

# Trends of undergoing formative assessment in undergraduate medical students

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## Author's Contribution

<sup>1</sup> Conception, synthesis, planning of research and manuscript writing

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## A B S T R A C T

**Objective:** Medical curriculum is always subject to new strategies to ensure effective delivery of learning material. Online formative assessments are gaining popularity over conventional paper based formative assessments due to recent advances in technology and increasing familiarity of students with computer-based examinations. With this background, objectives of this study were to explore trends of computer based formative assessment in undergraduate medical students and to investigate the impact of online formative assessments on summative assessment scores.

**Methodology:** A prospective cohort study was conducted on 100 medical students from 3rd year in November 2016 and July 2017. The data was collected using SPSS software and analyzed by T-tests and descriptive tables.

**Results:** The mean summative score of students who took an online formative assessment in a module was significantly higher compared to mean score of students who did not take formative assessment. Mean summative score of another group of students who took an online formative assessment in a different module was statistically different than mean score of students who did not take formative assessment ( $p$ -Value = 0.00).

**Conclusion:** Online formative assessment is an effective tool for improving student's performance in the summative assessment.

**Keywords:** Cohort study; Pakistan; Medical Education; CBA; Formative assessment

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## Introduction

Formative assessment is defined as "all those activities undertaken by teachers and/or students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" [1]. It has been made an integral part of medical education after various studies proved it to be an effective tool for improving students' learning by making them self-directed, self-regulated life-long learners [2, 3]. This assessment is incomplete without effective feedback that focuses on addressing the topic, response, discussing errors, providing examples, guidance and opportunity to review [4]. When combined, the student is able to make a personalized portfolio. A portfolio is defined as "a

collection of evidence that is gathered together to show a person's learning journey over time and to demonstrate their abilities" [5] and is essential for self-reflection. As shown by a study, self-reflection from a portfolio enhances the entire learning process [6].

Medical curriculum is known to be subject to various strategies to rejuvenate the teaching and learning delivery methods, formative assessments are one such means to ensure deeper learning and understanding [7]. One study proposed that repetitive exposure to such testing techniques will promote self-reflection and self-efficacy for subsequent tests [8]. However, this strategy is believed to

be only useful when there is no presumed evaluation stress present in the minds of the students [9].

Paper-based formative assessments have many limitations [10]: students have to be gathered and supervised; individualized feedback is time-consuming, and not be feasible with large class sizes [11]; and analysis of question reliability and validity can be tedious [12]. The most important limitation is the fact that majority of post-graduate and specialization examinations have opted for a web-based approach. This web-based approach requires a different mindset that makes practice by paper-based formative assessments outdated. These are persuasive arguments for moving from paper-based to online formative assessments.

In recent times the use of technology is gaining popularity in every field and medical education is no exception. New recommendations in medical education support the use of technology as a teaching modality as well as an assessment tool [13]. These include multimedia, e-portals, simulations, and Computer Based Assessment (CBA); which is both delivered and marked by computer [14]. Online formative assessments are very effective for students: immediate feedback; flexible time and place of undertaking the assessment; feedback can be linked to learning resources, thus motivating proper study habits; opportunity for spaced repetition; and interactivity [10]. Furthermore, a comparative study has reported that online formative assessments might be of greater benefit for learning than paper-based equivalents [12].

CBA, as a tool for formative assessment, is being tested for its efficacy in relation to the students' performance in the summative assessment. In a review study of 85 articles, it was found that CBA is being employed widely in undergraduate medical education. Most of these assessments are conducted in the Multiple Choice Question (MCQ) format in both formative and summative assessments. Formative CBAs are being used as a prelude to summative assessment as a tool for providing effective feedback, identifying learning gaps, and guiding students' to improve their academic performance [15]. As demonstrated by Henly and Reid, the students who voluntarily choose to take online formative assessments are shown to be more thorough in

completing their tasks and are thus high achieving [16, 17].

With this background, objective of this study was to explore reasons for taking formative assessments by medical students. Furthermore, this study aimed to investigate preference of students among different tools of formative assessments and to evaluate the impact of online formative assessment on summative scores.

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## Methodology

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A prospective cohort study was conducted in November 2016 and July 2017 to explore the impact of CBA on summative assessment in undergraduate medical students. The study was based on a population of 100 medical students from 3rd year, Shifa College of Medicine respectively, for the two modules that were assessed for the study

Shifa College of Medicine (SCM) follows an integrated curriculum with longitudinally and vertically integrated themes. Each academic year is divided into several modules and taught through a combination of Large Group Interactive Sessions and Small Group Discussions. The assessment comprises of formative assessments during the module followed by an end of module summative assessment. After approval for the study was granted by the Institutional Review Board, two online formative assessments were conducted in a class of 3rd year students.

One of these formative assessments (test I) was conducted in November 2016 in the Essentials of Medicine II (EOM II) module which was 3 weeks long. The other formative assessment (test II) was carried in July 2017 in the neurosciences module which included psychiatry (NEU). NEU consisted of 8 weeks of teaching after which the students appeared in an end of module summative assessment. The tests were designed by the module coordinators and presented using the online website classmarker.com. The questions were of the multiple choice format and items were developed by the content experts. Both formative assessments were optional. Voluntary participation in the assessment was considered as consent for this study. The students were informed about the formative assessment at the end of small group discussions and were later reminded through e-mail. The tests were accessible for 36 hours over the

weekend and the students were allowed to access it at their convenience. They were not allowed multiple attempts at the same test. For both tests all questions were mandatory and carried equal marks. There was no negative marking.

Test I consisted of 22 multiple choice questions. A total of 26 minutes were given for taking the test and a 'resume later' option was available. After submitting answer of any question, students were not allowed to go back to attempt the question again these are specific type of questions. After attempting any question, the students were given messages in case of correct or incorrect answers but the key was not displayed in case the answer was incorrect. Test II consisted of 20 MCQs and the students were allowed only one attempt for each question. The students were allowed to pause the test and resume later. On the completion of each test, a result was displayed for the students which showed the number of correct and incorrect answers and a customized feedback.

Following each test, an interactive large group discussion was conducted by the faculty to discuss the correct answers for the given questions. This was also an opportunity for the students to clarify any queries regarding these topics. In these sessions, the students were distributed sheets to record their reasons for either taking the formative assessment or not. The students were also requested to comment on the formative assessments. At the end of both of these modules a summative exam was carried out.

The scores of all students were recorded on an excel sheet which also included the summative exam score for each student. The students were divided into two groups for each module concerned, A1: students who took the formative assessment and B1: students who did not take the formative assessment. SPSS software-based t-tests were used to produce summaries comparing the summative assessment and formative assessment results in form of tables

## Results

The features of both the online formative assessments were recorded in Table 1. The mean scores were used in further statistical analysis.

**Table 1: Features of EOM and NEU formative assessments.**

| Features                     | EOM Formative Assessment | NEU Formative Assessment |
|------------------------------|--------------------------|--------------------------|
| Min. time taken (in seconds) | 424                      | 159                      |
| Max. time taken (in seconds) | 1560                     | 1320                     |
| Average time (in seconds)    | 1047                     | 710                      |
| Min. score (%)               | 0                        | 0                        |
| Max. score (%)               | 95.5                     | 100                      |

In the EOM module, out of 101 students, 49% took the formative assessment while 51% did not. The mean summative score for the group of students who took the online formative assessment was 11 marks more than the score of the students who did not. The male to female ratio was about 1:1. In the NEU module, out of 100 students, 48% took the formative assessment while 52% did not. The mean summative score for the group of students who took the online formative assessment was 9 marks more than the score of the students who did not. The male to female ratio was about 1:1.

To assess the overall impact of formative assessment assessments on the mean score for summative assessments, the scores were compared using a t-test and the results were recorded in Table 2.

**Table 2: Impact of computer-based formative assessments on summative assessments.**

| Exam Type                | Mean Score | p value |
|--------------------------|------------|---------|
| EOM formative assessment | 31.4       | < 0.05  |
| EOM summative assessment | 70.1       |         |
| NEU formative assessment | 36.1       | < 0.05  |
| NEU summative assessment | 72.9       |         |

Furthermore, to assess whether the summative scores of students who took the formative assessment in each module (A1) were better than those who did not take the

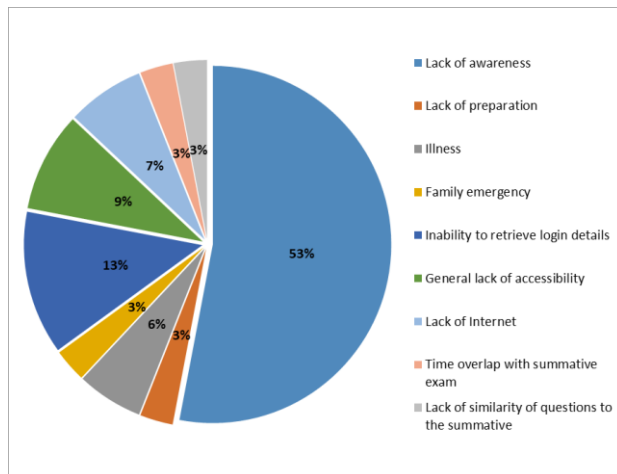
formative assessment (B1), another t-test was conducted and the results are in Table 3.

**Table 3: Comparison of summative scores for the two types of student groups.**

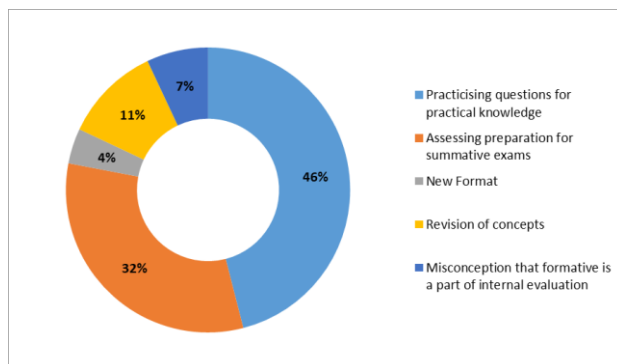
| Summative Exam | A1*  | B1*  | p value |
|----------------|------|------|---------|
| EOM            | 75.5 | 64.8 | 0.00    |
| NEU            | 77.4 | 68.2 |         |

\*A1=students who took the formative assessment, B1=students who did not take the formative assessment.

The Large Group Interactive Session that followed each formative assessment highlighted the students' reasons whether to take the formative assessment or not. Figure 1 and 2 display the results for the reasons provided by many students.



**Figure 1: Students' reasons for not taking the formative assessment.**



**Figure 2: Students' reasons for taking the formative assessment.**

General themes from the comments of the students were identified, with regard to specific unique details that some students had mentioned. Many participants commented that the formative assessments should be taken in every module (36%) with some mentioning that there should be a minimum of 3 online formative assessments (3%). Some participants even continued to explain that there is a lesser chance of bias (3%) and that this form of learning was both time-saving (8%) and mentally stimulating (3%). Some participants commented on one particular limitation about this form of assessment that the two exams, formative assessment and summative assessment be at least a week apart for less time overlap (5%).

## Discussion

The mean time in our study for both the online formative assessments was far lesser than the mean time of a 2008 study in which the average time was  $32 \pm 5$  minutes ( $1920 \pm 300$  seconds) [18]. This concludes that the number of questions in a formative assessment can definitely change the thinking time span because our study had 20 questions each for both online formative assessments whereas the study in 2008 had 25 questions [18]. Furthermore, our study included questions of a multiple-choice format while the study in 2008 had extended matching questions which concludes that the thinking time is also influenced by the style of these formative assessments. The percentage of students taking the formative assessment had slightly dropped (1%) in the NEU module which can be attributed to the fact that the summative assessment for NEU module was scheduled quite close to when the online formative assessment was conducted.

The formative assessment did generally improve the overall mean score of the summative exams for both the modules which was statistically significant ( $p$  value  $< 0.05$ ). Our results show that students who had taken the online formative assessment had a score of 75.5% in EOM and 77.4% in NEU summative assessment while the students who did not take the formative assessment had 64.8% and 68.2% in summative assessments respectively. This reinforces the idea produced by a 2015 study that formative assessments can improve learning

and students who might not be able to do well on the summative exam can be identified, beforehand [19, 20].

A study conducted in Malaysia showed that CBA with automated feedback improved the performance of high achieving students in subsequent summative assessment [21]. Although this needs further research, a positive impact of Computer Based formative assessment on summative performance, at least in the high achieving students, can be expected [22]. This is supported by our study. However, when compared with this study, the mean score of formative assessments of our students was lower, 31.4 and 36.1 versus  $61.7 \pm 17.6$  [23]. But, the scores of our students in summative exams were much higher than the students in the Malaysian study, 70.1 and 72.9 versus  $56.4 \pm 12.2$  [23]. The difference can be attributed to the reason that students focus more on exams that count towards their internal assessments.

In terms of students' perception towards CBA, a study in Singapore showed that 79.8% final-year students preferred computer based MCQ exam over paper-based assessment (PBA) [24]. Furthermore, in a similar study in post-graduate trainees in Pakistan, 61.8% rated CBA better than PBA [24]. Although our study did not aim at comparing the two modes of formative assessment our qualitative data reflected that the students will like to see more of this assessment tool in the course of their education which highlights the fact that computer-based assessments are much less threatening as shown by many studies [25].

The general themes that were concluded from the free-text comments provided by many participants strengthened the notion that CBA is a very flexible method of assessment [26]. Although online formative assessments are being introduced widely into undergraduate medical colleges, their benefits need validation by further studies. The results of our study can be taken as a cue for further exploration in the field of 'online formative assessments' as a replacement for 'paper based formative assessments' [27].

The noteworthy concerns regarding online formative assessments were mainly related to technical issues as stated by some students that they had difficulty in accessing the test due to poor internet connection and problems with the server which interferes with the validity

of CBA [28]. These factors will need further deliberation in our settings before online formative assessments can be made a more permanent feature of our assessment.

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## Conclusion

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To conclude, formative assessment is a very important tool to assess and improve learning. There should be more large-scale studies to evaluate multiple technological interventions to conduct formative assessment.

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