

# Using online practice quizzes as accessory learning tool for undergraduate medical students

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## ABSTRACT

**Objective:** To evaluate the impact of using online practice quizzes as accessory learning tool on academic performance of medical students.

**Study Design:** Quasi Experimental Study

**Place and Duration:** Physiology Department of CMH Multan Institute of Medical Sciences, Multan, from 15<sup>th</sup> January, 2019 to 15<sup>th</sup> March, 2019

**Methodology:** Two unsupervised digital quizzes were conducted before Physiology class test of 1<sup>st</sup> year MBBS. Volunteers attempting practice quizzes were regarded as “Experimental group” (n=51), while rest of the class was included in “Control group” (n=38). Short essay questions (SEQs) in the summative class test were classified as “Category A,” (from already tested topics) and “Category B” (from rest of the syllabus). Scores of practice quizzes and class test (SEQs and MCQs) were obtained for statistical analysis.

**Results:** Experimental group (who had attempted practice quiz) scored significantly higher in Category A SEQs ( $p=0.01$ ), Category B SEQs ( $p=0.001$ ) and MCQs ( $p=0.04$ ), as compared to the Control group. Moreover, Experimental group scored significantly higher ( $p=0.001$ ) in Category A SEQs (from already tested topics) as compared to Category B SEQs (from rest of the syllabus). We also found certain predictive validity of practice quiz score for summative assessment scores.

**Conclusion:** Online practice quizzes used as structured formative assessment can act as an accessory learning tool for the medical students.

**Keywords:** Physiology, Experimental design, Assessments, Test taking skills, Teaching methods, Educational status

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## INTRODUCTION

Students are often dissatisfied regarding discrepancy between their self-perceived examination performance and results of those exams<sup>1</sup>, in spite of improved assessment tools to minimize bias. Very often researches showed that students fail to reach high performance standards, in spite of self-

satisfactory preparedness for that exam<sup>2</sup>. Researchers and academicians in medical education have long been thriving to find its cause. Koriat and Bjork reported that usual passive learning style of the students (i.e. repeatedly reading the textbooks and reviewing notes), is not sufficient to produce maximum retrieval of acquired information, rather leads to “illusion of competence”<sup>3</sup>.

As facilitators, we need to create active learning strategies that can enhance retrieval probability of gained knowledge. Facing a desirable difficulty, e.g. producing a challenging answer, solving a problem or attempting a test can substantially trigger long term potentiation of information, as proposed by Bjork<sup>4</sup>. Carrying along Bjork’s concept, various researches have proved that practice tests can potentially enhance a student’s knowledge, in addition to its assessment<sup>5</sup>. Tests provide an opportunity for recall and utilization of even marginally accessible knowledge<sup>6</sup>. Other than a retrieval challenge, tests serve as feedback to the learner, thus further improving learning techniques<sup>7</sup>. Practice tests substantially limit the difference between learning and actual testing conditions, thus alleviating the illusion of competence<sup>3</sup>.

Despite the benefits, frequent testing is cumbersome pertaining to making, printing, distributing then grading and providing individual feedback in large groups. Fortunately, recent technology explosion has provided accessible and cost-effective solution to this problem<sup>8</sup>. Technology assisted online

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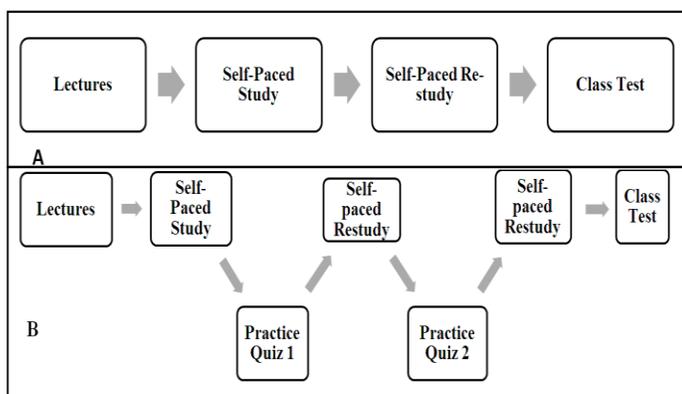
platforms are available to facilitate teaching, learning, assessing and providing immediate feedback<sup>9</sup>. Digital quizzes have already been used successfully in various capacities worldwide to revolutionize medical education<sup>10</sup>.

Simply modifying the already existing formative assessment practices into structured quiz pattern can serve as accessory learning tool for the students<sup>11</sup>. A lot of experimental work has been done in this domain worldwide, but not much relevant data has been reported in our region. Being a low socio-economic country, Pakistan cannot afford fancy gadgets, simulators or advanced labs to teach medical Physiology to the undergraduates; but utilizing properly constructed digital practice quizzes as learning tools to enhance academic excellence among medical students is achievable. This research may be the first step towards this goal by accessing the usefulness of this innovate technology in our existing culture of medical education. The objective of this study was to evaluate the impact of using online practice quizzes on the academic performance of undergraduate medical students.

## METHODOLOGY

This Quasi-Experimental study was conducted from 15<sup>th</sup> January 2019 to 15<sup>th</sup> March 2019 after approval from Institutional Review Board & Ethical Committee (IRB&EC) of CIMS, Multan (CMH Multan Institute of Medical Sciences).

At CIMS, first year MBBS class is taught Medical Physiology in three modules (each of eight weeks duration). The first module involves the topics of Cell, Blood, Nerve and Muscle physiology. Each module has two equally spaced written class tests before final modular assessment. In 2019, hundred students were enrolled in 1<sup>st</sup> year MBBS at CIMS Multan. Their first test on the topic of Cell and Blood Physiology was to be conducted on 4<sup>th</sup> March, 2019.



**Figure-1: (A) Routine Course Program (B) Intervention in Course Program**

Volunteers from 1<sup>st</sup> Year MBBS were invited to attempt online practice quizzes before their class test (Figure-1). Students were told that the aim of these quizzes was to help them self-assess their preparedness for the class test and these quizzes were neither compulsory for passing the exam nor a requirement of the coursework. We hypothesized that the students can perform better in their class test if they already have attempted practice quiz.

Volunteer students participating in either or both of the practice quizzes were labeled as “Experimental Group (n=51)”, while rest of the class was labelled “Control Group (n=38)”. Students absent from the class test were excluded from the study.

Thirty-one students participated in first quiz and thirty-three students participated in second quiz, both conducted unsupervised. Time and venue of both the quizzes were decided by the students. Quizzes were broadcast online for a duration of one hour each. Practice quizzes data was collected and compiled by Socrative online program and saved for further analysis.

Class assessment test was conducted as per routine on 4<sup>th</sup> March 2019, involving 20 MCQs (1 mark each) and 6 SEQs (5 marks each). Eighty-nine students of 1<sup>st</sup> year attempted the class test, including students of both “Experimental Group (n=51) and “Control Group” (n=38). Class test was conducted at the same time and place for both the groups. This class test was designed, conducted and marked according to the usual departmental protocol. SEQs in class test were classified into two categories; “Category A” contained three SEQs from the topics revised in the practice tests while “Category B” had three questions from rest of the topics of test syllabus. MCQs were not classified in such categories, as many covered more than one topic.

**Data Analysis:** The data was analyzed using SPSS version 20. All the test scores were reported in percentages as Mean  $\pm$  Standard Deviation (SD). Mean score of Category A SEQs, Category B SEQs and MCQs were compared among Experimental and Control Groups of Students using independent sample student t-test. Paired Student t-test was used to compare the mean scores of Category A and Category B SEQs within the Experimental Group. Correlation between practice quiz score and class test scores was assessed using linear regression analysis, after checking the assumptions.

## RESULTS

A total 51 students (Experimental group) of 1st year MBBS voluntarily attempted online practice quizzes. Thirty-one students participated in first quiz, thirty-three students participated in the second quiz, while thirteen of them attempted both the practice quizzes. Total eighty-nine students appeared in the final class test. Experimental group (n=51 students who had attempted practice quiz) scored significantly higher in Category A SEQs ( $p=0.01$ ), Category B SEQs ( $p=0.001$ ) and MCQs ( $p=0.04$ ), as compared to the Control Group (n=38 students who did not attempt any practice quiz), Table-I.

Moreover, Paired sample t-test showed that students with in Experimental Group scored significantly higher ( $p$ -value = 0.00) in Category A SEQs from already tested topics ( $63.98 \pm 13.03\%$ , mean  $\pm$  standard deviation) as compared to Category B SEQs (mean  $\pm$  standard deviation) from rest of the syllabus ( $55.06 \pm 16.59\%$ , mean  $\pm$  standard deviation).

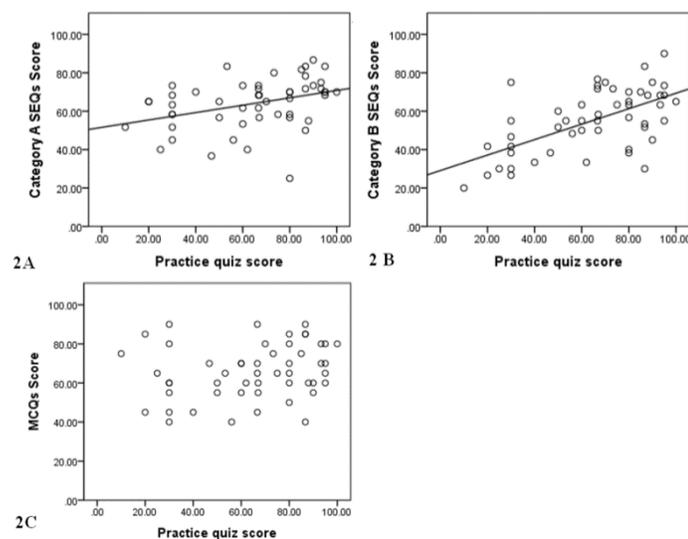
Linear regression analysis showed that practice quiz score had strong correlation with Category B SEQs score ( $r=0.60$ ,  $p=0.00$ ) and an intermediate correlation with Category A SEQs score ( $r=0.37$ ,  $p=0.008$ ) (Figure 3). Whereas, no significant correlation was found

between MCQs and practice quiz scores ( $p=0.12$ ) (Figure-2).

**Table-I: Comparison of class test scores among Experimental Group, n=51 (Practice quiz attempted) and Control Group, n= 38 (No practice quiz attempted) (N=89)**

|                           | Experimental Group<br>(Mean $\pm$ SD) | Control Group<br>(Mean $\pm$ SD) | p-Value |
|---------------------------|---------------------------------------|----------------------------------|---------|
| Category A SEQs Score (%) | 63.98 $\pm$ 13.03                     | 54.82 $\pm$ 19.18                | 0.01*   |
| Category B SEQs Score (%) | 55.06 $\pm$ 16.59                     | 41.59 $\pm$ 19.93                | 0.001*  |
| MCQs Score (%)            | 65.88 $\pm$ 13.92                     | 60 $\pm$ 11.74                   | 0.04*   |

(SEQs-Short Essay Questions, MCQs- Multiple Choice Questions, SD-Standard Deviation, Category A SEQs- from already tested topics, Category B SEQs- from rest of the syllabus. \*Significant difference reported at  $p<0.05$  and 95% Confidence Interval)



**Figure-2: Co-relation of practice quiz score with class test scores in Experimental Group (n=51)**

By Linear Regression Analysis, showing significant co-relation of Practice quiz score with Category A SEQs from already tested topics ( $p=0.008$ ), (Figure 2A) and Category B SEQs from rest of the syllabus ( $p=0.00$ ), (Figure 2B). Whereas, no significant relationship found between Practice quiz score and MCQs score ( $p=0.12$ ) in class test (Figure 2C).

## DISCUSSION

We hypothesized that students can perform better in their class tests if they have already attempted practice quiz. Results of our study supported this hypothesis. The Experimental group (who had attempted practice quiz) scored significantly higher in both the SEQs and MCQs, as compared to the Control group (who didn't attempt any practice quiz). Still, within the Experimental group, Category A SEQs score was significantly higher as compared to Category B SEQs.

Experimental group scored better in both Category A (from already tested topics) and Category B SEQs (from rest of the syllabus), as compared to the Control group. Our hypothesis is

supported by results of this study and also by available literature<sup>5</sup>. This improved performance of students can be attributed to the phenomenon of "test potentiated learning", as reported by Izawa<sup>12</sup>. As compared to simple book reading, active problem solving e.g. in form of practice tests potentiates the retrieval opportunities<sup>13</sup>. Tests serve as "desirable difficulties" along with feedback to the learner, alleviating the dilemma of wrongly perceived preparedness and competency<sup>6</sup>. This concept of desirable difficulties was given by Bjork in 1994, that refers to difficult conditions at learning that ultimately enhance performance<sup>4</sup>. Hence, formative assessments if properly structured in form of practice tests, can improve results in summative assessments<sup>14</sup>. This intervention has been successfully carried out in various experimental<sup>15</sup> and real-life<sup>16</sup> set ups worldwide. After looking for its acceptance and effectiveness in our set up, structured formative assessment can be carefully introduced in regular coursework.

Category A SEQs were taken from the topics of practice quiz. But the Experimental group scored higher than Control group even in Category B SEQs taken from topics not previously practiced. There could be a possible confounder that students in Experimental group were already more interested in their studies. So, their serious attitude made them score higher and attempting practice quiz was not the real cause. But this study clearly showed that Experimental group scored significantly higher in Category A SEQs as compared to Category B SEQs. This indicates the clear influence of our intervention on students' performance and results. The improved results in Category B SEQs can still be indirectly attributed to practice quiz. As structured formative assessment in form of practice quizzes imparts overall behavioral adjustments<sup>13</sup> e.g. study time management and learning style modifications. Another potential cause for improved Category B SEQs score is using multiple-choice questions in practice quizzes. As MCQs have proven benefit to potentiate retrieval of information related to possible alternative and incorrect options also<sup>17</sup>.

Literature in medical education is full of contradictory results regarding predictive validity of formative assessments<sup>18, 19</sup>. In our study, linear regression analysis showed that practice quiz scores possess predictive validity for summative examination SEQs scores.

This predictive validity is significant but inconsistent among various categories. In this study, predictive validity of practice quizzes is inconsistent as these practice quizzes were unsupervised and no ethical obligations were defined beforehand regarding study aids during tests. In 2007, Kibble reported that strategies used by students for solving unsupervised practice quizzes can be inappropriate and less effective in obtaining the ultimate goal<sup>11</sup>. Whereas, others are of the view that practice quizzes scores are of limited importance as compared to active participation<sup>20, 21</sup>.

Various real life and laboratory setting researches have shown that retrieval opportunities in tests, whether successful or failed, benefit the future retrieval attempts<sup>20</sup>. Despite the contradictory opinions, this predictive validity is of practical significance. These formative examination scores can be used as bench marks by students, for predicting the possibility of

passing the summative exam. But doing so would surely require eliminating the potential confounders and co-predictors. Although such projects have been previously conducted worldwide, but no such literature is available related to our local set up of medical education. This project was designed to look for the feasibility and acceptance of this intervention in our setup. Being an untraditional practice, our study had some limitations. Our data is limited because of scarcity of practice quizzes and inconsistency of students in attempting quizzes. Also, the potential confounders like gender, previous academic records and other cohort characteristics were not accounted into the data analysis. Still the improvement in summative exam scores indicates the strength of this intervention. A great advantage to this intervention is its easy accessibility, acceptability and efficacy without overwhelming our faculty and budget resources. If validly structured, already existing formative assessment practices can be improvised to improve the summative assessments. In future, we would like to inculcate structured formative assessment tests in our course outline, along with incentives for participation for students. One major challenge we still have to face is to ensure the consistency of students' participation and to maintain the desirable difficulty at a level that may keep the students motivated.

### CONCLUSION

Our study showed that online practice quizzes used as structured formative assessment can act as an accessory learning tool for the medical students.

### AUTHOR'S CONTRIBUTION

**Faiza:** Conceived idea, Data analysis, Manuscript writing, Final approval

**Rabbani MA:** Data collection, Data analysis, Manuscript writing

**Bashir MU:** Data interpretation, critical revision of manuscript

**Naeem S:** Data interpretation, Critical revision of the manuscript

**Arshad S:** Data collection, Literature search

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