Original Research Article

Bloom's Taxonomy and Examination Reform in Higher Education using ICT as a Tool

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Abstract

This study highlights the basic features of Bloom's Taxonomy and its importance in integrated teaching- learning-assessment system. This study detailed a plan of information and Communications Technology (ICT) based implementation of revised Bloom's taxonomy (2001) as a mark of examination reform to analyze students' attainment level by measuring knowledge level (K), course outcome (CO) and program outcome (PO) in respect to each curriculum. The plan ultimately facilitate to develop a portal and fulfil the basic objective of Outcome based Education (OBE) system as the students' attainment report is one of the required field for accreditation by *National Assessment and Accreditation Council* (NAAC).
Keywords: Bloom's Taxonomy, ICT, examination, Outcome based Education (OBE), *National Assessment and Accreditation Council* (NAAC).

INTRODUCTION

The examination is an integral part of education system which plays a pivotal role to evaluate the academic performance of a student. Several philosophers (like Socrates, Plato, Aristotle, Comenius, John Locke, Rousseau, Froebel, Dewey, H.G. Wells, Bertrand Russell *etc.*) has expressed their views on education in various ways. According to Whitehead (1967), the basic goals of education are to create people who symbolize cultural values and capable of assimilating in-depth knowledge in a particular topic or direction. Hence, it is essential to get rid of "inert concepts," which grow stale and irrelevant over time. The development of the contemporary educational system in India has occurred through many turning points over the course of time which has been less studied so far. In this context, Basu and Sarkar (2022) detailed the history of adopted education policies of India during pre- and post-independence era in correlation with gradual increase of the national literacy rate (using census reports as primary data). Generally, the academic practice begins with the teaching-learning process and concludes with assessment through examination. There are two different types of assessment process *i.e.,* summative assessment and formative assessment. In a nutshell, formative assessment is seen as being "for" learning while summative assessment is seen as being "of" learning. Yet, the review process largely relies on cyclical evaluation techniques. According to Aggarwal (1997), the evaluation and assessment processes can reform and revolutionize both education and learning results. The actual form of education assures learning outcomes which is ultimately linked with outcome based education (OBE) system. It is important to highlight that, proper set of questions have an impact on both instructional strategies and student learning results. According to Etemadzadeh *et al.,* (2013), a question has a keen relationship with "learning outcomes, achievements, retention, and thinking skills". The Bloom's Taxonomy serves a standard parameter for assessment of student's knowledge level for each curriculum. Therefore it is necessary to review these subjective and objective question papers for analyzing which order of Bloom's Taxonomy has been incorporated. This part is still hardly emphasized in the higher education sector especially in non-technical courses of West Bengal. Understanding the detail architecture of Bloom's taxonomy is also crucial in order to implement it in the examination system. The present study aims to unfold the basic features of Bloom's taxonomy and proposes a diagrammatic plan

for implementation by using ICT as a benchmark for examination reform in the higher education sector.

The basic Architecture of Bloom's Taxonomy:
Dr. Benjamin Bloom (an educational psychologist) proposed a theory in 1956 to elevate the teaching-learning process from the lower level of learning and memorization to the higher level of analysis, evaluation, creativity and problem-solving approach.

Cognitive, emotional and psychomotor learning - are the three academic learning domains listed in Bloom's Taxonomy. The affective domain provides steady emotional growth of attitude and self,

the psychomotor domain contains physical abilities, and the cognitive domain includes cerebral skills to produce knowledge. The acronym KSA (Knowledge [cognitive], Skills [psychomotor] and Attitude [affective]) is used to refer to it. The knowledge, understanding, application, analysis, synthesis and evaluation stages served as the initial foundation for the cognitive domain (Bloom, 1956). In the middle of the 1990s, Bloom's student L. Anderson and David Krathwohl updated the cognitive domain with a fresh perspective and three additions (Figure 1). They proposed several action verbs in respect to various categories instead of noun names, formed a process and level of knowledge matrix (Anderson *et al.,* 2001).
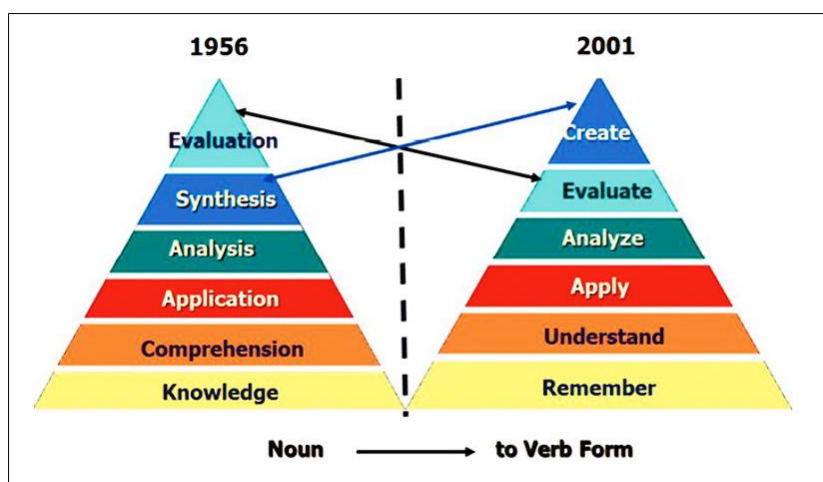

Fig. 1: A diagrammatic representation of comparative account between Original Bloom's Taxonomy (1956) and revised Bloom's Taxonomy (2001)
[**Source:** View of Improving Basic Design courses through Competences of Tuning MEDA | Tuning Journal for Higher Education]

The revised Bloom's taxonomy suggested several action verbs as ready references to carry out the curriculums as well as helps to constract the question papers as per the knowledge level (K).

These action verbs are important to measure Course outcome (CO) and programme outcome (PO) as per the guidelines of University Grants Commission (UGC) and other accreditation agencies. UGC in November, 2019 suggests to adopt revised Bloom's taxonomy (2001) as a mark of Examination Reform in Higher Education Institutions (HEIs). It is a part of learner centric evaluation system and regarded as most scientific method to frame Course outcome (CO) and Programme outcome (PO) with its relevant knowledge level (K). This form of assessment is not only significant to find out the weaker POs or well-established POs in accordance with the course objectives but also helps to revise curriculum systematically. The calculation is largely dependent on the question pattern according to revised Bloom's Taxonomy (2001) and marks obtained in each CO category during internal assessments/ sessional /

presentations/ projects/ practical / theoretical courses, *etc.*

Highlights of UGC Recommendations (2019) for Question Paper Setting:
The orientation of Indian higher education till date has been examination focused [UGC (2019)]. The current examination at university level is mainly based on memory retention tests. It simply depends on a question paper that evaluates memory recall as a talent. Although memorization learning might be necessary, but it is insufficient to function in the demanding work environment. Application skills or higher order abilities, such as analysis, creation and evaluation must be evaluated as mentioned in revised Bloom's Taxonomy (2001). In order to ensure confidence and the effectiveness of the assessment system, reforms are therefore urgently needed. UGC significantly emphasized on the creation of Course specific Question papers from dedicated question bank through moderation process according to revised Bloom's Taxonomy by using ICT based examination portal.

Table 1: The list of action verbs suggested in revised Bloom's Taxonomy (2001)

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

[**Source:** Microsoft Word - Revised Bloom's Taxonomy Action Verbs - Copy (astate.edu)]

Plan for Implementations of Revised Bloom's Taxonomy in Question Papers:

Generally, at the commencement of each Odd or Even semester, the Chairman, Board of Studies call for a meeting to prepare a list of Paper setters, Moderators, Examiners, Scrutineers, Reviewers *etc.* in presence of external member as per approval of the highest authority/ council/ board of the university. The members suggest names in each category and subsequently the Chairman prepares the list to submit before the Hon'ble Vice Chancellor (through Secretary of respective UG/ PG Council) for approval. After getting the approval, the list is forwarded to the office of the Controller of Examinations (CoE) for further processing. CoE issues appointment letter to each paper setter (Internal and External) as per the approved list. This study proposed a plan to issue e-appointment letter to paper setter via examination portal. After getting acceptance for the assigned job from the paper setter, CoE issue a confirmation mail with guidelines and syllabus to prepare the questions along with unique Log-In ID and password. If a paper setter decline to perform the assigned job, CoE may further intimate to the respective Chairman of Board of Studies for adding additional names as paper setter. The paper setter may log in to the question bank through authentic verification and download all instruction, syllabus, previous year question papers etc. Paper setters may

upload all the required number of questions prepared, using action verbs suggested in revised Blooms taxonomy (2001). Each question should be categorized with respective Course outcome (CO) level and Knowledge level (K). CoE can generate the status report of completion of updating question bank. After successful completion of updating question bank, CoE close the portal of updating Question bank and terminate all access of internal or external paper setters. Now CoE invites moderators as per the approved list, for confidential moderation process. If a moderator decline to perform the assigned job, CoE may further intimate to the respective Chairman, Board of Studies for adding additional names as moderator. During moderation, the internal and external moderators log in to the portal of Question Bank through authentic verification. Moderators select the questions as per the requirements of the university. In this context, CoE may prepare an instruction for setting final question papers. According to revised Bloom's taxonomy (2001), CoE may suggest the moderators to edit the text of the question, modify the Bloom's knowledge level of each question (if required), change the action verb according to the merit of questions etc. It is also considerable that the number of questions per knowledge level (K) along with Course outcome level (CO) may be variable according to curriculum. To consider the above mentioned facts one has to formulate a common table to designate each question according to each knowledge level (K) and Course outcome level (CO). For example, A, B, C, D, E and F denotes CO1K1, CO2K2, CO3K3, CO4K4, CO5K5 and CO6K6 respectively. The number of questions in each A, B, C, D, E and F varies according to different CO level defined in syllabus. As a result, percentage of marks for each CO/K level also varies from course to course or semester to semester even for the same programme. On the other hand, it will help to assess the students' knowledge level in each CO level through direct method of attainment calculation. After moderation, CoE will receive final sets of question papers according to revised Bloom's taxonomy (2001) for assessing the overall knowledge of an examinee as per the objective of Outcome Based Education (OBE).

Table 2: Diagrammatic presentation of Software Requirement Specification (SRS) to develop the BoS portal for Integrated Examination Management System
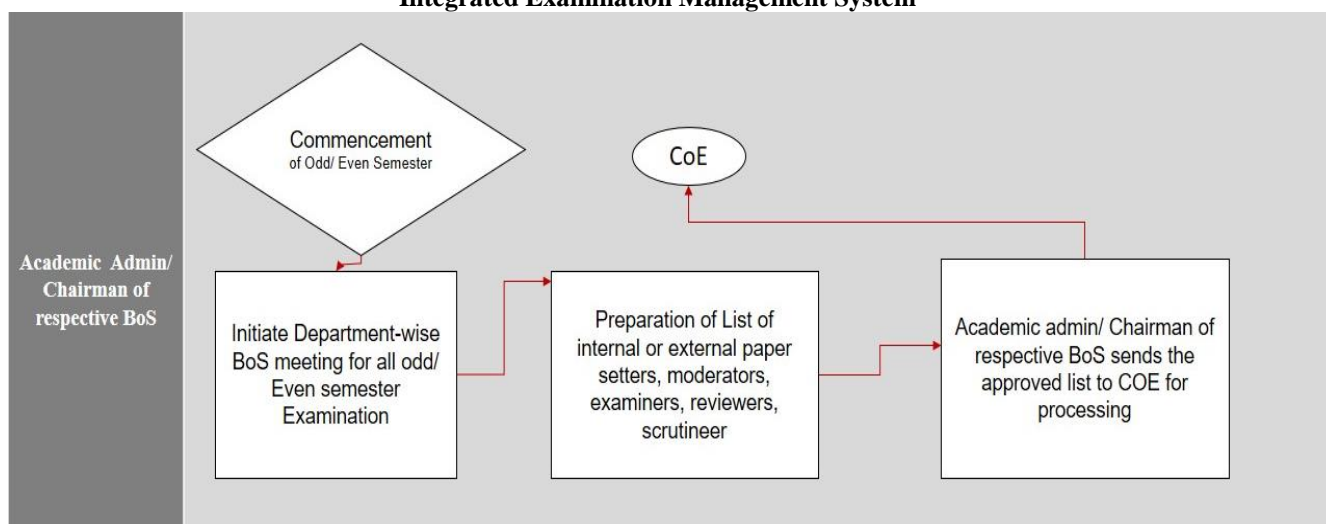

Table 4: Representation the proposed model of Abbreviated forms in respect to different levels of Course Outcome (CO) and Knowledge level (K) as per description in course curriculum

Number of COs		3	4	5	6
Abbreviation	A	CO1K1	CO1K1	CO1K1	CO1K1
	B	CO1K2	CO2K2	CO2K2	CO2K2
	C	CO2K3	CO3K3	CO3K3	CO3K3
	D	CO2K4	CO3K4	CO4K4	CO4K4
	E	CO3K5	CO4K5	CO5K5	CO5K5
	F	CO3K6	CO4K6	CO5K6	CO6K6

Table 3: Demonstration of Software Requirement Specification (SRS) to create question paper through dedicated portal of Integrated Examination Management System
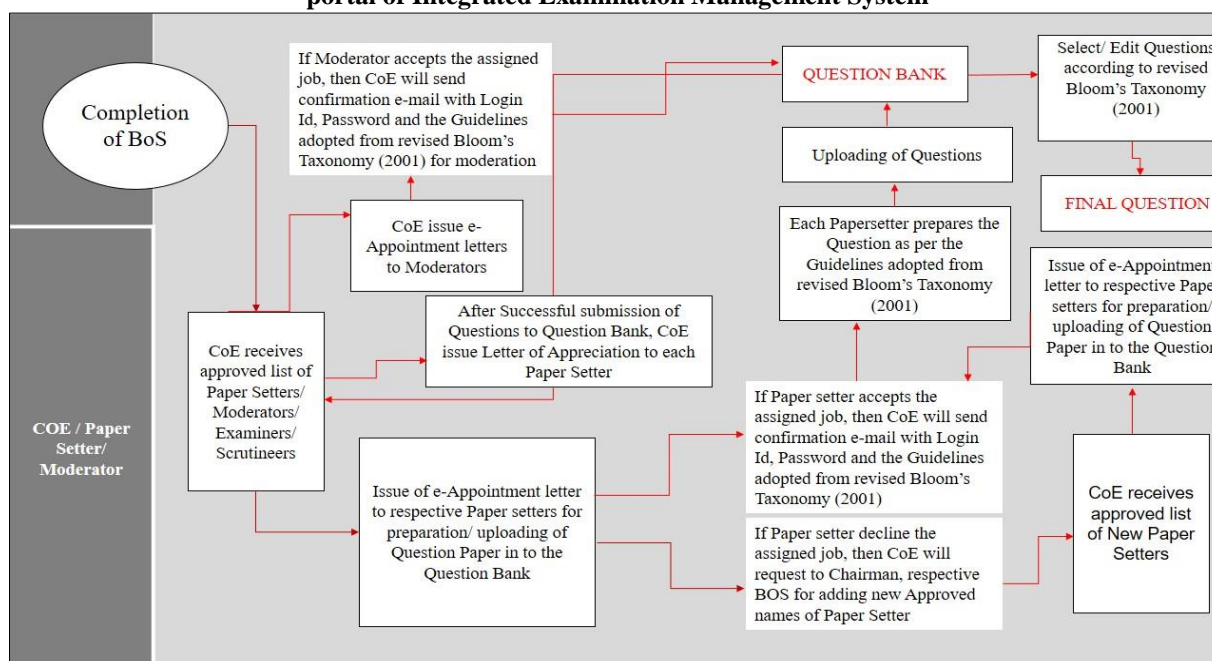
CONCLUSION

UGC and NAAC has suggested outcome-based education (OBE) in their primary framework for teaching, learning and evaluation based on the Bloom-Anderson taxonomy to ensure high-quality teaching and learning. Every component of the educational system is integrated and linked with learning outcomes (LOs) of every student (Hager & Holland, 2006). In this context, CoE plays an important role to provide the marks obtained for each question attempted. As a result the academic authority may compute the total percentage of obtained marks in each category of CO level through direct method which is ultimately related with calculation of programme outcome (PO) attainment using standard rubrics. Thus ICT based examination solution is the only way to compute the result as well as the student's attainment level more accurately in a short duration (Basu and Sarkar, 2023). Therefore the examination reform is not only significant to assess the overall progression of a student's academic performance but also helps to generate required reports for fulfilment of the basic objective of outcome based education system.

Conflict of Interest: No conflict of interest.

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REFERENCES

- Aggarwal, C. J. (1997). Essentials of Examination System: Evaluation, Test and Measurement. Vikas Publications Pvt Limited.
- Anderson, L. W., Krathwohl, D. R., & Bloom, B. S. (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.
- Basu, S., & Sarkar, S. K. (2022). Revisiting the History of Indian Education Policies. *International Journal for Innovative Research in Multidisciplinary Fields*, 8(9), 257- 265. doi: 10.2015/IJIRMF/202209042
- Basu, S., & Sarkar, S. K. (2023). Recent Trends in Digital Evaluation of Answer Scripts as a Mark of Examination Reform. *International Journal for Innovative Research in Multidisciplinary Fields*, 9(4), 118- 120. doi:10.2015/IJIRMF/202304021
- Bloom, B. S. (1956). Taxonomy of educational objectives. Vol. 1: Cognitive Domain. *New York: McKay,* 20, 24.
- Etemadzadeh, A., Seifi, S., & Far, H. R. (2013). The role of questioning technique in developing thinking skills: The ongoing effect on writing skill. *ProcediaSocial and Behavioral Sciences, 70*, 1024- 1031.
- University Grants Commission (2019). Evaluation Reforms in Higher Educational Institutions. Secretary, UGC, New Delhi.
- Whitehead, A. N. (1967). The Aims of Education and other Essays, The Free Press, New York.