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Students' perception of computer based assessment system after a pilot experience in an African medical school.

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Abstract
Background: Computer based assessment (CBA) is increasingly used for assessment of students in higher education. However, there is limited use of CBA in many African medical schools. The department of Medicine piloted the use of CBA for assessment in clinical examination prior to its introduction for regular use to a set of final year medical students at the end of their clinical posting in internal medicine.
Objectives: To evaluate the perception of final-year medical students to the pilot testing of the use of CBA for clinical based examination at the College of Medicine, University of Ibadan, Nigeria.
Methods: A voluntary self-administered questionnaire on basic demography and attitude towards CBA was completed by the students after a CBA clinical examination in internal medicine.
Results: Data were collected from 20(35.1%) female students and 37(63.8%) male students. The students reported a high level of previous IT experience with 95% females and 94.5% males rating themselves good to expert in general computer appreciation and internet use. Male students tended to agree more than the females with the statement that CBA are easier to handle than paper and pencil tests (3.50(0.890) vs 3.97(1.01), p=0.0405) and also with the statement that CBA reflected objectively a student's performance (3.2(1.05) vs 3.81(0.811), p=0.0191). The students reflected on the ease of examination process and the technical issues that could affect the conduct of the examination.
Conclusions: The pilot test was well received by the students and CBA could offer additional method of student evaluation in a low resource environment.

Keywords: *Africa, Clinical Examination, Computer based assessment, Medical Education, Medical Students*

Résumé
Contexte : L'évaluation assistée par ordinateur (EAO) est de plus en plus utilisée pour l'évaluation des étudiants dans l'enseignement supérieur. Cependant, l'utilisation de l'EAO est limitée dans de nombreux collèges de médecines africaines. Le département de médecine a piloté l'utilisation de l'EAO pour l'évaluation dans l'examen clinique avant son introduction pour une utilisation régulière à un ensemble d'étudiants en dernière année de médecine à la fin de leur affectation clinique en médecine interne.
Objectifs : Pour évaluer la perception des étudiants en dernière année de médecine à l'essai pilote de l'utilisation de l'EAO pour l'examen clinique au Collège de Médecine de l'Université d'Ibadan, au Nigéria.
Méthodes : Un questionnaire volontaire auto-administré sur la démographie de base et l'attitude envers l'EAO a été rempli par les étudiants après un examen clinique EAO en médecine interne.
Résultats : Les données ont été recueillies auprès de 20 étudiantes (35,1 %) et de 37 étudiants (63,8 %). Les étudiants ont rapporté un niveau élevé d'expérience préalable en informatique avec 95 % étudiantes et 94,5 % étudiants s'estimant bons à experts en matière d'appréciation générale de l'informatique et d'utilisation de l'internet. Les étudiants avaient tendance à être plus d'accord que les étudiantes avec l'affirmation selon laquelle les EAO sont plus faciles à gérer que les tests papier-crayon (3,50 (0,890) contre 3,97 (1,01), p = 0,0405) et aussi avec l'affirmation selon laquelle l'EAO représentait objectivement la performance d'un étudiant (3,2(1,05) contre 3,81(0,811), p=0,0191). Les étudiants ont réfléchi à la facilité du processus d'examen et aux problèmes techniques qui pourraient affecter le déroulement de l'examen.
Conclusions : Le test pilote a été bien accueilli par les étudiants et l'EAO pourrait offrir une méthode supplémentaire d'évaluation des étudiants dans un environnement à faibles ressources.

Mots-clés : *Afrique, examen clinique, évaluation informatisée, éducation médicale, étudiants en médecine*

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Introduction

Computer based assessment (CBA) is increasingly being used in educational measurement and assessment largely because of distinct advantages over traditional pen and paper-based assessment (PPA). These advantages include multimedia capability, user interactivity, adaptability, improved

reliability, near-real-time score reporting, time and space independence, efficient data collection for analysis, easier assessment and reduction in the task of assessment management such as invigilation and marking [1–3]. The obvious advantages of CBA had led to its worldwide adoption by higher educational institutions for formative, self-assessment and summative purposes [4].

Despite the widespread adoption, CBA is still of limited use in education in African countries including Nigeria. While a few higher institutions have adopted some form of CBA for summative assessment [5,6], CBA is used predominantly by the admission examination bodies for entrance examinations into higher institutions in Nigeria. Several challenges have been noted in the implementation of CBA in Nigeria and these include among other economic factors and poor ICT funding; security concerns; poor ICT culture, policy and implementation; power supply limitations; gender related issues and accessibility to internet facilities [7]. These factors have limited the wide adoption of CBA in many Nigerian higher educational institutions. Thus, most medical schools in Nigeria still undertakes students' evaluation via the traditional method while CBA is rarely used.

Several studies had examined the perception and acceptance of CBA by students of higher educational institutions within and outside Nigeria [6,8–10]. However, Nigerian medical schools are yet to incorporate CBA into undergraduate medical training and assessment. This study therefore aims to evaluate the perception of students to a pilot test of CBA for a clinical based assessment in internal medicine in a group of final year medical student

Methods

The department of Medicine of the College of Medicine, University of Ibadan opted to implement a pilot test of the use of CBA for the picture test aspect of the clinical examination. An open-source CBA software was hosted on the College intranet. A 50-item multiple choice clinical questions in Internal Medicine was delivered through the CBA system for the end-of-posting clinical examination to a group of final year medical students who had just completed their final rotation in internal medicine.

The study design is a survey using an online questionnaire. Immediately after the CBA, the students were asked to complete a self-administered questionnaire delivered on-line through REDCap™ electronic data capture tools hosted at the College of Medicine, University of Ibadan, Ibadan Nigeria [11]. The questionnaire contain sections on basic demographics, perceived IT experience, previous CBA exposure and a 17 likert scale questions exploring the student's perception of the CBA. The students were also asked to give 3 advantages and disadvantages each of the CBA and also to provide general comments on the examination.

The study received ethical approval from the institutional review board of the University of Ibadan and University College Hospital, Ibadan Nigeria (UI/EC/19/0271).

Data management and analysis

Data analysis was done with R version 3.6.1 [12]. Categorical data were expressed as frequency (proportions) while continuous data were expressed as median (inter-quartile range). A composite IT experience score was generated from the sum of the IT experience variables while a previous CBA score was also generated from the sum of the previous CBA exposure. The relationship between previous CBA experience score and the composite IT experience score was explored with the Kruskal-Wallis test while the gender differences was tested with Wilcoxon rank sum test. The level of statistical significance was $p<0.05$. The free-text entry of the advantages and disadvantages of CBA were explored with R-based Qualitative data analysis software(RQDA) version 0.3-1 [13]. Various themes identified were coded and the frequency of the codes were generated. The free-text entries were also processed to produce word frequencies from which word clouds were generated

Results

The fifty-eight students who took part in the CBA were asked to fill the evaluation form anonymously on-line through the REDCap™ system. Sixty-one (61) records were available in the system of which 4 were incomplete largely due to electricity failure at the end of the CBA. These students eventually completed the questionnaire on restoration of electricity supply. Only the complete records were included in the analysis. There were 20(35.1%) female students and 37(63.8%) male students. One student did not identify his/her gender status. The median age of the students was 23 years and ranged between 22 years and 35 years. Twenty-Four (70.6%) males versus 10(52.6%) females ($p=0.3132$) had previous experience with CBA through on-line self-improvement courses, 14(41.2%) males versus 6(30%) females ($p=0.5964$) had CBA experience through on-line academic courses and 14(41.2%) males versus 1(5.6%) females ($p=0.0175$) had CBA experience through admission examinations.

Table 1: Rating of previous Experience with Information Technology by the Students

Questions	1 (%)		2 (%)		3 (%)		4 (%)		5 (%)		Female	Male	p-value
	F	M	F	M	F	M	F	M	F	M	(n=20)	(n=37)	
General computer appreciation and basic internet use	0	0	5	5.4	30	32.4	40	24.3	25	37.8	3.85(0.875)	3.95(0.970)	0.7058
Use of word processing, spreadsheets and presentation softwares	5	8.6	10	17.1	35	34.3	45	37.1	5	2.9	3.35(0.933)	3.09(1.01)	0.3327
Graphic/Web Design	45	27	30	29.7	25	32.4	0	8.1	0	2.7	1.80(0.834)	2.30(1.05)	0.0563
Data/Statistical Analysis	20	24.3	20	24.3	60	27	0	21.6	0	2.7	2.40(0.821)	2.54(1.17)	0.5992
Programming (in any language)	73.7	59.5	21.1	21.6	5.3	10.8	0	8.1	0	0	1.32(0.582)	1.68(0.973)	0.0902
Composite IT Experience score											12.6(2.92)	13.4(4.00)	0.4357

M: Males, F: Females

Table 1 shows the students rating of their previous IT experience. Only few students rated themselves as being experienced in Data/Statistical analysis and computer programming. There is no gender difference in the rating of personal IT experience by the students. Similarly, there is no gender difference in previous CBA experience score of the students (p=0.1425) Figure 1 shows the relationship between previous CBA experience score and the composite IT experience score among the students. Students who had more previous CBA

their responses to questions 26 - 28 – as it relates to CBA being easier than paper and pencil tests, CBA reflecting objectively the student's performance and the acceptance of the results of CBA over paper and pen tests respectively.

The perceived advantages and disadvantages of the CBA system by the students are highlighted in the Figures 2- 4. Figure 4 shows the relative frequencies of the themes identified in the qualitative analysis of the advantages and the disadvantages of the CBA system. The students particularly highlighted

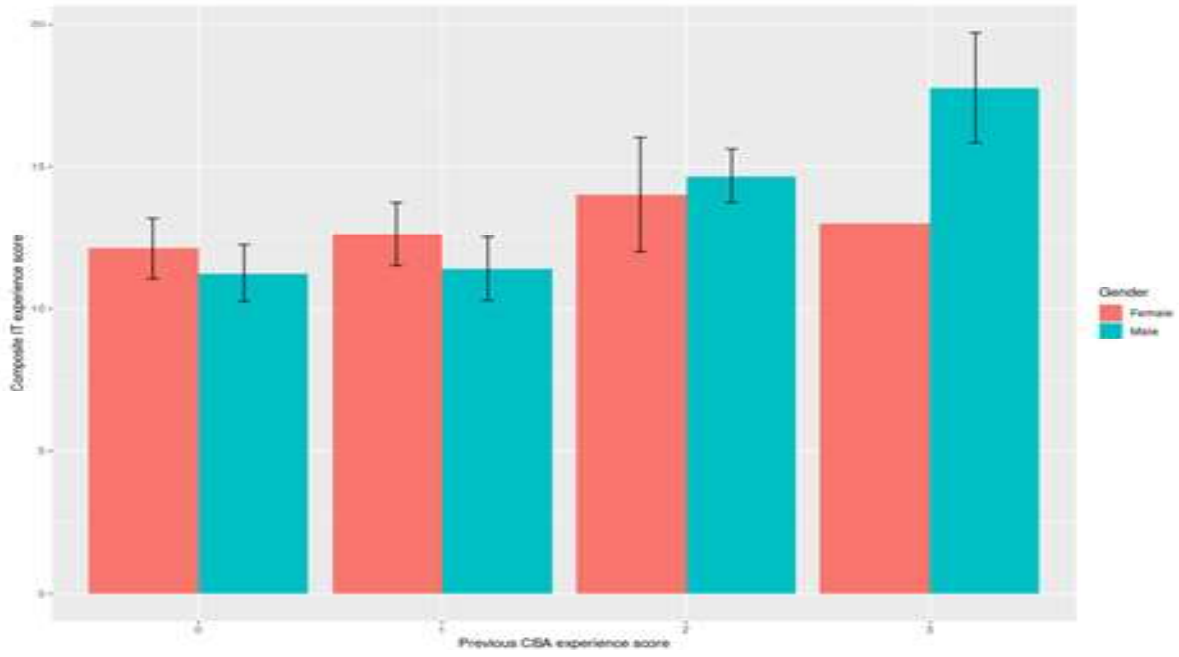

Fig.1: Relationship between Composite IT experience score and previous CBA experience

experience exposure were more likely to have higher composite IT experience score (p=0.0121). Table 2 shows the perception of the students to the CBA. The females are quite different from the males in

the fact that the use of CBA for picture tests allowed them to approach the questions "at their own pace" when compared with pen and paper tests. Also, of particular note is the fast processing of the

Table 2: Students' Perceptions on the Computer Based Assessment

No	Questions	Strongly Disagree (%)		Disagree (%)		Neutral (%)		Agree (%)		Strongly Agree (%)		Female (n=20)	Male (n=37)	p-value
		F	M	F	M	F	M	F	M	F	M			
q14	I found the CBA system easy to use	5.0	0.0	0.0	2.8	10.0	11.1	60.0	50.0	25.0	36.1	4.00(0.918)	4.19(0.749)	0.4709
q15	The instructions before and during the exam were clear and easy to understand	5.0	0.0	0.0	2.8	15.0	13.9	55.0	52.8	25.0	30.6	3.95(0.945)	4.11(0.747)	0.6235
q16	The questions were clear and unambiguous	5.0	2.7	10.0	16.2	20.0	18.9	55.0	43.2	10.0	18.9	3.55(0.999)	3.59(1.066)	0.8585
q17	The pictures were clear and straightforward	0.0	0.0	10.0	13.5	25.0	10.8	45.0	45.9	20.0	29.7	3.75(0.910)	3.92(0.983)	0.4126
q18	I would prefer further picture tests in this format	5.3	0.0	10.5	5.4	31.6	16.2	31.6	45.9	21.1	32.4	3.53(1.124)	4.05(0.848)	0.0795
q19	The time allotted was sufficient for me to answer all questions	0.0	0.0	0.0	5.4	10.5	2.7	63.2	54.1	26.3	37.8	4.16(0.602)	4.24(0.760)	0.4315
q20	Taking classroom exams on a computer heightened my anxiety	10.0	13.5	35.0	37.8	15.0	29.7	30.0	10.8	10.0	8.1	2.95(1.234)	2.62(1.114)	0.3396
q21	I would prefer to have my score displayed after the examination	15.0	10.8	25.0	10.8	5.0	13.5	20.0	24.3	35.0	40.5	3.35(1.565)	3.73(1.387)	0.4186
q22	This examination was fair	5.0	2.7	10.0	2.7	40.0	29.7	35.0	54.1	10.0	10.8	3.35(0.988)	3.68(0.818)	0.1752
q23	I would recommend that the College adopt CBA for future examinations	5.0	2.7	0.0	5.4	40.0	16.2	35.0	37.8	20.0	37.8	3.65(0.988)	4.03(1.013)	0.1175
q24	Overall, I think CBA is a good idea.	0.0	0.0	0.0	0.0	15.0	8.1	70.0	54.1	15.0	37.8	4.00(0.562)	4.30(0.618)	0.0745
q25	Computer- or web-based training should play a more important role in medical school.	0.0	0.0	0.0	0.0	5.3	13.9	63.2	47.2	31.6	38.9	4.26(0.562)	4.25(0.692)	0.9528
q26	CBA are easier to handle than paper-and-pencil-tests.	0.0	5.4	15.0	0.0	30.0	18.9	45.0	43.2	10.0	32.4	3.50(0.889)	3.97(1.013)	0.0405*
q27	A CBA reflects objectively a student's performance	5.0	0.0	15.0	5.4	50.0	27.0	15.0	48.6	15.0	18.9	3.20(1.056)	3.81(0.811)	0.0191*
q28	I would accept the results of a CBA as well as . those of a paper-and-pencil test	0.0	0.0	10.5	2.7	31.6	13.5	42.1	51.4	15.8	32.4	3.63(0.895)	4.14(0.751)	0.0368*
q29	I have reservations about technical problems influencing the accomplishment of a CBA.	0.0	2.8	5.0	8.3	15.0	11.1	55.0	50.0	25.0	27.8	4.00(0.795)	3.92(0.996)	0.9702
q30	Security and integrity of the examination would be a major concern in CBA	5.0	5.4	20.0	13.5	20.0	32.4	30.0	35.1	25.0	13.5	3.50(1.235)	3.38(1.063)	0.6524

M: Males, F: Females, *: statistical significance

Fig. 2: Wordcloud of the Advantages of CBA free text comments

Fig.3: Wordcloud of the Disadvantages of CBA free text comments

examination results through the CBA system. The students were concerned about system malfunction and technical issues as well as power supply issues during a CBA.

Discussion

Our study sought to explore the perception of a group of final year medical students to a pilot testing of CBA for clinical examination in a medical school.

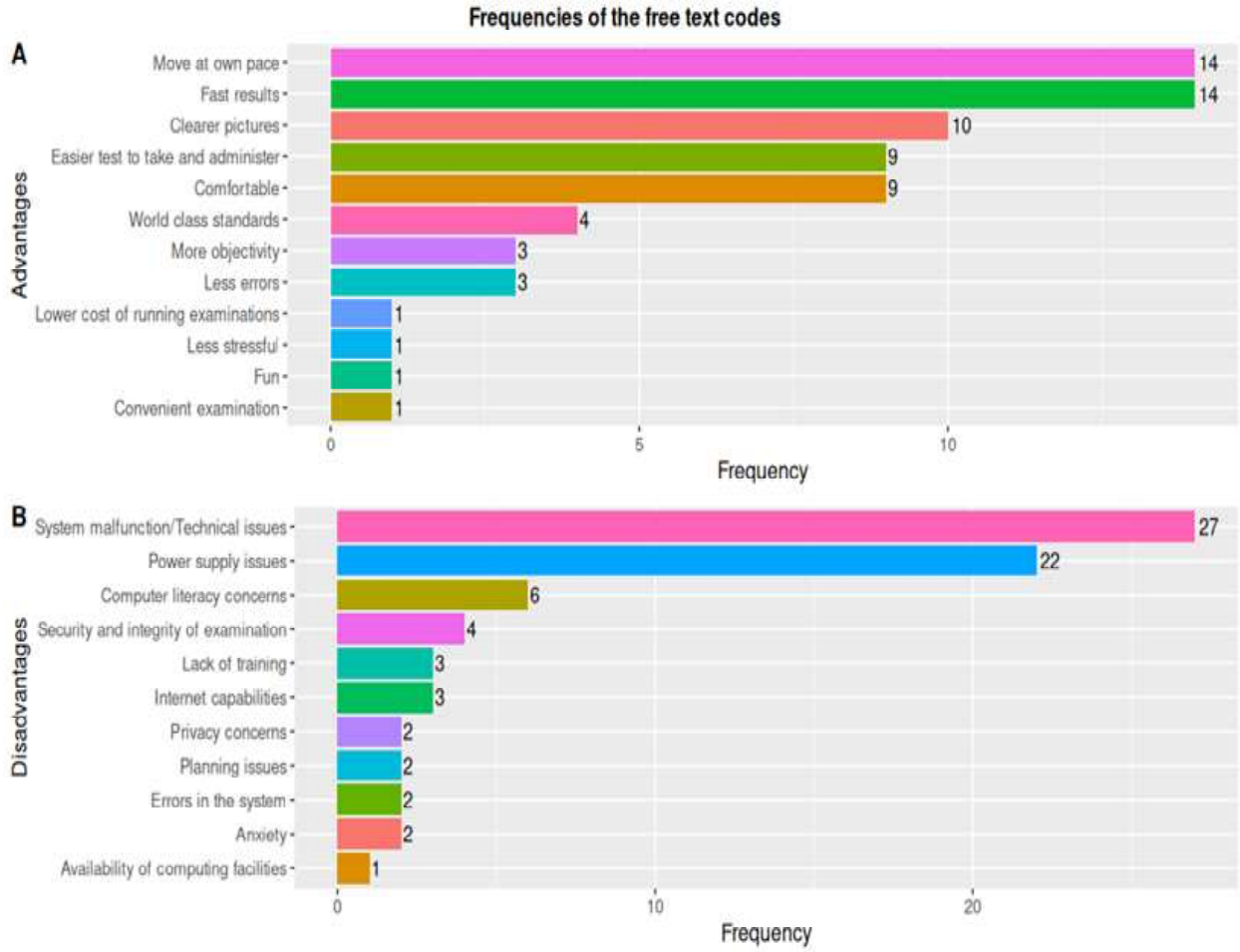

Fig. 4: Frequencies of the themes in the free text comments

Overall, the students reported a positive experience more than 85% of the respondents agreeing that CBA is a good idea and about 90% indicating that CBA should play more important role in medical education. Several studies [9,14–16] had found high level of acceptance CBA among diverse groups of higher education students for summative and formative assessments.

Our group of medical students rated themselves high on basic computer use proficiency with over 90% of the females rating themselves fair to excellent in basic computer appreciation and about 85% of the females with fair to excellent rating in the use of basic office software. Computer self-efficacy had been considered to be among the most important constructs that are related to the ICT acceptance and use by students [17]. It has also been described as a major factor in computer and information literacy by students [18] and influences the development of CBA induced test anxiety by students [8].

Our study found no gender differences in previous IT exposure of the students. Gender differences in exposure, attitude and use of ICT had been observed in many studies.[19–22]. However, our subjects, being final-year medical students undergoing longer schooling duration that most other undergraduates, have more opportunities to acquire ICT exposure and skills as there have been increased emphasis on the use of ICT tools for teaching and learning in our institution. A study among academicians in a Malaysian university noted a narrowing of the gender gap in ICT skills and in certain applications, the competencies of the females exceeded those of males [23].

However, despite no difference in previous IT exposure, the male students significantly found CBA easier to handle than PPT when compared with their female counterparts. Similarly, more males agree that CBA reflects objectively the student's performance when compared with females and the acceptance of the results of the CBA. Several studies

had found significant gender effect on the use and acceptance of CBA [10,24,25]. Similarly, Balogun and Olanrewaju [8] in their study of Nigerian undergraduates demonstrated that female students develop increased levels of CBA induced anxiety when compared with males.

The students recognised several challenges militating against the use of CBA in a resource poor country like Nigeria. These include adequate technical support skills, inadequate power supply, and security and integrity of the examination concerns. Some of these challenges had been highlighted by Abubakar and Adebayo [7] in their review.

In conclusion, our pilot testing of a CBA in a clinical environment of an African medical school was well received by the students. Some of the advantages and disadvantages were highlighted by the students. Computer based assessment could therefore be an additional method of evaluation of medical students in a low resource environment. Further studies could include the validity of a CBA when compared with the traditional pen and paper testing.

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