

EVALUATION OF HIGHER ORDER THINKING SKILLS IN THE LIGHT OF BLOOMS' TAXONOMY: THE PRESCRIBED VERSUS TESTED CURRICULA

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Abstract

Higher order thinking skills plays a vital role for the development of cognitive abilities of students. So, it is important to curriculum must have the instructions related to the development of cognitive skills of the students. The major objective of this research was to enlighten the prescribed and tested curricula with the cognitive domains of Bloom's Taxonomy. For this purpose text book of general science 8th grade was selected. This study was qualitative based on content analysis approach to analyze each chapter's Student Learning Outcomes and exercises questions of Punjab curriculum. The findings revealed that prescribed curriculum showed more significant as compare to tested curriculum. Moreover, the book analysis showed that SLOs support HOTS incorporation, but exercise questions and Punjab Examination Commission exams tend towards Lower Order Thinking Skills. Book exercises and exams should be improved and aligned with SLOs to incorporate HOTS in students. Moreover, book and exam criteria need to be revised to enhance higher-order thinking skills among students.

Keywords: Prescribed versus Tested Curricula; Higher Order Thinking Skills; Elementary Students

INTRODUCTION

In modern era, it is important to adopt various techniques and strategies for the enhancement of students skills. Therefore, higher order thinking skill is one the best skill to develop the cognitive abilities of the students to achieve maximum academic achievement through curriculum. Fisher (2005) contends that creativity and problem-solving are the essential elements of successful learning and hence should be included in the curriculum of primary and secondary schools. It is sometimes stated that the current era is the age of a 'knowledge explosion' and that dealing with it effectively necessitates critical information understanding (Zhang & Kim, 2018). It is realistic to expect the curriculum to include higher-order thinking. Thus, the aim of this study was to find out which levels of cognitive thinking are included in and tested by the grade 8 science curriculum.

The National Education Policy (NEP, 2009) and the National Curriculum (2006) of science subjects lay emphasis on the development of critical thinking among twenty-first-century learners. These policies also seek to foster critical thinking in pupils to aid in problem-solving and to prepare people to face global issues. The government of Pakistan is also working on Single National Curriculum and advocating that it will enhance student HOTS in the curriculum and improve the assessment framework (Sehgal, 2021).

According to McMahon (1999), the methods used by teachers to evaluate their students significantly affect the way they learn. Students pay more attention to the areas where a teacher is more concerned and ignore those elements where the teacher pays less attention.

The same is the case with higher-order thinking skills. If teachers include more assessment items from HOTS, then students will prepare themselves for this (Azmat et al., 2021; Jamil & Muhammad, 2019). Holt et al. (2015) have observed that in higher education, instructions include critical thinking skills, but exams are based on lower-order thinking skills.

Educationists and curriculum experts often seem concerned about the induction of HOTS in the curriculum. Still, it is observed that a portion of these skills in assessment is not up to a satisfactory level (FitzPatrick & Schulz, 2015). The situation in Pakistan has become worse as most educational institutes, parents, and society want to see students pass exams with good grades. This is why the assessment system in Pakistan promotes rote learning to get good marks, as questions cater to lower-order thinking skills (Jamil et al., 2021).

Assessing higher-order thinking skills, according to educators, is challenging (Grant & Smith, 2018). Many schools and institutions have created rubrics to measure critical thinking abilities, and these skills are included in standardized examinations at the secondary level. Therefore, the main purpose of this study is to explore how higher-order thinking skills are introduced in the grade 8 science curriculum and tested in exams. Recent academic work has contributed a lot to understanding the importance of HOTS and its role in developing successful students. The curriculum developer has found this concept necessary and incorporated it into the curriculum. They have planned and organized different learning and teaching activities to make learners more aware. Everyone is advocating its significance, adopting different strategies, and enriching the curriculum to become critical thinkers to face 21st-century challenges. Now it is time to pay attention to the assessment system along with the curriculum so we can analyze the criteria based on which HOTS are included in the assessment. If we have increased the content to promote HOTS, we add questions to assess and measure the students' learning levels. Exams and evaluations are an integral part of the education system as they confirm our efforts' effectiveness and help us improve the quality of work.

This study will help us understand the level of HOTS introduced in the prescribed curriculum and the extent to which these skills were considered while assessing students in exams. The degrees of higher-order thinking skills related to analyzing, creating, and evaluating are included in the curriculum and are aligned with the tested curriculum. It is important to identify the relation of HOTS in the prescribed and tested curriculum and evaluate whether the focus is balanced, more or less than the standard. There is very little research on measuring higher-order cognitive skills in the curriculum and assessing them in exams at the secondary level. This study explores higher-order cognitive skills introduced in the curriculum and to what extent it is tested in assessments. There is a gap in the literature, and we need to know the level of HOTS incorporated in the prescribed curriculum and evaluated in the tested curriculum.

Theoretical Framework

Bloom's taxonomy was adopted, and analytic categories were generated from Socratic taxonomy questions, a framework employed by Ilyas (2015). Six levels of revised Bloom's taxonomy and Socratic questioning are used to analyze the content of textbooks to examine the use of critical thinking abilities in the curriculum and exam questions. As a result, this study's conceptual framework is divided into two components. The first part shows the six levels of updated Bloom's taxonomy cognitive domains. In the second part, those cognitive areas are linked to the nine analytic categories generated from the Socratic inquiry. The conceptual framework was generated to graphically depict the connections between the study's major concepts and ideas. The figure used in this study is adopted from (Naseer et

al., 2020).

Research Objectives

- i. To explore the level of higher-order thinking in the prescribed curriculum
- ii. To what extent higher-order thinking skills are used in tested curriculum
- iii. To investigate the association between prescribed and test curriculum

RESEARCH METHODOLOGY

The study used a qualitative content analysis approach to determine how higher-order thinking skills are used in the prescribed and tested curriculum of the Grade-VIII science book. The above method was considered appropriate for this study to derive conclusions about the content because it involves the systematical classification of textual elements (Rose et al., 2014). Previous research has also utilized content analysis to know the use of higher and lower-order thinking abilities (Ulum, 2016).

This study's content analysis usually involves converting the raw textual material into standardized codes (Babbie, 2021). This means the researcher gathered qualitative data using qualitative data collection techniques and then quantified it by counting the codes (Rauf et al., 2021). The units of analysis in the textbooks were exercise questions, including short questions, descriptive questions, and multiple-choice questions (MCQs). The second source was the question papers of the PEC. The unit of analysis was, therefore, an exercise at the end of chapters and PEC exam papers.

Keeping the study's limitations and boundaries in mind, each researcher, tends to focus on specific areas and concepts to be explored based on the research design chosen, which determines the study's scope. Thus, this study anticipates identifying the strengths and weaknesses of current textbook content in terms of developing Higher-Order Thinking skills, particularly for textbook writers and curriculum developers.

Question papers from past years were collected and analyzed to check the level of HOTS used in them. Instead, the significance and importance of this study are to critically evaluate and determine whether the content and exams are effective at HOTS. Additionally, it covers the text-based questions and tasks mentioned in the textbook used in secondary-level schools published by the Punjab Textbook Board, indicating the importance and necessity of a textbook evaluation from various perspectives. The study may guide future analyses of textbooks and exams at various levels, whether for curriculum alignment or to reflect other skills in the content.

Data were collected solely from Punjab Textbook Board textbooks for one subject taught at the secondary level. Science textbooks for Grade-VIII and PEC exams held in 2017, 2018 and 2019 were used. The textbook used in this study was created by the Punjab Curriculum and Textbook Board (PCTB), which creates textbooks based on the national curriculum. Pakistan's education system is divided into primary, middle, and high schools. Till class 8th, all subjects are taught, whereas, in matric Islamic Studies, Urdu, English, and Pakistan Studies are considered compulsory subjects. At the same time, students choose the remaining subjects based on their selected science courses, like biology, computer science, or humanities. Each subject is covered by a textbook published by the PCTB board and made available on the PCTB's official website. Thus, the science textbook and previous years' exam papers were chosen to analyze the extent to which text-based questions in the book incorporated HOTS and to what degree these questions are asked in exams.

The purpose of research related to science education is to discover truth through reasoning

and experiences. To determine the most effective teaching methods for science students to enhance Higher-Order Thinking Skills, educational researchers employ various research approaches depending on the data collection and analysis methods. Although qualitative and quantitative research methods are distinct, they aim to identify educational problems through various approaches (Eyisi, 2016). Qualitative content analysis is a kind of research technique in which material is analyzed by classifying it according to common values (Moretti et al., 2011).

This approach was guided by a newly developed framework by Ilyas (2015), as discussed in Chapter 1, which focuses on evaluating textbook assignments in terms of HOTS. As a result, the data is analyzed utilizing a content analysis method and analytic categories for coding data as used in previous research (Khokhar & Muhammad, 2020; Muhammad & Brett, 2019, 2020).

The text-based SLOs and exercise questions in the 8th-grade science textbook were first classified according to the revised Bloom's taxonomy's six levels. PEC's last three exams were observed and similarly analyzed. The first three levels (1. Remembering, 2. Understanding, 3. Application) are classified as LOTS, and the last three levels (4. Analysis, 5. Evaluation, 6. Creation) are classified as HOTS and then analyzed based on the presence or absence of certain components, including questions about explanation, hypotheses, causes, facts, perspectives, inferences, outcomes, possibilities, queries, forecasts, consensus, conflict, syntheses, and findings (Ilyas, 2015).

FINDINGS

The findings of the textbook analysis presented in this chapter are divided into two main parts. The first part examines the prescribed curriculum, Punjab Textbook's grade 8th science subject, to report the thinking introduced in different chapters. The second part is about the tested curriculum, where the last three years, 2017, 2018 and 2019 exams of the Punjab Examination Commission were analyzed to determine the use of HOTS in questions. The purpose of this research is to conduct a qualitative content analysis of the textbook and past exams to determine how HOTS are reflected in both contents. The study was conducted using a revised Bloom's taxonomy and analytic categories generated from Socratic taxonomy questions.

Analyses of General Science Textbook for Eighth Grade

This study analyzed the eighth-grade science of Punjab Textbook Board which was released in 2017. The textbook consisted of twelve chapters naming "Human Organ System, Cell Division, Biotechnology, Pollutants and their Effects on Environment, Chemical Reactions, Acids, Bases/Alkalis and Salts, Force and Pressure, Measurement and Physical Quantities, Sources and Effects of Heat Energy, Lenses, Electricity and Exploring Space." All chapters start with Students' Learning Outcomes (SLOs), content explanation with the help of different activities, and exercise at the end of each chapter. The exercise

questions include MCQs, labeling the diagrams, differentiating terms, and short and descriptive questions. The researcher has analyzed SLOs and short and descriptive questions.

The first chapter, Organ System, covered two central human body parts: The Nervous System and the Excretory System. All the chapters have the same patterns, i.e., starting with SLOs, concepts description and finally, exercise at the end of the chapter. The exercise includes 10 to 15 MCQs and short and descriptive questions. The researcher studied and

reviewed all the chapters and found almost the same arrangement of contents. With the help of Bloom's taxonomy and pre-defined Socratic questions, the content was observed to know the level of Higher-Order thinking skills introduced in each chapter.

Student Learning Outcomes (SLOs) are mentioned at the start of each chapter to help the students to know what they will learn after completing the chapter. It is not possible that SLOs fall in lower-ordered thinking skills, and the content of the chapter incorporates higher-order thinking skills. For deep learning, SLO should be designed to engage students in the learning process. In the below table, SLOs from chapter 1 were taken and critically analyzed to see the level of higher-order thinking skills introduced in the 8th Science curriculum.

Table 1: Chapter 1 SLO According to Bloom's Taxonomy

Sr.	SLOs	Bloom Taxonomy Level
1	"Describe nervous system, its structure and function."	Remembering
2	"Describe how nervous system works."	Understanding
3	"Use an example to explain reflex action."	Understanding
4	"What is the difference between voluntary and involuntary actions"	Understanding
5	"Give definition of excretion."	Remembering
6	"Draw human excretory system and label it."	Remembering
7	"Describe the role that kidneys play to excrete nitrogenous wastes."	Understanding
8	"Investigate reasons that make kidneys malfunction."	Analyzing
9	"Suggest ways to cure kidney's problems."	Applying

Table 1 shows chapter 1 SLOs and their level of thinking according to Bloom's taxonomy. Statement of all SLOs observed to check in which level of thinking they fall. The researcher critically analyzed the SLOs statements and saw the action verbs to know the proper level of Bloom's taxonomy. In SLO 1, the 'describe' action verb is used to see the nervous system's structure and function, which fall in Bloom's taxonomy's 1st level of the cognitive domain. Similarly, all SLOs were checked, and their respective levels were mentioned in the Bloom taxonomy column of the table.

Table 2: Chapter 1 SLO Fall in Each Level of Bloom's taxonomy

Thinking Level	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SLO	3	4	1	1	-	-	9

Table 2 presents the number of SLOs that fall under each cognitive level of Bloom's taxonomy. All levels are denoted with different codes like Rem for Remembering, Und for Understanding, App for Applying, Ana for Analyzing, Eva for Evaluating and last Cre for Creating. There were three SLOs from the remembering level, four from understanding, and one from applying and analyzing. This shows that only one SLO in the first chapter is from HOTS, and the rest of all SLOs are from LOTS. As this book is for 8th-grade students and is the start of the book, the level of higher-order thinking skills is acceptable.

Table 3: Chapter 1 MCQs According to Bloom's Taxonomy

Sr.	SLOs	Bloom Taxonomy Level
1	"Neurons that decide action for a certain stimulus:"	Remembering
2	"Parts of a neuron that receive messages are called:"	Remembering



3	“What controls heartbeat?”	Remembering
4	“Axons present next to each other and enclosed in a common sheath:”	Remembering
5	“Sensory neurons take messages to:”	Remembering
6	“When body movements are neither precise nor accurate, the brain part that is affected:”	Remembering
7	“In toothache, we are in pain because:”	Understanding
8	“The body part that purifies blood from nitrogenous wastes:”	Remembering
9	“Reabsorption of useful materials occurs at which part from filtrate to blood:”	Remembering
10	“Nephron does”	Understanding

In Table 3 researchers have analyzed all the MCQs available in chapter 1 to observe the cognitive level. Stems of multiple-choice questions fall either in remembering or understanding level. Most statements start with ‘when’ having no element to think about the context, and students just recall the stored information. Therefore, chapter 1 MCQS are not contributing to enhancing the students’ higher-order thinking skills.

Table 4: Chapter 1 MCQs Fall in Each Level of Bloom’s taxonomy

Thinking Level	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SLO	8	2	-	-	-	-	10

Table 4 presents that all the MCQs of chapter 1 fall in Lower-Ordered Thinking Skills, and none of the MCQs fall in HOTS. The trend shows that MCQs in the prescribed curriculum have more tendency toward Lower-Ordered thinking skills.

Table 5: Chapter 1 Short Questions According to Bloom’s Taxonomy

Sr.	SLOs	Bloom Taxonomy Level
1	“Give three examples of actions that are voluntary.”	Understanding
2	“Give three examples of actions that are involuntary.”	Understanding
3	“Give definition of sensory neurons, motor neuron, and inter-neuron.”	Remembering
4	“Why is skin an excretory organ?”	Analyzing

Table 5 illustrates short questions according to different levels of Bloom’s taxonomy. Most of the short questions are from LOTs except one question, which is from HOTS. Question 3 is about defining the terms which are already well explained in the book.

Table 6: Chapter 1 Short Questions Fall in Each Level of Bloom’s taxonomy

Thinking Level	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SQ	1	2	-	1	-	-	4

Table 6 indicates that only one short question is from Higher-Order thinking, and the rest of the questions are from Lower-Order thinking skills. To promote HOTS, the book's author has introduced a few questions from critical thinking. While considering the students’ grades, one question from higher-order thinking in the first chapter shows efforts toward improving HOTS in students.

Table 7: Chapter 1 Descriptive Questions According to Bloom’s Taxonomy

Sr.	Descriptive Questions	Bloom Taxonomy Level
1	“What is central nervous system.”	Understanding
2	“How does peripheral nervous system work.”	Remembering



3	“What are the main parts of excretory system in humans.”	Remembering
4	“Describe the internal structure of kidney.”	Remembering
5	“Explain the structure of nephron.”	Remembering
6	“Write notes on: (a) Reflex action (b) Renal failure (c) Dialyzer.”	Remembering

Table 7 shows an analysis of descriptive questions from chapter 1. Most of the questions start with questions words like describe, explain, and write. Students memorize the text from the book to answer the questions. Results also show that students must learn the explanation of different concepts, definitions, laws, and diagrams from the textbook to answer the questions. The exercises at the end of the chapters promote knowledge and remembering of concepts. The researchers concluded that all the items in the descriptive questions were focused on lower-order thinking abilities. The development of Higher-Order Thinking Skills was not facilitated.

Table 8: *Chapter 1 Descriptive Questions Fall in Each Level of Bloom's taxonomy*

Thinking Level	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SLO	5	1	-	-	-	-	6

Table 8 presents there were six description questions in the first chapter's exercise. Descriptive questions are used to check students' concepts related to experiments, procedures, and explanations of different concepts.

Table 9: *Summary of Chapter 1 SLOs, MCQs, Short and Descriptive Exercise Questions Fall in Each Level of Bloom's Taxonomy*

Thinking Level	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SLOs	3	4	1	1	-	-	9
MCQs	8	2	-	-	-	-	10
Short Questions	1	2	-	1	-	-	4
Descriptive Questions	5	1	-	-	-	-	6

Table 9 shows the summary of chapter 1 about SLOs, MCQs, and Short and Descriptive exercise questions. The results show that only two items fall in Higher-Order Thinking Skills which is not up to mark.

Table 10: *Complete Book Chapter-Wise SLOs According to Different Levels of Bloom's Taxonomy*

Chapter No.	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
Ch 1	3	2	1	1	-	-	7
Ch 2	2	1	-	2	-	-	5
Ch 3	5	4	-	-	-	-	9
Ch 4	4	5	-	1	-	3	13
Ch 5	4	5	-	-	-	-	9
Ch 6	3	1	1	1	-	-	6
Ch 7	4	3	1	-	-	-	8
Ch 8	1	2	2	1	1	-	7
Ch 9	2	3	1	3	-	-	9
Ch 10	1	4	-	3	-	-	8
Ch 11	3	4	-	-	-	2	9
Ch 12	2	1	-	3	-	1	7
Total	34	35	6	15	1	6	97

Table 10 shows SLOs of all chapter that falls in different levels of Bloom's taxonomy. The numbers in the table show enough SLOs fall in higher-order thinking skills. This helps us to conclude that the prescribed curriculum has a satisfactory level of higher-order thinking skills.

Table 11: *Complete Book Chapter-Wise MCQs According to Bloom's Taxonomy*

Chapter No.	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Total
	<i>Lower-Order Thinking Skills</i>		<i>Higher-Order Thinking Skills</i>				
Ch 1	7	3	-	-	-	-	10
Ch 2	7	3	1	-	-	-	11
Ch 3	7	2	-	-	-	-	9
Ch 4	2	8	-	-	-	-	10
Ch 5	5	4	1	-	-	-	10
Ch 6	5	1	-	-	-	-	6
Ch 7	4	4	1	1	-	-	10
Ch 8	9	1	-	-	-	-	10
Ch 9	9	1	-	-	-	-	10
Ch 10	9	-	-	-	-	-	9
Ch 11	4	3	-	-	-	-	7
Ch 12	5	-	-	-	-	-	5
Total	73	30	3	1	0	0	107

Table 11 demonstrated that multiple-choice questions (MCQs) tended to promote lower-order thinking abilities, i.e., the remembering level of Bloom's taxonomy, which is solely concerned with recalling information and does not require any participation in the thinking process.

Table 12: *Complete Book Chapter-Wise Short Questions According to Bloom's Taxonomy*

	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Lower-Order
	<i>Thinking Skills</i>		<i>Higher-Order Thinking Skills</i>				
Ch 1	1	2	-	1	-	-	5
Ch 2	5	-	-	-	-	-	5
Ch 3	4	-	-	-	-	-	4
Ch 4	6	2	-	1	-	-	9
Ch 5	5	-	-	-	-	-	5
Ch 6	8	2	-	-	-	-	10
Ch 7	5	1	1	-	-	-	7
Ch 8	5	-	-	-	-	-	5
Ch 9	3	-	-	-	-	-	5
Ch 10	5	2	1	-	-	-	8
Ch 11	5	1	-	-	-	-	6
Ch 12	4	1	-	-	-	-	5
Total	56	11	2	2	0	0	71

Table 12 presents that the complete book Short-Questions fall into different levels of Bloom's taxonomy. Only two questions fall in higher order thinking skills which are not up to mark. Short questions have a significant contribution to enhancing students' HOTS skills of students, but in this book, fewer questions are used to focus on the critical thinking of learners.

Table 13: *Chapter-Wise Descriptive Questions According to Bloom's Taxonomy*



Chapter No.	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
Ch 1	6	1	-	-	-	-	7
Ch 2	5	1	-	-	-	-	6
Ch 3	2	3	-	-	-	-	5
Ch 4	3	3	1	-	-	3	10
Ch 5	3	5	1	-	1	-	10
Ch 6	4	3	-	2	1	-	10
Ch 7	2	1	-	-	-	-	3
Ch 8	7	-	-	-	-	-	7
Ch 9	3	3	1	-	-	-	7
Ch 10	0	4	-	1	-	-	5
Ch 11	-	1	2	-	-	1	4
Ch 12	4	1	-	-	-	-	5
Total	39	26	5	3	2	4	79

Table 13 shows complete book descriptive questions data. While answering descriptive questions, students are supposed to answer detailed answer questions. Significantly less descriptive questions fall in higher-order thinking skills.

Table 14: *Complete Book SLOs, MCQs, Short and Descriptive Exercise Questions using Bloom's Taxonomy*

Thinking Level	Rem	Und	App	Ana	Eva	Cre	Total
	Lower-Order Thinking Skills			Higher-Order Thinking Skills			
SLO	34	35	6	15	1	6	97
MCQs	73	30	3	1	0	0	107
Short Questions	56	11	2	2	0	0	71
Descriptive Questions	39	26	5	3	2	4	79
Total	202	102	16	21	3	10	354

Table 14 shows a complete picture of 8th-grade Science book higher-order thinking skills incorporated in SLO, MCQs, and Short and Descriptive questions. The results show that the book's author planned to teach higher-order thinking skills but didn't introduce them in exercises. A Significant number of SLOs support HOTS, but exercise questions are based on LOTs that encourage rote learning.

Short and Descriptive Questions Analysis Categorized Under Nine Predetermined Categories

The researchers evaluated the descriptive questions based on nine analytic categories developed from the taxonomy of Socratic questions. The textbook exercises contain questions that fall into different predetermined categories. Questions about viewpoints "Suggest ways for proper management of solid wastes." Similarly, "Point out the sources of air pollutants you find in your locality and suggest ways to reduce the pollution produced from these sources." Questions of clarification, "Why are the aqueous solutions of NaHCO_3 and Na_2CO_3 basic in nature? And how does the soil become acidic?" were found.

Table 15: *Short-answer Questions and Descriptive Questions Categorized under nine Predetermined Analytic Categories*

Nine predetermined analytic categories	No. of short answer questions	No. of descriptive answer questions
"Questions of clarification"	2	1

“Questions that probe assumptions”	-	-
“Questions that probe reasons and evidence”	11	1
“Questions about viewpoints or perspectives”	2	2
“Questions that probe implication consequences, and alternatives”	1	2
“Questions about question.”	-	-
“Questions about predictions.”	-	-
“Question about agreement and disagreement.”	-	1
“Questions about summary and conclusion.”	-	-

In conclusion, it was noticed and evaluated by the researchers that most of the text-based exercise questions, independent of their kinds, did not develop HOTS among eighth-grade students. The textbook authors concentrated on the memorization of the material, which either fall under the cognitive domain of Remembering or Understanding, tended towards lower-order thinking abilities. The researchers discovered descriptive answer questions, primarily dealing with memorization of various definitions, explanations, and science laws.

Analyses of PEC Exams for General Science Textbook of Eighth Grade

The Punjab Examination Commission (PEC) was established by the Punjab government to assess and examine students in grades 5 and 8. Each exam contains 32 MCQs, which is a major part of the exam. The researchers analyzed exam papers of 2017, 2018 and 2019 to observe the level of higher-ordered thinking skills introduced in the tested curriculum.

Table 16: *Past Exams MCQs According to Bloom's Taxonomy*

Years	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Total
	<i>Lower-Order Thinking Skills</i>			<i>Higher-Order Thinking Skills</i>			
2017	22	10	-	-	-	-	32
2018	25	7	-	-	-	-	32
2019	23	9	-	-	-	-	32
Total	70	26					96

Table 16 presents that all Multiple-Choice Questions fall under lower-order thinking skills. Not a single MCQ falls under HOTS, which shows that the tested curriculum does not introduce higher-order thinking skills in students.

Table 17: *Past Exams Short Questions According to Different Levels of Bloom's Taxonomy*

Years	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Total
	<i>Lower-Order Thinking Skills</i>			<i>Higher-Order Thinking Skills</i>			
2017	6	-	-	-	-	-	6
2018	4	1	-	1	-	-	6
2019	4	1	-	-	-	-	5
Total	14	3					17

Table 17 shows that only one short question falls in higher-order thinking skills—which is not sufficient to develop critical thinking skills in students. Short questions in the tested curriculum are not based on HOTS.

Table 18: *Past Exams Descriptive Questions According to Bloom's Taxonomy*

Years	<u>Rem</u>	<u>Und</u>	<u>App</u>	<u>Ana</u>	<u>Eva</u>	<u>Cre</u>	Total
	<i>Lower-Order Thinking Skills</i>			<i>Higher-Order Thinking Skills</i>			
2017	5	3	-	-	-	-	8
2018	5	3	-	-	-	-	8



2019	5	4	-	-	-	-	9
Total	15	10					25

Table 18 shows an analysis of the descriptive exams of the last three years. It is observed that all exam questions fall under lower-order thinking skills, and no question is planned to check students' higher-order thinking skills.

Table 19: *Past Exams Short and Descriptive Questions Categorized Under Nine Predetermined Analytic Categories*

<i>Nine predetermined analytic categories</i>	<i>No. of short answer questions</i>	<i>No. of descriptive questions</i>
"Questions of clarification"	-	-
"Questions that probe assumptions"	-	-
"Questions that probe reasons and evidence"	1	-
"Questions about viewpoints or perspectives"	-	-
"Questions that probe implication consequences, and alternatives"	-	-
"Questions about the question"	-	-
"Questions about predictions"	-	-
"Question about agreement and disagreement"	-	-
"Questions about summary and conclusion"	-	-

Considering the above findings, it can be concluded that the prescribed curriculum has a comparatively better focus on the development of HOTS than the tested curriculum. The way SLOs are planned to teach different concepts emphasizes HOTS, but exercise questions are not supportive of developing these skills. PEC exam analysis shows that questions are not particularly conducive to the development of HOTS. Most exam questions fall under lower-order thinking skills, and few questions are intended to assess students' higher-order thinking skills.

DISCUSSION

The curriculum has gained significant attention in making students good thinkers. Educationists are paying attention to enriching the curriculum and improving the assessment system. If the curriculum includes HOTS, but the assessment system does not consider it, then there are chances to lose the effectiveness of the curriculum. Similarly, if the curriculum does not have HOTS and assessment questions that include critical thinking, it may cause difficulty for students while attempting the exam. So prescribed curriculum must be aligned with the tested curriculum and should incorporate required HOTS in students. It is observed that students prepare themselves for exams according to the paper pattern; if exams focus on questions words like what, when, where, who, etc., they ignore learning the questions that start with words like why, suggest or create. This practice promotes rote learning, and students avoid

questions that use creativity, thinking, analysis, and problem-solving. Jamil et al. (2021) explored that the assessment system in Pakistan promotes rote learning to get good marks, as most of the time, questions are based on lower-order thinking skills. According to Bloom's taxonomy, starting at the bottom and working your way up in every learning environment is necessary. Lower-order abilities need fewer cognitive processes but offer a solid foundation for learning. Meanwhile, higher Bloom's levels need more in-depth

learning and cognitive processing, which can probably only be accomplished if lower-order abilities have been learned (Persaud, 2021). The importance of memorizing things is never denied, but when someone memorizes and repeats information without thinking, it is like a robot that performs what it's taught to do but doesn't think for itself. Therefore, higher-order thinking is a kind of reasoning that goes beyond recalling stored information.

Students studying in 8th Grade are sensible enough and able to answer some basic questions based on critical thinking. Instead of asking questions that recall memorized information, questions from HOTS are asked. Book exercise questions can be developed according to nine analytical categories of Socratic taxonomy. General Science book and previous years' exams questions analysis showed a lack of critical thinking questions. Many questions can be framed as why do you believe it to be true? Questions that probe reasons. What are you assuming? Questions that probe assumption. How does this relate to our issue? Questions that probe clarification. What are the other options to solve this problem? Questions that probe viewpoint. What are the implications of this issue? Questions that Probe Implications Results show that most of the questions in the book were from lower-order thinking skills and support rote learning. This practice may increase student English language skills but will have no impact on grooming as a scientist who needs to enhance reasoning and thinking skills. In chapter 2, the short question "What is a gene?" may be asked as "Investigate how gene plays a role in human characteristics transformation." "Define heredity" can be framed as "Why some of our attributes are on our parents?"

Previous research in the Pakistani setting emphasized the importance of critical thinking in the science textbooks curriculum. Naseer et al. (2020) explored the critical thinking skills included in text-based questions and tasks in the secondary-level Pakistan Studies textbooks. They found that the text-based question included in the book Pakistan Studies was not favorable for promoting critical thinking skills among students. Just one question was from higher-order thinking levels, and all others were from lower-order thinking levels. In another study, Jamil et al. (2020) analyzed education policy documents to develop critical thinking in secondary school students. They observed that policymakers want to see students self-sufficient, problem-solvers, and analytical thinkers. They either observed textbooks and assessments or analyzed the policies, but this research revealed how HOTS is introduced in the prescribed curriculum and tested in exams. The satisfactory level of SLOs fall in high order thinking skills which shows the reflection of policy, but this element was not observed in exercise questions and worst situation was found in past exam analysis. Each research has its own set of limits and constraints, demanding consistency in the research process, filling in the gaps, and removing barriers to keep studies up to date as time passes. In this study, the researchers have focused on the prescribed and tested curriculum only, with no consideration of teaching and learning quality. What is the professional development level of teachers, school climate and leadership vision? The curriculum does not drive by itself, so to introduce HOTS to students, there is a need for other factors to support it.

CONCLUSION

This research aimed to see the level of HOTS introduced in the prescribed curriculum and the extent to which these skills were considered while assessing students in exams. Considering the findings, it can be concluded that the prescribed curriculum has a comparatively better focus on the development of higher-order thinking skills than the tested curriculum. It is found that there is a need to improve higher-order thinking skills in

both prescribed and tested curricula, as most of the content focuses on lower-level thinking. Book analysis results showed that SLOs emphasized HOTS, but exercise questions were not well aligned to measure the required skills. Similarly, most of the tested curriculum measured lower-order thinking skills, and very few questions fell into higher-order thinking skills. Therefore, the books must be revised, and there should be an excellent balance of HOTS between the prescribed and tested

curriculum. Most exam questions were based on lower-order thinking skills, and very few were intended to assess students' higher-order thinking skills. The quality of the PEC examination system needs to be enhanced to incorporate higher-order thinking as well.

Recommendations

Though this research is a small-scale study analyzing a book and a few questions papers, this research might have significant implications for main educational stakeholders, policymakers, authors, publishers, and teachers. As books are considered the driving aspect in the development of HOTS in students, all those involved in its development and implementation are essential. After the 18th amendment, education is a provisional concern, and each province is responsible for educational policy. They are supposed to hire curriculum experts who have deep knowledge of the deployment of HOTS in our environment. Teachers' training departments should include training modules specifically on HOTS skills development, so teachers are well-equipped to understand the importance of this ability. Authors of books should include activities that promote students' ability to analyze, evaluate, and create. The authorities responsible for the examination system, like boards and Pakistan Examination Commission, must consider the questions that promote these skills. Finally, awareness sessions are arranged for the heads, principals, and other educational decision-makers to know the curriculum implementation.

The following future research studies are suggested:

1. The researchers may investigate teachers' practices and students' quality of work as one of the shortcomings of this study as it only looked at prescribed and tested curricula.
2. It would also be interesting to analyze teachers' perspectives of HOTS and their understanding of it.
3. The interest of teachers and school leadership in integrating HOTS into the curriculum needs to be investigated.
4. The current study used Bloom's taxonomy and predetermined categories of questions of Socratic taxonomy to evaluate SLO and exercise questions. The researchers may use other theories and taxonomies to analyze the content. The explanation of different concepts and activities can also be evaluated.

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