



Implementation of Online Formative Assessment in The Postgraduate Medical Education During COVID-19 Pandemic; A Pilot for Replication

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ABSTRACT

Background: During COVID-19 pandemic the demand for reliable, acceptable, and feasible methods of online formative assessment (FA) tools has increased. **Objective:** to assess the use of technology in FA through collecting the candidates and assessors' expectations before the exam and their opinions after the exam regarding the whole process. **Method:** This is a cross-sectional observational study conducted over 38 postgraduate candidates and 13 assessors testing the effectiveness of the implementation of online FA (includes MCQ, CBD & CSA) on the postgraduate learning process. Together with collecting the assessor's feedback on the FA processes and how they helped the students and the assessors. **Results:** Seven percent of the participants expected the registration process to be difficult. However, only three percent after the exam found it difficult ($P= 0.029$). The most influence for the FA was that it provides them with self-assessment and correction (score of 3.6). Participants expected own performance mean score before FA was 2.5, while was 3.3 afterwards ($P= 0.009$). CSA was the best among the used assessment tools (score: 4.06). Ninety percent preferred immediate feedback. Before the FA, 63.16% of them expected it to be an easy and comfortable process while this percentage increased to 75.76% after the FA. Seventy percent of the assessors believed that FA extremely benefits the candidates. **Conclusions:** The postgraduate's online FA including the MCQs, CBD and CSA is an easy, beneficiary and comfortable process that can give the candidates a feedback on their performance and giving the chance for improvement.

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INTRODUCTION

Assessment is an integral part of teaching and learning. There are 2 types of assessment, formative (FA) and summative (SA). FA provides the students with feedback on their learning and a better grasp of their learning materials. This feedback gives the students the chance to fill their learning gaps. It also provides feedback for teachers to modify subsequent learning activities.¹ SA at the end of the curriculum to judge students' performance is usually infrequent, involves grades or formal ratings, and is associated with curriculum decision-making. FA, in contrast, is frequently conducted throughout the training period, separate from grades or formal ratings.²⁻³ Despite the benefits of FA in a structured training

program, it is not usually a mandatory component of curricula, especially in developing countries, like Egypt.⁴

Due to the COVID-19 pandemic, there is a shift to the online educational environment increasing the demand for safe, valid, reliable, feasible, and fair methods for assessment.⁵

The real challenge is the disruption of clinical assessment. This emphasized the necessity of applying virtual simulation-based educational tools (VSBET) in clinical education, but validity, expertise, and cost are barriers.⁶ So, we depend on simulated patients as a method of VSBET in assessment. It is well suited to judge a learner's ability to

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communicate and adapt to patient needs and to assess the decision-making, critical thinking, and clinical reasoning skills of a student based on a clinical case.⁵⁻¹⁰

The available literature review found a lack of research that tested the satisfaction and perception of involving postgraduate medical students through a comprehensive online programmatic FA. Very limited research has focused on complex problem-solving tasks, especially in low-resource settings.³⁻⁷ The aim was to plan for an online programmatic FA for postgraduate medical students that assures social distancing together with the continuity of proper learning standards. Additionally, we aimed to test the FA effectiveness and candidates' and assessors' satisfaction.

METHODS

This cross-sectional study was conducted among 38 postgraduate candidates (as a pilot for replication) including the Master (MSc) and Doctorate (MD) candidates and thirteen staff members of the family medicine department shared in these FAs.

The study was conducted at the family medicine department, Faculty of Medicine, Cairo University during the COVID-19 pandemic (Academic year 2020-2021). During this period, the candidates, and the assessors (Mentors) were overwhelmed with the introduction of specialized COVID-19 clinics and a lot of colleagues' sick leaves due to COVID-19 infections. Meanwhile, the assessors were facing the new era of e-learning which was a brand-new technology that needed to be mastered. Moreover, the expected poor internet connectivity in Egypt, unavailability of a paid version of a remote video conferencing platform e.g. Zoom, and the absence of a real-time virtual proctoring system. All these factors were considered obstacles against FA implementation and continuous assessment of the learning process.

Curricular digital transformation: During the COVID-19 pandemic, the digital transformation of the family medicine postgraduate courses was done by weighting the contents and distributing them throughout the courses. Each course content was divided into modules according to the weight of the topics in the course specification according to the ILOs (Intended Learning Outcomes).¹¹

As a step to overcome the mentioned obstacles, a free Zoom meeting video conference version was adopted. Kahoot application as a Game-Based Learning tool was used. Also, a free proctoring application was installed. Besides, the available Cairo University Learning Management system

'Blackboard' was used as a learning platform. Technical training of the assessors was done through online free YouTube video sharing and self-learning.

Assessment data collection: An orientation session was given for the assessors and the candidates about the components and the process of the FA.

(A) During each module (continuous learning activities): Throughout the module game-based learning (Kahoot) and case-based learning were used. Student participation was an important part of their education and training, so the materials were prepared by the candidates themselves throughout the year relevant to each taught module. The materials then were revised by 2 senior staff members. Prepared relevant MCQs (Multiple-Choice Questions) were given to the candidates through online assignments through Google Forms and the Kahoot application as an Applied Knowledge Test (AKT). The top scorers were revealed, and the overall winner (s) was/were displayed on a scoreboard at the end of the session. Relevant case-based learning was also held to assess higher-order thinking which includes critical thinking and problem-solving ability of the candidates.

(B) After each module (Periodic formative assessment): There were two types of assessment; MCQs and Clinical Skills Assessment (CSA). MCQs (AKT) were prepared by the assessors and uploaded on the blackboard to be opened at a specific predetermined date to all candidates. We used the auto-proctor which is a form of automated online proctoring technique that uses audio-video and screen share feeds of exam-takers that help to prevent, detect, and gather evidence of any malpractice during an online exam. The candidates were oriented on how to take an exam with auto proctoring. The online CSA was done through the Zoom meetings application using the breakout rooms feature. The assessors were the role players of the cases. The focus of this exam was on communication skills, the conduct of interviews, the interpretation of data, and constructing a comprehensive management plan in various clinical scenarios addressing the most common medical problems in primary health care.

Feedback data collection: After the exam, each assessor delivered immediate structured feedback to each candidate about his/her performance in each case through a prepared checklist. An overall conclusive outcome from the assessors is shared with the candidates so they can plan their learning and improve themselves. An online standardization

Table 1: Mean score from 1 to 5 for each technique used in the modules.

	Mean score ± standard deviation
Case discussions	3.75±1.25
Assignments	3.66±1.40
Kahoot (game-based learning)	3.03±1.61
Formative assessment/simulation exam	3.84±1.20
CSA	4.06±1.17
Activities before face-to-face meeting (interactive lectures and webinars)	3.69±1.21
Activities during face-to-face meetings	3.72±1.30
Activities after face-to-face meeting	3.84±1.25

session for the assessors was done where the cases were discussed, and the evaluation forms. The consensus regarding the evaluation of each item in the forms was reached.

(A) Candidates’ feedback Questionnaires: Before the assessment, the candidates were asked to fill out a pre-assessment questionnaire made up of 17 questions, designed in the form of statements and answers using the 5-point Likert scale. And after the assessment, they were asked to fill in a post-assessment questionnaire consisting of 34 questions covering the whole process and their overall feedback. The questionnaires were sent through Google Forms.

(A1) Pre-questionnaire assessed the participants' opinions on online assessment, their expectations, and suggestions in general. They may have previous experience with online assessment or not. The questions were about feasibility of system registration, cheating, fairness, effect of network connection, importance of feedback for the learning processes, and previous online assessment (faced difficulties and preferences)

(A2) Post-questionnaire involved the 1st 5 items, but it also involved other items to assess their real experience of online Formative Assessment, so the questions were about: The form/ technical points of the assessment (e.g., arranging questions on one page and adding a timer, and duration), effect of FA on their learning process (how and to what extent), opinions on different techniques/forms of FA, feedback sessions, and clinical cases, recommendations for the module activities and assessment improvement, and difficulties faced during these assessments.

(B) Assessor feedback questionnaire: The allocated thirteen assessors were asked to complete

Table 2: Participants’ perception of reasons to apply formative assessment

	Mean score ± standard deviation
To clarify the learning objectives & success criteria	3.32±1.28
Self-assessment & misunderstanding correction	3.44±1.41
Give the instructor evidence on student assessment	3.36±1.35
Instructions Change based on feedback	3.28±1.27
Facilitate peer learning	3.32±1.24
Promote student learning ownership	3.20±1.22
Promote study habits	3.28±1.17
Improve learning	3.60±1.29
Non educational purposes	2.04±1.13

the assessors’ feedback consisting of 18 questions regarding their opinion about the assessment standardization, evaluation, timing, workload during the whole academic year’s assessment process and if the assessment process had a positive impact on them and candidates. The assessors’ feedback assessed the following; number of FAs they shared and number of candidates they assessed, opinion on FA process at all (zoom as application, CSA cases, standardization sessions, evaluation forms, workload as assessor, and as staff in the module, effectiveness of each one of FA (after 4 modules assessment), effect of FA on their medical education experience, and effect of FA on the candidate progress and learning process recommendations

Table 3: Participants’ perception of how formative assessment influenced their learning

	Mean score ± standard deviation
Clarify course objectives and success criteria	3.20±1.32
Self-assessment and misunderstanding correction	3.60±1.35
Facilitate peer learning	3.44±1.23
Promote student learning ownership	3.48±1.19
Promote study habits	3.40±1.26
Improve learning in general	3.56±1.26
Encourage or change thinking	3.56±1.32
Encourage interactions	3.32±1.28

Validation of the tools: We considered the first group of candidates who joined the first formative assessment of the academic year (14 participants) as

Table 4: Participants' satisfaction of formative assessment.

	Mean score ± standard deviation
Frequency of FA	3.20±1.22
Assessors' performance	3.60±1.32
MCQ	3.12±1.30
CSA	3.48±1.26
Online	3.48±1.29
Feedback	3.44±1.36
Proctoring	3.32±1.21
Overall satisfaction	3.60±1.29
Recommendation for applying in other courses	2.48±1.26

a pilot. Their responses were analyzed for validation and reliability of the pre-and post-questionnaires (reliability coefficient (r)=0.75 & 0.89 respectively)

Statistical Analysis: The statistical analysis was done using STATA statistical package version 16. The frequency data was presented in numbers and percentages. The scores were presented as mean score ± standard deviation (SD). The mean score was calculated by summation of all the variables given scores divided by the number of responses. The P-value was calculated using the Chi-square test with Monte Carlo Exact probability test when appropriate. P-value was considered significant if <0.05.

RESULTS

This study was conducted on all the postgraduate candidates of the Family Medicine Department during the academic year 2020-2021. There were 38 candidates (38 filled out the pre-assessment questionnaire and 33 filled out the post-assessment questionnaire); 64% of them were MD candidates, 16% were 1st part MSc candidates, and 20% were 2nd part MSc candidates. The mean number of FAs attended by each participant was 4.

The pre-FA showed that 18 candidates (47.37%) found the registration process easy. Most of the participants (84.21%) found the online assessment is consistent with the teaching style. About 42% had anxiety while using the online assessment rather than the paper one. Almost half of them (50%) were afraid of connection problems. Only 15% of them thought that it is helpful to have feedback.

The participants' responses after the assessment varied, where 36.36% were stressed during the online CSA. One-third (30.30%) agree that the FA had a positive effect on their learning progress. Almost half of them (57.57%) did not face difficulties in answering the questions (any difficulties related to the learning management system or the

assessment form that make it difficult for the students to answer the questions). Most of them (84.85%) agreed that seeing the timer makes them progress better.

Table (1) shows the various techniques used in the learning process. The CSA took the highest score of 4.06 (±1.17) followed by the FA at 3.84 (±1.20). The lowest score was for Kahoot. Nearly half of the participants found that it was helpful for them to identify how test questions would look like. And 51.52% found that the feedback helped them to correct misunderstandings. One-third saw that FA encouraged them and changed their thinking. Only 18.18% saw that this helped them through peer discussion.

Table (2) shows the participants' opinions on the purpose of FA usage during their courses. The highest score was 3.44 (±1.42) "To provide the student with self-assessment and correction of misunderstanding". That also took a score of 3.6 (±1.35) when asking about the participant's opinion on how FA influences their learning (Table 3).

Regarding the feedback process, 90% preferred immediate feedback, without actual preference towards the group (45%) or one-to-one (50%) feedback. Most of them preferred oral feedback (60%).

Table (4) shows the participant's satisfaction. There was great satisfaction regarding the assessors' performance. The MCQ exam got a lower score (3.12 ±1.30), and FA overall satisfaction was 3.6 (±1.30). When participants were asked about how modules and FA can be changed to improve learning; 'Improve feedback for students (follow up explanation/ availability of questions' answers)' got 69.70% of their responses, 'Improve questions and content format' got 39.39%, while 'Decreases the frequency of the assignments' got 18.18% of their responses. Regarding expected own performance, the mean participants' score before enrolment was 2.52 (±0.82), while the mean score after enrolment in the FA was 3.30 (±1.15) with a significant difference in the expected performance ($P= 0.009$)

Table (5) shows the comparison between the pre-and post-FA. Nearly 8% of the participants expected the registration process to be difficult, whereas only 3% after the exam found it difficult ($P= 0.043$). Where 63.16% of the candidates expected that FA would be an easy and comfortable process, this percentage increased to 75.76% after the exam. About 66% expected that the exam would be fair, and this percentage increased to 87.87% after the exam.

Table 5: Comparison between pre-and post-formative assessment participants' perception and impressions (pre-assessment N=38) & (post-assessment N=33)

	Strongly agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly disagree. N (%)	P-value
Is it easy to register to the system?						0.043
Pre-formative assessment	8 (21.05)	18 (47.37)	9 (23.68)	3 (7.89)	0 (0.00)	
Post-formative assessment	16 (50.00)	9 (28.13)	6 (18.75)	0 (0.00)	1 (3.13)	
I have followed the direction without any problem						0.035
Pre-formative assessment	8 (21.05)	17 (44.74)	8 (21.05)	5 (13.16)	0 (0.00)	
Post-formative assessment	15 (48.39)	10 (32.26)	6 (19.35)	0 (0.00)	0 (0.00)	
Is the online assessment system easy to use and comfortable?						0.114
Pre-formative assessment	10 (26.32)	14 (36.84)	12 (31.58)	2 (5.26)	0 (0.00)	
Post-formative assessment	18 (54.55)	7 (21.21)	7 (21.21)	1 (3.03)	0 (0.00)	
Do you expect that the online assessment will be better than the paper-and-pencil format?						0.025
Pre-formative assessment	7 (18.42)	18 (47.37)	8 (21.05)	5 (13.16)	0 (0.00)	
Post-formative assessment	17 (51.52)	8 (24.24)	3 (9.09)	4 (12.12)	1 (3.03)	
Do you expect that the online assessment is contemporary and more systematic?						0.158
Pre-formative assessment	9 (23.68)	17 (44.74)	9 (23.68)	3 (7.89)	0 (0.00)	
Post-formative assessment	14 (42.42)	14 (42.42)	5 (15.15)	0 (0.00)	0 (0.00)	
Is the online assessment consistent with the teaching style?						0.314
Pre-formative assessment	10 (26.32)	22 (57.89)	5 (13.16)	1 (2.63)	0 (0.00)	
Post-formative assessment	15 (45.45)	14 (38.89)	4 (12.12)	0 (0.00)	0 (0.00)	
Are you more anxious while using the online assessment system than the paper?						0.707
Pre-formative assessment	6 (15.79)	10 (26.32)	8 (21.05)	13 (34.21)	1 (2.63)	
Post-formative assessment	2 (6.06)	11 (33.33)	9 (27.27)	10 (30.30)	1 (3.03)	
Do you expect that the online assessment fair?						0.030
Pre-formative assessment	6 (15.79)	19 (50.00)	10 (26.32)	3 (7.89)	0 (0.00)	
Post-formative assessment	14 (42.42)	15 (45.45)	4 (12.12)	0 (0.00)	0 (0.00)	
Do you expect that the cheating will be difficult?						0.067
Pre-formative assessment	7 (18.42)	20 (52.63)	8 (21.05)	2 (5.26)	1 (2.63)	
Post-formative assessment	15 (45.45)	9 (27.27)	8 (24.24)	0 (0.00)	1 (3.03)	

*P-value was calculated Chi square with Monte Carlo Exact probability test

Regarding the assessors' feedback, 10 assessors out of 13 responded to the questionnaire. Seven out of 10 assessors believed that these assessments extremely benefit the candidates, while one of them was neutral. Eight out of 10 assessors did not find difficulty in being the role player and the assessor at the same time during the online CSA. And 9 assessors thought that sharing in the FA as an assessor enriched their experience, Figure (1). When asked to rate the perceived benefit of attending these assessments as assessors from 1 to 5, half of them chose 5 (very good) as a rating for the perceived benefit, while 2 and 3 assessors out of 10 chose 4 (good) and 3 (acceptable) respectively. Also, 5 and 4 assessors were chosen equally as a rating for the perceived benefit of participating as a simulated

case writer. One-third chose 5 (very good) as a rating for the perceived benefit of participating as an item writer in the AKT.

When asked to rate the workload of conducting the virtual clinical FA, half of the assessors chose 4 (satisfied) as a rating for the overall workload, while 3 and 2 out of 10 assessors chose 3 (neither dissatisfied nor satisfied) and 2 (dissatisfied) respectively. All the assessors equally chose 4, 3, and 2 (satisfied, neither dissatisfied nor satisfied, dissatisfied respectively) as a rating for workload in delivering comprehensive feedback. Two assessors chose 5 (very satisfied) as a rating for the workload in delivering the written feedback to the candidates, while 3, 2, and 2 assessors chose 4, 3, and 2,

(satisfied, neither dissatisfied nor satisfied, dissatisfied) respectively.

DISCUSSION

The assessment has an important role in detecting students' understanding and identifying their learning needs thus adjusting the teaching methodology. FA can give the candidates a supportive learning environment and credible feedback which is supposed to be positively reflected in their performance in the SA. Although, it is clear that FA is well suited to postgraduate medical training, giving them a great opportunity to engage in a learning environment similar to the SA exam settings, engaging both candidates and assessors in meaningful FA is considered a complex task for both. The current study demonstrated that although 36.36% of the participants were stressed during the online CSA exam, one-third agreed that the FA has a positive effect on their learning progress. This is in line with Velan et al 2008.¹² who enrolled undergraduate medical students in seven courses and analyzed end-of-course (EOC) marks concerning the effect of participation in voluntary online FAs. They concluded that performance in formative assessments correlated significantly with EOC marks ($p < 0.001$ for each course). Our study results were also in line with Chandra 2013¹³ who conducted a study on 22 obstetrics and gynecology residents in India using the mini-CEX tool for formative assessment to investigate the gap between the candidate performance in the SA and their performance in their actual workplace. The study found that initial difficulties for implementing FA including incomplete apprehension of the evaluation system were eliminated after recognizing the rating scale and getting structured feedback.

The current study showed that the FA is among the most accepted learning tools while Kahoot was the least accepted tool. This is opposite to Ismail et al 2019.⁸ who conducted five focus groups with medical students who participated in several Kahoot sessions. Their results suggested that Kahoot sessions motivate students to study and determine their needs. This difference between both studies may be attributed to the different participants as Ismail et al 2019.⁸ the study included undergraduate medical students who are expected to be motivated by game-based learning tools. Our study results were in line with Chandra 2013¹³ who concluded

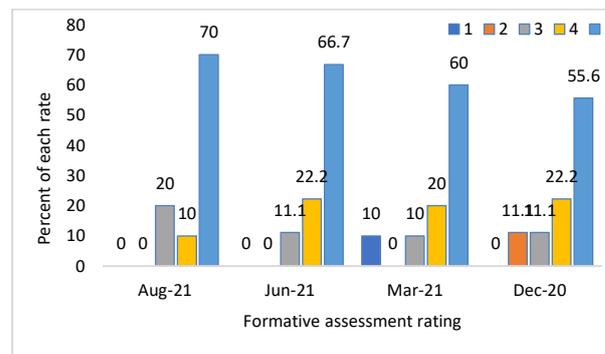


Figure 1: Assessors' rating of the four formative assessments done during the academic year

that FA improved the candidates' communication skills, clinical skills, and confidence levels and stressed on the willingness of the candidates and the assessors to continue with FA as one of the tools for improving candidates' clinical skills.

Most of the participants valued FA to provide self-assessment and correct any misunderstanding. This is in line with Velan et al 2008.¹² who demonstrated that the FAs were highly valued by students as a means of gaining feedback and planning future study. Our study results were also in concordance with Sharma et al 2015¹⁴, who found that the willingness of the candidates to ask for feedback on their performance in FA increases their awareness and active responsibility in mapping their learning pathway and so FA should be started as early as possible in their training program.

The current study showed that most of the participants found the assessment an easy and fair process. This agrees with Snekalatha et al 2021.¹⁵ who conducted a study on 100 medical students taking online classes and tests to assess their perceptions of the reliability, usefulness, and practical challenges of online tests. They concluded that although online testing is easy, fair, and useful, network connectivity and home-environment distractibility were of serious concern.

After the 4 FAs, 7 out of 10 assessors believed that these assessments extremely benefit the candidates. This agrees with Sharma et al 2015.¹⁴ who conducted a study in a rural medical college to explore perceptions about factors that determine active engagement in FA. They concluded that engaging in FA increased individual perspectives on feedback through goal-oriented training, created a supportive learning environment, and focused on the credibility of feedback through tailored feedback. This can be explained by the agreement that it is difficult for physicians to conduct self-assessments and identify areas that need improvement in their learning process. This makes it mandatory to implement FA

to get benefit from external evaluation in a setting similar to SA. Moreover, FA is more than just giving feedback in a single setting, it can formulate the learning action plan to prevent future frustration for both the candidates and the assessors.

Most of the assessors rate the workload of FA as 4 out of 5 on the Likert scale. This agrees with Byrne et al 2014.⁷, who measured the mental workload of 10 examiners during a Formative OSCE (Objective Structured Clinical Examination) using two validated methods while 24 trainee anesthetists working in an operating theatre were used as a control group. They found that the mental workload of examiners exceeded that of controls.

CONCLUSIONS

The postgraduate's online FA including the MCQs, CBD and CSA is an easy, beneficiary and comfortable process that can give the candidates a feedback on their performance and giving the chance for improvement.

Ethical Approval

The study was approved by the Research and Ethics Committee of the Faculty of Medicine, Cairo University, Cairo, Egypt (IRB Number: N-52-2021)

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