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Original Research Article

Designing Blueprints for Theoretical Assessments of the undergraduate Medical Students in Forensic Medicine and Toxicology.

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Key words

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Abstract

Introduction: Assessment is the one of the crucial aspects of medical education. The system for collecting and analysing assessments is the essential component of a curriculum. The most of the medical colleges and institutions adhere to the conventional tools for theory assessment. A blueprint is a systemically developed test plan or table of specifications to ensure proper weightage and content representativeness to a learning outcome in the assessment. **Material and methods:** The study was conducted the Blueprint taskforce team of three subject experts (One chairperson and two members) appointed from MUHS for creating a blueprint for Forensic Medicine and Toxicology subject assessment. Feedback on prevalidated questionnaire abiding five-point Likert scale was taken from twenty-one subject experts and statistical analysis was performed. **Result:** 90.5% positively reflected that the blueprints align competencies with their assessment objectives. 81 % faculty given feedback that blueprints will bring uniformity amongst the different paper setters in question paper setting using standard blueprints. **Conclusion:** Blueprints provides a proper base for assessment. It facilitates the actual execution of the CBME Curriculum for subject of Forensic Medicine and Toxicology by assigning specific weightage to various content areas and helps for uniform and valid assessment of students.

1. Introduction

Assessing the quantity and quality of knowledge that medical students have acquired is one of the most significant responsibilities of a medical teacher. Because of this, assessment is a crucial aspect of medical education, and as such, the system for collecting and analysing assessments

is an essential component of a course's curriculum.¹ The majority of medical colleges and institutes adhere to the conventional theory assessment tool pattern, which may not align with assessment principles. Many problems with the traditional or conventional pattern of theoretical

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assessment instrument in medical education exist, including the subjectivity of the paper setter, lack of uniformity, absence of peer reviewer pre-validation, and omission of the Specific learning objectives (SLOs). Following any theoretical examination, students' qualitative feedback frequently indicates that the question paper was excessively long and that not enough time was allotted to write the answers. It also frequently claims that the question paper was improperly designed, that it did not cover the entire syllabus, and that it omitted certain key topics.² This occurs because, under the conventional assessment approach used in the majority of Indian medical colleges, a single teacher or examiner sets the question paper, and another teacher administers the practical exam. There is typically no coordination between the two teachers and the exams are not usually connected with the objectives.³

It is frequently up to the examiners to decide what should be assessed. Additionally, the examiner/teacher assigns material based on what "she/he thinks is appropriate or important". Because, they are not expressed properly, the desired learning outcomes are disregarded. The assessment must be credible. Each assessment must be valid, which indicates that participants who meet the minimal performance standard have reached the level of proficiency specified in the learning objectives. Content validity is the validity that is related to academic achievement metrics. Assessment content is considered genuine when it aligns with the learning experiences and objectives. Blueprinting in assessment can help ensure congruence between these essential components of education.^{4,5} A competency based medical education curriculum is being implemented by National Medical Commission (NMC) in all medical colleges in India starting from first year undergraduates' batch since August 2019.⁶ Universities need to prepare proper assessment plan for a complete, valid and reliable assessment of all students.

A blueprint can provide a detailed plan or outline as a guide for examination strategy and specification test in education for a specific subject. It specifies the elements of performance being assessed and how items will be selected based on their core importance. At present, there are no guidelines available about the fair distribution of marks to each topic from the authority. At Maharashtra University of Health Sciences (MUHS), no blueprint was available for the assessment of the subject of Forensic

Medicine. So, this is the first blueprint of the CBME Curriculum for the subject of Forensic Medicine.

Context and Setting

The various levels of cognitive domains of medical students is assessed by the written assessment. The suitable design of the evaluation tool is vital towards quality assessment and its validity. The course content of particular subject and the appropriate modality of assessment for various competencies can be matched with help of blueprinting. Blueprinting helps to ensure aligning questions to the objectives and ascertains its content validity. It makes assessment fair and transparent and gives appropriate emphasis on levels of domains.

Why the idea was necessary?

Question paper setting is one of the major duty teachers has to do. Framing a question paper that covers the whole syllabus with proportionate weightage to various content areas according to their importance is a big challenge for the paper setter. There are no guidelines available about the fair distribution of marks to each topic from the authority. At Maharashtra University of Health Sciences (MUHS), no blueprint was existing for the evaluation of the subject of Forensic Medicine. So, this is the first blueprint of the CBME Curriculum for the subject of Forensic Medicine.

2. Materials and Methods:

The study was conducted at Maharashtra University of Health Sciences (MUHS). Before commencement of the study, Institutional Ethics Committee approval was taken. The Blueprint taskforce team of three subject experts (One chairperson and two members) were appointed from MUHS for creating a blueprint for each speciality subject in medical curriculum. A sensitization workshop was conducted for all taskforce teams at MUHS. The rating and weightage in blueprint for various topics in each speciality subjects were validated through the subject experts including various professors and associate professors in zoom meeting. Accordingly, corrections were made abiding the suggestions by various experts. The feedback on specific questionnaire was obtained from forensic experts including professors and associate professors working in various medical institutions affiliated to MUHS. The various major steps undertaken are as follows-

- a. Institutional Ethics Committee approval taken.**
- b. Sensitization workshop for the taskforce team Faculty about Blueprinting was done.** The

workshop on Preparation of blueprint had been conducted at MUHS, Nashik for sensitization of the task force members of Forensic Medicine and Toxicology (FMT) about blueprinting as an assessment tool. The expert resource persons had been invited to take a training session on Blueprinting.

c. Preparation for the weightage calculation (Activity by Sensitized Faculty)

- i. Listing of all content areas in the syllabus of FMT was done according to the allotted teaching hours, as per MUHS guidelines.
- ii. The skeleton of the assessment tool was prepared. Abiding MUHS & NMC norms, total allotted mark to FMT Theory is 100 Marks.
- iii. The weightage of each content area was decided using below **table 1**.

Table 1: Weightage of subject content area

Clinical Application of the topic	Weightage
No or Less Clinical Application	1
Moderate Clinical Application	2
High Clinical Application	3

- iv. Validation of the Weightage for Each Content Area was done from subject experts. The weightage of each content area was calculated and presented to all FMT professors and associate professors in a ZOOM meeting. The weightage was validated by obtaining consensus after incorporating modifications suggested by the attendees.
- v. A Blueprint was designed for the FMT examination paper based on validated weightage. The theory examination blueprints were prepared for summative assessment in FMT depending on the validated weightage. The blueprints were also validated in the same zoom meeting.
- vi. The validated weightage and the theory exam blueprints were made available to the faculty in the subject of FMT.
- vii. The feedback on specific questionnaire was obtained from 21 (twenty-one) forensic experts including professors and associate professors working in various medical institutions affiliated to MUHS.
- viii. Statistical analysis was done. Data entered using Microsoft Excel 2010 Software. All the response tabulated and Graphical representation made wherever necessary. Data analysed by using Statistical Package for the Social Sciences (SPSS) Software version

16.0. Statistical tool used as percentage and non-parametric test.

3. Results:

Weightage of various course content was calculated and the blueprint of theory assessment in FMT was actualized. Google form for feedback for obtaining perception of the participants regarding blueprinting process was created, and pre-validated by experts in medical education. Their quantitative and qualitative responses to the closed-ended and open-ended items in the feedback form were statistically analysed. Graphical representation of 21 responses on various questionnaire shown in **Figure 1 to 6**.

Fig. no. 1: Graphical representation of responses on questionnaire 1- Blueprint helps in aligning competencies with their assessment.

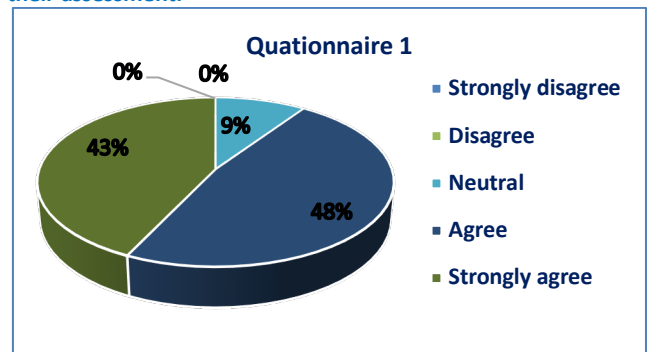


Fig. no. 2: Questionnaire 2 responses- Blueprint helps in having an appropriate weightage to recall, comprehension and application levels of cognitive domain.

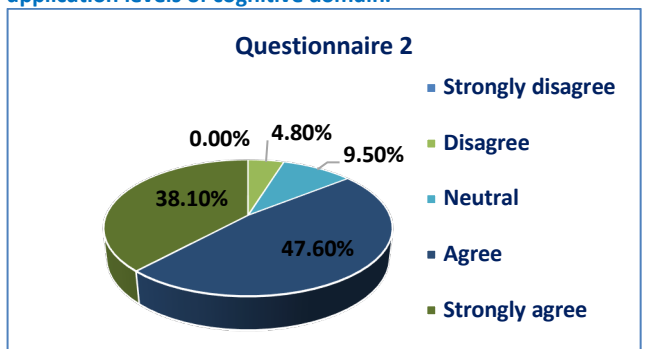


Fig. no. 3: Graphical representation of responses on questionnaire 3- Question paper setting becomes easy once the weightage and blueprints are ready.

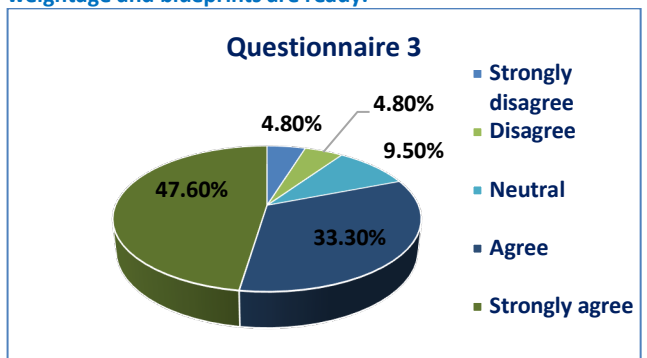


Fig. no. 4: Graphical representation of responses on questionnaire 4- Blueprint helps in focusing appropriately on core competencies while setting the question paper.

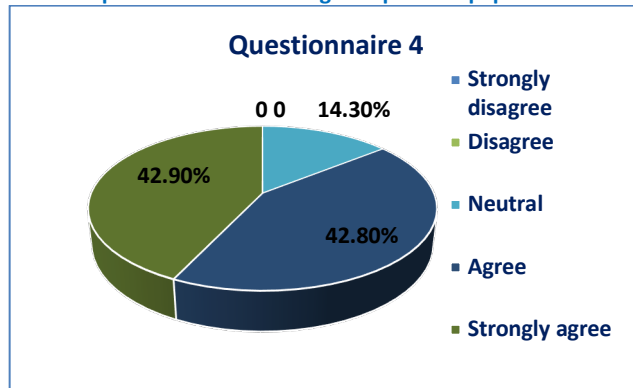


Fig. no. 5: Graphical representation of responses on questionnaire 5- Question paper setting using blueprint brings uniformity in the question paper setting.

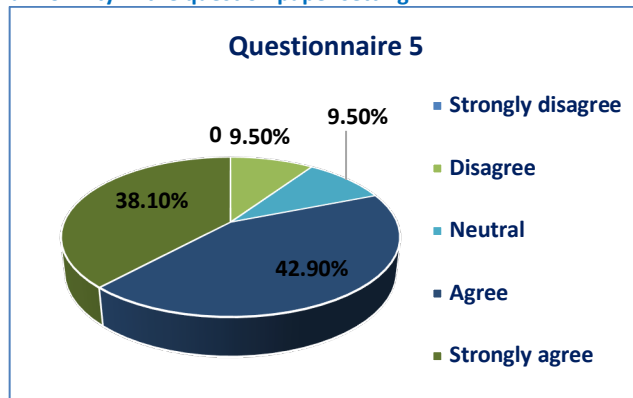
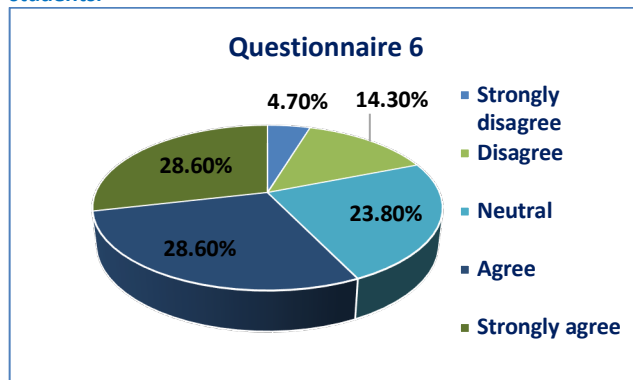


Fig. no. 6: Graphical representation of responses on questionnaire 6- Weightage and blueprint should be shared with students.



Out of all participants, 90.5% positively reflected that the blueprints align competencies with their assessment objectives (Fig. no. 1). Moreover, a majority of 86.1% opined that the blueprinting process helps in defining proper weightage of various content areas as per the levels of cognitive domain (Fig. no. 2). Also, almost 80% of the participants positively agreed that the blueprinting not only makes the paper setting easier, but also makes introduces uniformity in consequent assessments (Fig. no. 3). Appropriate focus on core competencies

using test blueprints was agreed upon by 85.8% of the participants (Fig. no. 4). 81% faculty given feedback that blueprints will bring uniformity amongst the different paper setters in question paper setting using standard blueprints (Fig. no. 5). When it came to whether the participating professors wanted to share the weightage and blueprints with the students, the response was mixed, with 57.2% of them willing to do so (Fig. no. 6). The negative feedback was perhaps due to the idea that sharing the blueprint will put a limit to the content that the students may read for the assessment. However, several authors are of the opinion that sharing the blueprint with the students will provide them a better idea of what is expected of them in the assessment, allow for organised study of content, as well as reduce stress of preparing for the exams.^{7,8}

These positive affirmations regarding the process were crucial feedbacks from participants who would potentially practice and propagate the concept to their colleagues and future professors.

4. Discussion:

According to Miller's pyramid of learning, a student demonstrates 4 levels of learning: Knows, knows how, shows how, and does.⁹ For instance, determining time since death in deceased, a student may first know factors to determine time since death, then learn how the factors vary, then make a general estimate in a fictional scenario given to them, and finally make calculated opinions during autopsies.

Each level requires a different format of testing, be it multiple choice questions, detailed answers, scenario-based questions, or practical sessions. Blooms taxonomy of assessment classifies learning behaviours into three main categories, namely cognitive, affective, and psychomotor.¹⁰ In the above instance, cognitive assessment can include rightly identifying signs of decomposition, raising suspicion regarding manner of death, and correctly dissecting the organs to expose pathology.

The cognitive domain is further divided into six levels, namely, knowledge, comprehension, application, analysis, synthesis, and evaluation. This domain is most commonly focused upon in teaching and assessment. The tasks in assessment involves testing these cognitive behaviours. However, a comprehensive set of all type of test formats is required to encompass all the six levels of the cognitive domain.

There are 4 stages of an effective test blueprint:¹¹

- 1. Identifying the major knowledge and skill domains:** It involves breaking down the subject into its important subunits. (For example, toxicology, forensic psychiatry, entomology, thanatology, etc)
- 2. Describing the objective:** The objective can be varied, from learning behaviours, to case-specific knowledge, and is documentation of what is to be expected from a student. (For example, students should be able to take informed consent for medicolegal examination of an accused; or students should be able to diagnose the poison from toxidromes)
- 3. Choosing the correct test format:** Test format should be appropriately chosen from Multiple choice questions (MCQs), theory questions, scenario-based questions, and practical assessments. (For example, a student may mark a correct MCQ regarding bi-spinous distance, but should also be practically assessed on correctly measuring the bi-spinous distance)
- 4. Specifying weightage:** Each category of assessment must be allotted marks as per their learning duration, frequency of encountering the subject in practice, importance in future learning, etc.

Validity and reliability is crucial of a good test blueprint. Validity is how good is the assessment to test the particular skill, and reliability is how trustworthy the scores in the particular test are, when it comes to judging the students. The assessment must be credible. Each assessment must be valid, which indicates that participants who meet the minimal performance standard have reached the level of proficiency specified in the learning objectives. Content validity is the validity that is related to academic achievement metrics. Assessment content is considered genuine when it aligns with the learning experiences and objectives. Blueprinting in assessment can help ensure congruence between these essential components of education.⁴ It is evident that test blueprinting not only makes the process of paper setting easier, it also allows the faculty to test the students in a holistic way. It will help the educator to evaluate student's competency on particular field appropriately.¹²

Abiding the responses from FMT experts, most of the experts given positive affirmation for the need of blueprints for uniformity in question paper setting which facilitates the proper aligning of most of the subject competencies with proper distribution of

questions abiding the weightage. These positive affirmations regarding the process were crucial feedbacks from participants who would potentially practice and propagate the concept to their colleagues and future professors.

Impact of the blueprint work:

The principal investigator and first author were initially working on this project at college level and applied for FAIMER Fellowship. Later, he was selected as Controller of Examinations at Maharashtra University of Health Sciences (MUHS), Nashik, Maharashtra, India and the chairman for FMT Blueprint taskforce. With administrative support and encouragement from Honorable Vice Chancellor, MUHS, Nashik blueprints of all 15 undergraduate medical subjects of MBBS CBME Curriculum had been prepared. Also, a book on blueprints on assessment of CBME curriculum had been released and made available to not only all colleges of Maharashtra but also to the governing council of National Medical Council (NMC). The Blueprint book is well appreciated by NMC authorities.

5. Conclusion:

Blueprints of various medical subjects including FMT abiding CBME Curriculum will improve validity, reliability and acceptability of both formative and summative assessments. There is positive feedback from sensitised faculty regarding the benefits of test blueprinting. All these results of the project conclude that blueprinting makes assessment clear, explicit and transparent to all the stakeholders. Blueprints will complement in actual implementation of the CBME Curriculum for subject of Forensic Medicine and Toxicology. Assessment is one of the key elements of competency-based medical education. A subject blueprint for assessment is must for the complete, proper, valid and reliable assessment.

Ethical Clearance: IEC approval is taken from the Institutional Ethical committee.

Contributor ship of Author: All authors equally contributed.

Conflict of interest: None to declare.

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