

Computer-based Versus Pen-and-paper Testing: Students' Perception

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Abstract

Background: Computer-based testing (CBT) has become increasingly popular as a testing modality in under- and postgraduate medical education. Since 2004, our medical school has utilised CBT to conduct 2 papers for the third- and final-year assessments - Paper 3, with 30 multiple choice questions featuring clinical vignettes, and the modified essay question (MEQ) paper. **Aims:** To obtain feedback from final-year students on their preferred mode of testing for Paper 3 and MEQ components of the Medicine track examination, and the reasons underlying their preferences. **Methods:** An online survey was carried out on 213 final-year undergraduates, in which they were asked to provide feedback on Paper 3 and MEQ papers. Students were asked if they thought that the CBT format was preferable to the pen-and-paper (PNP) format for Paper 3 and the MEQ, and why. **Results:** One hundred and fourteen out of 213 (53.5%) students completed the online survey. For Paper 3, 91 (79.8%) felt that CBT was preferable to PNP, 11 (9.6%) preferred the PNP format and 12 (10.5%) were unsure. For the MEQ, 62 (54.4%) preferred CBT over PNP, 30 (26.3%) preferred the PNP format and 22 (19.3%) were unsure. Reasons given to explain preference for CBT over PNP for Paper 3 included independence from seating position, better image quality (as images were shown on personal computer screens instead of projected onto a common screen) and the fact that CBT allowed them to proceed at their own pace. For the MEQ, better image quality, neater answer scripts and better indication of answer length in CBT format were cited as reasons for their preference. **Conclusions:** Our survey indicated that whereas the majority of students preferred CBT over PNP for Paper 3, a smaller margin had the same preference for the MEQ.

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Introduction

Computer-based testing (CBT) has gained popularity as a testing modality, with large-scale professional examinations such as the United States Medical Licensing Examination (USMLE) adopting a CBT format since 1999,¹ replacing the written pen-and-paper (PNP) format. Studies have found that testing format does not affect test scores, and that CBT offers several advantages over PNP testing, viz convenience of scheduling and the ability to score exam papers instantly (when applied to multiple choice questions) and enhanced security.² The main disadvantage has been increased anxiety amongst those unfamiliar with computer use. Some studies and surveys have indicated a preference for CBT over PNP.²

Our medical school at the National University of Singapore introduced CBT for both the clinical vignette-based multiple choice questions (Paper 3) and modified essay question (MEQ) examinations in 2004. We utilised our in-house IVLE (Integrated Virtual Learning Environment) as the means to conduct the CBT examinations. The IVLE (<https://ivle.nus.edu.sg>) is a campus-wide online learning and examinations management system, primarily used by members of faculty and the student body for self-managed learning. The IVLE can be used to post online tutorials, courses, assessments and examinations, both formative and summative. Access can be granted to all students, or limited to a small group. With an inbuilt calendar and clock, the start and stop times

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for publication of modules can be preset. Time limits can be set for the modules, and the number of attempts to complete the modules limited, if necessary. The system can be accessed by staff and students, both on and off-campus. For security purposes, all summative assessments and examinations are carried out on-campus in assigned computer laboratories.

CBT proffered several advantages to invigilators and faculty. Firstly, IVLE allowed faculty to make online changes to the questions and answers prior to publication of the examination. Secondly, there was little chance of a security breach, as only the “webmaster” in charge of the examination would have access to the paper. Thirdly, the IVLE minimised the risks of cheating, in that all students were given a fixed length of time to complete the examination, irrespective of start time. Finally, with IVLE, we were able to dictate which students would have access to the examination (hence students who were barred from taking the examination could not access it) and what time the examination could be published, ensuring uniformity of start and end times (give or take a few minutes). As we had a large cohort of 213 students and access to only 150 desktop computers in 2 computer laboratories, we had to divide the students into 2 groups, and only allow access during session 1 to the first cohort, disallowing access to the (quarantined) second group until they took the examination later.

We sought to determine if our final-year students preferred the CBT format over the PNP format for Paper 3 and the MEQ, and the reasons for their preferences. The survey provided an opportunity for the stakeholders (i.e., students) to provide feedback, thus fostering fairness and learning.³

Methodology

Final-year students sitting the MBBS examinations were emailed a request to log on to an e-survey site to provide anonymised feedback on the Medicine-track examination on the last day of their final examinations. It has been the practice at our university for the administration to contact students via e-mail as well as via normal mail during the course of the academic year. E-mail correspondence provides the opportunity for last-minute changes/amendments to scheduling to be communicated effectively to our student population. The students were asked if they considered CBT to be better than PNP testing for the MEQ and Paper 3. Irrespective of their answer (yes, no or don't know), students were asked why they had their stated preference.

Description of Clinical Vignette-Based Multiple Choice Questions (Paper 3)

Paper 3 was introduced into our medical curriculum in

1965. Traditionally carried out as a PNP test, it featured 30 clinical vignettes, consisting of photographic slides of a medical image or of medical data projected onto a screen for 2 minutes, accompanied by a printed clinical scenario and a question with 5 multiple choice answers, of which one was correct. Since 1980, computer marking was introduced. Students marked their answers onto a computer score sheet. Auto-marking was thus possible, but answers had to be submitted a few days in advance to the computer centre for programming purposes. Thus, the order of questions and answers could not be altered once the answer template was submitted, and the large number of staff (and steps) involved increased the risk of security breaches. The examination was held in a lecture theatre, and students were seated in alternate seats and rows to minimise cheating. Common complaints about this examination format were that quality of projected images was poor and image quality decreasing with distance from the screen. In addition, candidates had to answer sequentially regardless of how difficult the questions were.

In CBT format, the images and accompanying scenarios, questions and answers were uploaded onto the IVLE, with each student taking the examination on a standard desktop personal computer. Five questions were shown per scrollable page, the answers being submitted at the end of each of 6 pages. Figure 1 provides an example of a typical Paper 3 question, used in the final-year assessment. Students were not allowed to edit answers once they were submitted. The IVLE features an automated countdown timer, and the examination was programmed to terminate automatically after 60 minutes, saving the answers recorded on the screen at the time, irrespective of whether the “submit” icon was clicked. To be fair to students, this timer was prominently displayed on the screen.

Description of the Modified Essay Question (MEQ)

In 2004, we introduced the MEQ as part of the final-year Medicine track examinations in CBT format, with “back-up” prepared in PNP format. In the 2004 examination, we replaced one PNP traditional essay question with a CBT-administered MEQ. In the 2005 examination, 2 CBT-administered MEQs were used to replace 2 PNP traditional essay questions.

The MEQ is a test of clinical application. A short scenario was described and students were prompted to interpret significant symptoms, list out other symptoms they would elicit and list out differential diagnoses. After submitting these answers, additional history was provided, whereupon the students were asked what they would look for in the physical examination. Submission of these answers would lead to relevant clinical signs being revealed, the students were then required to list out investigations they would

their preference, 8 found it “easier” than the PNP testing modality, 4 liked the fact that there was a limitation in the length of the answers, indicating that this gave them an indication as to how much they should write. Three students, presumably with illegible handwriting, were happy with increased neatness and legibility of typed answers. Four students indicated their happiness with images shown as part of the investigations to be interpreted. Interestingly, 2 students found it good that they were not allowed to go back to the preceding page (as answers could be obtained from the next page). One student found it practical that invigilators do not need to collect answer sheets before the next section could be attempted. Despite preferring the CBT over PNP formats, 2 complained of being distracted by noise from students simultaneously typing on the keyboards, 1 noted technical difficulties with logging on to the IVLE and 4 complained of difficulty typing. Of the 30 who preferred the PNP format, 1 cited noise, 2 technical difficulties, 3 difficulty typing and 1 the fact that they could not return to preceding pages with CBT as the reasons for their preference. Despite preferring PNP testing, 1 liked the fact that it allowed them to proceed at their own pace, 2 thought the word limit offered by CBT a “good idea”, 2 acknowledged that CBT was easier on the invigilators and 1 preferred that typed answers were legible. Of the 22 who were unsure of preference, 1 thought CBT to be easier than PNP, 2 thought the images were better with CBT, and 1 took the opportunity to comment on technical difficulties encountered.

Discussion

Both Paper 3 and the MEQ are well established forms of assessment. Paper 3 is similar to Paper 2A, set as part of the examinations leading to membership of the Royal College of Physicians of the United Kingdom. The MEQ has been in existence since the 1970s.⁴ Adherence to assessment guidelines specified by the General Medical Council (Principles of Good Medical Education and Training) was ensured. We surveyed the stakeholders (students) to determine student acceptability of the process and provide feedback to enhance further development of the assessment. We were mindful of the 5-year study by Imperato et al,⁵ which showed that student opinions, though valuable, were vulnerable to influence by unrelated factors such as emotion.

CBT has been established to be useful as an assessment tool for under- and postgraduate assessments, as well as for the assessment of physician competence.⁶ In addition, computer-based technology has gained wide acceptance as a tool for imparting knowledge.⁷

In introducing CBT, it is imperative that the examination format measure the examinee’s knowledge, rather than their level of comfort and confidence with the technology.⁷

Lee and Weerakoon⁸ showed that some students do less well in CBT than they would have in a PNP format. This data differed markedly from a study by DeAngelis⁹ comparing the equivalence of CBT and PNP. The study population took 2 consecutive tests, using either CBT or PNP, then switching to the other format for the second test. Students fared as well, if not better, using CBT. However, student acceptance of the test was mixed.

In a survey of Malaysian students, Nurjahan et al¹⁰ noted that only 5% of students did not use a computer either at the university or at home. Most students surveyed reported adequacy in word processing (55%), e-mailing (78%) and surfing the worldwide web (67%). Our survey showed that our students were similarly, if not more, comfortable with computer technology. Despite being distracted by the noise from other students typing at their keyboards and expressing worry that their typing skills might prove inadequate, only 10 complaints about typing difficulties or computer-related matters were noted in the questions asking why they liked or disliked CBT or PNP formats. No students required help with using the IVLE.

It is interesting (but not surprising) that there was a disparity in the opinions of faculty and students with regard to the usefulness of CBT for Paper 3 and MEQ. Members of staff were of the opinion that CBT conferred equal benefit over PNP for both Paper 3 and the MEQ, whereas the students preferred CBT for Paper 3 over the MEQ. The advantages of CBT over PNP testing for Paper 3 were obvious: the independence of image quality from seat assignment, the fact that we could tweak images on the computer, thus ensuring that the images were of “top quality” and the fact that they could proceed with the examination at their own pace. It was less clear why the students were less rousing in their endorsement of CBT over PNP for the MEQ. One important reason perhaps is that they had actually taken a PNP test for Paper 3, and found CBT to be superior, whereas they had only taken the CBT-type MEQ, and had the concept of a PNP MEQ explained to them. The fact that the MEQ required longer answers struck a chord with some, who opined that CBT allowed them to avoid demonstrating illegible handwriting, but no clear reasons for the preference of CBT over PNP or vice versa were given.

We noted with interest that few students mentioned problems with computers or with the IVLE. We attribute this to our having pre-empted problems by having staff from the Information Technology Department on hand to troubleshoot, as well as thoroughly briefing our invigilators and having them attend a demonstration of CBT and the IVLE prior to the examination.

To conclude, both Paper 3 and the MEQ can be

successfully conducted using an online computer-based testing system such as the IVLE. Eighty per cent of our students felt that CBT was the preferred mode of administering the test for Paper 3, whereas only 55% had the same preference when it came to the MEQ. Our experience and positive student feedback should encourage other universities to adopt CBT for high-stakes examinations.

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