

Evaluation Of Students' Performance In Written Examination In Medical Pharmacology

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Abstract:

We retrospectively analyzed the results of 1243 written examination papers of students taking three courses in medical pharmacology. the examination paper consisted of two parts: part I was made up of multiple choice questions (MCQs), matching (match) and short answer questions (SA), while part II was made up of essay questions. The overall failure rates for courses I, II and III were 31%, 36.4% and 31.2% respectively. In the three courses around 12% of students obtained high grades (A and B), whereas 55% had low grades (C and D). IN course I, 1.8% of students obtained grade A, 13.1% grade B , 22.6% grade C and 32.1% grade D . Corresponding results in course II were 1.9%, 9.6%, 20% and 32.1% and in course III, 1.3%, 8.6% , 22.8% and 36.1% respectively.

Female students generally performed on a par with males in overall score except in course II, where male students performed slightly better than females in overall score, MCQs, and matching questions. The comparison of grades and failure rates in parts I and II of the examination of the three courses showed that less than 1% of students scored A grade in part II while 2.5 to 5.4% did so in part I. The failure rates in the two parts were 30% to 35% in part I and 45% to 63% in part II. In all the courses high correlation were linked to students performance in MCQ, short answer and matching questions while low correlation was demonstrated for essay questions.

MCQ, matching and short answer questions had lower failure rates and demonstrated an acceptable degree of correlation between them. essay questions had higher failure rate and showed poor correlation with other components of the examination. It is recommended that essay questions should be substituted (or a minimal use of them should be made) with objective types of questions like mcq , matching questions, and short answers.

Introduction

There has been a lot of discussion in the literature regarding reliability, validity and practicability of the various methods used to evaluate the knowledge of students. The age-old method of essay writing has gradually been disappearing because of various reasons such as low levels of reliability, and generalizability (Tombleson, 1990). Robinowitz and Hojat, (1989), reported that essay questions had the lowest correlation with overall performance when compared with multiple choice questions or clinical examination. Similar findings are also reported by McCloskey and Holland, (1976) while comparing essays with multiple choice questions. The objectively structured short answer questions have recently been introduced and a greater use of this question format has been recommended by Huxham et al., (1975). Not many medical schools have initiated systematic and scientific investigation into the nature and evaluation of their examination methods. By conducting a retrospective study, we have made a humble effort to assess and analyze students' performance in different types of questions in various courses of Medical Pharmacology. We also tried to find out the correlation between examination components and the students' score. In addition, the performance of male and female students was compared.

Pharmacology is offered in College of Medicine, King Faisal University in three courses at the third, fourth and fifth levels. Course I, basic pharmacology, is offered at the third level. Three lectures and one laboratory session per week are given for 16 weeks (one semester). The course contents include general pharmacology, autonomic pharmacology, autocoid pharmacology, antimicrobial and antiparasitic drugs. Course evaluation was carried out by a mid-course and a final written examination. An oral examination is given for the laboratory work.

Course II, systemic pharmacology, is offered at the fourth level and deals with the pharmacology of the cardiovascular, respiratory, endocrine, gastrointestinal, central nervous systems and chemotherapy of malignancy. Three lectures are given per week for a semester. Student evaluation consists of a mid-course and a final written examination.

Courses I and II are taken during preclinical years, where the students have taken anatomy, physiology and biochemistry and are taking simultaneously with pathology and microbiology.

Course III, clinical pharmacology, is offered to fifth year students during the clinical years. Two hours of didactic lectures per week and two weeks clinical clerkship are given for a semester. It deals with toxicology and the application of drugs in various disease conditions. The students take a mid-course, a final written, as well as an oral examination at the end of the clinical clerkship.

In courses II and III, male and female students are taught separately but by the same teacher. However, in course I, male students are taught by male teachers and female students by a female teacher. In all the courses male and female students are given the same examination paper.

Methods:

A retrospective analysis study of 1243 examination results of written papers of students taking the three different courses in Medical Pharmacology, College of Medicine, King Faisal University, was carried out. These examinations were conducted from 1990 to 1993. The written examination papers in all the courses are composed of the following:

Part I carries 80% of the total marks and consists of (I) single best response type of multiple-choice questions (MCQs): 40 questions in courses I and II, and 30 questions in course III; 1 mark was assigned for each correct answer (total 40 marks in courses I and II and 30 marks in course III). There was no negative marking. (II) matching (Match): 40 matching questions, each for 0.5 mark (total 20 marks); and (III) short answer questions (SA): 15 questions of 2 marks each (total 30 marks). This sums to 80 marks for part I in course III. However, it sums to 90 in courses I and II from which, 80 marks were computed for the total score.

Part II carries 20% of the total marks and consists of 2 essay questions of 10 marks each. In order to have uniformity in grading, short answers and essays were graded by one faculty member. Thus the written examination consisted of 80% for part I and 20% for part II.

The passing grade was an aggregate of 60% or more. The grading scheme was as follows: A = 90% or more, B = 80%-89%, C = 70%-79%, D = 60%-69% and F below 60%.

Data analysis and statistical methods

All the scores were entered into a computer and analyzed statistically by t-test and chi-square where appropriate. Correlation coefficient between different examination components were estimated using Pearson's product moment method. In all analyses a p-value of less than 0.05 was considered statistically significant.

Results

The written examination results of 1243 students were analyzed. The results of each course were evaluated separately. Tables 1-A, B, C for course I, II and III, respectively show students' performance in the various components of the examination papers .

In course I (Table 1-A), the analysis shows that 15% of students were graded B and above while over 54% of them graded C and D. The percentage of failure was 31. Comparison of grades obtained in parts I and II shows that a larger percentage of students failed in part II than part I (62.9% vs. 30%, respectively). A lower percentage of students achieved high grades in part II. About 7.7% of students obtained grades B and above and 29.4% obtained grades C and D. In contrast, in part I, 18% of students obtained grades B and above while 52% of them obtained C and D. These differences in grades in the two parts of the examination were statistically significant ($p = 0.0001$, chi-square).

A similar trend was observed in the analysis of the results in course II (Table 1-B). About 12% of students obtained grades B and above, while 52% of them obtained low grades (C and D). The percentage of failure was 36.4%. Comparison of grades obtained in part I and II shows that a larger percentage of students failed in part II than part I (60% vs. 35%, respectively). A lower percentage of students obtained high grades in part II. For instance 7% of students obtained grades B and above while 33.7% obtained C and D. In contrast, in part I, 15% of students obtained grades B and above while 49.6% of them obtained C and D. These differences in

grades in the two parts of the examination were statistically significant (p value = 0.0001).

In course III (Table 1-C), about 10% of students obtained grades B and above while 59% of them got low grades (C and D). The percentage of failure was 31. Comparison of grades obtained in parts I and II shows that a larger percentage of students failed in part II than part I (45% vs. 33%, respectively). In part II less than 13% of students obtained high grades B and above while 42% had grades C and D. In contrast, in part I, 13% of students obtained high grades B and above while 54% of them obtained grades (C and D). These differences in grades in the two parts of the examination were statistically significant (p value = 0.0001).

The results of analyses of students' scores in the three courses show that female students generally performed on a par with males in overall score except in course II, where male students performed slightly better than females in the overall score, MCQs, and matching questions (Table 2).

The correlation of various examination components (Table 3) shows that highest correlation was linked to MCQ. A low, though significant correlation was observed for essays. Among male students in course I, MCQ results correlated highly with short answer questions (0.69; p value = 0.0001) and matching questions (0.60; p -value = 0.0001) whereas its correlation with essays was only 0.45. A similar pattern was observed for female students.

Similarly among male students in course II highest correlation was found between MCQ and matching (0.71), short answer (0.60) and least with essays (0.45). As in course I, short answers correlated highly with matching (0.64) and MCQ (0.60) and least with essay (0.57). For females, a similar trend was observed. The same pattern was observed in course III.

Discussion:

Assessment of various evaluation procedures is as important task as teaching students. Medical teachers can no longer fulfill their educational responsibilities adequately without more knowledge than most now have of the criteria by which they can select from the increasing varied array of

evaluation tools. The results of this study clearly showed that grades were not uniformly distributed. A considerable number of students (over 50%) scored C and D, while only a small proportion (15%) achieved grades A and B. There was also a rather high failure rate in the three courses.

In this analysis the correlation between the various components of the examination paper demonstrated an acceptable degree of concordance between some components. MCQs correlated highest with all the other components of the examination. These data are in good agreement with previously reported findings from this University (Lugman and Ibrahim ,1987) and other institutions (Robinowitz and Hojat ,1989; Robinowitz ,1987; Ramsey et al., 1986; Edelstein et al., 2000). McCloskey and Holland ,(1976) have shown that students' performance was better in MCQ and in cued essay questions than in uncued essay questions. All this bore out the known objectivity of this evaluation tool (Hubbard ,1978; Daniel ,1987). However, to enhance or at least maintain its high discriminatory function, MCQs should be regularly subjected to psychometric analyses which consist of item analysis, reliability and validity testing (Schumacher ,1978a & 1978b).

Matching questions possess a reasonably high degree of correlation with MCQs and short answer questions. This is confirmed by our current findings. The reliability of matching questions has been shown by Fenderson et al., (1997). These types of questions were found to be able to discriminate between well prepared from marginal students; and are well suited for testing core knowledge (Fenderson et al.,1997 ;Blackwell et al.,1991).

A structured short answer question can test knowledge, assess problem solving ability and has the advantage that candidates construct their own answers, yet encourage sufficient precision for answers to be easily marked. The advantages of short answer questions over MCQs (Hettiaratchi ,1978) and the recommendations to make greater use of them in medical schools have been suggested in some reports (Wakeford and Robert ,1984; Webber ,1992). Evidence published in the literature suggests that the reliability of short essay questions (10 minutes) may be higher (Hettiaratchi ,1978). This type of questions may have a useful role in a broadly based examination system. Our experience is that short answer

questions can be set to cover a wider area of the subject and test the in-depth knowledge of students better than essays, which tend to be limited in their scope. This is confirmed by our analysis in this study where students' performance in short answers was better than in essays and correlated highly with the objective types of questions like MCQ and matching questions .

Although long essay questions have been shown generally to have a low inter examiner reliability, they are still much used in undergraduate medical examinations. Evidently because examiners feel that essays have greater inherent validity than some of the modern objective techniques like MCQs (Wakeford and Robert ,1979). In spite of the fact that the problem oriented essay questions in course III were answered better by the students, the failure rate in this part of paper was still high (45.3%), when compared with part I (33.2%). The failure rate in part II in course III was lower than courses I & II. This, probably, reflects more maturity and a better grasp of the subject by the students at this level. The poor reliability and validity of essay questions is well known (Tombleson ,1990; Wakeford and Robert ,1979) and this has been confirmed by our current study where essay questions correlated least with other components of the examination paper. In addition to the factors mentioned above, some other factors not in favor of essays are: idiosyncratic behaviors of the examiners in the distribution of marks awarded for essays, the language problem, emotional maturity of the students, poor and illegible handwriting, etc (Wakeford and Robert ,1979). These have led to significant differences in performance of students in MCQ and essays (Huxham et al.,1975). Psychometric studies of essays were shown to have unacceptably low level of reliability and generalizability and furthermore factor analysis showed that the papers perceived functions could not be supported statistically, therefore they these were replaced by MCQs (Tombleson ,1990). When modified essay questions were compared with MCQ format on similar material content, MCQ performance was found to be a better predictor of score in American National Board I and II examinations (Robinowitz ,1987). The National Board of Medical examiners of the United States has converted the essay portion of evaluation to MCQs (Schumacher ,1978a)

In conclusion, MCQ, matching and short answer questions are more objective and give a better insight into the students' understanding and application of knowledge. They also demonstrate an acceptable degree of concordance between them. We, therefore, recommend making greater use of them in the undergraduate medical examinations. Essay questions have low inter examiner reliability, higher failure rate and poor validity. Furthermore, they correlate poorly with other components of the examination. These findings strongly indicate a need for change. We suggest that essays should be substituted with objective types of questions like MCQ, matching questions, and short answers or a minimal use should be made of this examination component. We wait with interest the experience of others on this subject from other medical schools both within and outside the Kingdom.

Table 1-A (Course I)
Students' performance in the various components of the examination
n = 496

Exam components	Students grades (No) %					% Pass
	A	B	C	D	F	
Part I:						
MCQ	(31) 6.3	(79) 15.9	(126) 25.4	(112) 22.6	(148) 29.8	70.2
Match	(79) 15.9	(101) 20.4	(108) 21.8	(103) 20.7	(105) 21.2	78.8
SA	(28) 5.6	(57) 11.8	(71) 14.3	(66) 13.3	(274) 55	45
Total Part I	(26) 5.2	(64) 12.9	(120) 24.2	(137) 27.6	(149) 30	70
PartII: Essays	(3) 0.6	(35) 7.1	(84) 16.9	(62) 12.5	(312) 62.9	37.1
*P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Total (Parts I + II)	(9) 1.8	(65) 13.1	(109) 22	(159) 32.1	(154) 31	69

MCQ= Multiple choice questions

Match= Matching questions

SA= Short answer questions

* Comparison between Parts I and II (t-test)

Table 1-B (Course II)
Students' performance in the various components of the examination
n = 365

Exam components	Students grades (No) %					% Pass
	A	B	C	D	F	
Part I:						
MCQ	(22) 6	(54) 14.8	(90) 24.7	(94) 25.8	(105) 28.8	71.3
Match	(31) 8.5	(46) 12.6	(667) 18.4	(72) 19.7	(149) 40.8	59.2
SA	(15) 4.1	(42) 11.5	(73) 20	(58) 15.9	(177) 48.5	51.5
Total Part I	(12) 3.3	(44) 12.1	(76) 20.8	(105) 28.8	(128) 35	65.0
PartII:						
Essays	(2) 0.45	(23) 6.3	(62) 17	(61) 16.7	(217) 59.5	40.5
*P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Total (Parts I + II)	(7) 1.9	(35) 9.6	(73) 20	(117) 32.1	(133) 36.4	63.6

MCQ = multiple choice questions

Match= matching questions

SA= short answer questions

*Comparison between Parts I and II (t- test)

Table 1-C
(Course III)

Students' performance in the various components of the examination
n =382

Exam components	Students grades (No) %					% Pass
	A	B	C	D	F	
Part I:						
MCQ	(13) 3.4	(34) 8.9	(69) 18	(82) 21.5	(184) 48.2	51.8
Match	(36) 9.4	(66)17.3	(108)28.3	(69) 18.1	(103) 27	73.0
SA	(14) 3.7	(56) 14.7	(81) 21.2	(74) 19.4	(157) 41	59.0
Total Part I	(9) 2.4	(39) 10.2	(81) 21.2	(126) 33	(127) 33.2	66.8
PartII:						
Essays	(3) 0.78	(45) 11.8	(84) 22	(77) 20.2	(173) 45.3	54.7
*P value	0.0001	0.017	0.033	0.0001	0.0035	0.0001
Total (Parts I + II)	(5) 1.3	(33) 8.6	(87) 22.8	(138)36.1	(119) 31.2	68.8

MCQ= Multiple choice questions

Match= Matching questions

SA= short answer questions

* Comparison between parts I and II (t- test)

Table(2)
Distribution of Students' performance in different examination
components according to gender

Course No.	Gender	No. of Students	Students' Score (Mean \pm SD)					
			Part I (80 marks)				Part II (20 arks)	Total score Parts I+II 100
			MCQ	Match	SA	Total	Essay	
I	M	307	27.5 \pm 5.2	14.7 \pm 3.1	18 \pm 4.8	53.5 ^T \pm 10	12 \pm 3.1	66 \pm 12
	F	189	27.1 \pm 5.6	14.2 \pm 0.3	19.9 \pm 5.3	54.4 ^T \pm 11	11.8 \pm 3.2	66 \pm 13
	P value		0.26	0.33	0.08	0.10	0.60	0.
II	M	225	27.4 \pm 5.2	13.2 \pm 3.2	19.0 \pm 4.9	53 ^T \pm 10	11.7 \pm 3.1	65 \pm 15
	F	140	26 \pm 6.0	12.3 \pm 3.6	18.1 \pm 5.7	50 ^T \pm 13	11.9 \pm 3.6	62 \pm 9
	P value		0.04*	0.10	0.03*	0.02	0.04*	>0.01- <0.05
III	M	221	18.4 \pm 4.1	13.6 \pm 2.8	19.3 \pm 4.1	51.3 \pm 9	12.5 \pm 2.6	64 \pm 10
	F	161	19.1 \pm 4.3	14.2 \pm 3.1	20.2 \pm 4.6	53.5 \pm 11	13.4 \pm 2.8	67 \pm 12
	P value		0.41	0.16	0.07	.005	0.11	0.5

^T=Values weighed out of 80

MCQ = multiple choice questions

Match= matching questions

SA= short answer questions

Table 3
Correlation between student scores in different
examination components

Course no.	Gender	MCQ	Match	SA	Essay	
I	M		.601*	.694*	.445*	
			.601*	.654*	.408*	
			.694*	.654*	.602*	
	F		.445*	.408*	.602*	
			.632*	.632*	.721*	.477*
			.632*	.608*	.608*	.436*
II	M		.716*	.601*	.445*	
			.716*	.637*	.418*	
			.601*	.636*	.544*	
	F		.445*	.419*	.574*	
			.744*	.744*	.786*	.516*
			.744*	.747*	.747*	.544*
III	M		.786*	.747*	.623*	
			.516*	.544*	.623*	
			.554*	.554*	.472*	.270*
	F		.472*	.472*	.472*	.347*
			.270*	.347*	.307*	.307*
			.642*	.642*	.628*	.469*
		.642*	.661*	.661*	.547*	
		.628*	.661*		.461*	
		.469*	.547*	.461*		

* =P value 0.0001(chi-square)

MCQ= multiple choice questions

Match= matching questions

SA= short answer questions

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تقويم أداء الطلاب في الامتحان التحريري في مادة علم الأدوية الطبي

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الملخص :

قمنا بدراسة تحليلية سابقة لنتائج ١٢٤٣ ورقة امتحانات تحريرية لطلاب درسوا ثلاث مقررات في مادة علم الأدوية الطبي. تتكون ورقة الامتحان من جزأين : الجزء الأول يتكون من أسئلة ذات الخيارات المتعددة وأسئلة الخيارات المتطابقة وأسئلة الإجابات القصيرة. أما الجزء الثاني فيتكون من الأسئلة المقالية. المعدل العام للرسوب في المادة رقم ١ ، ٢ ، ٣ كان : ٣١ ، ٣٦.٤ ، ٣١.٢ % على التوالي. في الثلاث مقررات حوالي ١٢ % من الطلاب حصلوا على تقديرات عالية (أ ، ب) بينما ٥٥ % حصلوا على تقديرات منخفضة (ج ، د) ففي المقرر رقم (١) ١.٨ % من الطلاب حصلوا على تقدير (أ) ، ١٣.١ % تقدير (ب) ، ٢٢.٦ % تقدير (ج) و ٣١.١ % تقدير (د) النتائج المماثلة في المقرر رقم (٢) كانت : ١.٩ ، ٩.٦ ، ٢٠ ، ٣٢.١ % ، أما في المقرر رقم (٣) فكانت : ١.٣ ، ٨.٦ ، ٢٢.٨ ، ٣٦.١ % على التوالي.

نتائج الطالبات كانت - بصفة عامة - مماثلة للطلاب ما عدا في المقرر رقم (٢) كانت نتائج الطلاب أفضل - مقدار يسير - من نتائج الطالبات في العلامة النهائية والأسئلة ذات الخيارات المتعددة وكذلك في الأسئلة ذات الخيارات المتطابقة.

بمقارنة معدل العلامات ونسبة الرسوب بين الجزء الأول والثاني من الورقة للمقررات الثلاثة أتضح أن أقل من ١ % من الطلاب حصلوا على معدل (أ) في الجزء

الثاني بينما من ٢,٥٪ - ٥,٤٪ حصول على هذا المعدل في الجزء الأول. أما معدل الرسوب في جزأي الورقة كان ٣٠٪ - ٣٥٪ في الجزء الأول و ٤٥٪ - ٦٣٪ في الجزء الثاني من ورقة الامتحان. كما أتضح كذلك - في جميع المقررات - أن معامل الارتباط كبير بين التحصيل العام للطلاب والأسئلة ذات الخيارات المتعددة والأسئلة قصيرة الإجابة وكذلك الأسئلة ذات الخيارات المتطابقة، بينما كان معدل الارتباط صغير بين هذا النوع من الأسئلة والأسئلة المقالية.

الأسئلة متعددة الخيارات والأسئلة ذات الخيارات المتطابقة والأسئلة ذات الإجابة القصيرة، فقد كان نسبة الرسوب فيها قليل وأظهرت معامل ارتباط جيد فيما بينها، أما في الأسئلة المقالية فقد كانت نسبة الرسوب عالية، وأتضح أن معامل الارتباط بينها وبين الأنواع الأخرى من الأسئلة صغير. نوصي بأن يتم استبدال الأسئلة المقالية (أو يقلل من استخدامها في الامتحانات) بالأسئلة الموضوعية مثل الأسئلة ذات الخيارات المتعددة أو الأسئلة ذات الخيارات المتطابقة أو الأسئلة ذات الإجابة القصيرة.