ASSESSMENT OF BASIC MECHANICAL ENGINEERING COURSE QUESTION PAPER USING BLOOMS TAXONOMY

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ABSTRACT

Blooms taxonomy refers to three domains such as Cognitive, Affective and Psychomotor. The Cognitive domain states about different level of thinking in order to represent knowledge. The level of knowledge gained by student during the program is tested through various assessment tools such as Written Exam, Class Test, Assignment, and Quiz. Blooms taxonomy refers to different forms and levels of learning which are called as cognitive level. The aim of any assessment tool is to verify the cognitive level achieved by the students. The paper focuses on Questions selected from University Question papers for course on Basic Mechanical engineering. The result shows that percentage cognitive level of questions satisfying Blooms Taxonomy.

Keyword : - *Cognitive, Exam, Marks, Outcome, Question*

1. INTRODUCTION

Graduate Engineering programs are more focused about how to impart outcome based education to the students. Blooms taxonomy is used as one of the effective tool for defining learning outcomes and objective for all engineering courses for any Graduate Engineering program. Questions asked in various exams such as class test, university examination play an important role to assess student's skills. The question paper is designed such that student can recall what they had studied during their academic term and apply the fundamentals to solve the questions. In this paper 8 question papers are selected from Savitribai Phule Pune University Examination for a course on Basic Mechanical Engineering as a part of First Year curriculum for all the Engineering Programs running under Savitribai Phule Pune University. This will help for all academicians for setting well balanced exam papers as per the requirement.

2. BACKGROUND

Blooms Taxonomy is widely used in almost any known education field. It is still accepted and proved to be successful in assisting education practices and teachings. Assessment of learning outcomes for software engineering courses can be improved effectively through proper application of the taxonomy. Researchers are always in pursuit of bringing newer assessment techniques for improving student's intelligence of understanding the course. Bloom's taxonomy has been used for many years to promote higher level learning in the academic learning environment (Mahbubul Hasan et al. 2013) The authors have investigated application of Blooms Revised Taxonomy for designing the social science question papers of the Secondary School Certificate Examination of Dhaka Board. The study makes comparison of the level of applying Blooms revised taxonomy in the questions before and after creative question has been set. The question paper designed with the help of blooms revised taxonomy is appreciated. The important challenges with this system are its effective implementation and understanding by teachers. These challenges can be met by awareness and extensive training to teachers and educators. (Ummu Husna Azizan et al.2012) This paper presents cases of two primary school in Malaysia in order to record the cognitive level of students from the Fractions classes. There were four sets of questions about fractions consist of: name, write, and draw fractions in words and numerals, comparison of fractions, equivalent fractions, and simplify fractions. Each question in each set was developed as per the lowest three levels of Blooms taxonomy. The lowest levels are

important because once student get knowledge of the lowest levels they can answer any questions from the highest levels. While using Blooms taxonomy in the classroom, teachers must make sure that their pupils had passed the lowest level before entering the highest levels. (Faruque A. Haolader et al. 2015) The study focused on the implementation process of the Diploma in Engineering (Electronics Technology) curriculum. In this study investigation is done for three aspects 1.content of the teaching- learning materials for polytechnic education is designed with learning objectives.2. Determine the level of practicing the educational taxonomy for teaching-learning, and assessing with respect to the curricular objectives. 3. Determine how the above mentioned factors influence the development of Students competence by assessing the level of students cognitive competences achieved throughout their study. (Asim ARI 2011) The aim of this work is to define academic staff's opinions about Blooms Revised Cognitive Taxonomy working in the Department of Curriculum and Instruction. The study is done by cross sectional method of survey. Cross-sectional researches aims at collecting data in order to determine some special characters of a group. The result shows that Revised Bloom Taxonomy has been well known on the international front as compared with Africa. The revision has been positively understood by the academic staff of Department of the Curriculum and Instruction, and its applicability in the field gained recognition. (Heather M Bush et al.2014) Investigated educational course on statics in order to improve students outcome with the help of blooms taxonomy. There will be gap between course objectives and outcomes for this statics course. With the creation of assignments this gap can be eliminated as this assignment will employ higher order thinking skill in the students. (S. Ilango Sivaraman1 et al. 2015) Authors have presented case of assessment of exam papers with blooms Taxonomy. The questions are prepared as per the cognitive domain of Blooms taxonomy. Taxonomy system has enabled the teachers to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception. The study shows that the Blooms Taxonomy principles serve as guide lines to the staff framing the question paper but it is largely left to them to bring out a balanced paper as the final outcome. The review given by external examiner about this practice of question paper assessment is positive. (Gizem Karaali 2011) has presented Applying Blooms Taxonomy to the Calculus Classroom. The article also shares a brief summary of authors own observations and a discussion of experience on this calculus project. The Blooms Taxonomy defines learning domains and competency level. It is important to consider incorporating evaluative components into mathematics course. Author has recommended that evaluative tasks have a place in all mathematics course. (Ona Visockien et al. 2010) The paper presents validating the applicability of Blooms taxonomy in the research of the junction between comprehensive and high school from the perception of the education of critical thinking. The research is carried on to reveal the relevance and applicability of Blooms taxonomy through the method of expert evaluation. To evaluate whether Blooms taxonomy reveals the problems about the juncture between comprehensive and high school practically, using the method of a questionnaire. The research, using Blooms taxonomy, highlights the differences, so the taxonomy is the appropriate method of investigating the interface between the comprehensive and high school on the basis of aspect of education of critical contemplation. (Nurul Naslia Khairuddin et al. 2008) the author has explored Application of Blooms Taxonomy in Software Engineering Assessments. The aim of this work is to assist software engineering teaching and learning process as well as improve the quality of software engineering education. Assessments questions are either formative or summative in nature. These can be in the form of assignments, quizzes or formal examination. This study result shows that Blooms taxonomy will assist educators, teachers in designing their questions for software engineering assessments, given the level of question types. It will also assists to assess and ensure that software engineering students knowledge and level of skills acquired are in accordance with the learning outcomes.(Aaron C. Clark, et al. 2010) The authors have explored and compared the newly revised Blooms Taxonomy to the initial version and demonstrated how the revised taxonomy can be used in engineering/technical graphics education to bridge student learning, assessment, and curriculum development. The study also highlights, a comparison of current research in the field of taxonomy development and what is currently being pursued in the area of graphics education. The newly revised Blooms taxonomy is a more inclusive account, covering many required aspects of assessment that were either not specified or not addressed with necessary depth in the original taxonomy. The revised and original taxonomy act solely as frameworks. Bloom himself indicated that ideally each major field would use this taxonomy to develop their own unique objectives and language. As education continues its gradual transformation, hence the

taxonomies used to assess students, necessitating programmatic change. The theoretical, model is based on past experiences and observations within graphic communications, and generated with the aim that it will prompt further thought and research in how students are taught and assessed in their courses.(Mau-reen K. Flores, et al.2015) authors have presented the application of Bloom's Taxonomy in an Introductory Accounting Course in the online learning environment. This paper presents an approach to aid students gain the ability to understand, apply, and evaluate company financial information. Blooms taxonomy is applied to create a student learning model. As a result, students will develop critical thinking skills as they progress through the stages of higher level learning. Student discussion board assignments correspond to each level of Blooms Taxonomy. The assignments gradually impart the students skill set so the end result is a more advanced sophisticated level of accounting analysis. (Magorzata S. ywno et al.2003) This paper addresses on the investigation of a relationship between hypermedia and different cognitive levels of learning, as defined by Blooms Taxonomy of educational objectives. This study shows the effects of hypermedia instruction on different levels of cognition, as stated by Blooms Taxonomy. It should be noted that hyper-media is an outgrowth of hypertext, and provides a non-linear, associative linking of text, images (graphics and video) and sounds. The assessment is done by panel. The panel, consists of four engineering professors specializing in control theory and an expert with a background in psychology, reviewed the examinations and classified all items according to Blooms Taxonomy. The panelists discussed their classifications until consensus was reached. The study results that past many years, problem solving examinations in the course consisted mostly of items representing application and analysis level, while the higher-level thinking was mostly tested through laboratory design projects. The study has two limitations 1. a relatively small sample size, reducing significantly the statistical power when dealing with eight distinct learning style modalities, two levels of achievement and six levels of cognitive complexity.2.The examination format, with emphasis on tasks on application and analysis levels. (Bernard J. Jansen et al. 2009) Authors have investigated whether a learning process has unique information searching properties. The results of this research show that information searching is a learning process with unique searching characteristics specific to particular learning levels. In a laboratory experiment, we studied the searching characteristics of 72 participants engaged in 426 searching tasks. We classified the searching tasks according to Anderson and Krathwohls taxonomy of the cognitive learning domain. The result states that creating model searching episodes as levels of learning in the cognitive domain. Few suggestions in this research are as highlight the relationship between learning level and exhibited a searching characteristics, especially in terms of other moderating effects such as expertise and environment, one can categorize such searching intentions and that these intentions vary in terms of their cognitive demands. (Craig K. Tyran 2010) addressed gap by exploring how Bloom's taxonomy has been employed to sup-port the design of undergraduate and graduate spreadsheet-based DSS courses. The author has extended the existing literature on spreadsheet-based DSS education by reporting on student survey data collected over the past four years. The study collected these data from students enrolled in nine sections of DSS courses, have sections of an undergraduate course and four sections of a graduate MBA course. With reference to the survey findings, as well as the instructor's observations, it appears that a teaching strategy based on Bloom's taxonomy has better framework for instructors who teach a spreadsheet-based DSS course. The result indicates that Students tended to have very positive attitudes about the course and the learning exercises. Students seemed to grasp quickly the value of the learning strategy that the instructor employed, and they appeared to enjoy taking on each new course assignment. On the formal course evaluations forms distributed by the university, many students indicated that they considered the DSS course to be their favorite class. (E. Pappas et al. 2013) The authors have explained Instruction in sustainability contexts consists of a developmental approach using Blooms Taxonomy of Educational Objectives, which is a way to classify instructional activities or questions as they progress in cognitive difficulty level. The aim of this research work is to detail an instructional methodology that integrates developmental sustainability instruction in four contexts into our 3-year, six course design sequence. The instructional approach to educate sustainability is (1) developmental, (2) integrated, (3) interdisciplinary, and (4) hands-on or design-to-build. The study results indicates that increasing students' knowledge of, or positive attitudes to-ward, sustainability alone will not reliably result in the behaviors that promote sustainability in their careers and communities. Along with this an education in sustainability must be immersive and focus on more than knowledge, student's values and behaviors as an effective method for motivating sustainable behaviors and improving problem solving. In order to promote

sustainability development of methods for assessing social sustainability, having various dimensions as psychological, intellectual, social, economic, physical, and philosophical. (Deepti Singh et al. 2016) Authors presented that during the postgraduate education the evaluation and assessment skills do not form a part of training. To train Ayurveda teachers in designing MCQs, there is lack of formal mechanism. The graduate level program of Ayurveda education is more memory-oriented than being competence based. Hence, the kind of postgraduate scholars who get enrolled in different institutions through competitive process often may not meet the expected levels of academic and professional excellence. With this possibility is performed the present study with an objective of evaluating the levels of thinking skills that are actually assessed through MCQs in different PGEEs of Ayurveda, conducted in different universities across India. This is a retrospective observational study aimed at evaluating the Ayurveda PGEE question papers of last five years. The authors states that there is a need for including an appropriate proportion of the MCQs to assess higher order thinking skills in the PGEEs. Also, Ayurveda teachers are required to be trained well in the skills related to writing good MCQs since MCQs are able to assess more or less all the six levels of Bloom's taxonomy in cognitive level. (Margaret M. Placket al.2007) In this paper reflection assists learners to analyze their experiences and capture the wisdom that lies within. Effective teaching requires reliable methods of assessment. Several methods of assessing reflective writing have been described; however, they often require significant training, and reliability has seldom been assessed. This study was conducted to find the reliability of a method of assessing reflective writing with the help of modified Blooms Taxonomy. The method adopted consists of Twenty-one third-year medical students who have maintained reflective journals throughout their pediatric clerkship. A coding based on Blooms Taxonomy was developed to assess the level of cognitive processing evident in the journals. Journals were independently assessed by 3 evaluators. Percent agreement, kappa statistics, and intraclass correlation coeffcients (ICC) were used to assess reliability. This method creates basis for facilitating higher order processing, critical thinking, and reflective practices. (Roco Tjaro-Rojas et al. 2016) Present study is methodical and student-based learning sequence entitled Systematic and Integrative Sequence Approach (SISA). Initially utilized within STEM disciplines, SISA is inspired by instructivist and constructivist approaches to learning and ultimately seeks to help students reach mastery learning levels regarding complex concepts within these areas. The authors have introduced pedagogical tool which in turn integrates Blooms Revised Taxonomy to student learning. Due to SISA approach students are able to create their own knowledge to create innovative prototypes of technology. The principles of learning and the pedagogical techniques of SISA approach can be adapted to diverse disciplines. (Vadim Shmelev et al. 2015) In this paper a LO sequencing technique which takes into consideration above said characteristics of learning competences. The variety of LOs in online system is quite expansive, and the task of finding suboptimal learning sequences constitutes the problem examined. Hence, the Genetic Algorithm (GA) is used, to find the proper order of LOs in a sequence with 1.an ontology to find connections between Los 2.the revised version of Blooms taxonomy for assessing the quality of connections. The objective function uses the revised Blooms taxonomy and domain ontology. The ontology allows us to determine the connection between LOs, whereas Blooms taxonomy assists in assessing the quality of this connection. Blooms taxonomy is widely used in the assessment of student's skills and knowledge level both before a course and after its completion. (Samuel C. Karpen et al. 2016) The study is conducted to identify reliability and accuracy of pharmacy faculty member's classification of exam questions based on Blooms Taxonomy. The method adopted consists of Faculty at a college of pharmacy was given six example exam questions to align in accordance with the appropriate Blooms level. The reliability and accuracy were both low at 0.25 and 46.0%, respectively. Accuracy increased to 81.8% when the six Blooms levels drop down to three. The author concluded that both reliability and accuracy were found low. Blooms Taxonomy is only informative if educators use it accurately and reliably. Pharmacy faculty often map course content to specific program outcomes using Blooms Taxonomy. If teachers interpret Blooms Taxonomy in different ways, the reliability of content maps may be variable.

3. BLOOMS TAXONOMY

The system of Blooms Taxonomy was published by Benjamin Bloom in 1956 for educators. The sole purpose of the taxonomy was to develop a codification system whereby educators could design learning objectives that have a

hierarchical organization. Blooms taxonomy is designed to verify a student's cognitive quality during written examination. The famous Bloom's taxonomy consists of six levels i.e. Remember, Understand, Apply, Analyze, Evaluate, and Create.

Blooms taxonomy can be applied in the following specific areas.

a. Write and revise learning objectives
b. Plan curriculum
c. Identify simple to most difficult skills
d. Effectively align objectives to assessment techniques and standards.
e. Incorporate knowledge to be learned.
f. Facilitate questioning

Following are the various cognitive levels of Blooms Taxonomy.

3.1 Remember

Remember refers to recognizing or recalling relevant information from long-term memory. This level serves as the lower level or the beginning level of the hierarchy. The learner is able to recall, restate and remember learned information. The questions for Basic Mechanical Engineering in this level have the criteria of recalling specific data from previous lessons, defining or describing systems, stating the properties of the system.

Example: Define thermodynamic system.

3.2 Understand

Bloom (1956) describes this level as explaining ideas or concepts. The student grasps the meaning of information by interpreting and translating what has been studied. Understanding is the ability to make your own meaning from educational material such as reading and teacher explanations. The other skills for this process include interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining and calculating.

Example: Explain hydro-electric power plant with neat sketch.

3.3 Apply

Apply refers to using information in another familiar situation. The student makes use of information in a new situation from the one in which it was studied.

Example: Draw self-explanatory sketches of any four sheet metal cutting process.

3.4 Analyze

Students are expected to brake information into parts to explore understandings and relationships. The learner breaks learned information into its parts to be understand that information in an attempt through differentiating, organizing, and attributing.

Example: Distinguish between Welding and Brazing.

3.5. Evaluate

Evaluating refers to judge or assess the value of material and methods for a given purpose. The learner makes decisions based on in depth reflection, criticism and assessment.

Example: Justify the following statement.

3.6. Create

Creating refers to Generating new ideas, products, or ways of viewing things. The learner creates new ideas and information using what has been previously learned.

Example: Create design of power plant.

4. METHODOLOGY

The nature of questions in the question paper of Basic Mechanical Engineering are falling under cognitive domain since this course is in First Year Engineering Program, hence the assessment of questions is carried only for cognitive and not for affective and Psychomotor. The paper wise percentage analysis of cognitive level of blooms taxonomy is presented in Table1.

LO-LOCQ- Lower order cognitive questions-comprises of cognitive level as remember, understand, and apply.

HO-HOCQ- Higher order cognitive questions-comprises of cognitive level as Analyze, Evaluate, create.

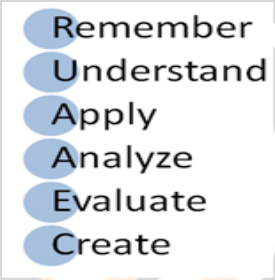

Fig -1: Revised Blooms Taxonomy Levels

Table -1: Paper wise Percentage Analysis of Cognitive Level

Cognitive Domain	1	2	3	4	5	6	7	8
Remember	40	26	39	40	37	47	40	28
Understand	37	32	37	33	29	29	34	38
Apply	18	26	15	2	24	14	17	5
Analyze	5	16	9	25	10	10	9	29
Evaluate	0	0	0	0	0	0	0	0
Create	0	0	0	0	0	0	0	0

5. RESULTS & DISCUSSION

Eight question papers from Basic Mechanical Engineering end semester examination are investigated. Table 1 shows the percentage of marks along with the cognitive levels for each question paper. Question papers shows that, 40% Marks questions are asked to test the remembering level cognitive skill, 37% Marks questions are asked to test the understanding level cognitive skill and 18% Marks questions are asked to test the applying level cognitive skill and 5% Marks questions are asked to test the analyzing level cognitive skill. Since the course of Basic Mechanical

Engineering deals with first year and no questions are asked in this paper to check evaluation and creating levels of cognitive skill.

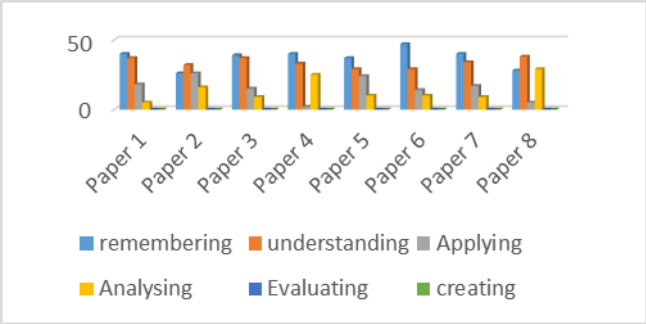

Chart -1: Paper wise Percentage Analysis

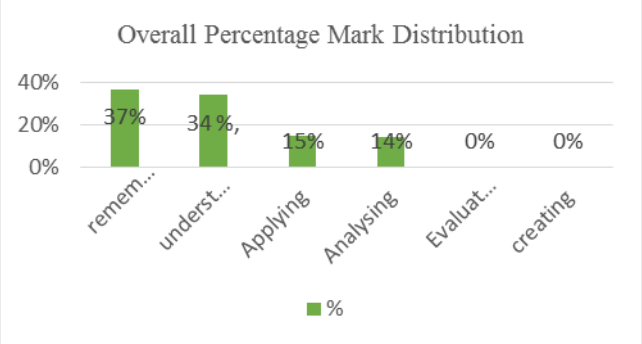

Chart -2: .Overall Percentage Distribution of Marks

Chart -3: Percentage Distribution over LOCQ & HCOQ

The chart 2 shows finding during question paper wise analysis. The chart 3 shows overall cognitive level wise distribution for all questions in all question papers. Finally remembering, understanding, Applying, and Analyzing these cognitive level skills are tested with 37%, 34%, 15% and 14% respectively.

6. CONCLUSION

Blooms Taxonomy is divided in three domains viz. cognitive, Affective, Psychomotor. As nature of questions in the question paper fall under cognitive level domain hence, analysis is focused on cognitive level skills. Blooms taxonomy will act as a basis for setting difficulty level of question paper for all the engineering courses. The comparative analysis shows that 86 % marks questions asked in examinations test Lower Order Cognitive Skill (LOCS) whereas only 14 % marks question test higher order cognitive skill. From the above observations we also conclude that the question paper must focus on the Higher Order Cognitive Skills (HOCS). As nature of every course is different hence types of questions also variable, hence more research is expected in setting question paper defining blooms taxonomy level skill accurately.

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