

Review Paper

Online Fellowship Exit Examination During the COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The COVID-19 pandemic requires minimizing close human interactions its aero digestive tract secretions serve as a carrier for this disease. During the early stages of the pandemic, when the nature of the coronavirus was still unknown, most institutes made the decision to temporarily avoid all in-person contact and close their campuses completely. For many higher education institutions, this resulted in the cancellation of upcoming examinations. Without a clear understanding of how the coronavirus operated and the most effective measures to prevent its spread, collecting students into one room for a prolonged period was no longer considered safe. However, examinations are a critical part of the higher education process and a necessary step in providing medical trainees with accurate grades. Online exams are still a new phenomenon at higher education institutions, so there's a lot to learn regarding the wide-spread implementation of these new exam processes. However, during a period where in-person contact comes with many risks, online exams are a great way of maintaining momentum in higher education and to ensure the learning process doesn't ground to a halt. Conducting online examinations is based on the Artificial intelligence (AI) designed databases and software. It reduces the use of paper and other resources. For medical trainees, online structural clinical examination (OSCE) can also be conducted online on software based video call applications.

This review article deals with four different patterns which have been followed in India. Based on this experience we consider that conducting online examination is a feasible option during pandemic situation.

Keywords: Examination, online, pandemic, education, corona virus, COVID-19

Introduction

An examination is a process of evaluating an individual's knowledge, ability, or skill in a particular subject. It is a systematic process of collecting, analyzing, and interpreting the information to determine the extent to which trainees are achieving and understanding instructional objectives [1]. The examination is used as a measuring tool to convert qualitative data (knowledge, skill, or ability) into quantitative data (rank, grade, etc.). An academic course aims to provide the source of knowledge in a particular subject during a pre-defined period. The examination is also used as a yardstick to assess the trainee's knowledge on a predefined scale of ranks and/or grades. It is a method of cross-sectional examination of knowledge as it relates to a particular subject matter applied either to a single individual or a group of individuals participating in this process. Historically, the examination process started when humans came into existence. In India, notes on the tradition of guru shishya (teacher and student) can be recognized in the great epics of the Ramayana and the Mahabharata where trainees are assessed regularly by a teacher through examinations. The teachers assessed their teaching skills through the achievement of their trainees. Takshashila (150-180AD) and Nalanda (450-850AD) are the ancient universities of India with a structured educational system with proper evaluation methods [2].

An examination/assessment can be a closed book type where the examinee depends on memory to respond to the questions. In an open book, system reference material is allowed to be used to give a response to a question. The examination can be conducted formally with a pattern of questions as indicated, and be supplemented for example, with an exit exam after a certification course. It may also be conducted informally for example, evaluating a trainee's ability to rate a story or read a paragraph. For those who have undergone training in health education, an examiner may observe the candidate's complete interaction with the patient and the team. An examination may be conducted orally either in person or digitally (virtually, online), securely on paper, using technology. The health care trainee evaluation may require the use of animals where indicated, volunteer model human actors, or by using high-fidelity simulation technology.

The effective delivery of healthcare needs not only didactic knowledge and technical skills but also good analytical and communication skills, interdisciplinary teamwork and care, counseling, evidence; problem-based learning and system-based practice. This requires our assessment systems to be thorough, sound, and robust enough to evaluate the requisite attributes along with testing for the required knowledge and skills. An individual assessment has a powerful positive steering result on learning and completion of the curriculum. It imparts what we value as important and is the most cogent motivator of student learning [3].

Why an online examination is required ?

The Corona virus disease 2019 (COVID-19) global pandemic requires minimizing close human interaction and the use of appropriate distancing and physical barriers to prevent the spread of this disease especially between asymptomatic but contagious folks and unexposed individuals. The aero-digestive tract secretions serve as a carrier for the virus causing disease. COVID-19 being a highly contagious viral illness has been responsible for inoculating individuals by aerosol generation, loud speaking, sneezing, and coughing. The use of a face-mask and social distancing has become a new public norm [4]. Many cities and academic campuses across the world are under lockdown. Public transport is scantily available and social gathering could be a punishable offense. In many places, the standard form of education with a physical presence in a classroom is no longer allowed nor encouraged. Medical trainees are receiving digital didactic and simulator-based education with proper distancing and facemask and face-shield protection. Direct learning from physical contact with patients is limited but gradually increasing as the dynamics of virus spread and its confirmation in patients are becoming available. At the University of Minnesota in the U.S, medical students and graduate trainees in anesthesiology have now been allowed to return and resume clinical work with the wearing of facemasks, hand-washing with detergent, and use of appropriate personal protective equipment (PPE) when required. The didactic teaching, grand-rounds, and morbidity and mortality discussions are still largely conducted on a digital platform. However, trainee evaluation and examination remain an essential part of the curriculum. The current unprecedented situation poses a great challenge in conducting assessments as per the past

protocols. The risk of contracting COVID-19 between the examiner, the candidate, and mock-patients is considerable. Unless all three groups of individuals are tested for the absence of COVID-19 the manual involvement in a room between personnel imposes a significant risk. Many candidates are usually clustered in a room for the required monitoring during the written examination. Similarly, during the viva portion of the exam there will be a close interaction between the examiner and examinee, not only a time-consuming process but also requires significant interaction with other individuals for the proper conduct of the examination process. Also, there are limitations in the number of candidates that may be able to take the live examination at a single physical place. The following changes that have occurred both in teaching and conduct of examinations are now reviewed as follows:

The technological advancement in communication has revolutionized the method of conducting examinations. The concept of online examination is not new to our medical community. Many overseas examinations are conducted using digital online media. They have proven to be efficient, less time consuming, and effective. COVID-19 posed social barricades for conducting manual examination that may thus be overcome by judiciously using online examination systems [5].

At present, a wide range of methods are available not only for assessing but also addressing patient care issues including modification of essay type questions (MEQs) checklists, Objective Structural Clinical Examination (OSCE), student projects, simulated surgeries, Constructed Response Questions (CRQs), critical reading of papers, rating scales and scores, tutor reports, portfolios, short and long case assessment, essay type questions, use of logbooks, trainer's reports, the conduct of audits, video assessments, simulator use, self-assessment, peer assessment and use of standardized patients.

Measuring progress in ascertaining deep knowledge and competencies may be a problem if the exams are designed to measure multiple integrated abilities, such as factual knowledge, solving problems, synthesis, and analysis of information. Trainees may delve into one's ability and ignore other options making it difficult to conduct holistic evaluations. Therefore, progress tests that are designed to measure growth from the beginning of learning until graduation should measure distinct abilities.

If a large amount of knowledge is required to be tested, MCQs should be used. Long and short cases should involve the use of clinical scenarios. Objective Structured Clinical examination (OSCE) consisting of multiple stations where each candidate is instructed to perform a defined task such as taking a focused history or performing an attentive clinical examination of a particular system needs to be performed. A standard grading scheme that is specific for each case has to be used. It is an effective alternative to unstructured short cases. The assessment is a basic component as part of the whole educational system. The assessment should be designed prospectively along with learning outcomes. It should be purpose-driven. Assessment methods must provide valid and usable data. Methods must yield both reliable and generalizable data.

Multiple assessment methods are essential to gather most aspects of clinical competency and any single method is not adequate to do the job. For knowledge, ideas, application of that knowledge ('Knows' and 'Knows How' of Miller's conceptual pyramid for clinical competence) context-based Multiple-choice questions, elongated matching items, and short answer questions are suitable. For 'Shows How' multi-station OSCE is useful. For performance-based assessment ('does') mini-CEX (Mini Clinical Evaluation Exercise), DOPS (Direct Observation of Procedural Skills) is appropriate. On the other hand, clinical work sampling or logbook may be used. Assessing a trainee is a comprehensive conclusion making process with many important indicators beyond the measure of a student's success. Trainee assessment is also related to program evaluation. It gives important data to determine the effectiveness of the program, improves the teaching program, and helps in the development of educational ideas.

The online examination system (OES) uses client/server architecture. A database is used to save the exam information. An instructor or administrator can add or delete questions; set the correct answer, set the time limit of the exam, can register, or delete a student name. They can show the questions randomly to registered trainees calculate the results automatically and show the results immediately. The information of questions displayed to trainees, their response to the question, the correct response, the score of the student are archived in a database, so it can be reviewed

anytime later [6]. All of this is done confidentially by the examiners with secure systems in place to avoid leaking of the examination.

The examinations will be split out in:

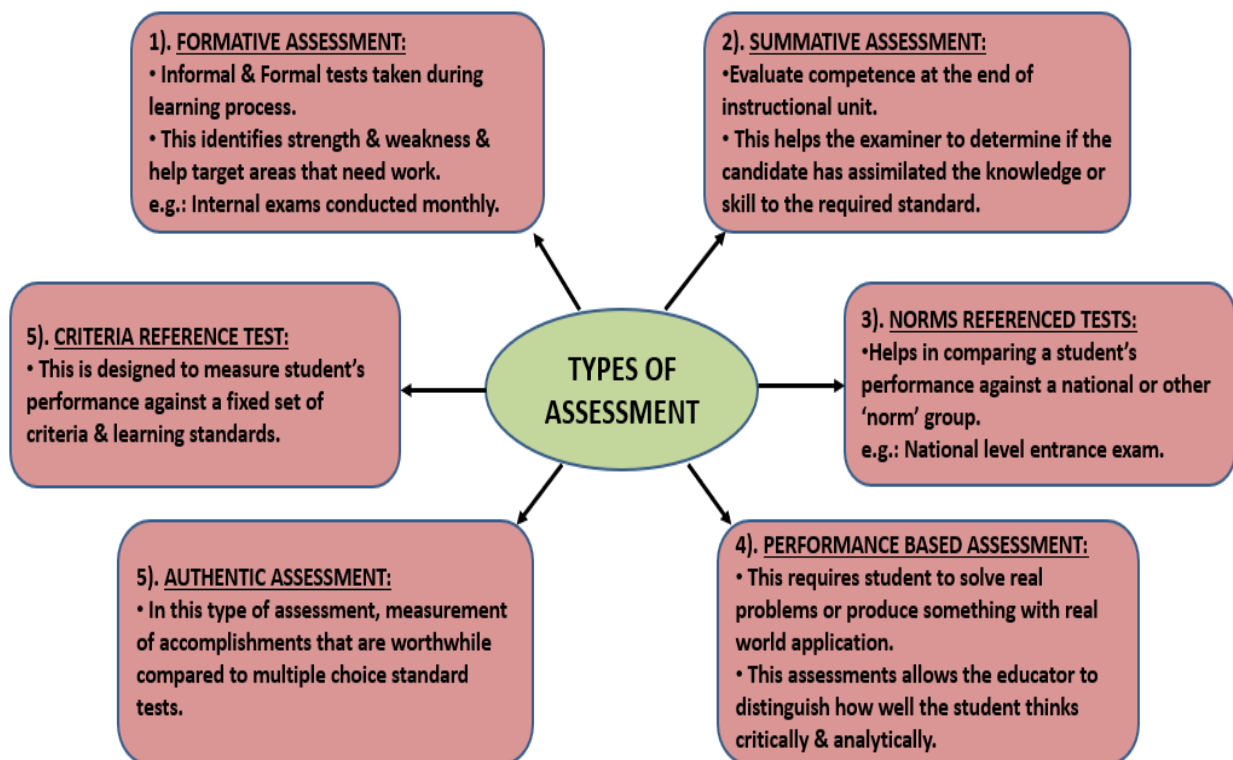
Written Exams: The written examination consists of Multiple-choice questions. Multiple choice questions may be administered in one of two ways:

- (1) **Single location:** All candidates in an urban area will need to reach and assemble in an examination center. The candidates will be allocated to an examination room where the multiple-choice questions are projected on the screen and the examinees are asked to choose the correct answer and write it on the answer sheet. By the end of the day, marking will be assigned based on the answers provided by the candidates. Another way to do this is using individual computers with specific safety log in criteria (e.g. Prometric). Here, the candidates are thoroughly frisked along with verification of their identity before allowing them to enter the exam hall equipped with multiple computers. They are randomly made to sit on different computer desks and are allowed to log in to the exam with their unique login and password.
- (2) **Multiple locations:** In this type of examination, the MCQs are transmitted electronically to several centers in a particular region.

Practical Exams: Practical exams are further divide into 3 parts –

- (1) Objective structural clinical examination
- (2) Cases discussion based on clinical scenario @ viva Stations

Figure 1: Assessment Types



Online Examination System

An online examination system is a computer-based test system that can be used to conduct computer-based tests online. This examination system uses fewer resources and reduces the need for question papers and answer scripts, exam room scheduling, arranging invigilators,

coordinating with examiners, and more. Objective structured clinical examination (OSCE) can also be conducted on the online platform using various video call applications. The examiner staying far can see the candidate performing at each virtual station using virtual patients. An oral examination (viva-voce) also may be conducted using video conference applications [7].

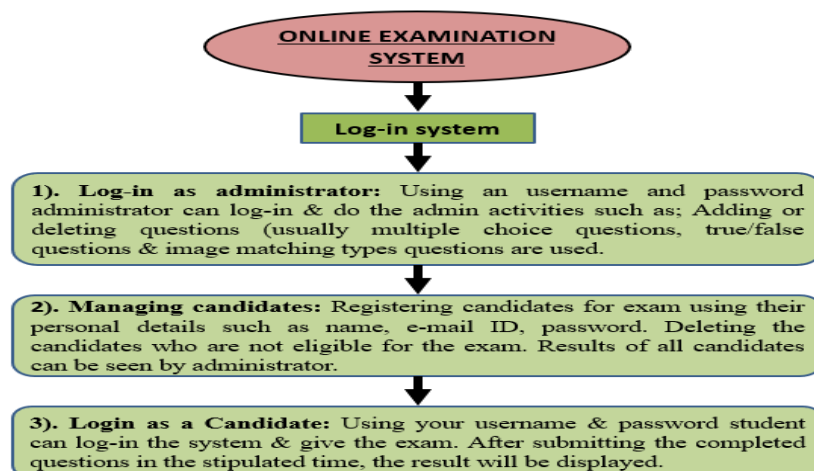


Figure 2: Flowchart depicting the components of online examination system (OES)

Role of Artificial Intelligence

Artificial Intelligence (AI) is a computer's ability to mimic human intelligence. In practice, it is a segment of computer science that involves designing computer applications to perform tasks that typically have required human intelligence such as visual perception, speech recognition, and decision making [8].

Due to the increasing scale in the number of patients with COVID-19, the education system has suffered in many aspects. As per the guidelines released by the central government, the institutions are not allowed to conduct regular examinations for the trainees and fellows until the COVID-19 situation is declared as controlled. In this situation, Artificial Intelligence (AI) can play an important role in many ways.

Online examination system with AI

Online examination system is software via a portal with one added artificial intelligence that is it even checks brief answers manually typed by a student along with the option of ticking and providing appropriate marks to the user. The online examination system first accepts a login id and password and then allows authenticated users to appear for the exam. The exam is of a limited time span as pre-determined and provides a set of questions in a random order for each user appearing for the test. Along with the option of selecting answers, some questions may even have the answer to be written as a brief. This answer was manually written by the examinee is graded by AI and given appropriate marks by the system. This is done by comparing the user's written answer with the real answer stored in the system database. When the test is completed the total marks are calculated and displayed to the user at the same instant.

Advantages of OES

1. **Safer during COVID-19 pandemic:** Manual examination system involves close contact of candidates with each other, with the examiner and the mock patients. As the COVID-19 virus spread by aerosol, this system poses a greater risk of infection spread to candidates, examiner, and the patients. Whereas the OES allow appropriate social distancing among candidates, the examiner need not have to travel to the exam center and avoids direct contact with candidates and patients, a standardized virtual patient can be used instead of real patients [9].
2. **Environment friendly:** The usage and thus wastage of paper is reduced by OES significantly. The ongoing environmental crisis caused by climate change can be reduced by effective and eco-friendly steps like OES.

3. **Time saver:** The time taken for the whole manual examination process is significantly reduced by OES. Manual preparation of questions and printing is avoided by OES. The exam can be conducted in batches with more students in each batch, thus the whole duration of the exam is reduced by OES.
4. **Reduces expenditure:** As the stationery cost and printing charge are not involved in OES, this system reduces the cost of examination considerably. OES also avoids the necessity of booking examination halls and invigilators needed to conduct the exam.
5. **Increased privacy and security:** Because of a secured login facility, unauthorized individuals cannot manipulate the system, thus the conduct of the exam and publication of results provides additional security. The results can be used by using a username and password and call-back double security, thus maintaining the privacy of the candidate.

Disadvantages of OES

1. **Open book exams:** OES becomes an open book exam as it provides freedom for candidates to access online subject related materials. But careful selection of questions and time restriction can avoid this negative effect of OES.
2. **Infrastructure requirement:** Technical requirements such as a desktop computer or laptop with a good quality internet connection, built-in or external webcam, microphone, and speaker must be arranged by the candidate or the institute. The candidate will require a clean desk and a lonely room for participation in the exam. The present era of technological advancement has allowed these facilities that are typically easily available in every household.
3. **Newer technology needs training** It is a mind-boggling job for those who are not used to the regular usage of the online platform. It needs multiple trial runs before actual exams. To avoid confusion, a model exam can be conducted for all candidates before the real exam. It avoids anxiety and improves the performance of the candidate and examiner [10].
4. **Unanticipated system failure:** Unanticipated system failure could foil the online exams which could result from power failure, inability to fulfill system requirements, lack of continuous high-speed internet facility, and unanticipated security issues. Any glitches in computer performance or internet connection must be accommodated contemporaneously.

Indian College of Anesthesiology (ICA)

Since March 2020 due to the lockdown, the routine academic schedule has become disrupted. Trainees enrolled for a year fellowship program in Cardiac Anesthesia and course coordinators have faced an unprecedented challenge of continuing the academic activity and were much more perplexed about the method to conduct the summative examination. Taking advantage of the significant advancement in communication technology, we propose a rapid shift to utilizing online teaching platforms that to date have helped the academic program to continue without any interruption. In a recent pilot, multiple-choice questions have been used to test the knowledge of candidates while decision-making skill has been assessed using OSCEs, problem-based learning and case discussions. Similarly, the performance skill was assessed by reviewing the logbook maintained by the candidate over the academic year. Interactions between the examiner and candidate have been successful via an online platform. A Time-limited display of MCQs has been performed. OSCE stations were arranged with 2 or 3 questions about a particular device/drug/images e.g. ECG, trans-esophageal echocardiography videos/images. A series of up to five stations were arranged and the images or videos shared with the candidate's desktop or laptop computer using a webcam and a microphone were provided.

The short and long case discussion has been conducted with a face-to-face interaction between the examiner and student using an online video system. In a two-week follow-up, none of the candidates developed COVID-19 symptoms. About 82% of candidates felt the online platform a better alternative to routine classroom examinations. Proper planning of the exam blueprint, a stable high-speed internet connection, a properly working microphone, and a web-camera are the minimum requirements to conduct a successful online examination. Though an examiner missed

the direct interaction with trainees, the examiner was able to evaluate the candidate's at par with the routine examination system. Examiners spent an average of three hours for the whole online exam while it used to take two days' preparation including travel and stay. The online exam is economical too. It reduced the money spent on stationeries, transport, and accommodation of examiners.

ICA Protocol for Exit examination during Covid- 19 Pandemic:

1. All candidates must report to the center at 8.00 am after breakfast. No breakfast will be provided but packed lunch will be provided. Candidates are advised to bring their own bottled water for drinking.
2. Candidates are advised not to sit for the examination if they suffer from fever, cough, or any other symptom suggestive of possible COVID-19; but no COVID-19 test will be necessary.
3. Temperature and SpO₂ will be checked before entry to the examination hall.
4. Hand sanitizer must be used before entry and at two-hourly intervals till the exit after the examination.
5. Safe distancing must be maintained at all times.
6. Face Mask (surgical mask or N95 (covering the face & mouth) must be worn all through); No PPE needed but face mask must be worn.
7. Cough and sneeze etiquette must be followed.
8. No thesis nor logbook verification is included in the evaluation.
9. Must bring Government-issued ID and admit card.
10. There will be no live patients for practical examination; instead case scenario will be provided case discussion.
11. A written exam with 50 MCQ pattern questions plus 25 OSCE pattern questions need to be prepared in PowerPoint presentation.
12. The practical examination will include viva-voce at 4 stations of 10 minutes each, and 2 virtual cases of 15 minutes each.
13. All examiners will be on a laptop screen and connected through Wi-Fi. Examiners are not required to travel to the center.
14. Candidates are advised to bring their laptops which are working; connectivity will be provided but there will be strict vigilance. If someone is found browsing the internet/books/notes during the exam, they will be debarred from the examination.
15. The candidates are prohibited from entering the clinical areas of the hospital.

ICA Fellowship Exit examination during Covid- 19 Pandemic:

Images: A, B, C, & D



A) Written exam with MCQ's being projected on screen with safe distance; B) OSCE on a screen; C) External examiners from distant location; D) Candidate interacted with external examiners online; E) Candidate face to face with internal examiners; F) Tabulation of marks at the end of the exam

The Simulation Society (TSS) pattern:

An online clinical examination for fellowship certification during the COVID-19 pandemic

The TSS platform, over the years has been doing online fellowships as shown in Figure 1A, 1B, 2 and table 1. An online solution was needed in which multiple cases and scenarios could be presented in a structured clinical vignette format and the students learn on simulators to enhance their clinical skills. This format was taken care by an information technology portal entitled "Buzz4health". The academic partnership between The Simulation Society and Buzz4health, is now four years old, bearing fruitful results.

Digital E-learning TSS fellowships in COVID-19 pandemic

The virtual e-learning platform is well known since 2015⁽¹¹⁾. The simulation society has been doing Digital e-learning fellowships since 2016. But in COVID-19 pandemic, the governments, all over the world are recommending shifting to online learning as transient arrangements to prevent any academic disruptions. TSS was ready for it, already with a batch ready for training enrolled in September 2019 and exam-going in August 2020. But, COVID-19, digital technology availability made it so much easier than before (Fig 1A and 1B)

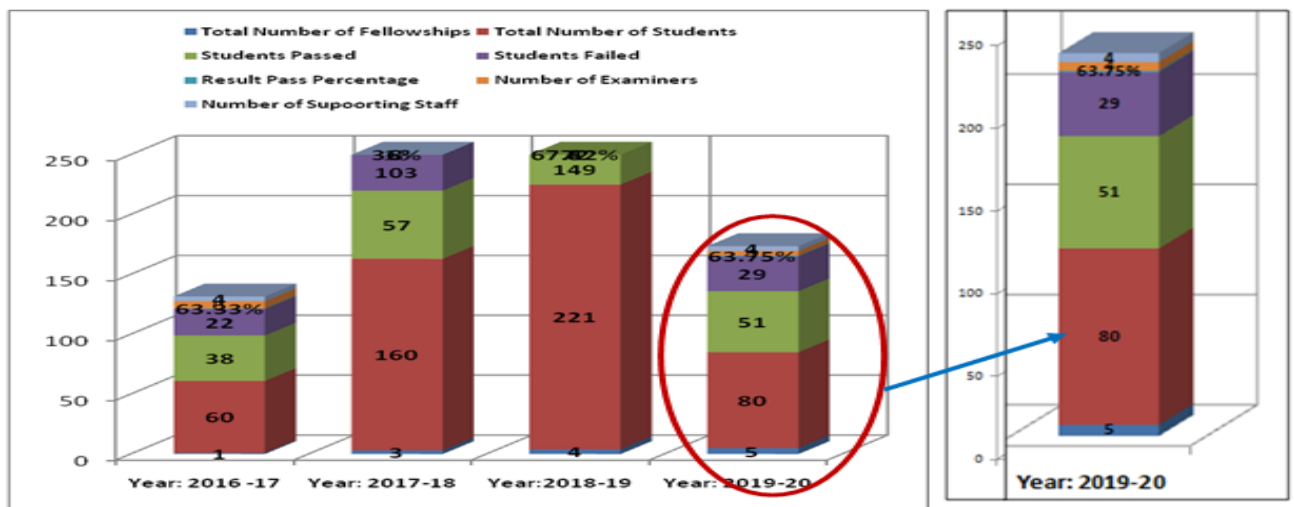
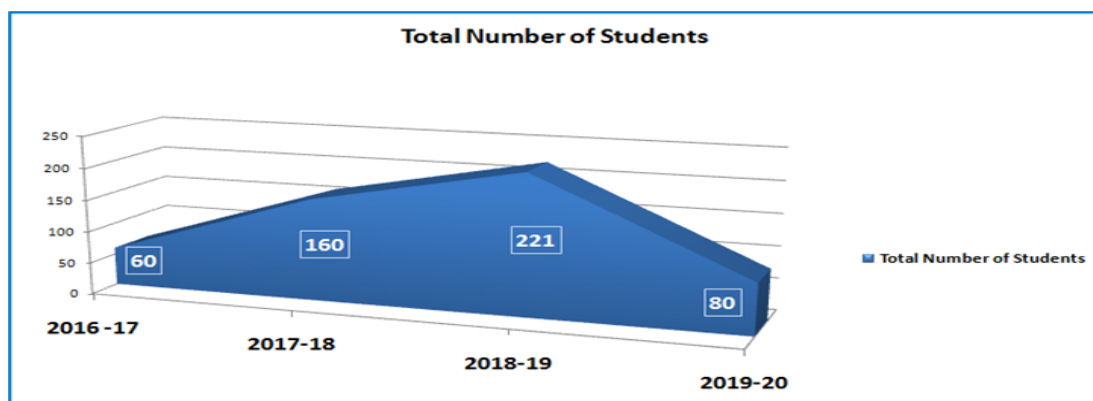
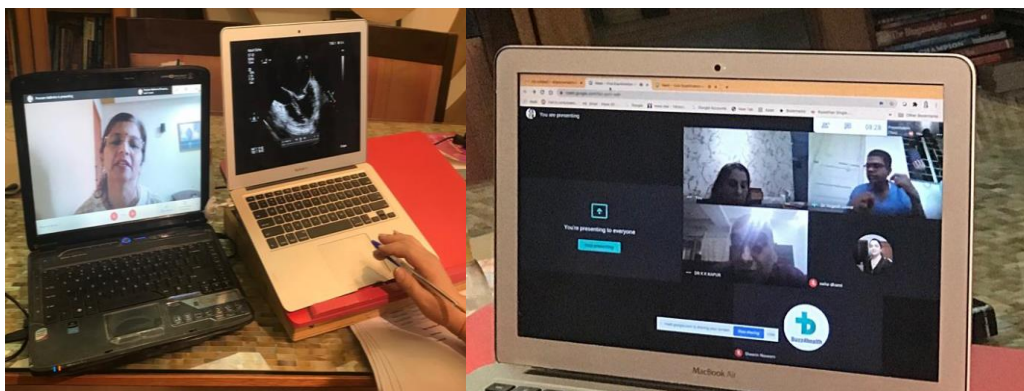


Figure 3A and 3B; 3A: JCCC-TSS Fellowships Statistics; 3B: Statistics in COVID pandemic TSS examination

	2016 -17	2017-18	2018-19	2019-20
Total Number of Fellowships	1	3	4	5
Total Number of Students	60	51	221	80
Students Passed	38	50	149	51
Students Failed	22	1	72	29
Result Pass Percentage	63.33%	98%	67.42%	63.75%
Number of Examiners	6	13	8	4
Number of Supporting Staff	4	8	6	4

Figure 4: Number of student's year wise in TSS Fellowships

In response to the COVID-19 pandemic, following lockdown and social distancing norms, The COVID-19 pandemic and TSS, there was a boom in digital E-learning platforms. The simulation Society (TSS), already had an existing 4th year batch of fellows – 80 of them, enrolled in five different fellowships since September 2019. They were to be final exam going in August 2020 scenario (Figure 3A and 3B).

**Figure (5A and 5B): Exit Examination of TSS Fellowship, a screen shot of the online methodology**

During COVID-19 pandemic, the content for fellowships in Echocardiography, Cardiac Critical Care, ECMO, ECMO specialist and Cardio diabetes were given in even a more diligent and sincere manner. The recent information quality, user satisfaction, communication between information technologies, all TSS fellows and faculty improved tremendously, mainly due to more time available, for most. The information technology, system quality too has improved with Zoom, Google meet, WebEx and such social media, portal sites, are easily available during this Pandemic era even with a wider variety. The examination was conducted in a timely and meticulous manner.

Methodology

What was different in 2019-20 Examination during COVID-19 pandemic?

The model adopted by TSS was a modification of the DeLone and Mclean IS model (Fig 3); the modification being hands on simulation based learning in a seminar/CME format with physical face to face 2-3 times as well.

Port-Mapping Tool for Digital Logic Design

Since most education industries are adopting the available digital technologies such as digital video conferencing platforms like Zoom, Microsoft platform and WebEx blackboard and Google classroom, this will be enhancing e-learning globally [12-13].

The Port-Mapping tool was made available for student download from the My E-learning course page. With this resource, students could have taken any data path block diagram and use the step-by-step teaching feature to arrive at the complete VHDL code for the port mapping of any system. A special Buzz4health Zoom webinar portfolio was created for each of 80 students.

Table 2: Down regulations and advantages in Exam during COVID-19 pandemic	
Down regulations in COVID-19 Exam	
➤	The hands-on workshops, before the exam on simulators were restricted this year due to COVID-19.
➤	Restricted physical face to face examiner-student viva voce.
➤	Student’s attention span was less than anticipated.
➤	Overall Students confidence was weaker this year, as many were doing COVID duty as well and had less time to read for the examination
Advantages in COVID-19 Exam	
➤	Communication was possible better than before, over Zoom and WhatsApp and the latter was hundred percent.

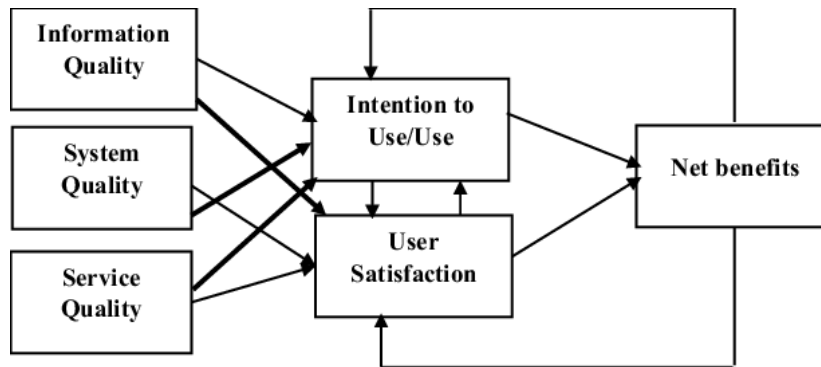


Figure 6: Updated De Lone and McLean IS Success Model (D&MISSM)

Male: Female comparison was different this year

Though numbers of females enrolled this year were less than the earlier year, we observed as examiners that the females were more punctual, communicative, and conscientious and more focused on the E-learning portal as compared to the male students. The timeliness, etiquettes and adaptation to the IT platform usage appeared to be better in females than most males. Thus, in the COVID-19 batch of this year, the females scored better! This could be a chance observation.

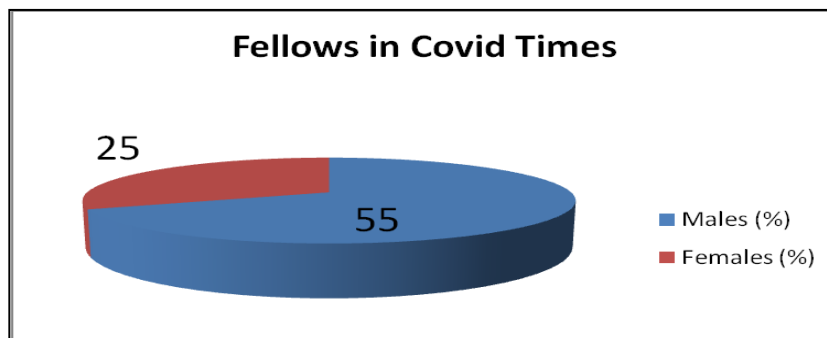


Figure 7: Male vs. female fellows

Post-hoc SWOC analysis of the TSS Fellowship this year

It's important for every digital programme, to do a repeated in-house SWOC analysis, of their strength, weakness, opportunities and challenges doing the course. We too, did it this year during the COVID-19 pandemic.

Introduction to the SWOC (Strengths, Weaknesses, Opportunities and Challenges) Analysis was done by TSS

The objective of conducting a SWOC analysis (in conjunction with other curriculum assessment tools) is to develop key areas of focus for improving the curriculum. The SWOC analysis at TSS was particularly effective when conducted in collaborative group settings at the early stages of the curriculum assessment process (e.g. faculty retreats, student, alumni and/or future employer focus groups) [14].

Debate style lecturing to engage and enrich resident education virtually

What Problems Were Addressed?

The need to create effective virtual educational content and tailor its delivery to the learner is paramount at a time where the corona virus disease 2019 (COVID-19) pandemic has rapidly flipped the traditional educational model on its head.

What were the lessons learned?

This online solution was proposed to solve a certification emergency induced by the lockdown. It was challenging to plan assessments with many stakeholders involved. To prevent any setbacks, system tests and 'dry-runs' were conducted many times before the actual examinations. The key to overcoming the multiple challenges was engaging key stakeholders and providing needed support with open communication channels. Importantly, we witnessed a positive change of perspective regarding online examinations during this process. According to the post-examination survey, 96% of examinees and 91% of examiners reported satisfaction with how the examination contents reflected real practice. As a result, SCFHS explored further adaptation to online oral assessment services for activities such as the assessment of ex-patriot practitioners seeking employment in Saudi Arabia prior to their being granted work visas. This service is expected to help reduce the expenses of travelling and accommodation costs commonly associated with certification examinations [15].

Table 2: Teachers and student's ratio

Year	No of students	No of Teachers
2016-17	55	6
2017-18	160	13
2018-19	221	8
2019-20	84	4

Feedback from students

Feedback from students indicated that students may have collaborated in the learning of topics. Although the results of students under the teaching strategies appear to be consistent with that of previous years under the traditional techniques. (Figure 6)

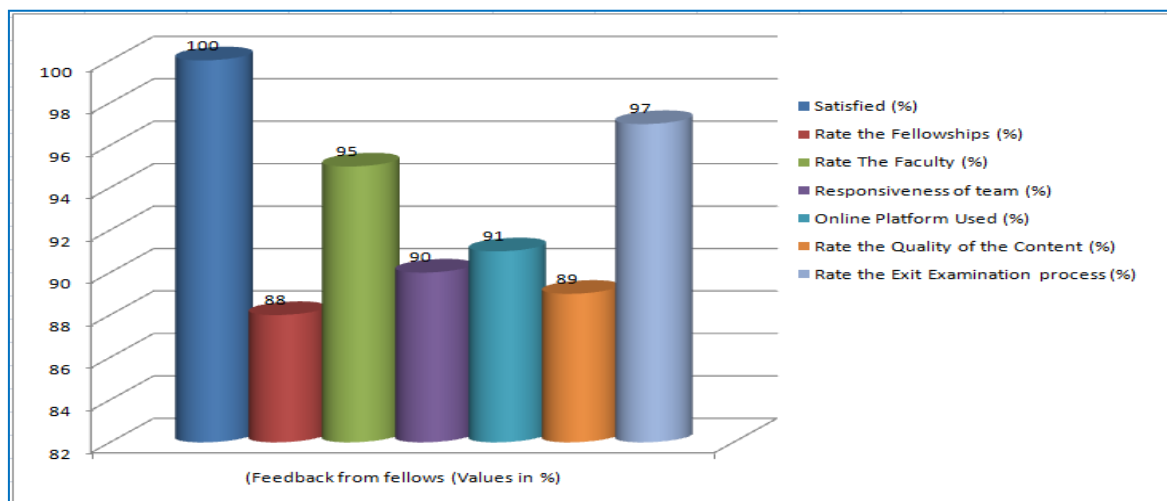


Figure 8: Feedback from fellows as received in COVID-19 TSS fellowships from 59 of 80 students who appeared for digital online examination

IPGMER pattern

Given the unique scenario of a florid pandemic situation, mandating universal social distancing norms, together with the stringent safety guidelines for conduction of examination issued by the Centre, strategizing a neutral, fair, and effective assessment of students at the end of an academic course was a mammoth challenge. More so, when the task was to assess not only the knowledge, competencies, and skill of the student but also their ability of clinical application.

Under the said circumstance, the state university for health sciences had laid down two options for conducting the practical examination in government Colleges for students appearing for DM/MCh exit exam for the super-specialty subjects, the conventional examination pattern with examiners assessing students face-to-face, following strict safety protocol, or the online examination format which does not mandate examiners to be present physically at the examination center.

Our Department opted to conduct the Practical part of DM cardiac anesthesia exit exam for the outgoing batch of 2017-2020 through the online portal. The format that was followed has been described in the following lines.

As per set guidelines, DM Practical exams have a total allotted mark of 400, with the following marks distribution.

One long case: 100 marks.

Two short cases: 50 marks each.

Viva-voce including spotters ECG, Chest X-ray, Echocardiography video/image, drugs, and instruments: 200 marks.

The two external examiners from outside the state, selected by the university, accepted the formal invitation and consented to participate in the conduction of the online format of practical examination.

We had only a single examinee, though the design of our online format was capable of accommodating a larger number of examinees.

During the process of creation of the skeletal structure of the online examination format, we had ensured the prior arrangement of the following requisites:

- A spacious examination hall, the department seminar room was used for the same.
- A high-speed internet connection as in a Wi-Fi router,
- An optimally functioning laptop with a microphone and web camera for the examinee. This was connected to a projector which projected the laptop screen on the larger display screen of the examination hall.
- A video conference app/platform with proven credentials.

- The two internal examiners used their cell phones with good internet connectivity to access the video conference room of the online practical examination.
- A separate video recorder to record the entire proceedings of the examination day.

A demo was enacted using the same online platform, a day before, to ensure smooth, uninterrupted functioning on the examination day, as well as to acquaint the participants to an alien format and thus ease the anxiety.

On the day, the examination started at 10 am, with the examinee and all four examiners logging into a pre-scheduled video conference link. The examinee was given three clinical case scenarios and an hour to go through the same and write down on the examination sheet to be submitted to the university. The online examination began at 11 am. The examinee, the two internal examiners, and the scrutinizer were seated in the examination hall, maintaining social distancing and other precautionary norms, logging into the video conference room with their respective gadgets. The externals logged in from long distances without actually being physically present. The laptop screen of the examinee was projected onto the bigger projector screen. The entire examination then took place with a virtual face to face interaction between the candidate and examiners on the video conference platform. The entire examination proceedings were recorded by an external video recorder for future reference.

Following this format, the long and short cases viva was carried out by each examiner within a pre-stipulated time limit, which was followed by the viva voce for spotters consisting of ECG, Chest X-Ray, TEE video clips, and stills. The latter was presented in the video conference platform using the incorporated application, for simultaneous viewing by all participants. This was followed by the examiners crossing the candidate on drugs and instruments which they asked the candidate to pick up from a pre-arranged array on display.

After thus completing the examination process, the signatures of all four examiners and the scrutinizer were obtained on the final tabulated assessment sheet through a process of scanning and exchange via email. The final assessment sheet, thus completed with all signatures, was submitted to the university in a sealed envelope.

The ISCCM Experience

There are mainly four critical care training courses conducted by the ISCCM (Indian Society of Critical Care Medicine) which include CTCCM (Certificate of Training in Critical Care Medicine), IDCCM (Indian Diploma in Critical Care Medicine), IFCCM (Indian Fellowship in Critical Care Medicine) and IDCCN (Indian Diploma in Critical Care Nursing). Each of the above courses has a theory as well as a clinical exit exam except for the FICCM course which has only a clinical exit exam. The theory exams consist of multiple-choice questions (MCQs) with a single correct answer model, and the clinical exams consist of case based scenarios (without real patients) followed by various exam stations. The exams are conducted twice a year. The theory exam is conducted in selected centers across a few metro cities in India, and the practical (clinical) exams were in various key hospitals in the different metros. The theory exams (MCQs) for the IDCCM course were conducted as online exams at the Prometric exam centers in the last few years. The candidates reaching the Prometric exam centers are thoroughly frisked with their identity closely verified before permitting them to enter the exam hall equipped with multiple computer systems where each candidate is seated randomly and allowed to log in with their unique ID/password. Potential for cheating at the exam is prevented by preparing the same answers in 2 or 3 different patterns. The exam process is also monitored by invigilators for the entire duration. In view of the ongoing COVID-19 pandemic, the exams had to be modified and converted into a pragmatic online version (except for IDCCN exams which are still conducted regularly). The exams had to restructure in such a way that the candidate could be assessed appropriately & adequately within the shortest time- frame within the given limitations.

ISCCM had collaborated with Prometric testing, a US-based company for the conduct of the above online theory exams with the remote proctoring facility, at candidates' place of convenience. In this model of online exam, each examinee that opts to give the online exam will be issued a unique login and ID details on the exam day just before the start of the exam. Each examinee will be monitored by a distant online human proctor whose job is to closely monitor the examinee and re-

ensure that he/she does not make any unacceptable actions or movements at the exam desk which could facilitate cheating. The remote proctor also reconfirms the identity of the student before the start of the exam by verifying their unique ID cards and hall tickets, soon after their login. One such remote proctor is expected to monitor 10-15 students. The proctoring system is further strengthened by an Artificial Intelligence (AI) system which again could independently micro monitor the candidate's movements and send 'warning signals' or concerns to the proctor (if any). The proctor could take an immediate decision regarding the concerns sent by the AI system either allowing the candidate or stop him/her, to continue the exam. When in doubt, the proctor can immediately contact a designated human 'security agent' who could go through and verify the candidate's entire motion pictures recorded by the system. The security agent can then make the final call on the concerns raised by the proctor or AI. It should be noted that only a few students still opted to give the theory exam at the Prometric exam centers in various cities. This is because the first two Prometric theory exams (for CTCCM and IDCCM where about 260 students were examined) faced significant setbacks with large chunks of students not being able to give the online exam due to technical as well logistic issues. Extreme anxiety and frustration were evident among the student community those who could not log in or complete the exam process. Many students were not able to login or those who logged in were not able to maintain the connectivity due to various reasons. The reasons for this failure could have been due to lack of experience or exposure of candidates to such online exams, failure to fulfill the system requirements, unanticipated power failure, lack of continuous high-speed broadband net connections in various places. "Makeup" exams were allowed twice for the above courses in the coming weeks to enable the students who could not give the exams for reasons beyond their control. The subsequent online Prometric theory exams for the next session fared much better than the first ones though makeup exams had still to be conducted for the smaller number of students who were unable to initiate or complete the online exams due to various technical reasons.

The online practical exams for IDCCM, IFCCM, and CTTCM were conducted successfully in zoom meeting mode with two online examiners attending each student. About 8-12 'digital halls' were created depending on the number of examinees on a particular day with 2 online examiners conducting online examination for 2-3 examinees per hall every day. The examinees were given unique login IDs and passwords to enter the digital hall. The examiners themselves crosschecked the ID /hall ticket of individual students before the commencement of exams. The online exam consisted of case-based scenarios (generally long and/or short cases) followed by consolidated exam stations on PowerPoint presentations. The exams lasted for about 5 days and were conducted smoothly in contrast to the theory exam.

Thus, after addressing the initial glitches in the computer based written examination, the online exams appear to be a promising option during the current pandemic scenario. These glitches did not occur in subsequent exams.

Conclusions

The suggested online examination system made it possible to evaluate trainees effectively without difficulty compared to the traditional methods. It has the added advantage of reducing the spread of infection during the pandemic. The success of an online examination system depends on proper planning, appropriate information technology resource availability, and the basic knowledge of online platform usage.

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