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In-training assessment of postgraduate students in pharmacology using an audiovisual quiz

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ABSTRACT

Quizzes are considered one of the more effective methods of learning and teaching as they promote self-learning and motivate students to be more attentive. The present study evaluated the impact of a quiz competition on learning behaviour of postgraduate students in pharmacology. Post-graduate students in pharmacology from medical (M.D.) and pharmaceutical degree colleges (Masters in pharmaceutical sciences) participated. A written preliminary round was followed by a main quiz. Later, a questionnaire regarding feedback about the quiz was sent to the members of participating teams. All 15 participants gave feedback. In the quiz 49.2% of the questions were answered. Fourteen out of 15 (93.3%) participants studied for the quiz. Topics asked in the quiz were read or discussed later by all the participants (100%). On a scale of 10, average points given by participants were 8.2. Quiz competition stimulated self-learning activities among postgraduate students. It may have more impact when organized at national/international conferences.

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INTRODUCTION

Among the several methods of learning and teaching, quizzes are considered one of the most effective [1]. During preparatory phase prior to the quiz, students are encouraged to study more intensively [2]. Post-quiz it may generate interest in several topics that may otherwise be ignored [3]. Thus it promotes self-learning and motivates students to be more attentive. It may also act as an integration tool for different institutions where standards of teaching, training and assessment may vary. Medical educational research has focused extensively on assessment issues. Programs like quiz may be regarded as a form of assessment which can potentially strengthen knowledge that will lead to improved expertise.

Assessment involves testing, measuring, collecting, and combining information, and providing feedback. In medical education, it drives and stimulates learning, provides information on educational efficacy to institutions and teachers, and protects patients [4].

Assessment has a powerful positive steering effect on learning and the curriculum. It conveys what we value as important and acts as the most cogent motivator of student learning [5]. Assessment is purpose driven. For improving students' learning experiences, reliable and easy-to use assessment tools that measure student understanding are required [5]. Computerized quizzes can be used as formative or summative assessments [5].

Spectrum of areas that need to be mastered by pharmacology- post-graduates (PGs) is quite wide and may include thorough knowledge of drug development process, statistics, basic calculus and other mathematical skills, animal behaviour, animal models of diseases besides basic and clinical medicine. It is important to introduce new modalities through which pharmacology can be studied and taught and explore the feasibility of using them to augment conventional methods. Assessment of medical students should give optimum emphasis to each domain from lower domains of factual knowledge/recall to higher domains of

critical thinking such as evaluation, synthesis, and analysis. Presently, PGs in preclinical disciplines do not get enough opportunities for target based learning. In many places they have to face a single test at the end of 3 year training program. Such a system does not provide any challenge or feedback regarding various aspects of their knowledge elements.

In this study, data on the psychometric and logistic characteristics of a post-graduate (PG) [MD / M.Sc. Pharmacology] quiz competition is reported. Main aim of this study is to investigate whether participation in a quiz program is associated with improved long-term learning outcomes in higher medical education. Further, the impact of a meticulously formatted quiz competition on the learning behaviour of PG students is also objectively evaluated.

METHODS

Announcement for the quiz was made along with a national level conference (on rational pharmacotherapeutics). Entries for the quiz were received about 2 months before the event. There was no mention regarding topics and students were expected to prepare on all aspects important to pharmacologists. Post-graduate students in pharmacology from medical (M.D.) and pharmaceutical degree colleges (Masters in pharmaceutical sciences) were allowed to participate in teams with 2-3 members. Participants had completed their MBBS or Bachelor of Pharmacy (4 year) courses. A total of 11 teams participated, out of which five teams were selected based upon a preliminary round consisting of 57 objective type questions which had to be written in 30 min. Questions in this round covered basic aspects of pharmacology for medicine undergraduates.

The main quiz consisted of six rounds, each of which centered on a specific theme. A PowerPoint® presentation of the quiz was made and care was taken to include some extra question/s in each round that would serve as reserve/audience questions.

Round 1 comprised of multiple choice questions covering systemic pharmacology.

Round 2 evaluated participants' understanding of various animal models used to identify potential new treatments for human diseases. Mostly, we described a common methodology and participants were asked to name the nature/ type of drugs which could be screened by that.

Round 3 was buzzer round and consisted of flow diagrams/ cascades/ pathways describing sites of action of medicines or endogenous substances. Their important component was erased and highlighted by a

question mark.

Round 4 dealt with histories in the development of drugs and receptors. A brief narration was made regarding the drug or experiment leading to understanding of physiological process/ drug development and participants had to identify the drug/chemical substance.

Round 5 dealt with basic concepts in statistics.

Round 6 was called the rapid fire round in which a maximum of seven questions could be answered in 60 seconds, by each team. It covered questions on basic and current topics in pharmacology. Questions were either "one word-fill in the blanks" or "true/false" type.

Questions were categorized as either testing primarily "recall of facts" or "knowledge and application".

15 days later a self-administered anonymous pre-tested questionnaire was sent to the members of participating teams by e-mail. It was designed to gather information on:

- A. Learning behavior of participants before and after the quiz.
- B. Emotional response to the quiz.

Later on, data from the final MD examination in pharmacology at the university level was also considered. This examination was conducted about five months after the quiz involving six examiners (3 internal and 3 external) and 6 examinees. Briefly, the examination consisted of theory- four papers (3 hours each) and practicals. Theory papers are titled as Paper I- General Pharmacology including General Principles of Pharmacodynamics and Pharmacokinetics of Drug Action, Paper II- systemic Pharmacology, Paper III- Applied Pharmacology, Therapeutics and Toxicology and Paper IV- Experimental Pharmacology including Bio-assay and Bio-statistics. Practical included bio-assays using intact animals and isolated tissue, drug estimation using chemical assay, short experiments on animals, microteaching, dissertation presentation, objectively structured problems on pharmacokinetics and pharmacodynamics and viva-voce. Pattern of examination at other universities had minor variations.

RESULTS

In the preliminary written test, scores of the teams selected for the main quiz were 99, 97, 91, 90 and 88 out of a maximum of 120. Scores of other teams were 81, 78, 78, 72, 63 and 58. There was only one team with a pharmaceutical science background which did not get selected for the main quiz. There was no statistically significant difference in the scores of the preliminary written test among the selected teams (χ^2

test = 0.000, d.f.4; P = 1).

Table 1 summarizes the psychometric characteristics of the quiz questions according to the tested domain. All questions in rounds 1 and 2, four out of 6 questions in round 4 and 16 out of 35 in rapid fire round were considered to test “knowledge and application”. All questions in round 3 (buzzer), 2 out of 6 questions in round 4 and 19 out of 35 in rapid fire round were considered to test “recall of facts”. Questions in round 5 (statistics) were considered to test both the elements. There was no correlation between the testing domain with the ability to answer a question.

The overall number of questions answered by all the teams (directly/passed) was 15 of 30 (50%) in rounds 1-5 and 17 of 35 (48.6%) in rapid fire round. In the rapid fire round, each team could answer 3-4 questions out of 7. For all the questions in buzzer round, buzzer was pressed by any team only after at least 30 seconds.

Table 1. Psychometric characteristics of the Quiz Questions

Round (no. of questions)	Tested domain	Correctly answered
1. systemic pharmacology (6)	KA	3
2. drug screening models (7)	KA	3
3. cascades/pathways (6)	F	3
4. history of drugs/receptors (5)	KA - 4 F - 2	3
5. statistics (6)	KA, F	3
6. Rapid Fire (35)	KA - 16 F - 19	17

KA: knowledge and application; F: recall of facts

All 15 participants responded to the feedback questionnaire (Table 2).

In final MD examination, out of the 6 examinees, 4 participated in the quiz program while 2 did not. Overall performance of the candidates who participated in the quiz was better in comparison to those who did not. Further, those who scored more in the quiz also performed better during the examination.

Table 2. Feedback of the participating students to Postgraduate Pharmacology Quiz

Items	Positive response (%) Participants (n=15)
Did you specifically study for the quiz?	14 (93.3)
Prior information for the quiz lead to better/in-depth study of pharmacology topics.	14 (93.3)
After the quiz, did you discuss/read any question/topic asked in the quiz?	15(100)
Relevance of the questions asked in the quiz for PG pharmacology training.	10 (66.7%)
Given a chance would you organize a similar activity at your institute?	15(100)
How was the experience of participation. [enjoyable(E)/strenuous(S)/inert(I)]	E- 15 (100)
Overall rating of conduct of the quiz out of 10	8.2

DISCUSSION

While designing assessment for a medical course the concept of an “end-process” assessment should be kept in mind, for example, doctors spend most of their time solving clinical problems, devising treatments plans, and appraising their efficacy, not recalling factual knowledge [7,8]. While designing this quiz we made a conscious effort to test factual knowledge and critical thinking and analysis. A distinction should be made between assessments that are suitable only for formative use and those that have sufficient psychometric rigor for summative use. This distinction is especially important in selecting a method of evaluating competence for high-stakes assessments (i.e., licensing and certification examinations) [9]. However, summative assessments may not provide sufficient feedback to drive learning [10]. Quizzes are considered an effective formative assessment tool that augments conventional teaching [11]. An audio-visual quiz can be a versatile teaching and assessment tool that can be adopted for periodic formative assessment. Research in cognitive psychology has shown that testing of knowledge can directly affect learning by promoting better retention of information, a phenomenon known as the testing effect [12]. Data in this study indicates students read and discussed various topics of their curriculum both before as well after the quiz. A previous study suggests few tests at predictable intervals throughout the semester led to procrastination and last-minute preparation [2].

We propose that voluntary participation opportunities in academic activities such as quizzes provide a platform for learning and self-assessment for students. These activities are not high-stakes, yet are challenging for the participants possibly because of the presence of audience. However, a study showed that readiness for self-directed learning may not be necessary for learning foundational knowledge but its impact on more complex learning remained unknown [13].

It is previously reported that a feedback from the participants should be obtained considering the importance of the face validity of assessments in ensuring students' engagement with the learning tasks and assessment activities. This may contribute to the broader validity of the assessment enterprise in predicting and enhancing skills in subsequent professional practice [14]. In this study, a feedback form was sent after a gap of 15 days. During this time participants could possibly ponder on various aspects of the quiz and their own gaps in knowledge.

14 out of 15 (93.3%) participants specifically studied for the quiz. Participants also agreed that prior information of the quiz motivated them to study of pharmacology topics in greater depth. Further, topics asked in the quiz were read or discussed later by all the participants (100%). Thus, quiz promoted self-learning among PG students both before as well as after the event. This emphasizes that quiz can be a very effective teaching method even in higher education.

10/15 (66.7%) of the participants regarded most of the quiz questions relevant for PG pharmacology training. This may suggest that many aspects touched in the quiz may not be important from the perspective of current system of examination at many places. Conversely, it may also point to the inadequate inclusion of several key areas. A repetitive conduct of such activities along with other assessment methods may overcome this shortcoming. One of the suggestions was to put more stress on recent developments than on history of pharmacology.

All the participants indicated that they would like to organize a similar type of activity at their institution. Many members of the audience also requested a copy of the quiz. None of participants indicated the overall experience of participation as strenuous which is usually the case with most high stakes examinations. On a scale of 10, average point given by participants was 8.2. This shows that the quiz was widely appreciated and it generated a lot of interest and enthusiasm.

In the current study, the overall view of participants was positive, although weaknesses were highlighted. We received quite useful suggestions regarding improvement in various facets of the quiz. Suggestions

pointed out towards inclusion of certain important topics like drugs withdrawn from the market, new drug development, adaptive designing in clinical trials, pre-clinical drug development strategies, pharmacovigilance, pharmacogenetics, pharmacoeconomics, pharmacoepidemiology, intellectual property rights, etc. and less emphasis on the history of drug development. Nevertheless, we would like to mention that the quiz programmes organized by us previously, were inclusive of the above suggested topics, at least to some extent, along with certain important aspects like structure-activity relationship of medicines. However, some changes in the theme of the rounds were thought essential to keep the element of surprise.

Our study provides preliminary evidence for learning effects of the quiz in the form of results at MD examination. An earlier study also showed students who elected to use online quizzes performed better in summative examinations in medical physiology [15]. Our findings are only preliminary with a small sample size; extended studies with additional participants need to be conducted to increase the overall strength of our findings. Also, we could gain insight on self reported learning behavior of students. More rigorous research is required to elucidate the long term learning goals achieved with quiz. Our study was not designed to assess the PGs individually or to detect differences among the second year and third year PGs since they joined to form a single team. We could comment upon their performance only as a team.

In conclusion, quiz competition stimulated self-learning and provided information on educational efficacy to PG students and teachers. Such events at the level of postgraduation can be an interesting and effective method of teaching and learning in a speciality. Such type of activities when organized at National/International conferences can have much more impact.

Appendix showing sample questions**Preliminary round**

“Vesamicol blocks/ inhibits -----.”

“-----is an Aluminium containing sulfated disaccharide used in the treatment of peptic ulcer.”

“The antidote used in the treatment of heparin induced bleeding is -----.”

Round 1

“A 50 year old man with type 2 diabetes mellitus remains uncontrolled with metformin. His physician adds another drug which commonly causes peripheral edema. Which mechanism is responsible for drug’s pharmacologic effect?”

- A) AMP-activated protein kinase
- B) blockade of ATP-sensitive potassium channels
- C) agonist action at peroxisome proliferator-activated receptor- γ
- D) blockade of G protein-coupled receptors
- E) inactivation of dipeptidyl peptidase IV enzyme”.

Round 2

“Naive rats are individually forced to swim inside a vertical plexiglas cylinder. Rats are initially highly active, vigorously swimming in circles, trying to climb the wall or diving to the bottom. After 2–3 min, activity begins to subside and to be interspersed with phases of immobility or floating of increasing length. After 5–6 min, immobility reaches a plateau where the rats remain immobile for approximately 80% of the time. This is a model for screening of -----.”

Round 4

“John Vane recognized that unstable products of arachidonic acid metabolism might be more easily identified using bioassay techniques rather than biochemical methodology. To provide assay specificity, Vane employed cascade superfusion, which used a combination of tissues such as stomach strip and rat colon together with the chick rectum. In addition strips of bovine coronary artery were particularly useful for identifying and quantitating specific eicosanoids, because this preparation contracted in the presence of -----and relaxed in response to-----.”

Round 5

“A new diagnostic test for typhoid shows following results against established test procedures:

Test Result	Disease Status	
	Present	Absent
Positive	35	15
Negative	6	25

Its sensitivity can be calculated as:

- a)15/40 b) 35/41 c)40/50 d) 6/31 e) 6/41”

Round 6

1. Epinephrine is a non-competitive antagonist of histamine.
2. Ratio of $LD_{50}:ED_{50}$ can be calculated in man.
3. Dose of a drug is reduced by 50%. Its steady state plasma levels will be ____ % of original.
4. Drug for Crohn’s disease which acts by antagonizing integrins:
5. Aminoglycosides require aerobic transport mechanisms to enter the bacterial wall.
6. Bile acids act on Pregnane x receptor which induces CYP3A4.
7. A single prospectively selected outcome most likely to yield a valid result from the Clinical Trial is called -----.

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