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Evaluating Cognitive and Knowledge Dimensions in Physics and Mathematics Exams of The Federal Board at The Secondary Level

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Abstract
Evaluation of the teaching and learning process plays a pivotal role in education. Various tools are employed to assess students' learning outcomes. However, a review of the literature reveals a lack of specific studies focusing on the application of the Revised Bloom's Taxonomy (RBT) in examination and paper-setting practices within the region. In response to this gap, the present study was undertaken to analyze Physics and Mathematics question papers for Grade 10, administered by the Federal Board of Intermediate and Secondary Education (FBISE), Islamabad, during the years 2015 to 2019, using the framework of RBT. Although the research population included all educational boards in Pakistan, due to resource constraints, only FBISE papers were selected as the sample. A checklist developed by L. Anderson et al. (2001), based on the Revised Bloom's Taxonomy, was used as the research instrument. The tool was validated by three subject-matter experts. The study examined both the Cognitive Process Dimension and the Knowledge Dimension of RBT. Data were analyzed using simple means and percentages and presented through tables and graphs. A comparative analysis between Physics and Mathematics papers was also conducted. The findings revealed that the FBISE question papers at the secondary level largely omitted higher-order cognitive skills such as Analyzing, Evaluating, and Creating. Furthermore, the Procedural and Metacognitive categories within the Knowledge Dimension were also underrepresented. The study concluded that the question papers did not comprehensively reflect all dimensions of the Revised Bloom's Taxonomy. Therefore, it is recommended that future paper-setting practices incorporate all aspects of RBT to align assessment with the demands of 21st-century learning skills.

Keywords: Federal Board Papers, Cognitive Processes Dimension, Knowledge Dimension, Revised Bloom Taxonomy, Physics, Mathematics

Introduction

Education Officers, Faculty of College of Education, Peshawar: Constituent College of Air University, Islamabad Assessment is an integral component of the educational process, serving as a powerful tool to evaluate the effectiveness of instruction and to measure students' learning outcomes. It not only influences students' academic development but also shapes teaching practices and curriculum implementation. In Pakistan, secondary-level board examinations are high-stakes assessments that play a decisive role in students' academic progression. Among these, Physics and Mathematics are considered core subjects that demand a sound understanding of concepts, application skills, and higher-order thinking abilities. The prevailing examination techniques in Pakistan have frequently been criticized for concentrating mostly on rote memorization and factual recall, despite curriculum improvements and policy suggestions that emphasize conceptual understanding and critical thinking. Matriculation exams are administered throughout the nation by the Federal Board of Intermediate and Secondary Education (FBISE), one of the most prestigious examining organizations. Concern over whether its tests accurately represent the cognitive demands supported by the national curriculum and contemporary educational standards is, nevertheless, growing. Educational researchers frequently use Revised Bloom's Taxonomy (RBT), a framework that divides learning objectives into four categories of knowledge (Factual, Conceptual, Procedural, and Metacognitive) and six cognitive process levels (Remember, Understand, Apply, Analyze, Evaluate, and Create), to assess the cognitive rigor of assessment items. This taxonomy offers a thorough method for examining how much exam questions focus on higher-order thinking skills (HOTS), which are crucial for students in the twenty-first century, in addition to lower-order thinking skills (LOTS). Examining previous board exam papers critically using Revised Bloom's Taxonomy might provide important information about how well or poorly national educational goals and evaluation procedures match up. Although this taxonomy has been used in many worldwide studies to assess question papers, little study has been done in Pakistan, especially with regard to secondary science and math courses. Therefore, the purpose of this study is to use the Revised Bloom's Taxonomy framework to assess the Federal Board of Intermediate and Secondary Education (FBISE) 10th grade Physics and Mathematics examination papers from 2012 to 2019. Determining the cognitive levels and knowledge kinds that are prioritized in these tests as well as evaluating how well the assessment procedures encourage students to use analytical reasoning, solve problems, and comprehend concepts are the goals. The findings of this study are expected to inform policymakers, curriculum developers, teachers, and assessment bodies in making data-driven decisions to improve the quality and fairness of examination systems in Pakistan.

Revised Bloom's Taxonomy

Anderson and Krathwohl (2001) created the Revised Bloom's Taxonomy (RBT) as an upgrade to Benjamin Bloom's 1956 original taxonomy. Although many people used the original Bloom's Taxonomy to categorize educational objectives, the updated version brought about two significant changes: (i) A change in representation of the cognitive processes from nouns to verbs. (ii) To provide a more thorough categorization of learning objectives, a second dimension the knowledge dimension is included. The RBT framework facilitates the development of both lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS) through the creation, analysis, and evaluation of curriculum, instruction, and assessments.

Cognitive Process Dimension of Revised Bloom's Taxonomy

The several levels of thought that students employ when interacting with learning materials are represented by Revised Bloom's Taxonomy. These stages emphasize the development of both lower-order and higher-order thinking skills, moving from simple knowledge recall to intricate idea generation.

Remember: The capacity to recover pertinent information from long-term memory falls under the "Remember" category. All other forms of learning are built upon this most fundamental level of cognition. This level does not call for comprehension of the significance or application of the material; instead, it concentrates on rote memory.

Understand: Students at this level show that they understand concepts and ideas and go beyond simple memorization. Constructing meaning from educational messages including written, spoken, and visual communication is the process of understanding. Since students need to understand a topic before they can apply or critique it, comprehension is essential.

Apply: This category entails applying learned information to practical or problem-solving scenarios. Students show that they can carry out or apply procedures based on their knowledge. Students must draw links between theory and practice at this level.

Analyze: "Analyze" refers to the process of dissecting information into its component elements and analyzing how these parts relate to a larger structure or goal. It aids in determining connections, root causes, and fundamental ideas. Deeper involvement with the material and critical thinking are encouraged at this level.

Evaluate: At this level, decisions must be made using standards and criteria. Evaluation entails verifying, analyzing, and determining the worth of concepts or resources. Evaluation necessitates in-depth knowledge and the capacity for reasoned decision-making.

Create: The taxonomy's highest level, "Create," describes combining components to create a new, cohesive whole or rearranging preexisting components in a different way. This is the phase of originality, creativity, and synthesis. Creativity and the creative application of knowledge are encouraged at this level.

Knowledge Dimension of Revised Bloom's Taxonomy

The Revised Knowledge Dimension Bloom's Taxonomy categorizes the kinds of information that students should learn and apply. It enhances the Cognitive Process Dimension by assisting teachers in comprehending the types of knowledge that children are acquiring, from basic facts to more intricate conceptual or procedural knowledge and even self-awareness regarding learning. The fundamental concepts that students need to understand in order to solve problems in a discipline or to be comfortable with it are referred to as "*factual knowledge*." This level of expertise is fundamental. Higher-order thinking and deeper comprehension are predicated on factual knowledge. It is necessary for understanding and memory. *Conceptual Knowledge*: This refers to the relationships between fundamental components that make up a broader organization. It illustrates the connections between concepts rather than just facts. Students are better able to recognize trends, draw connections, and apply what they have learned in a variety of settings thanks to this information. Knowing how to perform something is known as *procedural knowledge*. It is the understanding of procedures, methods, and techniques as well as the standards for their proper application. It assists students in carrying out assignments, resolving issues, and correctly applying strategies. Being aware of and comprehending one's own thought and learning processes is known as *metacognitive knowledge*. It entails self-awareness and cognitive control. Students that possess metacognitive knowledge become autonomous and proficient learners by being able to organize, track, and assess their own learning.

Problem Statement

Higher-order thinking abilities including critical thinking, creativity, problem-solving, and teamwork are crucial in the twenty-first century. However, secondary school examinations frequently prioritize lower-order cognitive abilities, which restricts the development of these crucial 21st-century talents. The purpose of this study is to examine how well the 10th grade Federal Board math and physics exam papers match the Revised Bloom's Taxonomy. In order to determine if the examination system is encouraging the development of higher-order thinking skills, it looks at the cognitive and knowledge components of these papers. According to the report, the exams emphasize lower-order cognitive skills and lack procedural expertise, which raises questions about how well these tests prepare students for challenges in the future.

Scope of the Study

Although the initial scope of the study aimed to consider examination papers from all secondary education boards in Pakistan, the actual analysis was limited to papers from the Federal Board of Intermediate and Secondary Education (FBISE). This decision was made deliberately due to the centralized status of FBISE, whose assessment practices are often considered standard-setting and are widely followed across various regions of the country. Therefore, while the study does not generalize findings to all boards, it offers meaningful insights into national assessment trends based on a representative and influential sample. This limitation has been acknowledged in the conclusion and recommendations section of the paper to ensure transparency and contextual accuracy.

Research Objectives

- To analyze the 10th-grade Federal Board Physics and Mathematics exam papers with respect to the levels of cognitive dimension of the Revised Bloom’s Taxonomy.

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- To assess the emphasis placed on different types of knowledge dimension (factual, conceptual, procedural, metacognitive) in the Physics and Mathematics exam papers.

- To compare the results of Physics and Mathematics according to Bloom's cognitive process dimension and knowledge dimension.

Research Questions

- What is the distribution of questions across the various cognitive levels (remembering, understanding, applying, analyzing, evaluating, and creating) in the Federal Board Physics and Mathematics exam papers?

- What types of knowledge (factual, conceptual, procedural, metacognitive) are most emphasized in the Physics and Mathematics exam papers of the Federal Board?

- How do the Federal Board Grade 10 Physics and Mathematics question papers (2015–2019) compare in terms of the Cognitive Process Dimension and Knowledge Dimension of Revised Bloom's Taxonomy?

Significance of the Study

The findings highlight an imbalance in the cognitive demands placed on students in the Federal Board examination system, with an overemphasis on lower-order cognitive skills such as remembering and understanding. This insight is crucial for educational policymakers and curriculum developers to adjust the focus of assessments, ensuring that students are adequately challenged and evaluated for higher-order cognitive skills such as applying, analyzing, evaluating, and creating. By identifying the lack of higher-order questions, this study draws attention to the need for a shift toward assessments that foster critical thinking, problem-solving, and creativity. Such changes are essential for preparing students for real-world challenges and encouraging deeper understanding. The study provides valuable insights for educators and examiners in refining their question-setting practices. It emphasizes the need for questions that promote a comprehensive understanding of concepts and the application of knowledge in varied contexts, aligning more with the modern educational demands for higher-order thinking. The study also emphasizes the underrepresentation of procedural knowledge in the exams. Recognizing this gap can help develop more well-rounded assessments that evaluate students' ability to apply theoretical knowledge in practical situations, fostering skills needed for future academic and professional success.

Literature Review

Particularly in disciplines like mathematics and physics that need conceptual knowledge and analytical reasoning, assessment procedures are crucial in determining how teaching and learning are carried out. A framework for classifying educational objectives into knowledge dimensions (Factual, Conceptual, Procedural, and Metacognitive) and cognitive process dimensions (Remember, Understand, Apply, Analyze, Evaluate, Create) is provided by the Revised Bloom's Taxonomy (RBT). This taxonomy has been used by a number of studies to examine exam papers and determine how well the assessment items match various cognitive levels. Exam systems in Pakistan, particularly those run by the Federal Board of Intermediate and Secondary Education (FBISE), often prioritize lower-order thinking skills (LOTS) over higher-order thinking skills (HOTS), according to an increasing amount of research. In their analysis of FBISE English exam papers, Qasim and Qasim (2021) found that just 25% of the questions evaluated higher-order cognitive processes like analyze, evaluate, and create, while 75% of the questions evaluated lower-order skills like remember and understand. This disparity implies that examination procedures do not place enough focus on abilities like critical thinking, synthesis, and problem-solving. Pakistan's grading methods were also challenged by Bhatti (1987) and Farooq (1996) for emphasizing rote memorization over all else. According to these studies, curricula frequently surpass students' cognitive abilities, yet examinations are too easy to provide students with a meaningful challenge. Specifically, Pakistan's public schools, particularly those in Sindh and Punjab, still use teacher-centered educational approaches and evaluation techniques that do not help pupils develop their critical thinking or creative skills. Similar patterns have been noted globally. For example, Alzu'bi (2014) examined the English Secondary Certificate Exam papers in Jordan and discovered that over 70% of the questions were related to application, knowledge, and comprehension levels. The fact that the higher levels—analysis, synthesis, and evaluation—made up just about 30% highlights the worldwide difficulty in encouraging higher-order cognitive abilities through testing. In the field of science education, Motlhabane (2017) examined Grade 12 Physics tests in South Africa and discovered that higher-order thinking skills like analysis and assessment were noticeably underrepresented, while 64% of the questions called for application-level thinking. This demonstrates the widespread trend of underutilizing the entire cognitive range in scientific exams, even though the topic requires inquiry-based learning and critical thinking. Amna, Danish, and Haseeb (2020) looked the M.A. English papers from Punjab University in a local setting and discovered that comprehension-level questions accounted for 83.72% of the total, evaluation-level questions made up only 1.39 percent, and creation-level questions were nonexistent. This demonstrates once more the focus on LOTS and the alarming disregard for higher order cognitive abilities. A similar overemphasis on lower-level skills like remembering and comprehending was also noted by Muchlis (2015) and Tayyeh et al. (2021), who used textbook content analysis to assess the distribution of cognitive levels in reading comprehension questions. The argument that traditional evaluations rarely match contemporary educational aims was further supported by Bayaydah (2020), which also verified that remembering-level questions accounted for 30.75 percent of Grade 9 and 10 final exam papers in Jordan. Although there are frameworks such as Bloom's Taxonomy, there is comparatively little use of its knowledge dimensions (factual, conceptual, procedural, and metacognitive) in paper analysis. The cognitive process dimension is the exclusive focus of the majority of investigations. This creates a substantial research gap, especially in the fields of science and math education, where assessing students' application of concepts in practical problem-solving situations requires incorporating both aspects. Given these results, it is clear that a thorough examination of FBISE 10th grade math and physics exam papers is required to ascertain the degree to which these tests encourage higher-order thinking. Understanding the current status of assessments and guiding the development of future policies and curricula that support 21st-century learning goals like creativity, critical thinking, and problem-solving would be two benefits of such a study.

Research Methodology

This study employs a descriptive research design combined with a qualitative document analysis approach to examine the 10th-grade Physics and Mathematics annual examination papers administered by the Federal Board of Intermediate and Secondary Education (FBISE) from 2015 to 2019. The objective is to evaluate and classify the test items using the Dimensions of Revised Bloom's Taxonomy (RBT) framework. A purposive sampling technique was used to select representative annual examination papers for each subject over the five-year period. Only regular board exam papers were included, while supplementary and model papers were excluded to ensure uniformity and comparability. The primary research tool was a structured checklist based on the two-dimensional RBT framework, comprising six cognitive process levels (Remember, Understand, Apply, Analyze, Evaluate, Create) and four knowledge categories (Factual, Conceptual, Procedural, Metacognitive). The checklist was reviewed by a panel of three experts two subject specialists and one educational assessment expert to ensure clarity, relevance, and alignment with national curriculum objectives. Their feedback was used to refine the coding guide for accurate classification. Each question was independently analyzed and classified according to the RBT dimensions using a detailed coding manual that included definitions, examples, and decision rules. The categorization process involved identifying the type of mental operation required (cognitive process) and the domain of knowledge being assessed (knowledge dimension). The mean percentage method was used to quantify the distribution of cognitive and knowledge categories across subjects and years, enabling a comparative analysis between Physics and Mathematics papers. To ensure reliability, two trained raters independently coded the exam questions. The degree of agreement was measured using Cohen's Kappa, yielding a value of 0.82, which indicates substantial agreement. Any discrepancies were resolved through joint review and discussion to reach consensus. This study is based solely on publicly available secondary data i.e., officially published question papers. However, to maintain academic integrity and comply with institutional research protocols, ethical clearance was obtained from the research committee of the affiliated institution prior to data collection. Furthermore, since the examination papers are publicly accessible documents, formal permission from FBISE was not required. Nonetheless, the source of the documents has been duly cited, and the research was conducted in adherence to ethical standards regarding the use of public documents and intellectual transparency.

Limitations of the Study

- The study is limited to the analysis of 10th-grade Physics and Mathematics exam papers from the Federal Board of Intermediate and Secondary Education (FBISE), excluding other subjects and grade levels.

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- It focuses solely on a five-year period (2015–2019); changes or trends outside this timeframe are not considered.

- No primary data was collected from students or teachers, restricting insights into their perceptions of the exam content.

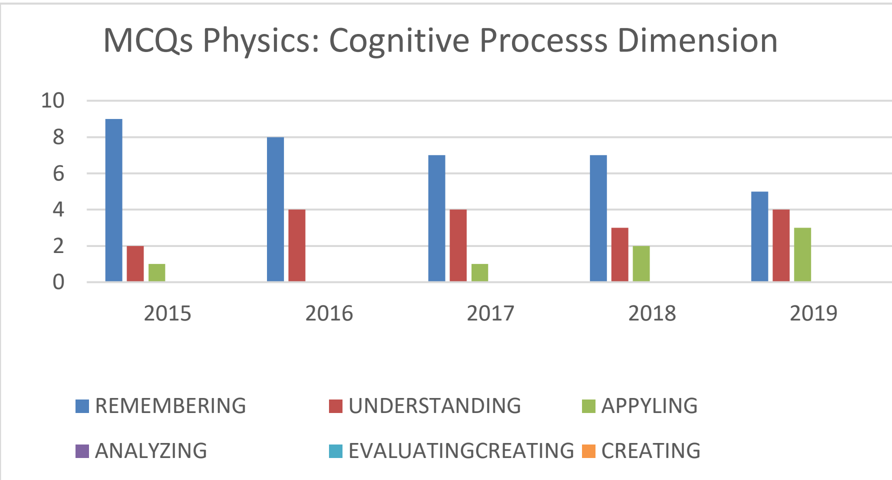
- The findings are specific to FBISE and may not be generalizable to other educational boards or systems.

- The analysis is based exclusively on the Revised Bloom's Taxonomy framework, without incorporating alternative assessment models or classifications.

Findings and Analysis

Analysis of Physics Question Papers

Analysis of Physics MCQs: The following chart indicates that the 2015 exam paper placed the greatest emphasis on the Remembering level compared to other years. However, there is a noticeable decline in focus on lower-order thinking skills (LOTS) from 2015 to 2019, suggesting a gradual shift toward more complex cognitive levels over time. The Understanding level was most emphasized in the 2016 and 2017 papers, while the 2015 paper had the least focus on this domain. The upward trend from 2015 to 2019 highlights increasing attention to this cognitive process, reflecting a more balanced approach to LOTS in the later years. The Applying level was not addressed in the 2016 paper, but from 2015 to 2019 (excluding 2016), there was a steady increase in the number of questions targeting this level. This trend indicates that paper setters were aligning with FBISE Islamabad's recommendations to gradually increase the cognitive complexity of exam questions.



On the knowledge dimension, the 2015 paper focused most heavily on Factual Knowledge, with a declining trend from 2015 to 2019. This suggests a deliberate shift from factual recall toward fostering students' critical thinking skills. Conceptual Knowledge was most prominent in the 2017 and 2019 papers, both at the same level and higher than in other years. This upward trend reflects a

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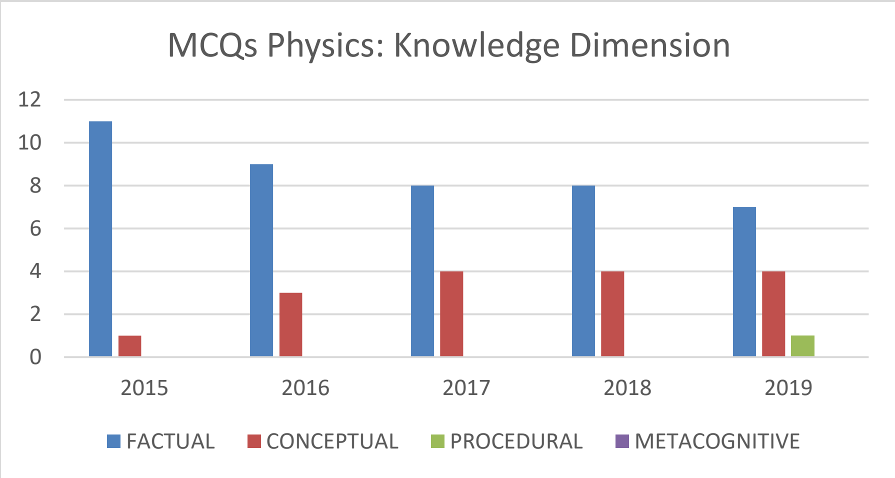
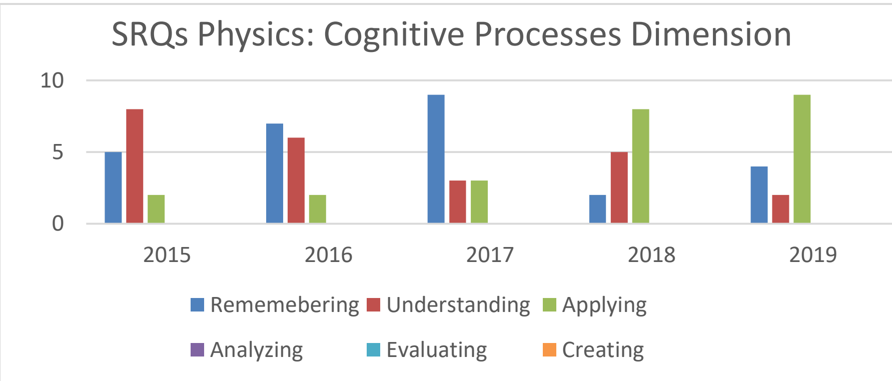
growing emphasis on deeper understanding in the later papers. Procedural Knowledge appeared only in the 2019 paper, indicating an effort to raise the overall standard and rigor of the examination. knowledge



Analysis of Physics SRQs: The following chart shows that the 2017 paper emphasized the Remembering level more than other years, although the overall trend from 2015 to 2019 shows a decline in focus on lower-order thinking skills (LOTS). This indicates a gradual shift towards higher-order thinking and increased complexity over time. The 2015 paper placed the greatest emphasis on the Understanding level, but the trend from 2015 to 2019 is again decreasing, further suggesting that paper setters initially focused more on LOTS and progressively shifted towards more complex cognitive demands. In contrast, the Applying level shows a gradual increase in emphasis from 2015 to 2019. This upward trend reflects the paper setters' intention to enhance the cognitive complexity of the exams in alignment with modern assessment practices.



On the Knowledge Dimension, the following chart shows that Factual Knowledge was most emphasized in the 2016 and 2018 papers. However, the trend is irregular, indicating alternating emphasis on factual content across the years. Conceptual Knowledge received nearly equal weightage in the 2015 and 2017 papers, with a gradual increase in the graph over the five years, suggesting growing importance placed on deeper understanding. Procedural Knowledge was addressed only in the 2017 and 2019 papers, indicating an effort to raise the

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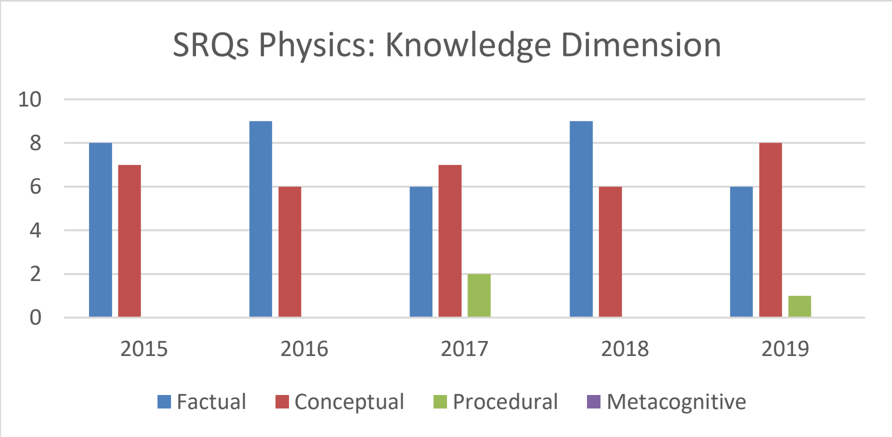
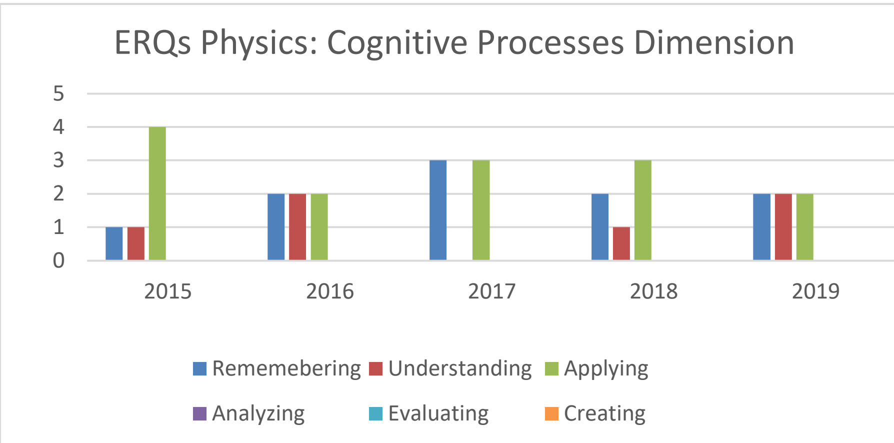
quality and standard of assessments by incorporating more advanced knowledge types.



Analysis of Physics ERQs: The following chart indicates that the 2017 paper emphasized the Remembering level more than any other year. Equal weightage was given to the 2016, 2018, and 2019 papers, while the 2015 paper received the least emphasis in this domain. The graph from 2015 to 2019 shows a gradual increase in focus on remembering skills. Regarding the Understanding level, the 2017 paper did not include questions at this level, while the 2015 paper had minimal emphasis. However, the overall trend from 2015 to 2019 is upward, suggesting an increasing focus on lower-order thinking skills (LOTS) over time. In contrast, the Applying level was most emphasized in the 2015 paper, whereas the 2016 and 2019 papers gave it the least attention. The graph shows a decline in the application of knowledge from 2015 to 2019, indicating reduced emphasis on this cognitive domain in recent years.



On the Knowledge Dimension, Factual Knowledge was most prominent in the 2015 paper, with a general decline over the five years. The 2017 paper gave the least importance to factual knowledge, reflecting a shift in focus. Conceptual Knowledge saw an increasing trend from 2015 to 2019, indicating greater emphasis on deeper understanding in later years. Procedural Knowledge was addressed only in the 2017 paper, with no representation in the other years, suggesting limited focus on this domain.

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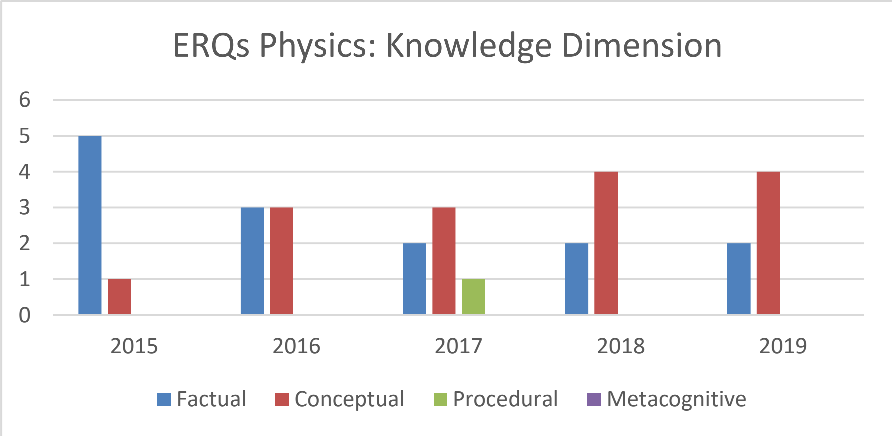
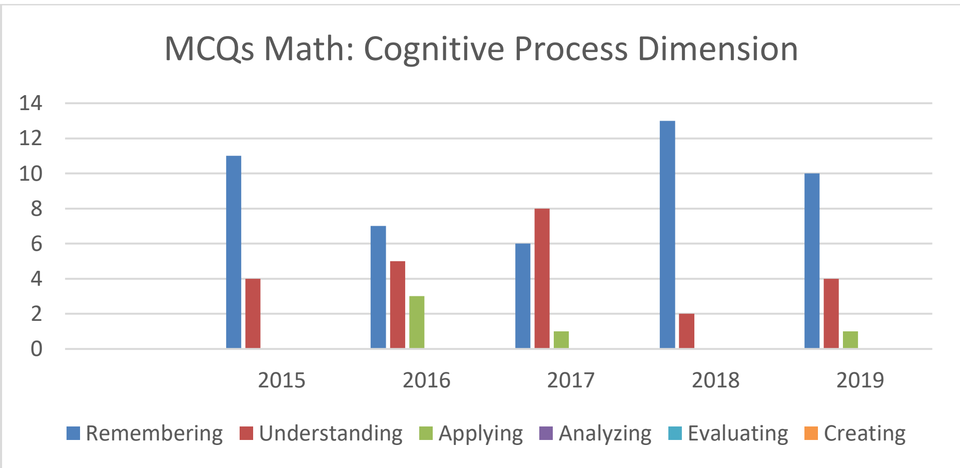


Analysis of Mathematics Question Papers
Cognitive Process Dimension
The following graph of the MCQs from the 10th-grade Federal Board Mathematics papers (2015–2019) highlight the distribution of questions across the Remembering, Understanding, and Applying levels of the cognitive process dimension: The 2018 paper contains the highest proportion of remembering-level questions, while 2016 has the least. The graph shows a gradual increase from 2015 to 2019, indicating growing emphasis on recall-based questions over time. The 2017 paper shows the greatest focus on the understanding level, whereas the 2018 paper has the least. The graph reveals a gradual decrease from 2015 to 2019, suggesting a decline in the inclusion of comprehension-based questions in recent years. The 2018 paper has the highest proportion of applying-level questions, while the 2017 paper has the lowest. The graph declines from 2015 to 2019, indicating reduced emphasis on application-based items over the years.



The graphs for Short Response Questions (SRQs) from 2015–2019 illustrate the following: The 2015 paper includes no remembering-level questions, while the years 2016 to 2019 show a constant trend, with equal representation each year. The 2015 paper places the most emphasis on understanding-level questions. The graph shows a gradual decrease from 2015 to 2019, indicating a decline in the

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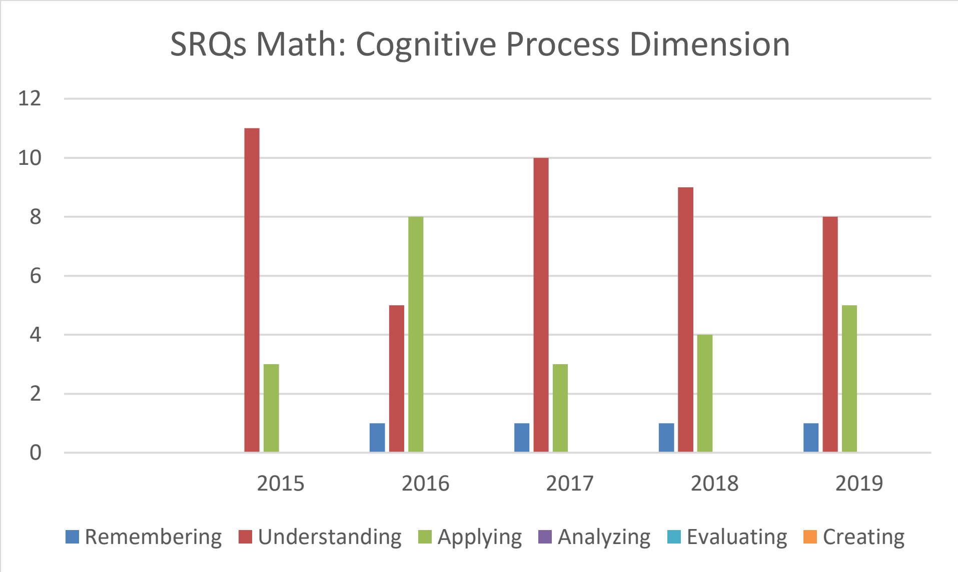
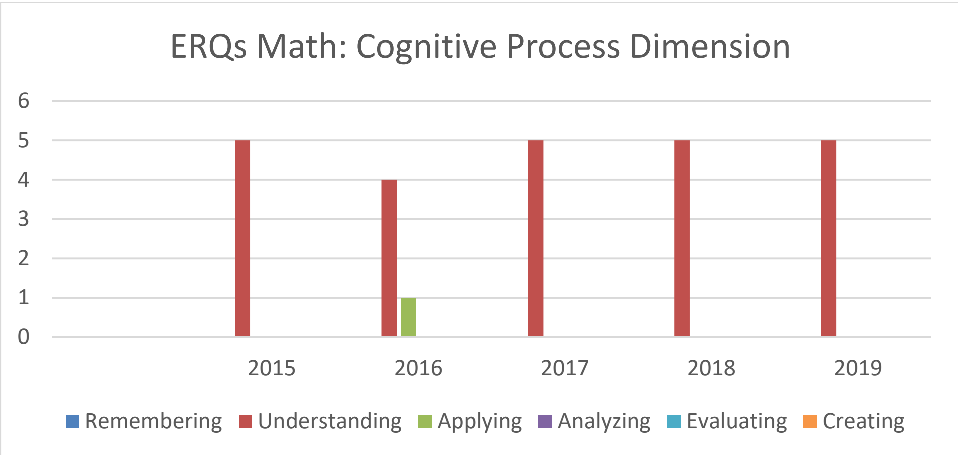
focus on comprehension. The 2016 paper includes the highest number of applying-level questions. However, the graph remains constant from 2015 to 2019, reflecting a consistent presence of these types of questions across the years.



The Extended Response Questions (ERQs) show the following patterns: The 2016 paper has the least emphasis on understanding-level questions, while the graph shows a gradual increase from 2015 to 2019. This indicates growing importance of comprehension in the long-answer section over time. Only the 2016 paper contains an applying-level ERQ; the other years do not include any such questions, showing minimal focus on application in this section throughout the period.



Knowledge Dimension

The chart below presents the graph for the *factual knowledge* type in the MCQs of Mathematics 10th-grade Federal Board question papers from 2015 to 2019. The graph indicates a gradual increase in factual questions over the years, with 2019 having the highest number and 2017 the lowest. This suggests a greater focus on factual knowledge in 2019. The next chart shows the trend for *conceptual knowledge* type in the MCQs during the same period. The graph

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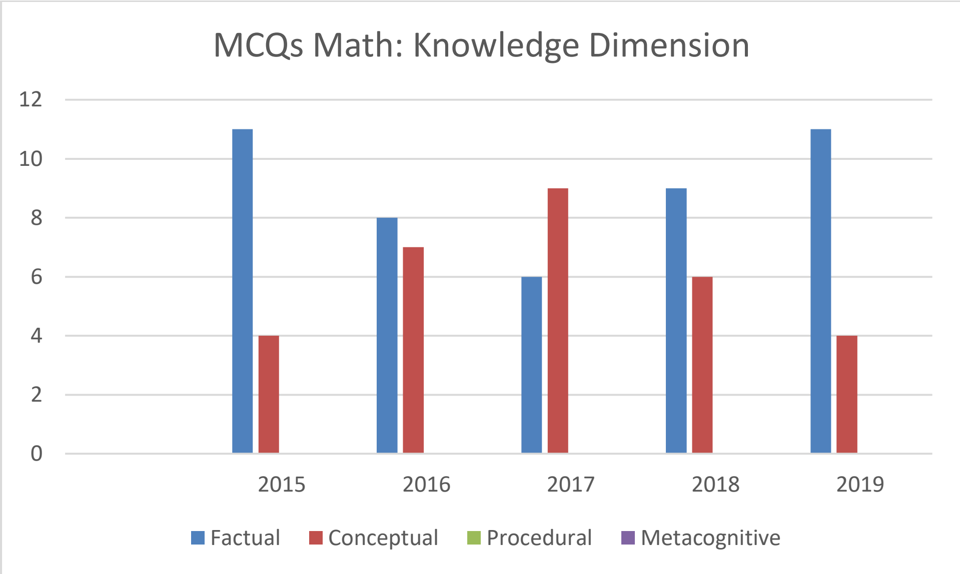
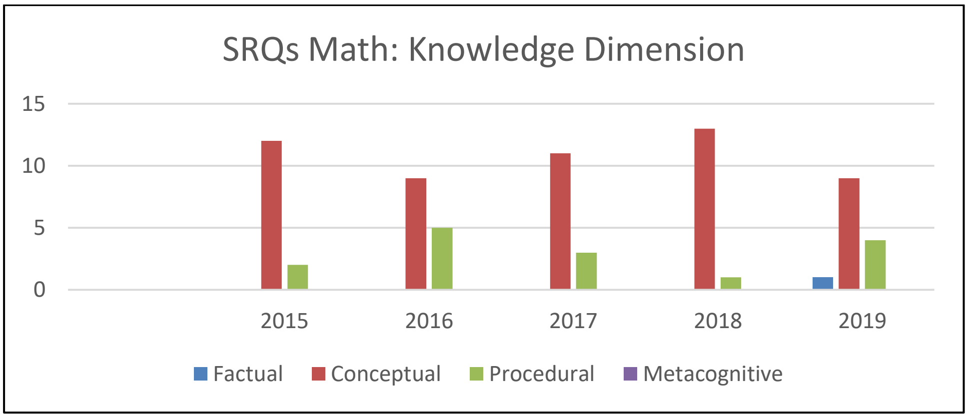
demonstrates a decline from 2015 to 2019, with 2017 containing the most conceptual questions and 2015 and 2016 the fewest. This indicates a peak in conceptual knowledge emphasis in 2017.



The chart for *factual knowledge* in the SRQs from 2015 to 2019 shows that only the 2019 paper contains a factual question, while the other years contain none. The graph for *conceptual knowledge* in SRQs indicates a decrease from 2015 to 2019, with 2018 containing the most conceptual questions, and 2016 and 2019 the fewest. This reflects a declining emphasis on conceptual knowledge in short questions over time. For *procedural knowledge* in SRQs, the trend remains constant across the five years. However, 2016 contains the highest number of procedural questions, while 2018 contains the least.



The graph for *conceptual knowledge* in ERQs from 2015 to 2019 shows a gradual increase. The years 2017, 2018, and 2019 include more conceptual questions compared to 2015 and 2016, indicating a growing focus on conceptual understanding in long questions. Finally, the chart for *procedural knowledge* in ERQs reveals a decreasing trend from 2015 to 2019. The highest number of procedural questions appears in 2015 and 2016, while fewer are found in the subsequent years.

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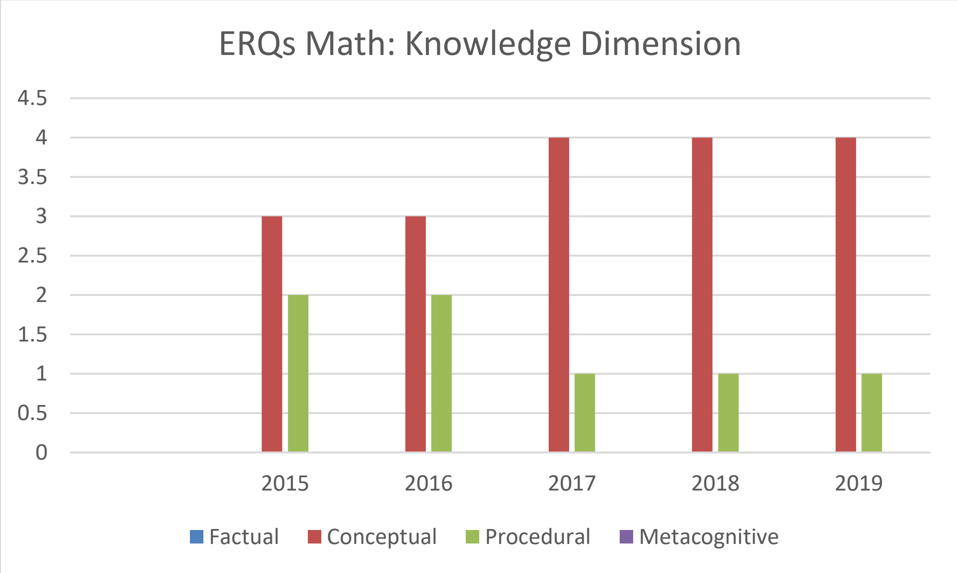

Comparative Analysis Based on Cognitive Process Dimension

Remembering Level: The Physics papers placed significant emphasis on the Remembering level in the early years, particularly in 2015, especially in MCQs and ERQs. However, there was a gradual decline in this focus from 2015 to 2019 in MCQs and SRQs, suggesting a shift toward more complex thinking. In contrast, Mathematics showed an increasing trend in Remembering-level questions, especially in MCQs. The 2018 paper had the highest proportion of recall-based questions. SRQs maintained a steady presence of remembering-level items from 2016 to 2019, while ERQs largely avoided this level. While Physics reduced reliance on recall, Mathematics intensified its use over time. This indicates that Physics aimed to reduce rote memorization, whereas Mathematics moved in the opposite direction in MCQs.

Understanding Level: Understanding-level questions were highly emphasized in Physics papers from 2016 to 2017 in both MCQs and SRQs. Although there was some decline in the ERQs, the overall trend showed an increasing focus in later years, indicating a shift toward comprehension. Mathematics initially focused heavily on understanding in 2015 and 2017. However, the trend showed a gradual decline from 2015 to 2019 across all question types, including MCQs, SRQs, and ERQs. Physics exhibited a positive trajectory toward fostering comprehension, while Mathematics showed a regressive trend, emphasizing it less over time.

Applying Level: Application-level questions were inconsistently present in Physics papers. For instance, the 2016 MCQs lacked applying-level questions, but the overall trend from 2015 to 2019 was increasing, particularly in SRQs. ERQs, however, showed a declining trend in applying-level content. Mathematics saw its highest proportion of application-based MCQs in 2018. However, the overall trend declined from 2015 to 2019 in MCQs and was nearly absent in ERQs, appearing only in 2016. SRQs maintained a consistent presence. Physics showed a more deliberate and increasing integration of applying-level questions in MCQs and SRQs, unlike Mathematics, which showed inconsistency and eventual decline, especially in ERQs.

Comparative Analysis Based on Knowledge Dimension

Factual Knowledge: The Physics MCQs in 2015 had a high concentration of factual questions, but the trend declined by 2019. This shows a move away from factual recall. Factual knowledge questions in Mathematics MCQs increased over time, peaking in 2019. In SRQs, however, only 2019 included factual items, and ERQs showed minimal factual content. Physics made a conscious shift away from factual emphasis, while Mathematics increased reliance on factual recall, especially in MCQs.

Conceptual Knowledge: There was a significant increase in conceptual questions in Physics papers, especially in 2017 and 2019, indicating greater depth in understanding scientific concepts. Mathematics also showed a peak in 2017 for conceptual knowledge in MCQs but declined thereafter. In ERQs, however, the conceptual trend increased, especially in 2017–2019. Both subjects highlighted conceptual knowledge around 2017. However, Physics sustained this focus, while Mathematics shifted conceptual emphasis more to ERQs and away from MCQs and SRQs.

Procedural Knowledge: Procedural knowledge was rare, appearing only in selected years 2017 and 2019 in SRQs and ERQs, signaling an attempt to introduce problem-solving skills. Procedural knowledge had a stronger and more consistent presence in SRQs across the years, especially in 2016. In ERQs, it declined steadily, showing less focus in later years. Mathematics incorporated procedural content more consistently than Physics. However, Physics attempted to increase its presence in recent years, likely to encourage skill-based learning. Overall, the Physics papers reflect a strategic shift toward higher-order thinking, gradually moving away from rote memorization and emphasizing conceptual understanding and application. In contrast, Mathematics papers show a mixed pattern, with an increased focus on recall (Remembering) in MCQs and a decline in conceptual and procedural focus in some areas, especially in later years. The findings suggest that Physics assessments are evolving in alignment with modern educational goals such as critical thinking and problem-solving, whereas Mathematics papers maintain a more traditional focus with only selective attention to deeper cognitive levels and knowledge types.

Conclusion

This study reveals critical insights into the nature of the 10th-grade Federal Board examinations in Physics and Mathematics. Over the five-year period analyzed (2015–2019), the majority of the exam questions focused on lower-order cognitive skills, particularly remembering and understanding, while higher-order cognitive skills were largely neglected. Similarly, the assessment placed more emphasis on factual and conceptual knowledge, with little attention given to procedural knowledge. These findings suggest that the current examination system may not adequately challenge students to develop higher-order thinking skills and may not assess their ability to apply knowledge in practical or procedural contexts. Given these results, it is clear that the examination system needs to be redesigned to promote a more balanced evaluation of students' knowledge and cognitive abilities, ensuring that all dimensions of Bloom's Taxonomy are represented in a way that encourages critical thinking, problem-solving, and the application of knowledge.

Recommendations and Future Work

Following recommendations are suggested based on the current study; It is recommended that future examination papers include a higher proportion of questions targeting higher-order cognitive skills, such as analyzing, evaluating, and creating. These skills should be integrated throughout the exam papers to better assess students' deep understanding and ability to apply knowledge in complex contexts. There should be a stronger focus on procedural knowledge as well as metacognitive knowledge in the exam questions. Questions that require students to apply their knowledge in practical, real-world situations (e.g., solving problems, demonstrating experiments, or analyzing data) will better prepare them for future academic and career challenges. The Federal Board should consider revising the current assessment framework to align more closely with the Revised Bloom's Taxonomy. This would involve not only diversifying the types of cognitive skills tested but also ensuring that the assessments provide a more comprehensive evaluation of students' abilities across all three knowledge dimensions (factual, conceptual, and procedural). Teachers should be trained to create and administer assessments that challenge students to engage in higher-order thinking. Professional development programs focusing on Bloom's Taxonomy and effective assessment techniques can help educators design more effective exam questions that foster critical thinking. Regular review and updates to the examination papers are necessary to ensure that the assessments remain aligned with current educational goals and standards. This would also help in continuously improving the fairness and effectiveness of the examination system. Following future work is suggested to explore the different dimensions of the study; Future research could extend the study to include a broader range of subjects and examine the alignment of various other subjects with Bloom's Taxonomy. This would provide a more comprehensive understanding of the overall trends in examination practices across different disciplines. A longitudinal study examining the evolution of exam papers over a longer period (e.g., 10–20 years) could offer valuable insights into trends and shifts in educational priorities, particularly with regard to the integration of higher-order cognitive skills and procedural knowledge in exams. Future research could compare the findings from the Federal Board exams with international educational standards and assessment practices, such as those used by other national boards or international frameworks like PISA. This could help identify areas for improvement in the global context of assessment. Research exploring how students perform on exams with varying cognitive demands could provide insights into the effectiveness of these assessments in measuring true understanding. This could also inform strategies for improving teaching and learning to better prepare students for future assessments. With the increasing integration of technology in education, future work could investigate how digital tools, such as online assessments or interactive learning platforms, can be used to assess higher-order thinking skills more effectively, offering students opportunities to engage in problem-solving, critical thinking, and collaboration.

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