

Computer Based Assessment in Medical Education: Evolving Trends and Developing Digitalized Question Items

Huma Musarrat Khan*

Foundation University School of Health Sciences, Islamabad, Pakistan

ABSTRACT

The use of computers is being adopted in all fields of Medical Education including assessment. This paper sheds light on the difference between Computer Based (CBA) and Computer Assisted Assessment (CAA). It proposes how different multimedia tools may be used to develop digitalized question items and presents a system of classification for these question items based on the level of interaction and the educational role played by the media tools in these question items.

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INTRODUCTION

Assessment has always been considered an integral part of learning, as educationists believe that “Assessment drives learning.” Assessment not only provides short term goals and guides learning, but also defines priorities, and provides feedback to the students (Schuwirth and Vleuten., 2020). In the last few decades, due to increase in use of information technology in medical education, computers have also made their way into assessment (Jawaid et al., 2014) and digitalised assessment is rapidly being adopted by many institutes (Egarter et al., 2020).

The use of computers in assessment can be categorized into two types; “Computer Based Assessment” and “Computer Assisted Assessment.” “Computer-Based Assessment (CBA)” is assessment which is delivered and answered through a computer-student interface.

The result is generated, and the feedback shared with the student using the computer. These may be a stand-alone computer, or computers using a private or public network. In “Computer Assisted Assessment (CAA)”, the computer is only used as part of the process of assessment and some dependence on paper and physical assessor is maintained. One example of this is that students mark their answers on a special paper which is fed into the computer optical mark reader and the result is generated by the computer (Cantillon et al., 2004). Another modification of CAA which is practiced in many institutes is, that one or more components of the exam is computer based, and the remaining is in traditional form (Fig 1).

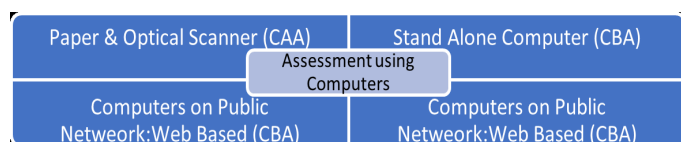


Fig 1. Use of computers for assessing learning

Correspondence

Huma Musarrat Khan

E-mail: huma.anat@gmail.com

Affiliation: Department of Anatomy Foundation University School of Health Sciences, Islamabad

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The perception to quality assessment has changed significantly in the recent decades. Originally, it was considered as a simple tool to differentiate students' knowledge (Schuwirth and Vleuten., 2020). Later, educationists started emphasising on reliability as a measure of quality assessments. As the wheel of time turned, the focus shifted to validity and with it the recognition that competence is not a simple aggregate of homogeneous performances but is multidimensional (Sood and Singh., 2012). These legacies have found their way into the modern medical education of today's digital world and with them the use of computers for effective assessment. Therefore, educationists need to embrace information technology and develop digitalized assessment tools, optimising their full potential in light of the expectations and challenges of the today's world (Ferris and Flynn., 2015).

The use of computers offers not only an alternative assessment method with increased reliability and efficient compilation of results, but also has the potential to offer a paradigm shift away from conventional paper-based assessments (Shrivastava and Shrivastava., 2022). It opens a doorway to creating innovative and powerful assessment modes using a variety of online/offline digitalized media tools (DMT). Question items for CBA can be developed by integration and incorporation of different media tools (DMT) such as images, audio/videoclips, graphics, animation, simulations and complex student-computer interactions along with text. This would thereby increase the potential of assessment to far beyond the limits of paper-based exams. Moreover, studies claim that a blend of images and text has a thought provoking role and addition of relevant visual data helps in memory mapping and supports recall (David, et l., 1998). This is further supported by studies which claim that adding images to the questions helps students to choose the correct answer as compared to text-only questions (Martín-SanJosé J.F, Juan M.C, Vivó R., 2015). However, developing such question items for CBA needs careful planning and training of the assessor. A direct conversion of questions from paper-based assessments to online CBA assessment is inappropriate and would minimize the potential of this system (Martín-SanJosé

J.F. Juan M.C, Vivó R., 2015). With this background in mind, this paper proposes a system of classification for digitalized question items, based on the level of interaction and the educational role played by the media tools in these question items. It is hoped that such a system will help assessors to create effective and valid questions with digitalized tools according to the objective and learning outcomes of the curriculum.

Types of Digitalized Question Items for CBA

Multiple choice digitalized question items with multimedia tools (images) consist of the following standard components.

“Stem”: Which states the problem/background. Provides context of the question “Lead in”: Actual query regarding the problem/background.

“Options”: Four options, one of which is the key and 3 are distractors. Based on the level of interaction and the educational role played by the media tools the question items were classified into the following categories.

Table 1. Classification of Digitalized Question Items for CBA, based on the role of DMTs

Category Of Question	Description	Remarks
I Media tool supplements the text in the stem	Problem is presented partly by the text and partly by the DMT both of which together make up the “stem”.	This reflects the optimum use of DMTs.
II Media tool complements the text in the stem.	Problem is given in the text of the “stem”. The “lead in” is based on text.	DMT is added to enhance conceptualization and application in the student’s mind.
III Nesting Questions, where the media tool is incorporated within the “stem.”	The problem is given in the text, followed by the DMT which provides a prerequisite question. The “lead in” is based on how the prerequisite question in DMT is answered or perceived.	Recommended for developing questions with high difficulty index.
IV The predominant part of “Stem” comprises of the media tool.	Problem is presented by the media tool which constitutes the “Stem”. The “lead in” is based directly on the multimedia tool.	May also be used to assess practical component (skill).
V Items with active Student-computer interaction.	Engages student dynamically and discussion is customized.	Advanced software tool is required. May be used for theory as well as practical exams. Has the potential to be adaptive.

Categories I, II, and III predominantly assess Cognition (Knowledge) and so they should be used in theory papers, whereas Category IV is constructed for assessing skills and so should be used in practical exams. Category V, in the hands of a trained assessor may be used in theory as well as practical exams.

Category I comprises of questions in which the media tool supplements the text, and both of them together constitute the “Stem” of the question. In these questions, part of the context is

given in the text and part of it is given in the DMT. The “Stem” would be incomplete without either of them.

Category II comprises of questions in which the media tool complements the text. In this type of questions, the media tool is an optional part of the stem and has been added to increase the level of application in the mind of the student and to enhance conceptualization by image schemas. Researchers claim that images relate with image schemas through spatiotemporal relationships and act as building blocks of cognition that help to conceptualise structures and concepts on a high level of application and abstraction (Hedblom et al., 2019). Therefore, adding images to complement the text in the “Stem” is expected to improve applicability and student performance.

Category III comprises of Nesting questions. Here, the media tool is an integral part of the “stem”. It includes items, in which there is a series of one or more pre-requisite questions, the answer to which acts as a trigger to the “lead in.” The answer to “lead in” is based on how the prerequisite question embedded in the DMT is answered or perceived. These questions are expected to have a high difficulty index as two or more concepts are assessed by a single question.

Category IV comprises of questions in which the media tool predominantly makes up the “stem”, and the “lead in” is directly related to it. This category is typically used in assessment of a skills e.g reading an ECG, identifying the sound of a murmur, identifying a structure on model. Thus, these types of question items should be reserved for practical exams which are meant to assess skills.

Category V includes question items which involve dynamic interaction between the student and computers. The computer responses are customised according to the student response. This requires availability of an advanced software. Thus, the role of student-computer interaction is yet to be explored and will increase as more and more relevant softwares are developed. However, it can safely be assumed that they would be applicable in both theory and practical exams.

As discussed earlier, presently, the focus of quality assessment is on reliability and validity and the role of human judgement is being minimised. However, another evolution in assessment seems to be approaching in which assessment is considered as an integrated whole system judging the overall competence of the student with focus shifting back on the assessor, yet providing significant support for expert human judgement of the assessor (Schuwirth and Vleuten., 2020). The use of CBA and the different types of items discussed above can provide this support and their optimal use will open endless avenues and potentials for developing powerful modes of digitalized assessment in future.

CONCLUSION

We conclude by saying that the use of computers for assessment has opened new horizons in the field of assessment. However, its optimum utilization is dependent on how the media tool is incorporated into the question items. Different roles of DMTs in developing question items have been discussed, and a system of classification based on the level of interaction and the educational role played by the media tools in these question items is proposed in this paper. It is hoped that this will help to create uniformity and clarity in the mind of the assessor regarding developing question items.

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