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Analysis Of Existing Exam Questions And Designing Test Items According To Blooms Taxonomy For Engineering Students In Select Affiliated Colleges In Telangana

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Abstract
Teaching and testing have evolved significantly over the years, incorporating technological advancements and innovative pedagogical strategies to enhance student learning and assessment. There have been many changes in testing procedures in recent years. It is the assessment system that has the most discerning effect on learning. The present study aims to assess the use of taxonomy while designing question papers and developing test items. The paper comprises a reflective analysis of I B. Tech. question paper of two Engineering Colleges, affiliated with JNTU & Osmania University, Hyderabad. Questions were analyzed individually to examine if the taxonomy was used in each question and the type of cognition was analyzed from each question. Bloom's hierarchy of cognitive learning was employed to categorize and modify the data. While most questions in the papers incorporated action verbs, they predominantly assessed lower-order thinking skills, thereby limiting the evaluation of higher-order thinking skills. The written examination greatly assessed understanding and remembering components of the cognitive domain. To effectively stimulate students' cognitive abilities, it is crucial to enhance the evaluation of their mental and reasoning skills. This can be achieved by crafting balanced questions that target both lower-order thinking skills (LOTS) and higherorder thinking skills (HOTS).

Keywords: engineering question paper, bloom's taxonomy, lower-order thinking skills, higher-order thinking skills, application

1. Introduction

Innovations in teaching and assessment methods are an impulse in this 21st century. Universities and Boards are trying to innovate and implement many such new techniques in teaching and assessment. Hence, different assessment methods have been introduced starting from testing students' knowledge to applying and creating the level of what they have learned. Assessment plays

a significant role in analyzing the learning process at all levels. Understanding and recognizing educational goals are essential before designing the examination paper. Further, other characteristics such as: whether the question is mapped against the learning outcome, how many marks have to be awarded to the question, etc. have to be considered. Apart from this, the most important feature to be considered is mapping the questions against Bloom's Taxonomy and setting the question items as per Bloom's Taxonomy. Gipps (1994) believed that "Always a relationship existed between assessment and the process in which subject matter is presented in teaching." However, Bloom, Engelhart, Frust, Hill, and Krathwohl (1956) were curious about the purpose of instruction, therefore they made the following statement [6]:

Teachers have different beliefs about what their pupils should learn. Some think they should "really understand," while others want them to "internalize knowledge." Still others think they should "grasp the core or essence" or "comprehend." Are they all expressing the same idea?

Benjamin Bloom and his team developed a taxonomy of educational objectives to address this subject. This taxonomy assists educators in setting clear learning goals for their courses and devising assessment methods to measure student learning outcomes accurately. The present paper discusses how Bloom's Taxonomy has assisted teachers in not only designing questions but also giving a basic idea to test various types of cognition.

The structure of this paper is as follows. The significance of Bloom's Taxonomy is emphasized in Section 2. The study's objectives are outlined in Section 3. The methodology employed for the study is covered in Section 4. The educational analysis is presented in Section 5. The study's findings are emphasized in Section 6, and the work is concluded in Section 7.

A. Blooms Taxonomy

Bloom's taxonomy is a very significant and valuable approach introduced to structure the thinking process in education. It is relevant to plan and design the teaching, learning, and assessment methods. In 1965, Benjamin Bloom formulated a hierarchical model commonly used in teaching and learning systems. To efficiently evaluate students' learning, ideas and questions are arranged in this hierarchy. Bloom's Taxonomy is the name given to this classification system. From the level of remembering to the level of producing, Bloom outlined the stages of the cognitive domain, ranging from easy to challenging. Remembering, comprehending, analysing, applying, assessing, and producing are the six learning goals.

Bloom's Taxonomy provides a parameter to prepare a question paper to measure the students' cognition at different levels. Though Bloom's Taxonomy has strongly influenced assessment for many years, even today, teachers find it difficult to employ Bloom's Taxonomy correctly while designing an examination paper. Studies reveal that Bloom's Taxonomy has been used as a standard to judge whether the questions test lower or higher-order thinking skills. For instance, Kastberg and Vidakovic, Bevis, and Alexander 2003 provided examples of how Bloom's Taxonomy was used to develop test items in high school and colleges by mathematics teachers and the attention was more on testing LOTS. As (Narayanan et al., 2015) illustrate faculty must be trained to frame question paper that focuses on testing Higher Order Thinking Skills of the students, rather than just concentrating on testing Lower Order Thinking Skills to encourage students' critical thinking and creative ability.

Bloom's Taxonomy not only serves as a model to design the paper but also helps analyze the present style of test papers. The findings further assisted in setting a paper for I B. Tech. students, according to Blooms mapped against lower and higher-order thinking skills. This study explores the degree to which examiners are prepared to assess students' knowledge and abilities, offering insightful

information to educators as well as teachers, examiners, and educationists. The results show that examiners frequently overlook higher-order cognitive skills in favor of concentrating primarily on queries requiring lower-order thinking skills. The study highlights the existing connection between learning outcomes and student performance and has important ramifications for instructional strategies. While questioning is recognized as one of the most effective instructional strategies, research on questioning reveals that the use of questions by teachers is predominantly low-level. Azar (2005) observed that teachers often ask knowledgelevel questions, comprising 80% to 90% of their inquiries. While these questions are not inherently bad, relying solely on them is not ideal. To enhance learning, it's beneficial to incorporate higherorder questions that demand deeper reasoning and more detailed responses.

The table given below presents the kinds of questions to be asked and the verbs that can be used while setting up the question papers.

Table 1: Cognitive Domain of the Revised Taxonomy by Overbaugh and Schultz

Bloom's Taxonomic Level & Explanatory Questions	Corresponding Action Verbs
Remembering: can the student recall or remember the information?	define, duplicate, list, memorize, recall, repeat, reproduce, state
Understanding: can the student explain ideas or concepts?	classify, describe, discuss, explain, identify, locate,
	recognize, report, select, translate, paraphrase
Applying: can the student apply the information in a new way?	choose, demonstrate, dramatize, employ, illustrate,
	interpret, operate, schedule, sketch, solve, use, write
Analyzing: can the student distinguish between the parts or break them into parts?	appraise, compare, contrast, criticize, differentiate,
	discriminate, distinguish, examine, experiment, question, test
Evaluating: can the student justify a stand or decision?	appraise, argue, defend, judge, select, support, value, evaluate
Creating: can the student create a new product or point of view?	assemble, construct, create, design, develop, formulate, write

Source:http://faculty.academyart.edu/faculty/teaching-topics/teaching-curriculum/enhancingteacher-student-interaction/different-types-questions-blooms-taxonomy.html

2. Objectives of the study

The main purpose of this study is to find out the implementation of Bloom's Taxonomy in English question papers of two Engineering Colleges. The objectives of the study are:

a. Analyze and study the final question papers of the English subject of two Engineering colleges affiliated to JNTUH and Osmania University, Hyderabad, Telangana. b. Design test items for the respective exam papers.

Bloom's Taxonomy is beneficial in training the examiners to design and set proper question papers. Swart, et al., (MAY 2010) analyzed variation between lower-order thinking and higherorder thinking questions and examined if the question evaluates low and deep-level cognition with the help of Bloom's Taxonomy. Teachers should be trained to evaluate students' critical thinking or higher-order thinking skills. According to the results of the current study, the majority of the questions tested the two lower cognitive domains—understanding and remembering, respectively—with relatively few coming from the application domain and none from the upper domains. Therefore, there is less opportunity to assess higher-order thinking skills because the questions are structured to assess lower-order thinking skills.

According to Dillon (1988), cited in Shen & Yodkhumlue (2011), asking questions is the most powerful way to facilitate students' learning and thinking while also assisting the teacher in assessing the students' learning strategies. So, a teacher plays a pivotal role in framing questions that must fit according to their level of understanding. Effective questions assist students in focusing their attention on the content, enhance their interest, trigger their imagination, and encourage them to acquire new knowledge (Husin, 2006). Thus, the teacher must be aware of the level of difficulty to be asked through the question to help in students' cognitive growth.

The Graduate Engineering programs emphasize outcome-based education, with Bloom's Taxonomy being a key framework for defining learning outcomes and objectives as recommended by AICTE. Exam questions, whether in-class assessments or end-semester exams are crucial for evaluating student skills. This paper analyses two semester-end question papers for the English subject from the First-Year curriculum: one from an Engineering College affiliated with Jawaharlal Nehru Technological University, Hyderabad, and the other from an Engineering College affiliated with Osmania University, Hyderabad. Both institutions are in Telangana. The study aims to help teachers develop well-balanced exam papers that incorporate both lower and higher order thinking skills, enhancing the overall assessment process.

3. Research Methodology

This descriptive research study was conducted using both qualitative and quantitative approaches. Data were collected from two autonomous engineering colleges and analyzed to discuss the results. Primarily based on document analysis, the study focused on English question papers from the I B.Tech. Engineering Examination. Samples were drawn from two engineering colleges, and the question papers were examined to determine if the test items aligned with Bloom's Taxonomy. A comparative analysis was then conducted, followed by the development of new test items based on the findings.

4. Discussion & Analysis

Bloom (1965) developed a hierarchy for categorizing the levels of questions that frequently appear in question papers as well as a classification of the educational process's goals. Bloom's Taxonomy has six levels: Remember, Understand, Apply, Analyze, Evaluate, and Create. A mixture of these levels is used in the Papers of I B. Tech. Autonomous Engineering Colleges in Telangana such as long essay writing, short essay questions, paragraph writing (compare & contrast, problemsolution, cause & effect), grammar (transitional words, articles, prepositions, simple, compound and complex sentences), reading comprehension, Letter Writing, etc. Comprehension questions are more

prevalent in both parts of the I B. Tech., English exam papers. This paper presents an analysis of exam questions to determine their appropriate level based on Bloom's Taxonomy and to develop corresponding test items. The taxonomy concept enables teachers to design examination papers that assess various cognitive skills without bias toward being perceived as too difficult or too easy. Consequently, Bloom's Taxonomy serves as a model for creating balanced question papers.

The following paragraphs analyze different questions from the semester-end exam paper, identifying the level of each question according to Bloom's Taxonomy and developing new exam questions accordingly. In the annual examination of Parts I and II, both universities' papers included a wide range of questions, including ones that had to be explained concerning the context, lengthy essays, sentence correction, paragraph writing, letter writing, and many more. The research's conclusions indicate that the question sheets demonstrated each of Bloom's Taxonomy's five levels of cognitive functioning. To gauge the level of intellect being assessed, each question was examined.

The first paper analyzed is of an Autonomous Engineering College affiliated with Osmania University. The paper is for seventy marks and Part A of the paper contains seventeen questions. Two questions were based on remembering, four questions were based on understanding, two questions were based on applying and two questions were based on creating. The other two levels were completely missing. Part- A has more questions on lower-order thinking skills and fewer questions on higher-order thinking skills.

Part B consists of seven questions. To assess students' interpretive skills, there were four types of questions: two comprehension-based, two memory-based, and two creation-based. There was a lack of analysis and evaluation levels. The six levels of the UG Part-A and Part-B old papers of an engineering college connected to Osmania University are divided in the graph below. The graph indicates that the purpose of the questions is to assess students' understanding, which is prioritized over remembering, applying, and creating levels. While understanding the information was more important than recalling details or using knowledge to solve problems, analysis, and assessment only included one question. The absence of all six thinking levels in the paper demonstrates the necessity for teachers or paper setters to have training in creating wellstructured papers that adhere to Bloom's Taxonomy principles. In general, the paper setting was primarily designed to assess lower-order cognitive abilities.

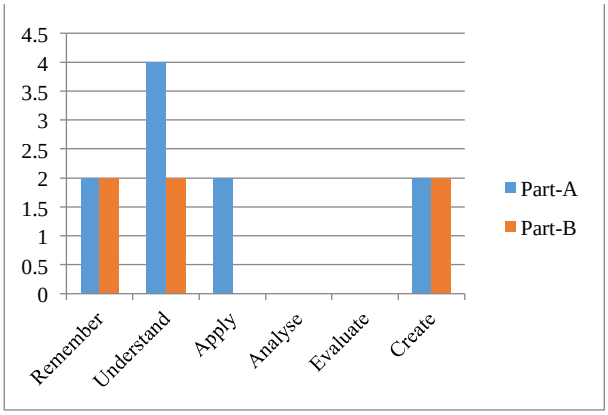

Figure 1. Questions on Blooms Levels of a college affiliated to Osmania University

The second question paper is prepared by an autonomous engineering college affiliated with Jawaharlal Nehru Technological University, Hyderabad. The paper is worth sixty marks and is divided into two sections: Part A and Part B. The first part contains ten questions, and all are compulsory questions, each carrying two marks. Part A has two questions based on understanding, four

questions based on remembering, two questions based on applying, and two questions based on creating. Questions on analyzing and evaluating were either few or absent. This is presented in the graph given below which shows that questions based on lower-order thinking skills were more than higher-order thinking skills.

The second part contains five questions each carrying eight marks with internal choice. Out of ten questions, two questions are based on remembering, two questions are based on understanding, one question is based on applying, and five questions are based on creating.

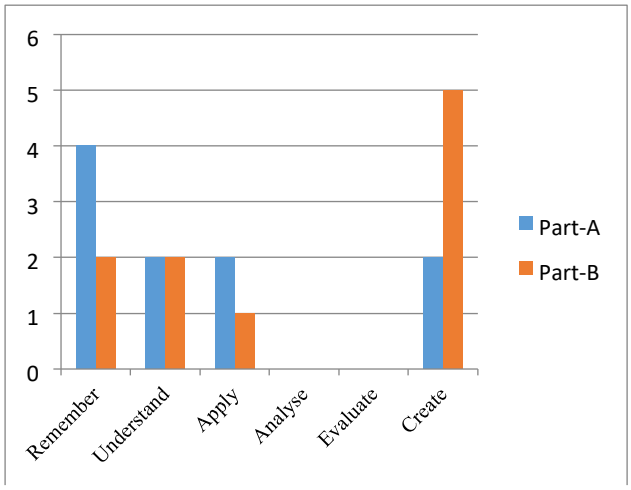

Figure 2. Questions on Blooms Levels of a college affiliated to JNTUH

From the figure given above, it is stimulating to note that both Institutions have included questions on lower-order thinking skills in a balanced manner. However, the institutions did not incorporate questions on analysis and evaluation, although a few questions focused on creation were included in the paper. Designing questions employing Bloom's Taxonomy could be a challenging task if employed effectively; it will bring a lot of changes in the existing examination process of designing question papers. The All-India Council for Technical Education mandates the use of Bloom's Taxonomy in question design and has highlighted deficiencies that institutions need to address to ensure comprehensive assessment and improved alignment with educational objectives.

5. Results

The findings of the study present that though the format of the question paper has changed after the introduction of Bloom's taxonomy; the questions are not designed keeping the cognitive levels in mind. The questions mostly focus on remembering, understanding, and applying, giving less scope to higher-order thinking skills such as analyzing, evaluating, and creating. The study reveals that designing test items is a significant element of written exams and has gained a lot of importance in recent years. The system of preparing questions based on cognitive levels is a good practice and would yield fruitful results. However, this is not being practiced by the Institutions but can be improved in the coming years and will assist the learners in achieving the overall goal of education. Designing an effective question paper is crucial, yet often insufficiently emphasized. The question paper from the first college affiliated with Jawaharlal Nehru Technological University, Hyderabad, illustrates that improvements could be made in the design. While the paper demonstrated effective use of taxonomy verbs, it did not consistently adhere to the taxonomy levels. Although incorporating these verbs was a component of the paper, it was not sufficient to ensure that all questions aligned with the appropriate taxonomy levels. This highlights the need for a more systematic approach to

designing questions that fully align with Bloom's Taxonomy. The table given below is an attempt to design the test items keeping Bloom's in mind and prepare questions to test the higher-order thinking skills of students. The table includes questions given by the Institute, the taxonomy level, and the questions developed for testing HOTS.

Table 2: Sample test items designed mapping against BT

Sl. No	Question	BT Level	Developed Test item	BT Level
Question Paper by Engineering College affiliated to JNTU Hyderabad Part-A				
1.	Rewrite the sentences after correcting them for grammatical accuracy.	L2, L3	1. Identify the mistakes and write the sentences correctly. (apply) 2. For each blank, select one entry from the corresponding column of choices. Fill in all blanks in the way that best completes the text. (understand)	L3
2.	Fill in the blanks using appropriate prepositions.	L2	1. Identify the most appropriate preposition from the given clues to fill in the blank to make the sentence meaningfully complete. (apply)	L3
3.	Rewrite the paragraph using transitional words.	L2, L3	1. Assemble the following sentences so that they form a coherent paragraph. (create) 2. Interpret the following statement and support using examples. (evaluate)	L5 & L6
4.	Describe the landscape of Ladakh.	L2	1. Reorder the sentences to develop a coherent paragraph. (analyse) 2. Create a skeletal paragraph on Ladakh's landscape. (create)	L4 & L6
5.	Explain intensive and extensive reading.	L2	1. Distinguish between intensive and extensive reading. Give appropriate examples. (apply)	L3, L2

			2. Discuss the types of reading with appropriate examples. (understand)	
6.	State the differences between a letter and a memo.	L2	1. Write a memo to your team members informing them about the new policy change. 2. Write a letter to a partner organization informing them about the same policy change. After completing both tasks, evaluate the merits and demerits of using a memo versus a letter for internal and external communication, respectively. Discuss which form of communication you believe is more effective in each scenario and justify your reasoning. (apply)	L3
7.	Arrange the sentences to form a coherent paragraph.	L2	1. Read the following four sentences and rearrange them to make a coherent and logical paragraph. (evaluate) 2. Reframe the topic sentence across the two paragraphs for overall cohesion. (apply, evaluate)	L3 & L5
8.	Why did Ms. Krishna collect beautiful artifacts?	L2	1. Why do you think Ms. Krishna can be called a connoisseur and relate your love towards such things with examples? (analyze)	L4
9.	Why is Cuddalore a backward district?	L2	1. Analyse four reasons for Cuddalore being called a backward district and suggest solutions. (understand, analyze)	L2, L4

10.	Write a short paragraph.	L2	1. Create a paragraph that illustrates the transition from school life to college life, highlighting how students adapt to the increased independence and responsibility that come with college. Include specific examples of changes in academic and social aspects. (create)	L6

Therefore, the findings indicate that examiners primarily focused on lower-order thinking skills questions rather than higher-order skills questions. Mostly the questions covered testing remembering & understanding levels; so, the study attempted to design questions testing both levels which are shown in the table given above.

Table 3: Sample test items designed mapping against BT

l. No	Question	BT Level	Developed Test item	BT Level
Question Paper by Engineering College affiliated to JNTU Hyderabad Part-B				
1.	Write a letter.	L3	1. Write a letter using the clues given below. (create)	L6
2.	Rewrite the sentences after correcting them.	L2, L3	1. Identify the mistakes and write the sentences correctly. (apply) 2. In the questions given below, a part of the sentence is underlined. Below are given alternatives to the underlined part which may improve the sentence. Choose the correct alternative. (evaluate)	L3 & L5
3.	Choose an appropriate transitional word.	L1	1. Write a paragraph using the transitional words given. (apply) 2. Remove the inappropriate linkers in the following paragraph and rewrite the paragraph. (analyze)	L3, & L4

4.	Write a paragraph using cause and effect pattern.	L6	1. Construct a paragraph using different patterns of writing. (create)	L6
5.	Read the passage and answer the questions.	L2, L3, L4 & L5	1. Read the passage and answer the questions. (understand) 2. Identify the point, the background, the support, and implications in the following passage. (evaluate)	L2, L5
6. & 7.	Descriptive questions from the lesson. Why according to the author Ladakh seems to be like Heaven's Gate?	L1, L2, L6	1. Write a cause-and-effect essay about Ladakh's culture and tradition & its way towards extinction. (analyze) 2. Describe the landscape of Ladakh and discuss the pros and cons of the place. (understand)	L2, L4
8.	Write a paragraph using patterns of writing.	L6	1. Write a paragraph using patterns of writing. (create) 2. Read the following five sentences and rearrange them to make a coherent and logical paragraph. After deciding the sequence, answer the questions given below. (analyse)	L4, L6

It is identified that Part B focuses on both lower-order and higher-order thinking skills but with a greater emphasis on lower-order skills. The second paper, selected for analysis, comes from an engineering college affiliated with Osmania University.

Table 4: Sample test items designed mapping against BT

Sl. No	Question	BT Level	Developed Test item	BT Level
Question Paper by Engineering College affiliated to Osmania University, Hyderabad Part-A				
1.	Fill in the blanks by choosing appropriate words from the list.	L1, L3	1. Use the words in the list and arrange the sentences to form a logical paragraph. (understand)	L2, L3

			2. Identify the mistakes and write the sentences correctly. (apply)	
2.	Match the following.	L1	1. In each question below, there is a sentence in which some parts have been jumbled up. Rearrange these parts to produce the correct sentence. (understand)	L2
3.	Add suitable suffixes to the root words.	L1, L3	1. Add suffixes to the words and make sentences. (apply)	L3
4.	Change from active to passive.	L2, L3	1. In the questions below the sentences have been given in Active/Passive voice. From the given alternatives, choose the one that best expresses the given sentence in Passive/Active voice. (apply, evaluate)	L3, & L5
5.	Rewrite the sentences the after making necessary corrections.	L2, L3	1. Identify the mistakes and write the sentences correctly. (apply) 2. In each question below a sentence is broken into five or six parts. Join these parts to make a meaningful sentence. (analyze, apply)	L3, L4
6.	Write Precis.	L2	Create a precis of a paragraph that compares and contrasts the academic and social experiences of high school and college, highlighting how students' roles and responsibilities evolve with the transition. Include a title for your precis. (create)	L6
7.	Expand the idiom.	L3	1. Some idioms are given below together with their meanings. Choose the	L3

			correct meaning of the idiom. (apply)	
8.	Write synonyms & antonyms.	L1	1. In the following questions choose the word which is the exact opposite of the given words. (remember)	L1, L3
			2. In the following questions choose the word that best expresses the meaning of the given word. (apply)	
9.	Change the tense form.	L2	In the questions given below, a part of the sentence is underlined. Below are given alternatives to the underlined part which may improve the sentence. Choose the right option. (understand, apply)	L2 & L3

The analysis of the paper reveals that Part A primarily tests lower-order thinking skills, providing minimal or no opportunities for higher-order thinking questions. Consequently, an effort has been made to include questions that assess higher-order thinking skills, as outlined in the table.

Table 5: Sample test items designed mapping against BT

Sl. No	Question	BT Level	Developed item	BT Level
Question Paper by Engineering College affiliated to Osmania University, Hyderabad Part-B				
1.	Explain the role of communication in today's world.	L2	1. Create a detailed plan for a presentation on the role of communication in today's world, including the key points you would cover, the types of visual aids you would use, and how you would engage your audience to illustrate the impact of effective communication in	L6

			various aspects of modern life, such as technology, business, and personal relationships. (create)	
2.	Write 10 differences between verbal and nonverbal communication	L2	1. Analyze a recent scenario where both verbal and non-verbal communication played a critical role in a successful or failed interaction. Discuss how each type of communication contributed to the outcome, examining specific verbal and non-verbal elements used and their impact on the effectiveness of the communication. (analyze)	L4
3.	Write an essay on a world without water.	L3	1. Analyze the potential social and economic impacts of a world without water on urban and rural communities, comparing how each community might be differently affected and what specific strategies	L4
			could be implemented to address these distinct challenges. (analyze)	
4.	Give meanings.	L1	1. Write meanings & frame sentences. (remember, apply) 2. In the following questions choose the word that best expresses the meaning	L1, L3

			of the given word. (apply)	
5.	Descriptive questions from the lesson.	L2	1. Write a detailed description using the given clues. Compose an appropriate topic sentence using minimum words from the question and differentiate between major and insignificant details. (analyze, evaluate)	L4, L5

Part B primarily addresses lower-order thinking skills, with only a few questions on higher-order thinking skills. Therefore, the paper should be designed to incorporate both lower and higherorder thinking questions. This paper has tried to include questions that assess higher-order thinking skills.

6. Recommendations

Here are some suggestions to improve the quality of questions in the exam paper for the betterment of the curriculum and students' skills.

• Classroom practices and textbooks should be revised to emphasize higher-order thinking.

• Teachers should be trained in preparing balanced questions highlighting LOTS & HOTS.

7. Conclusion

Question papers and their evaluation are the main instruments of education, serving as primary tools to assess student performance. Both question setters and examiners typically approach this task with dedication and integrity. However, while the importance of carefully crafting questions is emphasized, it is often not fully adhered to. The challenge for our education system, including its planners and educators, is to ensure that Bloom's Taxonomy is consistently applied when designing exam questions. Bloom's Taxonomy provides a structured framework for assessing various levels of cognitive skills, from basic knowledge recall to complex analysis and evaluation. Despite its significance, integrating this taxonomy into question design remains a persistent challenge. Addressing this issue requires a concerted effort to align question papers with Bloom's Taxonomy, ensuring a comprehensive assessment of students' higher-order thinking skills and enhancing the overall effectiveness of evaluations in the educational system.

This study reveals that UG-level examiners predominantly design question papers to assess students' comprehension, primarily aiming to evaluate lower-level cognitive skills. From this study, it is observed that both institutions employ Bloom's taxonomy as a tool in setting up question papers. However, the usage of each domain varies between the institutions. Finally, it could be considered that the Institutes should continue with a similar procedure of setting up papers in LOTS. Although some institutes include questions on analysis and creation, they often fall short in designing question papers that effectively assess higher-order thinking skills. To address this issue, faculty members should receive training on creating questions that evaluate these advanced

cognitive skills. Institutions struggling with this aspect need to take proactive measures to enhance their capabilities by providing more comprehensive training for their faculty. Implementing changes to ensure question papers encompass a range of lower to higher-order thinking skills is crucial. To achieve positive and impactful improvements, it is essential to enhance reliable tools and methods, as well as to develop better training programs for teachers and educational administrators. These programs should focus on supporting new curriculum designs, innovative teaching strategies, diverse learning styles, and effective evaluation techniques, thereby fostering a more robust and well-rounded educational assessment approach.

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