicated the importance of higher order thinking skills to promote active learning in the classroom so that students could practically utilize their knowledge in a better way.

In order to make students innovative, it is very important to equip them with sound knowledge. In Pakistan, emphasis is more on content knowledge instead of developing critical thinking in students. As a result, students lack in analytical and evaluation skills. Without equipping the students with the higher order skills from the basic level students face hardships in the future. Students become unable to develop proper conceptual understanding and become incompetent. Knowing these circumstances, this study will be helpful to get a picture of the students' critical thinking in general science at elementary level. In science learning it is important to teach logic and rationale to students. The study is significant for the teachers to know the higher order thinking skillsof their students and to make changes in their teaching methods and assessment strategies to fulfill the required needs of the presenttime.

This study is significant for educational institutes, teachers and the bodies responsible for monitoring assessment related to higherorder thinking skills so that they can improve their activities regarding the development of higher order thinking skills in educational institutes. This research study highlighted the need of higher order thinking skills for students learning so this study may be significant for teachers to teach students in a way that fosters their higher order thinking skills.

2. Literature Review

Higher order thinking is one of the most important aspects of the education system. Learning is incomplete without thinking. Bloom (1956) referred critical thinking as higher order thinking in his taxonomy to provide classification of levels of learning. Higher order thinking skill is an umbrellaterm that includes creative and critical thinking. Higherorder thinking involves analytical and reflective thinking that contain different problem-solving aspects like questioning, developing linkages in concepts, evaluation andjudgment (Krulika & Rudnick,

1995). Scholars agree on three conceptual approaches of critical thinking. These approaches include philosophical, psychological and philosophical approaches. Higher order thinking includes various skills like reasoning, judgment and critical thinking. These skills are activated by encountering with puzzling situations that provoke thinking. These skills enable individuals to perform better and enhance intellectual skills (King, 1997; Halo et al, 2024).

According to (Brook Hart, 2010) there are different dimensions to define higher order learning. These dimensions include defining higher order thinking as transfer, defining higher order thinking as critical thinking and third dimension is defining higher order thinking as problem solving. (Facione, 2010; Paul & Elder, 2006; Bailin,2002 and Rasool *et al*., 2023). Promoting higher order thinking in students preparesthem to be an important part of society. Moreover these skills strengthen the abilities of students to face real life problems and finding their solutions. (Zohar & Dori, 2003) documented the study „Higher Order Thinking Skills and Low Achieving Students; Are they mutually exclusive? This study was aimed to find out that whether there is any difference in the achievement of higher order thinking skillsin low achievers and high achievers. According to the studyafter the conduction of different projects in classrooms for fostering higher order thinking skills in students it is found that both the groups i-e high achievers and low achievers didimprovement in skills. So it is wrong to consider that only high achieve could perform well so it is the duty of teacher to engage all students in higher order thinking tasks.

Thinking is associated with mental activities that could not be observed directly. It involves variety of mental functions to operate (Griffen, 2001). According to (Fisher, 2005), there are various processes that develop the basis of thinking and develop the abilities in individuals to solve the problems and learn.

Al-Osaimi et al. (2014) did analysis on thinking process and categorized it in following categories.

Table 1: Categories of Thinking

Categories	Descriptions
Higher order Thinking	Asking What, Why and How type questions
Logical Thinking	Scientific method that involves Experimentation
Innovative Thinking	New idea new insight
Efficient Thinking	Comprehension of investigated system

2.1 Critical Thinking

C Wade (1995) identified eight characteristics of critical thinking that includes probing questions, defining problem, examination of evidence, analyzing, avoiding emotional reasoning, avoiding generalizations, consideration of other clarifications and tolerating abstruseness. Critical thinking contributes in the academic achievement of students (Fero,

2010). The ability to think in creative way is very importantlife skill (Galinsky, 2010). (Hove, 2011) said as students‟ progress from lower levels to higher it is necessary to develop critical thinking in them for analyzing information and making decisions. According to (Liu, 2014) Critical thinking involves higher order thinking that includesproblem solving.

2.2 Assessment of Higher Order

In order to comprehend whether the students are developingcritical thinking or not it is necessary for the teachers to assess their skills. Teacher while keeping in mind that he/sheis assessing critical thinking of students will plan such activities like asking questions that are applicable and provoke thinking. Students in return have to think critically in order to answer those questions. In this way teacher will get a picture of students critical skills (Alpert, 2011). Accordnd to the (Widana, 2018), higher order thinking assessment requires real thinking that includes creative thinking, decision making and problem solving. Whenever the ability of analysis is assessed learners are required to connect the parts of information in a logical way. In analysis learners are assessed on the basis of their ability to focus on the main idea of question and then analyzing the argument using logics or comparison. In order to assess the evaluation ability learners are expected to provide justifications, assumptions and information credibility.

2.3 Multiple Choice items as Assessment Tool

In education system, Multiple Choice Items (MCQs) are renowned instrument to carryout summative assessment. MCQs are most widely used assessment tool worldwide (Faris et al, 2010). There are different formats of MCQ‟S but there is no any significance difference between using three options, four options and five options questions. According to Denhad et al (2014) 3 option questions are better than others because it would be easy for new teachers to develop such test items. Moreover, the use of four-options will make them use the defective distractors. As compared to essay type and short answer questions the multiple-choice items are more suitable because they could be administered quickly on a large population and could be scored using machine when there is a huge number of population (Morrison & Free, 2001). Multiple choice items have greater objectivity, reliability and have superior concurrent validity (Zeug & Webb, 2007).

Multiple choice items can be constructed for any cognitive level. Test constructor has to keep in mind those action verbs that are identified by Bloom's under each cognitive level. Some of the action verbs when used in multiple choice items could be replaced with its known derivate to make the statement of multiple-choice item correct (Dickinson, 2011).

2.4 Constructed Response Questions

Constructed response questions have been utilized by instructors to check writing skills, ability to construct paragraph and sentence structure writing arguments, representation of logical thoughts through writing. These questions are time efficient and could be used to assess the small number of students. However, scoring of constructed response questions is difficult and time consuming. Validitythreats are there in these questions as in essay type of CRQ‟Smore subjective is involved so there might be the chances ofbiasness associated with the reader.

2.5 Assessment System in Pakistan

In Pakistan assessment system is narrow, as students are assessed on the basis of learned lessons during classroom rather than creativity (Khan,2006). Assessments are carried out annually that decide about the promotion of students upto next level or retaining them at the same level. Examinations are very important part of pedagogy. At primary level (1 to 5) assessments of students is carried out by respective schools. At fifth grade education department conduct the public examination for promoting students to the next level. Moreover, for outstanding students another examination is conducted in which they compete and gain scholarships. At lower secondary level (6-7), respective schools carry out assessments of students and at grade 8 education department conduct the public examination. But Pakistani assessment system has been criticized by UNESCO in their study. According to UNESCO (2007) assessment system of Pakistan is failing in the developmentof necessary skills in children. There is lack of ongoing assessment at the primary level and students are provided with less feedback. Educational stakeholders i-e schools usually have objective that their students pass examinations with good grades and build the name of institute (Rehmani,2003). The problem in the examination system is that the teachers teach students for testing; they do not focus on their learning (Rehmani, 2003). Another problem in the assessment is that the examinations that are conducted there has been an increase in the reoccurrence of questions and selected material every year. As a result, students do selective study and utilize past papers for preparation of exams and get good scores. This is the main reason that leads students to rely on route memorization (Shah & Afzal, 2004). According to Shah and Saleem (2010) teachers prescribe students to learn the text book knowledge word by word and then write down in the exams as it is. As a result of this approach students become passive recipients of knowledge.

2.6 Approaches to Critical Thinking

There are different approaches to critical thinking that include philosophical approach, psychological approach and educational approach.

Philosophical approach of critical thinking extends from Socrates, Aristotle and Plato to Dewey, Paul and Ennis. Concept of critical thinking is rooted in Socratic idea of questioning in which he taught through questioning. (Paul, 1997).When students are trained to think critically they become able to develop a positive impact in education. Dewey is considered as the founder of modern critical thinking. According to his point of view critical thinking is reflective thinking that involves that require systematic inquiry of problem (Fisher,2001).

According to Lai (2011) psychological approach of critical thinking includes the actions and behaviors of critical thinkers that represent their creativity. According to psychological approach critical thinking is concerned with the mental strategies and skills for solving problems. These skills put more emphasis on problem solving practices rather than ideal context. (Robert Sternberg,1986). As this approach focuses on the specific skills so it creates misconception.

Educational approach of critical thinking aims at developing critical thinkers. This goal of educational approach is achieved by utilizing the processes and skills that develop problem solving and decision-making abilities in students. Critical thinking involves thinking. Our examination and assessment system are utilized at many levels: a) for further growth and

development of our students' abilities thus,it is very important to utilize variety of assessment strategiesin classrooms. (b) There is a need to revise the examinationand assessment system that is presently running in our institutes. Along with the academic excellence there is a need to develop higher order thinking skills like problem solving and decision-making abilities in students (Kamrani,2010).

2.7 Creativity

Creativity is not just a single concept, it includes various components. Like condition the personality of a person, wayof thinking of a person, the outcomes produced by a person,the environment in which a person is producing the creativeoutput (Rhodes, 1961). In order to be innovative and creative mastery of content knowledge is important on the first stage. (Weisberg, 2006). The content knowledge is important but it is not enough to support creative thinking because creativity requires application of learned knowledge (Hatano & Inagaki, 1986). Creativity refers to capability ofindividuals to comprehend that why some specific phenomena occurred, how this occurred; how it can be altered and how new procedures could be invented (Hatano,1982).

Villalba (2017) states that critical thinking and creativity are associated with each other. Creativity involves critical thinking processes like decision making using logics, analysis and problem solving. Creativity plays its central role in the development of ingenious thinkers. Critical thinkers usually put emphasison the source of knowledge, its validity; analyze the reliability so that clear explanations regarding the tasks and situations could be provided. (Halpern, 2014; Hong & Choi, 2015). In order to fulfill the educational requirements of students effective teaching is required that includes creativity and flexibility. Learning becomes effective when students are taught in a way that is aligned with their interests. When teacher teaches the in the style that studentsprefer and is according to their interest as a result teacher become able to gain in-depth information about the differentabout diversity in classroom (Fayombo,2015).

2.7.1 Developing Critical Thinking in Students:

According to Borg under Bakke and Peterson (1993) one of the major priorities of education is the development of thinking. For management of complex issues of modern world, it is very important to equip the generation with the thinking skills. Significance of thinking skills has been highlighted by many researches. Teaching the thinking skillsthrough curriculum has positive impact on teaching. Lewis and Smith (1993) states as higher order thinking involves critical thinking, creative thinking, decision making andproblem solving, so teaching become effective when these higher order thinking skills are nurtured in students.

2.7.2 Development of Creative Thinking through Brain Storming:

According to Vinak (2006) brain storming is an effective tool for development of creative thinking. According to De Bono (1990) brain storming is the tool for ideas generation. It involves cross stimulation and suspending judgment. These processes in brain storming not only include generation of ideas but also the conversion of ideas in practicality.

2.8 Barriers in Higher order Thinking

In the literature different barriers related to the developmentof higher order thinking has been identified. From the students‟ point of view these barriers include authority of teachers, lack of experience and no culture of critical thinking and consideration of memorization as an easy and quick task. While according to the opinion of teachers, authorities are not accountable and teachers suffer with the lack of time due to teaching pressure and unawareness of assessment of critical thinking (Buskist & Irons,2008). There are four broad areas that are affecting the higher order thinking enhancement in the students and these aspects include the learning environment that is not fostering the development of critical thinking in students, teachers are notcompetent and trained enough to inculcate these skills in their students. Additionally, students' nurturement and resources are also insufficient (Cassum, Gul, Dilshad & Syeda,2013; Halo, 2022). In Asian countries more focus is on memorization and route learningdue to content-based examination system. These students when in future become teachers they become passive teachers because of this system. These practices lead to poor learning outcomes. (Shaheen, 2012). There is need to focus on new pedagogies for the achievement of deep learning thatgoes beyond the rote memorization and develop learning experience. Meaningful learning could only take place when there is a complex relationship between teachers and 46 students and students become able to build new knowledge based on information they possess. Teachers play an important role in the development of constructive approach in the students by guiding them to learn new concepts and ideas and encouraging them for the development of deep analysis to enrich their learning experience. (Vacek, 2009). Critical thinking skills are also helpful for the students in their work place for taking active decisions. In order to develop and improve critical learning assessment and evaluation also plays a crucial role. Quality of learning couldbe improved by appropriate assessment strategies because assessment that is final step in the learning process provide the complete knowledge about the achievements of studentsaccording to proposed curriculum aimed to take decisions for the up gradation of students up to next level. (Halpern, 2010).

2.9 Relationship between Curriculum and Higher Order

Thinking Development of higher order thinking skills should be the primary role of education system. This process should take place from the earlier grades. Thoughtful learning could be promoted by different tools like Socratic teaching that include discussion and probing question. Moreover, providing feedback to the students and guiding them to practice the learned knowledge (Perkins, 1992; Halo, 2021). In order to produce knowledgeable students utilizing route memorization method in classrooms education system fails in developing a well-known student that can cope up with the changes of world. The students fail to learn the concept and just memorize the knowledge.

In order to fully cover the gaps in education system it is important that along with route memorization critical thinking should also be facilitated. Teacher inside the classroom must teach students that how to become responsive, keen and observant while lesson presentation inclassroom. (Edmonds, Hull, Janik, & Rylance, 2005; Irfaner,2006; Sezer, 2008; Salvin, 2012 and Khatti, Rasool & Keerio). One of the previous researches indicates that students mostly prefer the hands onand inquiry based approach of learning rather than lecture method in

which interaction with peers is ignored. (Baildon& Baildon, 2008; Savich, 2009). A research study titled Students Higher Order Thinking Skills and their Relationship with Problem Posing Ability‟ conducted in Malaysia identified higher order thinking skills and students ability in mathematical problem posing. This study revealedthat students‟ achievement is moderate in higher order thinking as well as mathematical problem posing ability. (Ismail, Norulbiah & Tasir, 2015 and Khatti, Rasool & Keerio). One of the positive techniques that can be utilized by the teacher inside the classroom for diagnosis of critical thinking is the utilizationof minute paper at the end of lesson. The minute paper willbe utilized by the students to discuss the most important concepts that they learnt from the lesson, provide their perception regarding lesson and pose the question that is in their mind and they need to clarify the concept. In this way teacher will be able to get an idea about the understanding ofstudents regarding lesson. Minute papers are basically synopsis that are written from the point of view of student and need correction as well as feedback (Divol & Browning,2010).

3 Research Methodology

This was a descriptive study in which data were collected by administrating the self-constructed test. Double stage sampling was used to select sample. Data analysis was done using appropriate statistics. The study followed the quantitative approach (Khatti, Rasool & Keerio and Rasool, Keerio & Faisal). Descriptive research design was used.

3.1 Population and sampling

The population of 8th grade female students of Islamabad model colleges for girls located in urban area is three thousand and twenty nine (3029). According to Kerjcie & Morgans (1970) criteria for calculation of sample size, 341 students‟ out of 3029 students would be enough for sample. So, the sample of research study was 341 students. Similarly, 11% of sample from the population was selected concerning the criteria. As double stage sampling was utilized by researcher. As per list of Federal Directorate of Education out of 34, researcher utilized systematic sampling and selected every fifth college from the list provided by Federal Directorate of Education (FDE). From the selected colleges all the students present in their institutions were taken as a sample for study i.e. Cluster sampling was done.

3.2 Instruments

Researcher constructed a test based on higher order thinking questions as a tool for data collection. The levels of higher order thinking in students were identified by administering a test based on Bloom‟s taxonomy of higher order thinking. In order to assess the higher order thinking level of elementary level students in general science researcher constructed the test from the curriculum & text book of General Science of grade 8th. Table of specification was developed before test construction. Researcher selected first four chapters from the book of general science Test contained Multiple Choice Questions i-e MCQ‟S attached in (Appendix C). Keeping in view the higher order thinking domain of Bloom‟s Taxonomy the researcher focused on analysis, synthesis and evaluation phase of cognitive domain while constructing the test. Test contained total 22 MCQs. Researcher assigned 1.5 marks for each item and total marks for test were 33. Rubric for test items was developed for evaluation (Attached in Appendix-C). Item analysis was carried out on pilot test data. Report of Pilot test explained

the item analysis that resulted removal and revision of items in detail.

3.3 Pilot test Validity and Reliability

Pilot test was carried out on the sample selected from the same population. The sample for pilot test was one fourth of the actual sample size and it is not included in actual data collection. Test constructed by the researcher included 22 MCQ‟S as test items. In the test 11 even and 11 odd items were present. These items were arranged in difficulty order In this way, two sets of tests were formed and then reliability of the test was determined through Kuder Richardson Formula.

3.4 Validity of Instruments

In order to determine the validity researcher consulted the experts. As the test was developed for science students of grade 8th so researcher consulted the experts including 2 teachers of science field. One of the experts was from International Islamic University while the other one was from Islamabad Model Schools for Girls G10/1. All the experts provided valuable feedbacks. On the basis, of feedback provided by experts researcher did modifications in instrument as per requirement.

3.5 Report of Pilot Test

After validation researcher did pilot study. This pilot phase of study was conducted in Islamabad Model School for Girls G10/1 Test containing 22 MCQ‟S was distributed among the students. Test was conducted in classroom situation and students were provided 33mins, 1.5 mins for each item. The objective of pilot study was to find out the level of higher order thinking in students.

3.6 Item Analysis

Researcher did item analysis on MS Excel. Table shows the detailed result of item difficulty and discrimination index.

Table 2: Item Difficulty Item Discrimination Decision

Item	Item difficulty	Item discrimination	Decision
1	0.32	0	REMOVE
2	0.28	0.42	RETAIN
3	0.36	0.14	REVISE
4	0.2	0.42	RETAIN
5	0.52	0.14	REVISE
6	0.16	0.57	RETAIN
7	0.2	0.42	RETAIN
8	0.4	0.28	REVISE
9	0.12	0.42	RETAIN
10	0.32	0	REMOVE

11	0.24	0.28	RETAIN
12	0.28	0.71	RETAIN
13	0.24	0.28	RETAIN
14	0.32	0.28	RETAIN
15	0.28	0.14	REMOVE
16	0.16	0.28	RETAIN
17	0.2	0.42	RETAIN
18	0.08	0	REMOVE
19	0.16	0.28	RETAIN
20	0.28	0.42	RETAIN
21	0.16	0.28	REVISE
22	0.16	0.28	REVISE

After item analysis those items that were poor and answered equally by the upper group and lower group students were removed. Some items were rephrased and revised by the researcher. After item analysis 4 items were removed while other 2 items were rephrased. Item no 1, 10, 15 and 18 were removed. The final achievement test after pilot testing comprised of 18 MCQs having the score of 27 which was administered on the selected sample.

3.7 Reliability

In order to determine the reliability of test Split-half reliability method was used by the researcher. Test constructed by the researcher included 22 MCQs as test items. In the test 11 even and 11 odd items were present. These items were arranged in difficulty order. This test was administered during pilot test. For analysis test was split in to two halves on the basis of even and odd items. In this way two sets of tests were formed and reliability of the test was calculated using Kuder- Richardson Formula 20. Value of reliability after the application of formula comes out to be 0.79 that is high reliability.

3.8 Data Collection and Analysis

Data was collected by researcher through test. In the test 27 items were added and for solving the items duration of 27 minutes was provided. In order to collect data researcher personally visited the selected colleges. Researcher considered all the ethical considerations while collecting the data. Researcher took prior permission for conducting test in classroom. The data analyzed on the basis of scores obtained by the students in test on each skill. Researcher calculated the percentages of students who are below average, average, above average. The students who scored below 50% were labeled as below average, the students who scored between 51-80% were labeled as average and the students who scored above 80 % were labeled as above average level.

4. Data Analysis and Interpretation

This section deals with the analysis of data obtained from the research instrument as well as interpretation of data. Data analysis and interpretation are given below.

Table 3: Analysis of Synthetic Skill of Higher Order Thinking

Total No of Analysis Questions: 07 Total Marks:10.5		
Level	Number of student	Percentage
Below 50% (1-5)	246	72%
Average 50-80% (6-8)	82	24%
Above 80% (9-10.5)	13	4%

Table 3 illustrates the analysis, researcher calculated three levels i-e below average, average and above average to analytical thinking of cognitive domain. As the total number of analytical skill questions in the test were seven having score of 10.5. The students whose scores are between 1-5 they are falling below average, 6-8 are falling in average level while the students having the score range between 9-10.5 are above average. In analytical skill out of 341, 246 students are falling below average as their scoresare very low. 82 students are in average level while only 13 students are in above level.

Table 4: Analysis of Synthetic Skill of Higher Order Thinking

Total No of Synthesis Items: 03 Total Marks: 4.5		
Level	No of Students	Percentage %
Below 50%(1-2)	199	58%
Average 50-80% (3-3.5)	104	31%
Above 80% (4-4.5)	38	11%

This table represents the percentages of students regarding synthetic skill of higher order thinking. Fig illustrates that 58% studentsare below average in the skill of synthesizing the information, 31% students are in average level and only 11% students are aboveaverage in synthetic skill.

Table 5 Analysis of Evaluation Skill of Higher Order Thinking

Total No of Evaluation Items: 08 Total Marks: 12		
Level	No of Students	Percentage%
Below 50% (1-6)	254	74%
Average 50-80% (7-9)	68	20%
Above 80% (10-12)	19	6%

Table 5 Represents percentages of students in evaluation based questions. Analysis shows that 74% students are below average in evaluation skill, 20% students are falling in average range while 6% students have higher level of evaluation skill.

Table 6: Level of Higher Order Thinking Skills

Total Items: 18 Total Marks: 18×1.5 = 27		
Level	No of Students	Overall Percentages
Below 50%	228	67%
Average 50-80%	102	30%
Above 80%	11	3%

Table 6 represents the overall higher order thinking level in students. It shows that 67% students are falling below average in higher order thinking which means they have least higher order thinking skills. Moreover 30% students are in average level regarding higher order thinking level and 3% students are in the below average range of higher order thinking skills.

Table 7: Comparison of Below Average Level Students

Skills	No of Students	Percentage (%)
Analysis	246	72%
Synthesis	199	58%
Evaluation	254	74%

The comparison of below average students in each skill. Fig shows that in analysis 72% are below average, in synthesis level 58%while in evaluation skill 74% students are in below average level.

Table 8: Comparison of Average Level Students

Skills	No of Students	Percentage (%)
Analysis	82	24%
Synthesis	104	31%
Evaluation	68	20%

Table 8 illustrates the comparison of students falling in average level for all the skills. Table shows that for analytical skill 82 students are falling in average level, for synthetic skill 104 students are falling in average level and for evaluation 68 students are in average level.

Table 9: Comparison of Above Average Level in all the Skills

Skills	No of Students	Percentage (%)
Analysis	13	4%
Synthesis	38	11%
Evaluation	19	6%

Table 9 illustrates the percentage of students that are in above average level in various skills. In analytical skill 4% students are falling in above average range. In synthesis 11% students are above average while in evaluation 6% students are in above averagelevel.

Conclusion

The researchers were motivated to undertake this study by the fact that students are lacking in higher order thinking skills (HOTS). This issue is strongly related to the survival of students in disruption era. For the emerging production and developmental challenges students‟ require these skills such as creativity, origination and imagination. The findings of the study followed by discussion lead to draw the following conclusions. It is concluded from the finding 1 of this study that students are not able to analyze the information from the first 4 chapters of their general science subject. It seems they are not taught in the way that they could answer such questions from their syllabus. Students are mostly encouraged to rote learning, completing the syllabus and get good grades in examination by memorizing the things. Such memorizing leads toward the failure of students‟ in higher order thinking skills.

Findings also revealed that most of the students failed in the ability of combining parts of information in a new and collective way. It is concluded that students scored in below average in evaluation skill of higher order thinking. This indicates that students are incapable of tracking inconsistencies of different processes. On the basis of findings related to evaluation phase of higher orderthinking it is concluded that students; lack in decision making skills. Furthermore, it is concluded that students lack in higher order thinking skills as majority of them fallen in below average in all the three levelsof higher order thinking domain. They are not capable of analyzing, synthesizing and evaluating the information properly. Additionally, it is concluded that students faced more difficulty in analyzing the information and evaluation of learned knowledge. Along with it, it is also concluded on the basis of comparison of average level for all the skills that students are somehow better in synthetic skill as compared to other two skills. Students are also lacking in the skill of building structures or patterns from different elements. At the final highest level of higher order thinking students are also failing. They are not able to evaluate and develop judgments about ideas.

Recommendations

Following recommendations are made on the basis of findings of study and conclusions.

1. The findings of this research study in relation to higher order thinking skills in general science indicated the low level of analytical skills of higher order thinking domain. They are not able to properly differentiate, organize and attribute the relationship in questions. In our education system there is limited scope of opportunities for new ideas. The main duty for the development of higher order thinking skills rely on stakeholders responsible for designing the activities related to course. Therefore, it is recommended that in every school the head and subject teachers may have the proper knowledge regarding higher order thinking skill so that they can incorporate these skills in students and assess them on regular basis.
2. The study also concluded that students are not able to synthesize the learned information properly. The findings of study revealed that majority of students are failing in ability of combining parts of information in a new and collective way. As the science subjectinclude reasoning, judgments, experiments and application of knowledge in problem based situations. The lack of higher order thinking skills at elementary level students is the indication of poor education practices and assessment criteria in our education system. When students will have higher order thinking skills from the beginning levels they will not have to face problems in research and in intelligence tests. It is recommended that in teaching the

teacher may categorize the lesson in concrete, abstract, verbal and nonverbal concepts. In this way those concepts that need critical understanding enable students to align 83 their thinking that goes beyond ordinary understanding and then teacher may assess students and get a clear picture of their understanding.

3. The study concluded that students are not able to evaluate the information and conclude solution of problem in general science.To develop mastery in this skill it is crucial to utilize questioning technique in classrooms. Therefore, it is recommended that in classroom students may be encouraged to ask questions to involve them in discussions and argumentation. As a result students would express their thinking and will evaluate the problem based situation in own way. This would make them identify their strengths and weaknesses. In this way the area of thinking skill where students are lacking may be identified and improvements would be done.

The study concluded that students have very low level of higher order thinking skills. Students lacked in all the three levels of higher order thinking domain. As the National Education Curriculum also mentions that the aim of general science subject is to develop critical thinking in students but unfortunately the critical level and creativity of students is in disquieting stage. Students would improve in these skills when they would be taught to examine the presented information to make logical conclusions. In order to develop higher order thinking skills in students it is recommended that teachers may be trained properly by the subject specialists and experts to teach the students in such a way that their critical thinking abilities get improved. Teachers may be encouraged to use student center approaches in teaching. Seminars, workshops and conferences may be organized for school levelteachers on regular basis to train teachers and introducing the 84 latest techniques to be inculcated in classroom practices. In the conferences foreign and native experts may provide their useful information that could help teachers in developing higher order thinking skills in students.

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