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Using MCQs in postgraduate orthodontic education



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Using Multiple-Choice Questions (MCQs) as an Effective Assessment Method in Postgraduate Orthodontic Education in Nigeria: A Review Article

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Abstract

Introduction: Multiple choice questions (MCQs) have been effectively utilized as an assessment method in postgraduate medical and dental education. The main objective of this article was to review MCQs in the medical education literature, with the aim to suggest concepts and theories that can be applied to enhance the use and effectiveness of MCQs in postgraduate orthodontic education in Nigeria.

Methods: An extensive review of the medical education literature was conducted to highlight the reasons for using MCQs as an assessment method in medical education. In addition, there was a review of different assessment frameworks that can be used to enhance learning by using MCQs. The Part I examination in Dental Surgery of the National Postgraduate Medical College of Nigeria, was used as a case-study for this purpose. The different concepts highlighted from the literature were applied to describe how the quality of learning and assessment with MCQs in the Part I Dental Surgery examination, can be improved upon.

Results: A review of the literature showed that MCQs can be used to test higher levels of knowledge and clinical reasoning. Assessment frameworks such as Millard's theory and Learning Oriented Assessment were also used to highlight different ways of enhancing the quality of assessment and the learning opportunities that can be created from the use of MCQs, using the Part I examination of the NPMCN as a case study. The review also highlighted effective principles to take into consideration in designing and setting good quality MCQs.

Conclusion: MCQs can be effectively utilized as an assessment tool to facilitate learning in postgraduate dental education. The Part I examination in Dental surgery has been used as a case study to describe how MCQs can be used to facilitate assessment and learning at higher levels of clinical reasoning, while also focussing on the right principles to design very good MCQs.

Keywords: MCQs, Post-graduate orthodonticn education, Nigeria

ORIGINAL ARTICLE

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Introduction

Multiple choice questions (MCQs) are widely utilized in the assessment of students in medical education.[1] This article discusses how the use of multiple-choice questions (MCQs) can support learning, teaching, and preparation for practice for dental residents in Nigeria, using the Part 1 professional examination in dental surgery of the National Postgraduate Medical College of Nigeria (NPMCN) as a reference point. Orthodontics is one of the dental specialties in which the residents are assessed, in the Part I professional examination using MCQs.

Postgraduate dental training in Nigeria and the Part 1 professional (summative) examination: Postgraduate dental training in Nigeria is coordinated by the NPMCN. The residency training programme is a 6-year programme. The curriculum of the NPMCN is competency based and divides the residency training into two parts. The first part of the training coincides with the first three years, during which residents rotate through different dental specialties, after which they write the Part I examination. The Part 1

examination is a summative assessment, which means that it is an assessment of learning and a high-stake examination. Successful candidates in this examination become Senior Registrars in their respective dental specialties. The MCQs in the Part I examination are administered via a computer-based test, with all candidates from across the country taking the examination on the same day. The MCQ examination is used to screen the candidates who can proceed to the second aspect of the Part 1 examination, which includes essays, orals and OSCE assessments.

MCQs can be divided into two families: those that require test takers to indicate all responses that are appropriate (true-false), and those that require test takers to indicate a single, most accurate response (one-best-answer).[1,2] The type of MCQ used in this proposal is the single best answer question. This has been reported to be more accurate compared to the 'True-false' response, as these question types are better able to assess application of knowledge, integration, synthesis, and judgment.[1,2]

One of the main reasons for choosing MCQs is the fact that well-constructed MCQs can be used to test application of knowledge, problem-solving skills, and clinical reasoning.[2–4] Furthermore, MCQs provide a relatively cost-effective assessment and objective format for assessment [2,3]. This is particularly important bearing in mind that the environment in which I work is resource limited. However, one of the areas in which the cost effectiveness of MCQs may sometimes be questioned, is the huge time demands required for setting good questions, particularly for inexperienced examiners. [4] However, it is also important to bear in mind that other types of assessment formats such as OSCEs may also be time demanding to construct. In addition to this, computer based MCQs have proven to be very efficient and significantly reduce the time for marking and collation of results, and the burden associated with testing large student cohorts.[5]

Purpose of assessment in dental education

Assessment drives learning[6], however, a fundamental challenge is to stimulate the right kind of learning. [7] According to Boud (2000), assessments have the 'double duty' of both grading the students and facilitating learning.[8] In addition, assessments are expected to be rigorous but not exclusive, authentic yet reliable, exacting while also being fair and equitable, to adhere to long-established standards while reflecting and adapting to contemporary needs, and at the same time, accommodate the expectations not only of academics, their students, and the university in which both are engaged, but also of government and government bodies.[9]

Several advantages of using MCQs as an assessment format in medical education have been cited in the literature.[2] One of these is that it provides an objective and efficient means of assessment through its numerous sampling opportunities. In addition, it allows for consistent scoring by ensuring a correct or single best answer which is chosen a priori (from theoretical deduction) and allows for consistent marking by either human markers or with the aid of computer technology.[2,5] Some studies have also reported that performance in high-stakes examinations comprised mainly of MCQs have been shown to predict certain clinical practice outcomes.[2,10,11]

Multiple choice questions present with some limitations and disadvantages. One of the often-cited criticisms of MCQs is that they may be restricted to the assessment of lower-level cognitive abilities because they promote memorisation and factual recall and do not encourage (or test for) high-level cognitive processes and abilities.[5,12,13] However, some researchers such as Nicol (2007) and Pugh et al. (2019) have argued that this depends on how the tests are constructed and that well-constructed MCQs can actually be used to test higher levels of knowledge and clinical reasoning. A second argument against MCQs is that they provide very limited room for feedback and thus do not allow for personalized feedback based on the students' needs. In addition to this, students often have very limited roles in setting the goals and standards for MCQs and are often unable to clarify questions during the test.[5] Thus, it is argued that this form of assessment does not allow for active student participation in the assessment process[8] or allow students to develop the skills needed to self-regulate their own learning. [14,15]Self-regulated learning simply refers to students' ability to regulate their own learning. [14]

The following paragraphs describe how different assessment frameworks can be used to enhance learning using MCQs, while overcoming some of the limitations of MCQs highlighted above and how they can be used to improve the quality of MCQ assessment in the Part 1 professional examination.

1. Miller's Pyramid: In 1990, Miller[16] described the Millers pyramid - an assessment framework for medical education in which he described four different levels of

assessment; with the base of the pyramid assessing knowledge, ('knows'), the next level assessing competence ('knows how to use the knowledge'), the second level assessing performance ('shows how to use the knowledge') and the highest-level assessing action ('does').[16] Miller further stated that while it may be reasonable to assume that either action or performance implies the achievement of the more basic aspects of the pyramid, conversely, measurement of the infrastructure (knowledge and competence) cannot be said to predict fully and with confidence, the achievement of the more complex goals. [16]

In addition to Miller's pyramid, Bloom's taxonomy of educational objectives is also used as a guide.[17] Bloom described a framework for assessing educational goals, consisting of six major categorising factors; knowledge (at the base), comprehension, application, analysis, synthesis, and evaluation particularly with respect to Orthodontics.

Thus, in designing MCQs for the Part 1 examination, the aim will be to design questions that will address the higher levels of Miller's pyramid and Bloom's taxonomy such as analysis, synthesis, and evaluation. Therefore, a greater emphasis will be placed on questions that test clinical application of the basic orthodontic knowledge of the candidates.

2. Learning Oriented Assessment: This is an assessment framework that focuses on learning as the major goal of assessment and was described by Carless.[7] The main aim of LOA is to strengthen the learning aspects of the assessment, which can be achieved through formative (assessment for learning) or summative assessment, provided the central focus is on engineering appropriate student learning. LOA emphasizes that once the assessment task embodies the desired learning outcomes, the students are primed for deep learning experiences by progressing towards these outcomes.[7] The learning outcomes describe the major competencies expected of the students at the end of a course. The three main elements of LOA are assessment tasks as learning tasks, students' involvement in assessment as peer-or self-educators, and feedback as feedforward. Further explanation will be provided on the latter two in subsequent paragraphs as they also overlap with the learning assessment framework described by Nicol.[5]

In the context of the Part I examination, it is important that the learning outcomes are clearly stated in the residents' handbook. This handbook also contains the curriculum for the residency programme in Nigeria and is given to each resident at the commencement of training. The learning outcomes enumerated should consistently form the core for the design and content of the MCQs to be used in the Part 1 examination. Furthermore, these MCQs should test real-life clinical scenarios of the orthodontic knowledge and skills outlined in the course handbook.

3. **Students' involvement in assessment and feedback:** Nicol (2007) argued that the development of a proper assessment framework may be used to facilitate active student participation and self-regulation in the use of MCQs as an assessment format.[5] It is interesting to note that this framework also describes the latter two principles of LOA which are students' participation in assessment and feedback. This framework highlights the fact that the power of MCQs to enhance learning is not dependent only on proper test construction, but also by manipulating the context in which these texts are used to enhance feedback, increase student participation, and enhance self-regulation. Nicol and MacFarlane-Dick (2006) described seven principles of good feedback practice that will support the development of learner self-regulation, thus promoting assessment for learning. These principles include the fact that to self-regulate their own learning, students should have a good understanding of what is required in the assessment tasks; secondly, they emphasize the power of dialogue in learning through group interaction, peer feedback and discussion; third, self-regulation requires motivation and a belief that effort will yield results.[5] It is important to note that feedback in itself will not promote learning[18], rather, timeliness and prompt student engagement are key factors to success.[7]

In the context of the Part 1 examination, one of the ways to improve on students' participation in the assessment process is by introducing an MCQ setting exercise during the revision course for the examination. The revision course takes place three months before the examination and is organized for all candidates preparing for the Part I examination. The candidates may be divided into different groups of six each and each group asked to design 5 MCQ questions based on the topics revised during the course, with reference to Orthodontics. The groups should be given a guide on setting MCQs using Miller's pyramid to ensure that only questions that assess higher levels are included. The questions developed by each group are then presented to the rest of the Class and vetted for quality during the

Class presentation. This process will enable the students to play an active role in formulating the questions, selecting the correct answers, and providing feedback for the selected questions. In addition, it will be done as part of a group exercise, thus allowing peer feedback, and the students also get personalized feedback during the class-review of the questions. Some of these questions will ultimately become included in the summative assessment examination either in their original form or with some modifications. This exercise will help to increase motivation and self-belief. The entire exercise, with the early feedback, will help to facilitate learning and hopefully improve the performance of the students in the summative Part 1 MCQ examination.

Design of MCQS

Van der Vleuten (1996) described a conceptual model for assessing the utility of assessment methods. In this model, the utility (U) of an assessment is described as a multiplicative function of the reliability (R), validity (V), educational impact (E), acceptability (A) and Cost (C), with differential weights (w) accorded to each of them. This model will be used as a guide in this study to design the MCQs in orthodontics for the Part I examination. In doing this, a greater weighting will be given to reliability and validity as these are very important for proper design of the MCQs as a summative assessment.

A. Reliability: This is a measure of the reproducibility or consistency of a test.[20] A wide sampling of content across the area of interest allows for stable and reproducible scores. This can easily be achieved with MCQs by increasing the number of questions set or to be answered per unit time, and increasing the duration of the exam (Van der Vleuten, 1996). Reliability can also be increased by adding a wide variety of subtests. [21]

Implementation: The exam will consist of 200 MCQ questions, with a duration of three-hours. This will help to increase the reliability of the test. In addition, apart from the MCQs, other assessment tests such as OSCEs and oral examinations will also be used to assess the candidates during the Part 1 examination, to increase the reliability of the results. The OSCEs will be used to assess communication skills and practical clinical skills in orthodontics, which cannot be assessed with MCQs.

B. Validity: This pertains to whether a test measures the competency it is supposed to measure.[4]

i. **Ensuring the questions assess clinical application and problem-solving skills related to the learning outcomes for junior residency training:** Miller's pyramid[16] and Bloom's taxonomy[17] , will both be used as expatiated in the previous section. The 'Key feature approach' will be used in setting questions. This approach assesses examinees' ability to apply their knowledge and make critical decisions at specific decision points. (Page et al., 1995)This requires examiners to focus on the critical steps in the resolution of a problem before they begin question formulation and can be effectively used in MCQs.[2]

ii. Quality of the MCQs Questions:

a. Use of Context rich questions: Context-rich questions refer to questions which include a clinical vignette accompanied by one or more questions.[2] A clinical vignette is an abridged report of a patient summarizing any relevant history, clinical findings, investigations data and treatment. Studies have shown that examinees use clinical reasoning when answering these questions.[23,24] However, it is important that the information presented in the vignette is required to answer the question correctly, and not just included as a 'window dressing'. This will ensure that the questions test for application of knowledge and clinical reasoning.[2]

b. Avoiding technical flaws: Each MCQ should pass the 'cover-test', which means that the answer to each question can be provided without looking at the options. (Van der Vleuten, 1996). In addition, technical item flaws i.e flaws related to 'irrelevant difficulty' and 'test wiseness' should be avoided.[1] Flaws related to 'irrelevant difficulty' include: options that are overtly long and complicated; non-homogenous and using 'none of the above' as an option. Flaws related to 'test wiseness' include: grammatical cues where options don't follow from the stem; using absolute terms such as 'always' or' never' and where the correct answer is more specific and longer than the other options.[1] The 'cuing effect' described by Van der Vleuten, (1996) in which the options guide the candidate to select the correct answer, will also be avoided.

iii. **A review process for the questions**: Validity is strongly enhanced when the test material is scrutinised by a review process.[19]

iv. **Score Validity, Standard setting, and Item analysis**: Once the item scores are valid, the total score will be valid. The final score for the examination will be 100%. There will be no negative marking. The pass-mark for the examination will be determined by standard setting, using a criterion referenced method-the Modified Angoff method. Standard setting is the process of determining the minimum pass-level in an examination. [26]The Modified Angoff method deals with the desirable competency level that each student should achieve and uses the borderline student as a reference for defining the pass score. Item analysis, including an assessment of the difficulty and discrimination index for each question, should be conducted after the examination.

Implementation: All the examiners involved in the Part 1 examination will undergo a two-day online training on how to set very good context-rich MCQs. A panel of judges consisting of subject experts will sit two months before the examination to scrutinize all the questions for the examination to ensure they are of high quality as outlined above. This panel will also carry out the standard setting for the MCQs and determine the pass-mark using the criterion reference method referenced above. The panel will also be trained on how to carry out standard settings.

C. Educational impact: The educational impact of the test will be greatly increased if the MCQs are directly related to the learning objectives. This has been well expatiated under Learning Oriented Assessment.

D. Acceptability: The test acceptability is closely linked to fairness. Fairness in assessment in this examination has been positively affected by all the design choices listed above. Two other key factors include location of assessment and feedback. The examination will be conducted in different locations in Nigeria via computer-based testing. Acceptability to the examiners is also very important and will be enhanced by training. Candidates who do not pass the current examination will be able to sit for the examination again in six months and have multiple attempts at passing the examination.

E. Cost: The use of MCQs presents a very cost-effective assessment format as discussed earlier in this presentation.

Conclusion

In conclusion, MCQs can be effectively deployed to assess higher levels of knowledge and clinical reasoning, using the Part I examination in Dental Surgery in orthodontics as a reference point. In addition, they can be used to drive learning by placing emphasis on improved student self-regulation and enhanced feedback. This review has also presented details on the proper design of good MCQs, while laying emphasis on a high level of reliability and validity in making the design choices to create high quality MCQs. Ultimately, the design and use of high quality MCQs in orthodontics assessment in postgraduate education in Nigeria, will positively influence the quality of training in orthodontics in the country.

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