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Analysis of Physics Questions Papers at Secondary Level through the Lens of Revised Bloom Taxonomy

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Abstract

Evaluation of teaching learning process plays an important role in education. Different tools are used to measure the students' learning outcomes. Literature reveals that some specific studies is not available on using the revised bloom taxonomy in our examination / paper setting in the area. So, it was felt that specific study is needed to further investigate and suggest measures to include all shades in the paper setting. Therefore, this study was undertaken to analyse Physics question papers for grades 9th and 10th of the years-(2012 to 2019) in the light of Revised Bloom's Taxonomy (RBT) having two main dimensions Cognitive and Knowledge. The research population was all boards of Pakistan. But due to scarcity of resources only the Federal Board of Intermediate and Secondary Education (FBISE) Islamabad, Physics question papers of secondary level conducted in the years 2012 to 2019 was taken as a sample. The checklist created by L. Anderson et al. in 2001 was based on the framework of RBT and used as the research instrument. Four experts in the relevant field validated the research tool of the study. Both the cognitive processes and knowledge dimensions categories of RBT were examined. Statistical tool simple mean and percentage was used for data collection and analysis. The data was also presented in the form of graphs. Comparison between grades 9th and 10th was also made using tables. During data analysis it was found that FBISE question papers of the secondary level did not contain dimensions of cognitive process including "applying," "analysing," "evaluating," and "creating" thinking skills. Further it was also revealed that the procedural and metacognitive knowledge of knowledge dimensions was ignored in questions paper settings. It was concluded that all dimension of the RBT were not present in paper setting. So, it is recommended that during paper setting process dimension of RBT may be included to fulfil the requirements of 21st century learning skills.

Keywords Physics, Revised Bloom Taxonomy (RBT), FBISE, Cognitive Process, Knowledge Dimensions

Introduction

There has been a lot of talk regarding the skills and knowledge that 21st century students and recent graduates must possess to be prepared for further education and/or the workforce and contribute to society in a better way. There is an almost continual stream of high-profile calls to action for reforms in education to meet the new needs of an information-based, linked society, coming from a variety of levels, including national and state government, industry, and educational policy wonks. Here is a quick rundown of what is now deemed "essential" knowledge for students. It includes deep comprehension of key ideas in significant subject areas and disciplines; cognitive abilities, including problem-solving, judgement, critical thinking, and metacognition; originality and creative thinking;

social and communication skills; global understanding and viewpoints / attitudes, like accountability, adaptability, self-direction, tenacity, risk-taking, and integrity.

Assessments need to evaluate the material being taught, but we also need to design and implement exams that support the development of all these 21st-century abilities. Students will continue to be the most valuable natural resource in the twenty-first century for guaranteeing the progress and eventual betterment of civilization and quality of life. Everyone involved in education must make sure that pupils are equipped to handle the demands of a global society that is undergoing continual change. It's time to demand that the bar for student learning be raised. Requiring more rigor and relevance from the curriculum is necessary to ensure that pupils are ready for success in the millennium and beyond. In adult roles, people are expected to collaborate in a team environment, possess a foundation of knowledge, be able to expand and improve upon it, create new applications and knowledge, and regularly evaluate how well they have assimilated each dimension into their daily decision-making. To support students' development and advancement, the National Curriculum for Physics, Grades IX–X, 2006 was constructed using Standards, Benchmarks, and Learning Outcomes. What is expected of pupils is outlined in standards. The broad information and abilities that students should learn in a given area are described by standards. Knowledge consists of significant and timeless concepts, ideas, problems, and data. The ways that a subject area is characterised by thinking, working, communicating, reasoning, and exploring are all included in the competencies. Both topics from the basic academic areas and interdisciplinary issues may be emphasised in standards. *Standards are based on the following:*

- **Higher Order Thinking**: In order to develop new meaning and knowledge for themselves, students must manipulate information and ideas through synthesis, generalisation, explanation, and/or conclusion-making.
- **Deep Knowledge**: teaching covers the main concepts of a subject or field in sufficient detail to examine links and linkages and generate knowledge that is quite sophisticated.
- **Substantive Conversation**: Students discuss subjects in-depth and cooperatively with classmates and/or the teacher in order to get a better comprehension of the subject matter.
- **Connections to the World beyond the Classroom**: Students draw links between their academic understanding and either real-world issues or their own experiences.

Benchmarks define the knowledge and skills that students should possess at different stages of development. Here benchmarks are divided into five developmental stages:

- Grades Kachi through 3
- Grades 4 through 5
- Grades 6 through 8
- Grades 9 through 10; and
- Grades 11 through 12

Learning outcomes specify, at the appropriate developmental level, what students should know and be able to perform for each topic in any subject area. The entire set of requirements for the learner is summed up in the learning outcomes. The Learning Outcomes are organised into three subheadings in this document:

- Understanding
- Skills including laboratory work
- Science, Technology and Society connections

The Standards and their corresponding Benchmarks will support the creation of complete curricula, encourage variety in the establishment of superior Learning Outcomes, and give those working in the education sector a mechanism for accountability. These ensure that all students are assessed using the same methodology and are tested on the same knowledge and abilities by providing a common denominator for gauging performance. Pakistan's Ministry of Education, Islamabad, Government of Pakistan, 2006, National Curriculum for Physics, Grades IX–X. The main goal of every evaluation system is to gauge the cognitive ability of the students. To make sure that the student is examined for the various cognitive levels of learning, it could be essential to revisit and add stages to the examination paper design. The many levels of learning processes that students go through when their learning objectives are specified in a teaching programme are categorised by Bloom's Taxonomy, which bears Benjamin Bloom's name. Consistency in assessment across all modules becomes a huge problem in an educational setting because several programmes and modules are taught by different teachers with varying learning objectives. An essential component of the study of education is examination. It determines the pupils' future. It serves as the primary scale for increasing the student body size. The FBISE Exams are administered for the evaluation at grade IX (SSC I) and grade X (SSC II) respectively. At the conclusion of grades IX and X, students are required to take the FBISE exam. Good students receive high school credits (SSC) or short metric after passing both exams. The low student achievement levels and the lack of standard school information illustrate this fact. This is one of the strong evident: since education is essential to success, the assessment process for educational institutions is a crucial step in evaluating learners' results; the content of the examination papers is the key criterion for ensuring the standard of education of the institutions created by the students. Despite the government's significant efforts to increase access to colleges, increase enrolment, and boost attendance, the government has still significantly delayed the efforts to improve the standard of education.

Students use the test as a guide as they advance in their pursuit of knowledge. As such, it is crucial to adhere to the proper protocol while assembling exam papers. One of the most important procedures for evaluating student performance in educational institutions is the evaluation process. The evaluation of graduates' quality is closely linked to the type of exams they take. But creating question papers is a difficult task for the academics. Any effective teaching effort must include assessment, and according to Rowntree (1977), "if we want to discover the truth about the educational system, we need to look into its assessment procedures." As a result, an essential component of educational analysis is examination. It determines the student's fate. It serves as the primary grading scale for pupils. The FBISE administers exams to pupils in high school and upper secondary classes in order to assess them. Examiners tended to focus primarily on straightforward and easy questions when assessing candidates, ignoring issues that required more complex abilities including application, understanding, analysis, synthesis, and evaluation. For this reason, in order to pass the test, the pupils continued to focus on memory. Over the past three decades, a great deal of study has described this circumstance. These studies indicate that the fundamental flaw in the exams is that they only assessed facts that candidates had committed to memory in the cognitive domain, ignoring additional goals like understanding, application analysis, critical thinking, and reasoning, among others. The secondary school years are vital and demanding because they mark the shift from a broad scientific curriculum to a discipline-based one. At this level, students enrol in physics as a subject with the intention of pursuing employment in the fundamental sciences or pre-professional programmes like further education in technology, engineering, or medicine. Therefore, it is necessary to give students a solid conceptual foundation in physics so that they can eventually handle the demands of academic and pre-professional courses beyond the secondary level. The secondary school physics course's objectives are to provide students the ability to:

1. Foster a sense of accomplishment, drive, and enthusiasm in the study of physics.
2. Gain the capacity to define and clarify physics-related ideas, principles, systems, procedures, and applications.
3. Enhance your capacity for critical thought, creativity, problem-solving, data management, research, and communication.
4. Adopt a responsible citizenship mind-set that values resource conservation and environmental stewardship.
5. Understand the applications and constraints of the scientific process as well as the relationships between science, technology, and society.

Problem Statement

Despite the extensive use of RBT in educational assessment, there is limited research analysing the cognitive and knowledge dimensions of physics question papers in FBISE for grades 9th and 10th. This study aims to fill this gap by conducting a comprehensive analysis of FBISE Physics question papers from the year 2012 to 2019, focusing on the cognitive process dimension and knowledge dimension of RBT. The analysis will provide valuable insights into the nature of questions asked in these papers, the level of cognitive skills required, and the distribution of knowledge types assessed, which can inform educators and policymakers about the alignment between curriculum goals, teaching practices, and assessment strategies in physics education at the secondary level.

Contribution to the Literature

The present research discloses that few studies have been found in the field, mainly from the viewpoint of the environment, our society, and educational boards. Furthermore, no specific study is accessible in this specific area of speciality. Besides, there are gaps in the studies conducted and arises some queries that need to be addressed regarding the subject of the study. Thus, the existing research aims to address several gaps and thus make significant contributions to existing knowledge and literature and certainly open new vistas of knowledge. This research will hopefully be beneficial for students, educators, educational planners, and curriculum designers. It is truly important for the improvement of educational institutions, the system of education, the quality of the examination boards and policymakers of the nation. It will certainly be useful in other testing communities locally and worldwide. As a result, it would open new perspectives and contribute significantly to existing knowledge. The present study has suggested some important ethics for upcoming researches. Therefore, it can serve as a source of inspiration and guide for upcoming researchers to look at additional aspects of the present study and lay a foundation for future research.

Objectives of the Study

Followings were the research objectives of the study:

1. To examine the question papers (Year 2012-2019) of Physics of 9th and 10th grades in the light of Cognitive Processes Dimension of Revised Bloom Taxonomy.
2. To examine the question papers (Year 2012-2019) of Physics of 9th and 10th grades in the context of Knowledge Dimension of Revised Bloom Taxonomy.
3. To compare the of question papers of grade-9th and question papers of grade-10th (Year 2012-2019) of Physics through Revised Bloom Taxonomy.

Research Questions

1. Are all levels of cognitive processes (remembering, understanding, applying, analysing, evaluating, and creating) included in the question papers?
2. Are all categories of knowledge (factual, conceptual, procedural, and metacognitive) included in the question papers?

Hypothesis

1. **H_0**: There is no significant difference in the distribution of cognitive processes and level of knowledge between 9th and 10th-grade question papers.
2. **H_1**: There is a significant difference in the distribution of cognitive processes and level of knowledge between 9th and 10th-grade question papers.

Significance of the Study

The significance of the study "Analysis of Federal Board Question Papers of Physics at the Secondary Level (9th and 10th classes) in Pakistan Using the Cognitive Processes Dimension and Knowledge Dimension of Revised Bloom Taxonomy" lies in several key areas:

1. It can help in assessing the alignment between the intended curriculum (as represented by the prescribed syllabus) and the assessed curriculum (as represented by the question papers). This alignment is crucial for ensuring that the assessments are measuring what is intended to be taught.
2. The findings of the study can have implications for educational policies related to curriculum design and assessment practices. It can inform policymakers about the cognitive demands placed on students in physics exams and help in making informed decisions about curriculum reform.
3. Understanding the cognitive processes and knowledge dimensions assessed in the question papers can provide valuable insights for teacher training programs. It can help teachers align their teaching strategies with the assessed cognitive levels, leading to more effective instruction.
4. By identifying the distribution of cognitive processes and knowledge levels in the question papers, the study can provide guidance for teachers to design instructional activities that target these levels. This can enhance student learning outcomes by ensuring that teaching is aligned with assessment.
5. The study can contribute to the existing body of knowledge in the field of educational assessment and curriculum development. It can serve as a basis for further research on the effectiveness of assessment practices and their impact on student learning.

Conceptual Framework:

The conceptual framework for this study is based on the Revised Bloom's Taxonomy, which provides a conceptual basis for categorizing educational objectives into cognitive processes and knowledge dimensions. The framework also incorporates some of key concepts. This dimension includes six levels of cognitive processes, ranging from simple recall of information (remembering) to the ability to create new ideas or products (creating). Analyzing question papers based on this dimension helps in understanding the cognitive demands placed on students. The knowledge dimension categorizes knowledge into four levels: factual, conceptual, procedural, and metacognitive. This dimension helps in identifying the types of knowledge assessed in question papers, providing insights into the depth of understanding required from students. The conceptual framework includes the concept of curriculum alignment, which emphasizes the importance of ensuring that assessments are aligned with the intended curriculum. The analysis of question papers helps in assessing this alignment and identifying any discrepancies. The framework also considers the educational objectives of the physics curriculum at the secondary level, which serve as the basis for designing assessments. Analyzing question papers based on Bloom's Taxonomy helps in evaluating the extent to which these objectives are being met through assessments.

Literature Review

Anderson and Krathwohl's (2001) revision of Bloom's taxonomy aimed to update and expand upon the original cognitive taxonomy by Benjamin Bloom. The revised taxonomy is structured into a hierarchy of six cognitive processes, ranging from lower-order thinking skills (LOTS) to higher-order thinking skills (HOTS). Each level builds upon the previous one, with higher levels requiring more complex cognitive processes. The taxonomy also incorporates a knowledge dimension, which categorizes knowledge into four types: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. This dimension highlights the importance of different types of knowledge in the learning process and emphasizes the need for learners to develop a deep understanding of concepts rather than just memorizing facts. The revised taxonomy has been widely adopted in educational settings as a framework for developing learning objectives, designing curriculum, and assessing student learning. It provides educators with a systematic way to scaffold learning experiences and promote the development of critical thinking skills. However, critics argue that the taxonomy may oversimplify the complexity of human cognition and that the hierarchical nature of the taxonomy may not accurately reflect the nonlinear nature of learning. Despite these criticisms, the revised taxonomy remains a valuable tool for educators seeking to enhance student learning outcomes.

Bumen's (2007) study delved into the implications of the Revised Bloom's Taxonomy (RBT) for both assessment and instruction in educational settings. One of the key implications discussed in the study is how the RBT can be used to align learning objectives, assessments, and instructional strategies. By clearly defining learning objectives at each level of the taxonomy, educators can design assessments that measure students' ability to perform specific cognitive tasks. Likewise, instructional strategies can be tailored to help students achieve these objectives by targeting the appropriate cognitive processes. The study also highlighted the importance of using a variety of assessment methods to measure student learning across the cognitive levels outlined in the RBT. This included traditional methods such as quizzes and exams, as well as more innovative approaches such as performance assessments and portfolios. By structuring learning activities and assessments to target these higher-order skills, educators can help students develop the critical thinking skills necessary for success in academic and real-world settings. Leach's (2007) study explored the practical application of RBT in nursing education. Leach focused on how educators can use the RBT to plan curriculum, construct assessments, and evaluate student mastery in nursing education. One key aspect of the study is how the RBT can be used to guide curriculum development. By aligning learning objectives with the cognitive levels of the taxonomy, educators can ensure that the curriculum addresses a range of cognitive skills. For example, educators can design learning activities and assessments that require students to not only recall information but also analyze case studies, evaluate nursing interventions, and create care plans. The study also discusses how the RBT can inform the construction of assessments in nursing education. By designing assessments that target specific cognitive levels, educators can measure students' ability to perform various nursing tasks. For instance, assessments can include multiple-choice questions to assess remembering and understanding, as well as case studies and simulations to assess applying, analyzing, and evaluating. Furthermore, Leach highlights the importance of using the RBT to evaluate student mastery in nursing education. By using the taxonomy as a framework for evaluating student performance, educators can provide targeted feedback to help students improve their critical thinking and clinical reasoning skills.

Parker and Eber's (2007) research provided an in-depth exploration of Bloom's Taxonomy, aiming to clarify its concepts and applications in educational psychology. The authors began by tracing the history of the taxonomy, explaining its development by Benjamin Bloom and his colleagues in the 1950s and its subsequent revisions. One key aspect of the study is the detailed explanation of each level of the taxonomy. The authors provided examples of behaviors and activities that correspond to each level, helping readers understand how the taxonomy can be applied in educational settings. For example, remembering may involve recalling facts or information, while creating may involve generating new ideas or products. The study also discusses the implications of Bloom's Taxonomy for teaching and learning. The taxonomy can guide educators in setting learning objectives, designing curriculum, and developing assessments that target a range of cognitive skills. By aligning instructional strategies with the cognitive levels of the taxonomy, educators can create meaningful learning experiences that promote deeper understanding and critical thinking. Furthermore, Parker and Eber address common misconceptions about Bloom's Taxonomy, such as the idea that higher levels of the taxonomy are inherently better or more important than lower levels. They emphasize that all levels of the taxonomy are valuable and necessary for learning, and that educators should strive to address a range of cognitive skills in their teaching.

Forehand's (2008) study offers a comprehensive overview of Bloom's Taxonomy, providing insights into its development, structure, and applications in educational research. The author begins by tracing the origins of the taxonomy, highlighting Benjamin Bloom's work in the 1950s and the subsequent revisions by Anderson and Krathwohl in 2001. Forehand explains each level in detail, providing examples of behaviors and activities associated with each level. The study also discusses the implications of Bloom's Taxonomy for educational research. Researchers can use the taxonomy as a framework for designing studies that investigate the effectiveness of different instructional strategies and assessment methods. Furthermore, Forehand addresses some common misconceptions about Bloom's Taxonomy, such as the idea that it is a hierarchy where higher levels are more important than lower levels. The author emphasizes that all levels of the taxonomy are valuable and should be addressed in educational practice. Jafari and Arain's (2002) studied the application of Bloom's taxonomy in the context of physics education. The authors examined how the taxonomy has been used to categorize cognitive processes in physics publications. The authors also noted that while RBT provides a useful framework for categorizing cognitive processes, it may not fully capture the complexity of thinking involved in physics problem-solving. Physics problems often require students to apply a combination of lower and higher-order thinking skills, making them challenging to categorize within the taxonomy.

Khan's (2006) explored research in the field of evaluations, particularly focusing on educational assessment. The author discussed various aspects of evaluations, including their importance in educational settings, different types of evaluations, and the challenges associated with conducting evaluations. One key aspect of the study was the discussion on the purposes of evaluations, which include measuring student learning outcomes, improving teaching practices, and informing decision-making at the institutional level. Khan emphasized the importance of using evaluations as a tool for continuous improvement in education. The study also highlighted the different types of evaluations, such as formative evaluations, which are conducted during the learning process to provide feedback for improvement, and summative evaluations, which are conducted at the end of a learning period to assess overall learning outcomes. Khan discussed the importance of using a combination of formative and summative evaluations to provide a comprehensive assessment of student learning. In addition, the study addressed the challenges associated with conducting evaluations, such as ensuring the validity and reliability of assessment tools, addressing bias in evaluations, and interpreting evaluation results accurately. Khan emphasized the need for educators and policymakers to be aware of these challenges and to take steps to mitigate them in order to ensure that evaluations are conducted effectively.

Mehmood Tariq et al. (2016) conducted an analysis of exam questions using RBT to understand the cognitive complexity of the questions and the alignment with intended learning outcomes. The study revealed variations in the cognitive complexity of exam questions across subjects and levels. For example, questions in mathematics and science tended to be more cognitively demanding compared to questions in language and social studies. Additionally, questions at higher educational levels were more likely to assess higher-order cognitive processes compared to questions at lower levels. Raza and Anwar's (2016) study focused on evaluating secondary level physics question papers in the Pakistani educational system using RBT. The authors recommended that question paper designers incorporate a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts. Khan and Akhtar's (2017) study focused on assessing physics examination questions at the secondary level using RBT. The authors recommended that question setters incorporate a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts. Ali (2018) conducted an analysis of physics question papers at the secondary level using Bloom's Taxonomy. The study suggested that there is a need to enhance the assessment practices in physics question papers at the secondary level. Ali recommended that question paper designers include a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts. Siddiqui and Khan (2018) conducted a cognitive level analysis of physics question papers for the Secondary School Certificate Examination using Bloom's Taxonomy. The study suggested that there is a need to revise the assessment practices in physics question papers for the Secondary School Certificate Examination. Siddiqui and Khan recommended that question paper designers incorporate a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts.

Javed Iqbal et al. (2019) conducted a study using Bloom's Taxonomy to analyze physics papers. The authors recommended that paper setters include a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts. Malik and Shah (2019) conducted an analysis of secondary level physics question papers using Bloom's Taxonomy in Pakistan. The study suggested that there is a need to enhance the assessment practices in physics question papers at the secondary level in Pakistan. Malik and Shah recommended that question paper designers include a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts. Zaman and Ali (2019) conducted a comparative study of physics question papers at the secondary level using Bloom's Taxonomy. The research aimed to compare the cognitive complexity of questions in physics question papers and assess the extent to which higher-order thinking skills were being assessed. The study suggested that there is a need for greater consistency in the assessment practices in physics question papers at the secondary level. Zaman and Ali recommended that question paper designers strive to include a more balanced mix of cognitive levels to better assess students' understanding and application of physics concepts.

Revised Bloom Taxonomy

Educational psychologist Benjamin Samuel Bloom was adamantly opposed to rote learning and memorising. As a result, he established and developed Learning Taxonomy in the cognitive domain under his direction, which went on to become known as Bloom's Taxonomy. In 1956, this taxonomy was first developed. It was simply done to encourage students to think more critically while they were being taught. Later, in 2001, Dr. Lorin Anderson et al., Bloom's pupil, changed the basic taxonomy of the cognitive domain. There are two aspects to the more recent (2001) version of Revised Bloom's Taxonomy:

(a) Cognitive process dimension;
(b) Knowledge dimension

Cognitive Process Dimension

Learning abilities primarily connected to mental (thinking) processes are included in the cognitive process component. A hierarchy of abilities including information processing, understanding construction, knowledge application, problem solving, and research are among the learning processes in the cognitive process dimension. Teachers can find numerous more aspects in the updated Bloom's taxonomy very helpful for creating the best possible learning experiences. The more recent version of Bloom's Taxonomy (2001) has six areas of cognitive complexity:

(a) Remember
(b) Understand
(c) Apply
(d) Analyze

(e) Evaluate
(f) Create

Level 1: Remember: The applicable process category is Remember when the goal of instruction is to encourage retention of the content in a form similar to what was taught. Retrieving pertinent information from long-term memory is a necessary part of remembering.

Level 2: Understand: Understand is the most extensive category of transfer-based educational objectives that are prioritised in educational establishments. When students are able to deduce meaning from oral, written, and graphic communication that is provided to them in books, on computer screens, or during lectures, it is considered that they have understood the material.

Level 3: Apply: It entails following protocols to carry out tasks or find solutions to issues. Applying is hence directly related to procedural understanding.

Level 4: Analyse: Analyse involves breaking material into its constituent parts and determining how the parts are related to one another and to an overall structure.

Level 5: Evaluate: Evaluate is defining as making judgements based on standards and criteria. Consistency, quality, effectiveness, and efficiency are the most common criteria used.

Level 6: Create: In Create, elements are assembled to form a coherent or functional whole. For example, learners create a new product by mentally rearranging some parts or elements into a pattern or structure that was not previously evident. The procedures involved in Create are typically synchronised with the students' prior learning experiences.

Knowledge Dimension

The knowledge dimension, which has four categories ranging from tangible knowledge to abstract knowledge, is the other dimension in the Revised Bloom's Taxonomy.

Factual knowledge: The fundamental components that specialists utilise to comprehend, communicate, and arrange their academic subject matter is all included in the category of factual knowledge. The fundamentals of factual knowledge are what students need to know in order to understand the field and be able to solve any difficulties that arise in it.

Conceptual Knowledge: Understanding categories, classifications, and the connections between and among them is a component of conceptual knowledge (more complicated, organized knowledge forms).

Procedural Knowledge: The "knowledge of how" to do a task is known as procedural knowledge. The "something" might be anything from finishing fairly basic activities to figuring out new challenges.

Metacognitive Knowledge: Metacognitive knowledge encompasses both awareness of and understanding of one's own cognition as well as generic information about cognition.

Research Methodology

The research approach employed in this study was quantitative, focusing on numerical data analysis. The research design utilized was descriptive, aimed at analyzing and describing the characteristics of the question papers. The data collection method involved the document analysis of past question papers from the Federal Board. An ordinal scale was used to categorize cognitive processes and knowledge levels. The measuring instrument utilized was checklist based on framework of Revised Bloom's Taxonomy developed by L. Anderson et al. (2001) for categorizing cognitive processes and knowledge levels. Purposive sampling of question papers from each year (2012-2019) was conducted to ensure representation across the years. At the end, mean percentage method and frequency distribution was employed to analyze the distribution of cognitive processes and levels of knowledge for both 9^{th} and 10^{th} grades from years 2012 to 2019.

The data have been presented through graphs after the statistical analysis.

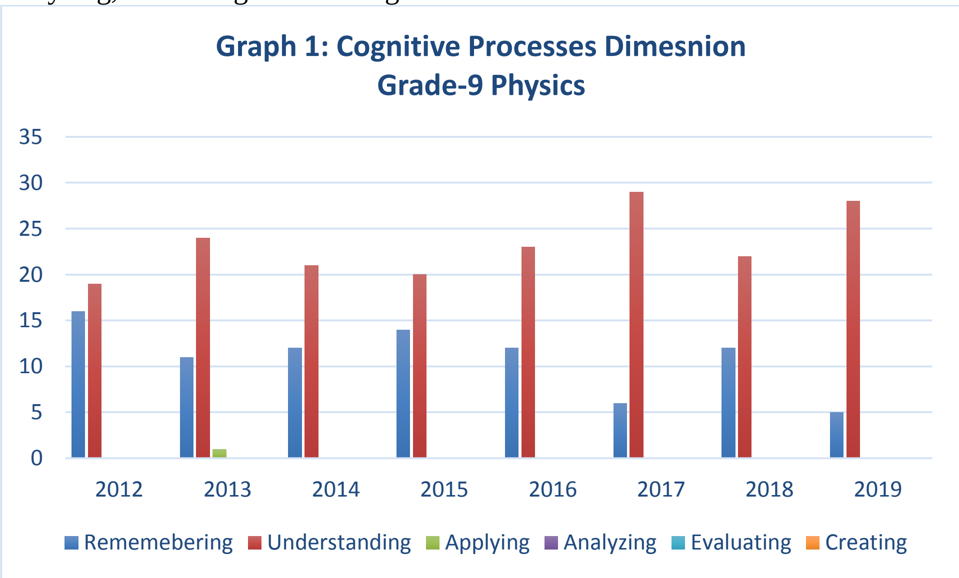
Cognitive Dimension	**Knowledge Dimension**			
	A. Factual	**B. Conceptual**	**C. Procedural**	**D. Metacognitive**
1.Remembering	1A	1B	1C	1D
2.Understanding	2A	2B	2C	2D
3.Applying	3A	3B	3C	3D
4.Analyzing	4A	4B	4C	4D
5.Evaluating	5A	5B	5C	5D
6.Creating	6A	6B	6C	6D

Table: Revised Bloom Taxonomy Table developed by L. Anderson in 2001

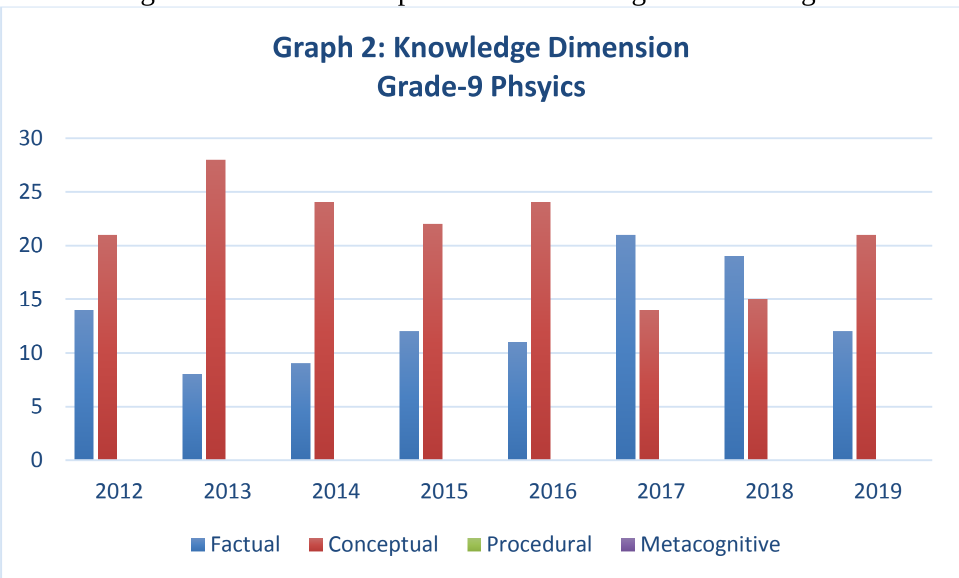
Data Analysis

In the present study researcher measured every item of question paper (2012-2019) of group-I of Physics of grade-IX and grade-X against the cognitive process dimension and knowledge dimension of RBT. The summary of both the classes are shown in appendix A and B comprising MCQs, SRQs and ERQs.

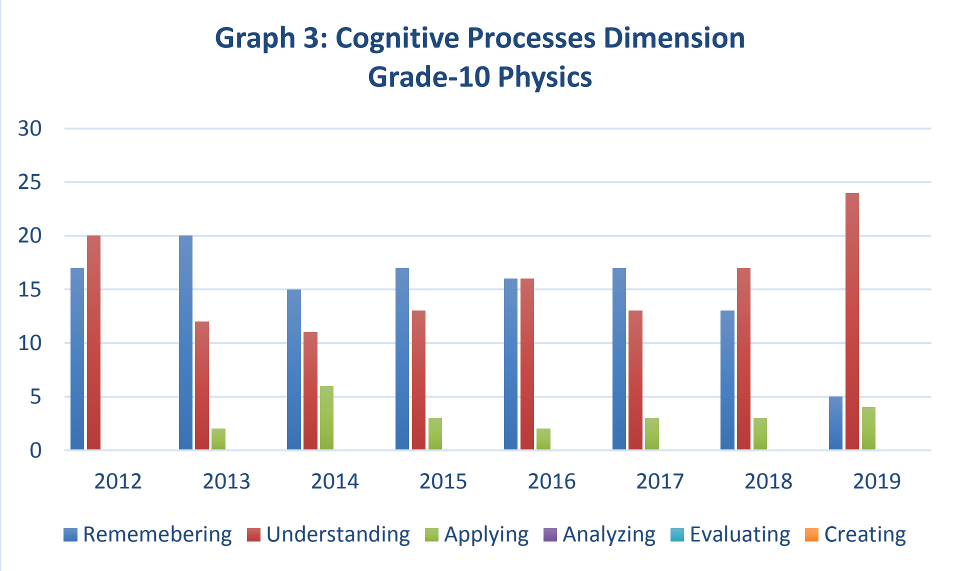
Graph 1 shows the combined summary of MCQs, SRQs and ERQs of past papers (2012-2019) for grade-IX with reference to cognitive processes dimension of RBT. It is observed that only two cognitive skills (Remembering and Understanding) were measured throughout the past papers (2012-2019) for grade-IX. The questions papers were not assessing the other cognitive skills such as applying, analysing, evaluating and creating.



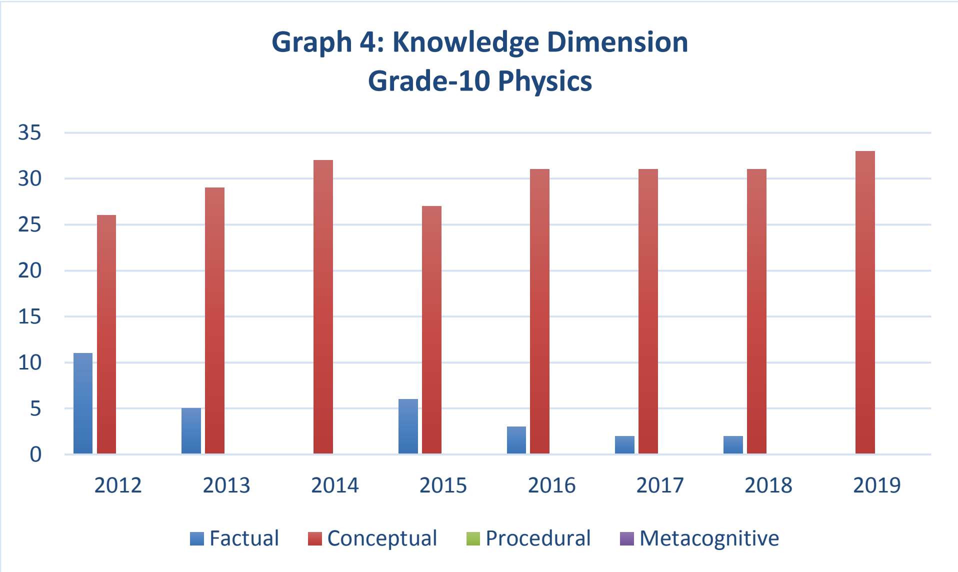
Graph 2 shows the combined summary of MCQs, SRQs and ERQs of past papers (2012-2019) for grade-IX with reference to knowledge dimension of revised bloom taxonomy. It is revealed that only two categories of knowledge dimension such as Factual and conceptual were measured throughout the past papers (2012-2019) for grade-IX. The questions papers were not assessing the other categories of knowledge dimension such as procedural knowledge and metacognitive knowledge.



Graph 3 shows the combined summary of MCQs, SRQs and ERQs of past papers (2012-2019) for grade-X with reference to cognitive processes dimension of Revised Bloom Taxonomy. It is to be noted that three cognitive skills (Remembering, Understanding and Applying) were measured throughout the past papers (2012-2019) for grade-X. The questions papers were not assessing the higher order thinking skills (HOTS) such as analysing, evaluating and creating.



Graph 4 shows the combined summary of MCQs, SRQs and ERQs of past papers (2012-2019) for grade-X with reference to Knowledge Dimension of Revised Bloom Taxonomy. It is observed that only two categories of knowledge dimension such as Factual and conceptual were measured throughout the past papers (2012-2019) for grade-X. The questions papers were not assessing the other categories of knowledge dimension such as procedural knowledge and metacognitive knowledge.



Comparison

On the basis of data collected, comparison is drawn in the following paragraphs:

Cognitive Processes Dimension

Both graphs analyze the cognitive processes dimension of the Revised Bloom Taxonomy in past papers (2012-2019) for grades 9 and 10 for physics. Both graphs indicate that the assessed cognitive skills are limited to Remembering and Understanding, with no questions assessing HOTS such as Analyzing, Evaluating, and Creating. On the other hand, Graph 1 is for grade 9, while Graph 3 is for grade 10, indicating a difference in the grade levels being studied. Graph 3 shows that Applying is also assessed in grade 10, which is not the case for grade 9 as shown in Graph 1. Graph 3 suggests that grade 10 question papers assess one additional cognitive skill (Applying) compared to grade 9 question papers, which only assess Remembering and Understanding.

Knowledge Dimension

Both graphs analyse the knowledge dimension of the Revised Bloom Taxonomy in past papers (2012-2019) for grades 9 and 10. Both graphs indicate that the assessed categories of knowledge dimension are limited to Factual and Conceptual, with no questions assessing Procedural Knowledge and

Metacognitive Knowledge. On the other hand, Graph 2 is for grade 9, while Graph 4 is for grade 10, indicating a difference in the grade levels being studied. Graph 4 suggests that Conceptual Knowledge is given more weightage compared to Factual Knowledge in grade 10 question papers, which is not explicitly mentioned in the description of Graph 2 for grade 9. Graph 4 indicates that the level of knowledge measured (Conceptual vs. Factual) is not balanced, with more emphasis on Conceptual Knowledge, whereas Graph 2 suggests that the levels of knowledge measured are almost equal in grade 9 question papers.

Findings of the Study

Findings of the present study revealed that in the assessment of students' learning achievement in Physics only students' knowledge or information gaining ability is assessed. The abilities that have been described in NC 2006 including applying analysing, evaluating, and creating were largely ignored. Students' ability to analyse things and generate new ideas is not assessed. The findings of the study indicate that the Federal Board of Intermediate and Secondary Education (FBISE) primarily assessed only the lower levels of cognitive processes, specifically Remembering and Understanding, in 9th-grade physics question papers. However, in 10th grade, the assessment included an additional cognitive ability, applying, but did not extend to HOTS. Similarly, in terms of the knowledge dimension of the RBT, the question papers for both grades focused solely on Factual and Conceptual knowledge, neglecting Procedural and Metacognitive knowledge. Furthermore, the study suggests that the selection of question paper setters might not align with best practices, as expertise in physics and familiarity with assessment techniques seem crucial for this task. Additionally, it appears that the criteria outlined in the National Curriculum document for assessing students in physics may not be fully adhered to.

Limitations & Delimitations

(a) The study focuses specifically on question papers for 9th and 10th-grade physics, excluding question papers for other grades.

(b) The study is limited to the analysis of physics question papers and does not include question papers from other subjects.

(c) The study is delimited to question papers from the FBISE Pakistan only and does not include question papers from other educational boards or countries.

(d) The study is delimited to question papers from the years 2012-2019 and does not include question papers from other time periods.

(e) The study is delimited to a quantitative analysis of question papers using RBT only and does not include qualitative analysis or other analytical frameworks.

Recommendations and Suggestions

Based on the findings of the study, the following recommendations and suggestions are outlined:

(a) The assessment of students' learning achievement in physics should go beyond just testing knowledge or information gaining ability. There should be a greater emphasis on assessing higher-order thinking skills such as applying, analyzing, evaluating, and creating. Question papers should be designed to include a variety of question types that target these skills.

(b) The assessment practices should align more closely with the objectives outlined in the National Curriculum (NC) 2006 for physics. This includes assessing students' ability to analyze things and generate new ideas. Question papers should be designed to reflect these objectives.

(c) Question paper setters should receive training in physics and assessment techniques to ensure that they are able to create question papers that effectively assess students' understanding and skills. This training should focus on aligning assessment practices with curriculum objectives and incorporating higher-order thinking skills into assessments.

(d) There is a need to review and revise the assessment practices of the Federal Board of Intermediate and Secondary Education (FBISE) to ensure that they are in line with best practices. This may involve updating question paper formats, including a wider range of question types, and revising the criteria for selecting question paper setters.

(e) Authorities should ensure that the criteria outlined in the National Curriculum document for assessing students in physics are fully adhered to. This may require monitoring and evaluation of assessment practices to ensure compliance.

(f) Teachers should be provided with opportunities for professional development to enhance their understanding of assessment practices and their ability to effectively assess students' learning achievement in physics. This could include workshops, seminars, and training programs focused on assessment techniques and the integration of higher-order thinking skills into assessments.

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