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# A comparative study of students' performance in preclinical physiology assessed by multiple choice and short essay questions

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**Summary**
This study was designed to compare the performance of medical students in physiology when assessed by multiple choice questions (MCQs) and short essay questions (SEQs). The study also examined the influence of factors such as age, sex, O/level grades and JAMB scores on performance in the MCQs and SEQs. A structured questionnaire was administered to 264 medical students' four months before the Part I MBBS examination. Apart from personal data of each student, the questionnaire sought information on the JAMB scores and GCE O' Level grades of each student in English Language, Biology, Chemistry, Physics and Mathematics. The physiology syllabus was divided into five parts and the students were administered separate examinations (tests) on each part. Each test consisted of MCQs and SEQs. The performance in MCQs and SEQs were compared. Also, the effects of JAMB scores and GCE O/level grades on the performance in both the MCQs and SEQs were assessed. The results showed that the students performed better in all MCQ tests than in the SEQs. JAMB scores and O' level English Language grade had no significant effect on students' performance in MCQs and SEQs. However O' level grades in Biology, Chemistry, Physics and Mathematics had significant effects on performance in MCQs and SEQs. Inadequate knowledge of physiology and inability to present information in a logical sequence are believed to be major factors contributing to the poorer performance in the SEQs compared with MCQs. In view of the finding of significant association between performance in MCQs and SEQs and GCE O/level grades in science subjects and mathematics, it was recommended that both JAMB results and the GCE results in the four O/level subjects above may be considered when selecting candidates for admission into the medical schools.

**Keywords:** *Pre-clinical physiology, multiple choice questions, short essay questions, JAMB score, GCE O' Level results*

**Résumé**
Cette étude a été faite pour comparer la performance des étuliants (en médecine) en physiologie lorsgri ils sont testies par questions á choix multiples (QCM) et les courtes dissentation (CD). L'étude examine aussi l'influence des facteurs tels que l'age, le sex, lesgrades du O/level et les scores du JAMB sur la performance de QCM et CD. Un Questionnaire structuré était administré á 264 cétudiants en médecine quatre mois avant l'examen de premiére année (MBBS). En dehors des information personnelles de chaque étudiant, le questionaire recherchait les informations sur les scores du JAMB et les grade en Anglais,Biologic, Chimie, Physique et Mathématiques du GCE O/Level de chaque étudiant. Le programme de physiologie était divisé en cing parties et les tests étaient administés séparément sur chaque partie. Chaque devoir consistait de QCM et CD. Les performances en QCM et CD étaient comparisés. Aussi, l'effet des scores du JAMB et les grades du GCE\Olevel sur la performance á la fois de QCM et CD étaient considérés. Les résultats montrent que les étudiants ont une bonne performance sur tous les devoirs de QCM que cenx de CD. Les scores du JAMB et la lonque Anglaise an O'Level n'ont anum effet significatif sur la performance des étudiants en QCM et CD. Cependant les grandis de Biologie, Chimie, Physique et Mathématiques an O' level ont un effet significatif sur les QCM et CD. Les connaissances inadequates en physiologie et l'inabilité de présenter les informations en séquence logique sont la canse majenre des facteurs contribuant á la paurre performance en CD comparé á QCM. En vue du role de l'association trés significative entre performance en QCM et CD et les grades ddu O'Level sur les matiéres scientifiques et les mathématiques, il a été recommendé que les résultats du JAMB et de GCE en quatre matiéres du O'Level ci-dessus pent cêtre considés lors de la selection des candidats pour l'admission dans les ecoles de médecine.

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## Introduction

During the last four decades, examining methods in medical faculties and in other faculties of many universities have been subjected to increase scrutiny [1]. The traditional "long essays" mode of examination has been found to suffer from several defects [2-4]. Some of these defects are that long essays test only limited area of the subject, they consume excessive time in assessment especially, with large students' enrollment, scores obtained are highly dependent on the examiners' subjective judgement and there is poor correlation between marks awarded by different examiners for the same essays. Attempts to solve these problems led to using an increased number of questions as short essays or questions requiring only brief answers. Even then, the problem of examiners' subjective judgement remained unsolved. In an attempt to solve the essay-associated problems, multiple choice item examinations were introduced and are now widely used in several medical schools in the world. They have been found to be an objective method of grading examinations at all levels, from primary school to higher degree standard, including professional examinations [5,6,7].

In an extensive search of the literature, there were only three publications that reported the comparative performance of medical students in multiple choice and short essay type of questions in preclinical physiology [6,8,9]. Besides, only one of these publications [8] investigated the reasons for the differential performance in

multiple choice and essay test. The "reasons" assessed were however limited to personal characteristics of the students. Also the study by Hettiaratchi [9] used "special" MCQs of the true and false type, which were specially constructed to reflect the expected answers to the SEQs earlier administered to the students. It is also conceivable that apart from the personal characteristics of the students and their study habits, other variables may influence the students' achievement [10].

In view of the dearth of information in the literature comparing MCQs and SEQs, the present study was designed to compare the performance of medical students in physiology when assessed by multiple choice questions (MCQs) and short essay questions (SEQs). This study will also examine the influence of some factors such as age, sex, O/level grades, Joint Admissions and Matriculation Board scores (in Nigeria) on their performance in MCQs and short essays.

## Materials and methods

The study was carried out three months before the Part I MBBS examination at the University of Ibadan Medical School. It involved the entire class of 313 medical students who were preparing for their first professional examination in basic medical science subjects of Anatomy, Physiology and Biochemistry in the 1995/96 session. The study consisted of two parts: (a) a questionnaire which was completed by each of the students and (b) five continuous assessment tests, details of which are given below. The students willingly completed the questionnaires. All the tests were taken by the students as part of their normal course work (these are the continuous assessment tests).

The questionnaire sought information on each student's matriculation number, age, sex, and their O/level results in English Language, Biology, Chemistry, Physics and Mathematics. A minimum of GCE O' Level credits (or its equivalent) in these subjects are pre-requisites for entry into the medical school at the University of Ibadan. The students were required to state their mode of entry, whether it is via Joint Admissions & Matriculation Board (JAMB) examination or by direct entry (A/levels or holders of first degree). Students were also required to state whether they were repeating or not. Finally, the students were asked to indicate which of the textbooks of Physiology that is available in the Nigerian bookshops they read on a regular basis.

In the written examination part of the study, which was part of the normal continuous assessment of the students, the body systems taught in Physiology were divided into five groups; blood, cardiovascular system and respiration; peripheral nervous system and muscle; central nervous system and special senses; gastro-intestinal system, renals and body fluids; endocrines and reproduction. After the test on blood, cardiovascular system and respiration, the remaining four groups mentioned above were examined at 3-week intervals over a period of 3 months. This was allow the students adequate time to prepare for each test. Each test consists of two parts: a multiple choice questions (MCQs) part and a short essay questions (SEQs) part. Each MCQ test consists of 10 questions, of the True and False type, each question requiring the students to make five decisions. The questions are the same pattern as those used in the MBBS/BDS Part I examinations and are similar to those published by Bindman, Jewell and Smaje [11]. The short essays consist of three questions. All MCQs and SEQs on a particular date were based on the systems to be examined as earlier advertised. The students were required to answer all questions in both parts of the examination. The MCQs and SEQs used in this study were of the same level of difficulty and validity as those used in our Part I MBBS examination. Each part was assessed separately and the scores were expressed, as per cent of the total marks obtainable. In accordance with the instruction to candidates on the MCQ examination papers, the MCQs were marked by scoring plus 1 for every true or false statement correctly identified by the student, zero for responses left blank which, according to the instructions on the question papers will be interpreted as "don't know" or "am unwilling to commit myself" and minus ½ for incorrect responses. The scores for each student in all the tests were transferred to spaces already provided for these on the questionnaire earlier completed by each student. Students who missed any of the tests and those who did not complete the questionnaires were excluded from the final analysis. The information provided in the questionnaire and the scores in all the tests for each student were transferred into the computer.

The summary statistics (mean ± SD) of scores in the MCQs and SEQs were computed and the significance of the difference in performance in the MCQs and SEQs observed was assessed. The performance of the students in each part of the tests was cross-tabulated against each of the variables such as age, sex, O/Level results and JAMB scores and a statistical test of significance on the associations was carried out [10]. p values of 0.05 or less were taken as statistically significant.

**Table1:** Mean scores percent (± SD) in five MCQ and five SEQ tests, n = 264

| | Test 1 | Test 2 | Test 3 | Test 4 | Test 5 |
|---|---|---|---|---|---|
| MCQ Score: Mean | 48.31 | 63.02 | 51.88 | 55.37 | 56.67 |
| | ± | ± | ± | ± | ± |
| S.D. | 11.24 | 13.06 | 9.93 | 14.44 | 13.69 |
| SEQ Score: Mean | 36.87 | 41.69 | 42.77 | 43.71 | 41.45 |
| S.D. | ± | ± | ± | ± | ± |
| | 9.79 | 10.63 | 10.01 | 9.15 | 9.45 |

*Note: In Table 1 all MCQ scores were significantly higher than all SEQ scores (P < 0.05).*

## Results

Out of the 313 students in the class, only 264 students completed the questionnaire adequately and did not miss any of the tests. The remaining 49 students, who either did not complete the questionnaire adequately and/or missed one or more tests were excluded from the study because of incomplete data. Thus, data from the 264 students, consisting of 176 males and 86 females that completed the questionnaire adequately and did not miss any of the tests, were used during the analysis of results. The students were aged 18 – 33 years, with a mean age of 21.75 (± 3.16) years.

**Table 2:** Correlation of Grades in GCE O/level subjects and performance in MCQ tests, $T_1M$ to $T_5M$ n = 264.

| GCE Sub | $T_1M$ | $T_2M$ | $T_3M$ | $T_4M$ | $T_5M$ | Average |
|---|---|---|---|---|---|---|
| Eng. Lang. | -0.0146 | 0.0028 | 0.0998 | -0.0664 | 0.1344 | 0.0431 |
| Biology | 0.1676* | 0.1242 | 0.1547 | 0.1407 | 0.1150 | 0.2136* |
| Chemistry | 0.1096 | 0.1526 | 0.0945 | 0.1818* | 0.1915* | 0.2324* |
| Physics | 0.2303* | 0.1715* | -0.0344 | 0.2067* | 0.1985* | 0.2516* |
| Maths. | 0.0538 | 0.1227 | -0.0186 | 0.0402 | 0.1646* | 0.1199 |

* = *significant at 1% level*

**Table 3:** Correlation of grades in GCE O/level subjects and performance in SEQ tests, $T_1E$ to $T_5E$, n = 264

| GCE Subjects | $T_1E$ | $T_2E$ | $T_3E$ | $T_4E$ | $T_5E$ | Average |
|---|---|---|---|---|---|---|
| Eng. Lang | -0.0127 | 0.1324 | 0.0242 | 0.0842 | 0.1167 | 0.0953 |
| Biology | 0.2041* | 0.1451 | 0.2587* | 0.2121* | 0.2814* | 0.3011* |
| Chemistry | 0.1764* | 0.1632* | 0.1326 | 0.1365 | 0.1761* | 0.2162* |
| Physics | 0.2177* | 0.1334 | 0.2079* | 0.2059* | 0.1943* | 0.2625* |
| Maths | 0.1288 | 0.1468 | 0.1601* | 0.1588* | 0.1437 | 0.2031* |

* = *significant at 1% level*

**Table 4:** Correlation of grades in GCE O/level subjects and performance in combined MCQ and SEQ tests, 1 to 5, n = 264.

| GCE Subjects | 1 | 2 | 3 | 4 | 5 | Average |
|---|---|---|---|---|---|---|
| Eng. Lang | -0.0088 | 0.0514 | 0.0955 | -0.0543 | 0.1658* | 0.0680 |
| Biology | 0.1942* | 0.1609* | 0.2447* | 0.1994* | 0.1795* | 0.2782* |
| Chemistry | 0.1412 | 0.1854* | 0.1359 | 0.1979* | 0.2099* | 0.2546* |
| Physics | 0.2734* | 0.2001* | 0.0546 | 0.2629* | 0.2233* | 0.3025* |
| Maths | 0.0906 | 0.1450 | 0.0420 | 0.0775 | 0.1859 | 0.1606* |

* = *significant at 1% level*

The results of the tests are shown in Tables 1 to 4. The scores in the MCQs and SEQs are shown in Table 1. Table 1 shows that the performance of the students in all the MCQs tests was significantly better than their performance in all the SEQ tests ($P < 0.05$). Even, the lowest mean score in the test (Test 1) was significantly higher than the highest mean score in any of the SEQ tests.

The correlation coefficient of the average score in all the MCQ tests and average score in all the essay type tests is highly significant at the 1% level. This result suggests that those students doing well in the MCQ tests are more likely to do well in essay type tests.

Tables 2, 3 and 4 show the correlation between the grades obtained in GCE ordinary level subjects and MCQ, SEQ and combined MCQ and SEQ results, respectively. Table 2 shows that the GCE O/level grades in biology, chemistry and physics are significantly correlated with the overall performance in MCQs ($P = 0.001$), where GCE grades in English Language and Mathematics had no statistically significant effects. Table 3 shows that the GCE O/level grades in Biology, Chemistry, Physics and Mathematics significantly correlated with the students' performance in SEQs ($P < 0.001$). Table 4 shows that when MCQ and SEQ results are combined, GCE O' level grades in Biology, Chemistry, Physics and Mathematics statistically significantly correlate with the overall performance of the students; the first three subjects being more strongly significant in their effect ($P = 0.001$) than mathematics ($P = 0.01$). English language has no significant effect on students' overall performance.

Statistical analysis of the test results against the other variables showed that age, gender and whether a student is repeating or not repeating had no significant effect on performance in both MCQ and essay tests. Also, JAMB scores had no significant effect on average scores in MCQ and essay tests in all the candidates taken together. However, JAMB scores had a significant effect on the average score in MCQ tests for males but not for females. JAMB score had no significant effect on average scores in essay tests in both males and females.

## Discussion

The results of the present study have shown that performance of our students in MCQs is much better than their performance in SEQs when the two formats of tests were administered simultaneously to the students. The present result is similar to those of McClosky and Holland [12] who reported a better performance in MCQs than in essays when cues are not provided to the essays. However, the performance in MCQs is similar to the performance in essays where cues are deliberately provided [12]. This suggests, according to them, that a substantial amount of cues is provided to the correct answers in the MCQ format. Also, Hettiaratchi [9], in a study carried out in the Kenya Medical School, noted that some element of "recognition" plays a significant part in answering MCQs. Since no cues were provided to the essays in our study, it is reasonable to suggest that inadequate knowledge of the subject is a major factor in the poorer performance of our students in SEQs compared with MCQs. In addition, the ability to organise facts in a logical sequence and present them in well-written English is essential to a satisfactory performance in short or long essays. Inadequacy in the latter respect on the part of our students may well be an additional reason for the poorer performance in SEQs in the present study.

Huxham, Lipton and Hamilton [8] reported that students whose first language was not English did not fare well in MCQs compared with essay questions. The reason adduced for this was poor understanding of English Language. Although English is not the first language of our students, their better performance in MCQs compared with SEQs suggested that English language was not a handicap to our students.

The finding that the performance in the first test was the lowest both for MCQs and SEQs but improved in subsequent tests is similar to that reported by Lipton and Huxman [6]. It is probable that the students' performance in the first test was affected by inexperience in handling this type of test. In addition, in the present study, the result of an earlier test is usually released before the next test. Since the students are aware that their results in these tests constitute 30% of the final marks in the Part I MBBS examination, it is likely that a poor performance in an earlier test will stimulate the students to work harder for subsequent tests so as to improve on their performance.

Our results have shown that JAMB results, which are used solely at present in determining eligibility for admission into Nigerian universities (including the medical schools), have no effect on the performance of the students in preclinical physiology. The finding in respect of JAMB scores is similar to the report of Nwoha [14] on student's performance in an anatomy examination at the Obafemi Awolowo University, Ile-Ife. On the other hand GCE O' level grades in Biology, Chemistry, Physics and Mathematics, which are of present not even considered in determining eligibility for admission into medical schools, affect significantly the academic achievement of the students. In other words, the grades in these four O' level subjects, especially the first three, can be used as a predictor of the likely academic performance in the university of the students seeking admission into the medical school. On the basis of the present result, we suggest that both JAMB scores and GCE O' level grades in the above-mentioned subjects should be used in the selection of students into the medical school. Where there is gross disparity between JAMB score and GCE O' level grades, the latter should be given greater emphasis. In addition, our experience with the students suggests that achievement of students in the University most probably depends on the seriousness of the students as judged by regular attendance at lectures, practicals, tutorials, possession of relevant textbook(s) and devotion of adequate time to study. This is consistent with the view of Savage (1972) [15] who pointed out that apart from the minimal entry requirements into medical schools, other factors such as methods of examination, personality of the students and their study habits become increasingly important in the differential performance of students once they have been admitted.

Most of the students read Review of Medical Physiology by W. G. Ganong as their main textbook and only use other books to supplement when necessary. It was therefore not possible to assess the effect of textbooks used by the students on their performances. Also, only 6 students were admitted by direct entry. The remaining 258 were via JAMB. The effect of mode of entry on performance could therefore not be assessed.

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## References

1. Hubbard, JP and Clemans WV. In: Multiple Choice Examination in Medicine. Kimpton, London, 1961.
2. Bull, GM. An examination of the final examination in Medicine. Lancet 1956; 2: 368-372.
3. Lennox B, Anderson JR. and Moorhouse P. A comparative trial of objective papers and essay papers in pathology and bacteriology class examinations. Lancet 1957; 2: 396-402.
4. Nunnaliv, JC. In: Educational measurement and evaluation. Chapter 6, McGraw-Hill, New York, 1964.
5. Owens, SG., Robson, MG., Sanderson, PH. Smart, GA. and Stokes, JR. Experience of Multiple Choice Question Examination for Part I of the M.R.C.P. Lancet 1967; 2: 1034-1038.
6. Lipton, A. and Huxham, GJ. Comparison of multiple choice and essay testing in preclinical physiology. Br J Med Educ 1970; 4: 228-238.
7. Thorndike, RL. In: Educational measurement (second edition). Chapters 2-8. American Council on Education, Washington, DC. (1971).
8. Huxham, GJ. Lipton A. and Hamilton, D. Reasons for differential performance in multiple choice and essay tests. Br J Med Educ 1975; 9: 264-272.

9. Hettiaratchi, ESG. A comparison of student performance in two parallel physiology tests in multiple choice and short answer forms. Med Educ 1978; 12: 209-296.
10. Oyebola, Moji, Fasanmade, AA. and Oyebola, DDO. Factors influencing the academic environment of medical students in the basic medical sciences. Afr J Med & med Sci 1992; 21: 29-34.
11. Bindman L; Jewell, B. & Smaje, L. Multiple choice questions in physiology. Edward Arnold, London, 1978.
12. McCloskey, DI. and Holland, RAB. A comparison of student performance in answering essay-type and multiple choice questions. Med Educ 1976; 10: 382-387.
13. Harden, R., Brown, R. A. Biran, L. A.; Dallas Ross, W. P. & Wakeford, R.E. Multiple choice questions: to guess or not to guess. Med Educ 1976; 10: 27-35.
14. Nwoha, P.U. Student's attitude and predictor of performance in anatomy. Afr J Med med Sci 1992; 21: 41-45.
15. Savage, R. D. An explanatory study in individual characteristics associated with attainment in medical school. Brit J Med Educ 1972; 6: 68-77.