The Covid 19 Pandemic learning strategy: From traditional simulation to online simulation

La stratégie d'apprentissage lors de la pandémie Covid 19 : De la simulation traditionnelle à la simulation en ligne

Chadli Dziri[1], MD, FACS, Ibrahim Amara[2], NP, Mouna Ben Rhouma[3], NA, CHSE, Wejden Mnasri[4], NA, Mamoun Ben Cheikh[5], MD, Medical Simulation Center team of Honoris United Universities

1. *Professor Emeritus of General Surgery, Tunis El Manar University, Medical school of Tunis, Director of Honoris Medical Simulation Center - email: cdziri@tn.honoris.net*
2. *Nurse Pediatrics - Honoris Medical Simulation Center - email: bamara@tn.honoris.net*
3. *Nurse anesthetist - Certified healthcare simulation educator - Honoris Medical Simulation Center- email: mouna.benrhouma@ universitecentrale.tn*
4. *Nurse anesthetist - Honoris Medical Simulation Center- email: wejdenmnasri@gmail.com*
5. *Professor of anesthesia, Simulation educator, Honoris Medical Simulation center-Tunis – email: benche2005@gmail.com*

ABSTRACT

Introduction: In Tunisia, during the COVID-19 pandemic, face-to-face teaching was replaced by online teaching.

Aim: This study aimed to compare three teaching periods: face-to-face teaching in October 2020, screen-based simulation in November 2020 and screen-based simulation in April 2021.

Methods: It was a comparison of the three periods of face-to-face teaching "October 2020" versus online teaching "November 2020" versus "April 2021" online teaching using Chi-square and Fisher Exact test when appropriate for categorical variables and Analysis of Variance (ANO-VA) for quantitative variables. During the April 2021 period, we introduced knowledge assessment through pre- and post-tests. The interactivity was facilitated by the questions and answers with the "Google forms" and the simulation session performed by the facilitator guided by remote learners. The main criterion was "Overall satisfaction".

Results: Face-to-face teaching was superior to online teaching using screen-based simulation in terms of overall satisfaction, educational goal achievement, behavior change and recommendation.

The online teaching in April 2021 was superior to the online teaching in November 2020 in terms of satisfaction and recommendation rates.

This was probably due to the interactivity of the Google forms questionnaire and the simulation by the facilitator guided by remote learners.

Conclusion: Face-to-face teaching was superior to online teaching in terms of overall satisfaction, educational goals achievement, behavior change and recommendation.

RÉSUMÉ

Introduction : En Tunisie, lors de la pandémie de COVID-19, l'enseignement en présentiel a été remplacé par un enseignement en ligne.

L'Objectif : était de comparer trois périodes d'enseignement : enseignement en présentiel en « octobre 2020 », simulation sur écran en novembre 2020 et simulation sur écran en avril 2021.

Méthodes : Il s'agissait de comparer les trois périodes d'enseignement en présentiel « octobre 2020» versus l'enseignement en ligne « novembre 2020 » versus l'enseignement en ligne « avril 2021 » en utilisant le test du Khi-deux et le test exact de Fisher le cas échéant pour les variables qualitatives et l'analyse de la variance (ANOVA) pour les variables quantitatives. Au cours de la période d'avril 2021, nous avons introduit l'évaluation des connaissances par le biais de pré et de post-tests. L'interactivité a été facilitée par les questions-réponses avec les «Google forms» et la session de simulation réalisée par le facilitateur guidé par les apprenants à distance. Le critère principal était la «satisfaction globale».

Résultats : L'enseignement en face à face était supérieur à l'enseignement en ligne utilisant la simulation sur écran en termes de satisfaction globale, d'atteinte des objectifs éducationnels, de changement de comportement et de recommandation.

L'enseignement en ligne en avril 2021 était supérieur à l'enseignement en ligne en novembre 2020 en termes de satisfaction et de taux de recommandation. Ceci est probablement dû à l'interactivité du questionnaire Google forms et à la simulation par le facilitateur guidé par les apprenants à distance.

Conclusion : L'enseignement en face à face était supérieur à l'enseignement en ligne en termes de satisfaction globale, d'atteinte des objectifs éducationnels, de changement de comportement et de recommandation.

Correspondance
Chadli DZIRI, MD,
FACS - Professor Emeritus of General Surgery, Tunis El Manar University, Medical school of Tunis, Director of Honoris Medical Simulation Center
Email: cdziri@tn.honoris.net
ORCID: 0000-0003-2779-0930

INTRODUCTION

Simulation is an imitation of a situation or process. As applied in medicine, medical simulation involves the use of synthetic materials, virtual reality or standardized patients to reproduce situations to teach the know-how of diagnostic and therapeutic procedures or decision-making for the health care provider. Medical simulation is intended to help healthcare providers reduce accidents in general medicine, critical care and surgery (1).

In practice, medical simulation is interesting for paramedical students, medical students, resident physicians, and general practitioner physicians, but also for managers, clerks, technicians, regulators and multidisciplinary healthcare providers.

Henceforth, we must retain the maxim "Never the first time on the patient" which is based on meta-analyses with level 1 evidence and grade A recommendation (2).

The Medical Simulation Center (MSC) was inaugurated on November 10, 2018, and the 1st medical simulation workshop was held on February 18, 2019. The workshops are conducted face-to-face and the students appreciated the immersive experience in a near-real environment.

In March 2020, the Covid 19 pandemic became threatening in Tunisia, it caused different kind of problems for educators working in clinical training. The government's decision to stop face-to-face teaching courses was taken on Friday, March 13, 2020. The asked question was: how to achieve the same learning outcomes as before?

The solution was proposed by the International Nursing Association for Clinical Simulation and Learning (INACSL) and the Society for Simulation in Healthcare (SSH) (3). This solution allowed us to move to augmented reality and virtual reality. A webinar (4) with the participation of the Medical Simulation Center, the Medical School of Monastir and the University of Montreal which took place on July 23rd, 2020, concluded that the educational objectives should be respected while taking into account the realism that should improve the commitment and adherence of the learners. A good simulation is the result of a good debriefing (4).

The MSC was not ready yet to practice this virtual and/or augmented reality, so we decided to use Screen-Based Simulation, respecting the different sequences:

- Clarification: Through a demonstration video prepared at the MSC as a briefing

- Illustration: the facilitator performs the scenario on the mannequin.

- Distance learning and participation of students were provided by commenting on previous videos viewed online by the facilitator.

This online teaching (OT) method was conducted from November 2nd to 13th, 2020, however, when comparing it to the face-to-face teaching technique, the students were not satisfied and did not recommend this new online approach.

In January 2021, at the Society for Simulation in Healthcare (SSH) congress "International Meeting for Simulation in Healthcare of 2021" a new online teaching method with better immersion was described.

This new approach, while respecting the pedagogical concepts of Clarification, Illustration, Learning and Participation, consisted in ensuring interactivity through a questionnaire with Google forms and improving learners' participation through a demonstration of a similar situation where the facilitator performed the scenario according to the remote learners' instructions. Each decision is discussed between facilitator and learner with justification beforehand, which has led to better engagement and better adherence from learners.

This work aimed to compare the three teaching periods: face-to-face teaching in October 2020, screen-based simulation in November 2020 and screen-based simulation in April 2021.

METHODS

This was a study comparing three periods of teaching: face-to-face teaching (FT) «October 2020», online teaching (OT) «November 2020", and online (OT) «April 2021».

Inclusion criteria: 2nd and 3rd year nursing, anesthesia and midwifery students were included.

Teaching techniques

- October 2020 face-to-face teaching

The workshops that took place during this period were entitled: Nasogastric tube, Cardiorespiratory Arrest, and Normal Delivery.

The October 2020 face-to-face simulation sessions took place in the MSC. Each session begins with a medical and then technical briefing: the facilitator introduces the simulation room and the available equipment, followed by the running scenario. The learner goes into the simulation room to perform

the procedure and ends with the debriefing. The facilitator summarizes the scenario by focusing on the learner's gestures in order to give a correct approach. The sessions were then evaluated through the learners' feedback and the facilitator was evaluated by the Debriefing Assessment for Simulation in Healthcare (DASH) (5).

November 2020 Online Teaching

The workshops that took place during this period were entitled: Nasogastric tube, Cardiorespiratory Arrest, Normal Delivery, Breech presentation and Difficult Intubation.

The November 2020 online teaching was organized in the following sequences:

• A clarification during the briefing with a demonstration video was made at the Medical Simulation Center.

• An illustration where the facilitator performs the scenario on the mannequin at the MSC.

• A debriefing session was held to evaluate knowledge retention and to further engage the learner by commenting on the previous videos to identify mistakes to avoid.

April 2021 Online Teaching

The workshop that took place during this period was entitled: the placement of a peripheral venous line.

Clarifications and illustrations were done in the same manner as in November 2020. Knowledge retention was assessed by a questionnaire sent via Google forms, followed by the correction of each question to identify questions with inadequate answers which allowed for immediate correction of the messages transmitted. In order to increase interactivity, a demonstration was again done by the facilitator but this time the facilitator was guided by the learners. The facilitator performed the gestures dictated by the learners which allowed for interactivity with questions and answers to justify each gesture. The result was better learning engagement and adherence. This last step lasted 30 minutes.

Outcome measures

Main criterion (For all three periods)

- Overall satisfaction: the learner must answer the following question in the feedback «Rate the overall quality of the online simulation by selecting one of the following choices: very satisfied/satisfied/slightly satisfied/ unsatisfied».

Secondary criteria (For the period of October 2020): The

grid consisted of ten variables. Only three were in common

with the «November 2020» and «April 2021» periods.

- *Educational objectives:* the following question is asked in the learners' feedback: «Were the expected objectives of the topic covered in the simulation achieved? The learner must choose one of the following: very satisfied/satisfied/ slightly satisfied/unsatisfied»

Behavior change: the following question is asked in the learners' feedback: «Will this simulation session lead to a change in your practice? The learner must choose one of the following: very satisfied/satisfied/slightly satisfied/unsatisfied».

Recommendation: the student must answer the following question «Would you recommend this online simulation session to your colleague?» Give a score from 0 to 10, by checking one of the following ten boxes:
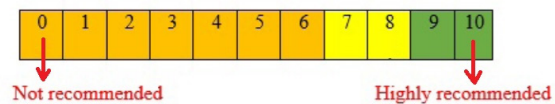
Learners' recommendations are measured with this scale. Its objective is to identify the three types of learners: Detractors (0 to 6), Passives (7 to 8) and Promoters (9 to 10) (6).

- In addition, learners are asked to evaluate the facilitator through a "Debriefing Assessment for Simulation in Healthcare (DASH) form".

DASH is a tool designed to assess and develop debriefing skills. It assesses the strategies and techniques used by facilitators to conduct debriefing sessions by examining their behavior. It is based on evidence and theories of learning and change in experiential contexts. It contains six components (5):

*Element 1: T*he facilitator established an engaging learning environment (rated from 1 [poor] to 7 [excellent])

Element 2: The facilitator maintained an engaging learning environment (rated from 1[poor] to 7[excellent])

Element 3: The facilitator structured the debriefing in an organized way. (rated from 1[poor] to 7[excellent])

Element 4: The facilitator provoked in-depth discussions that led me to reflect on my performance (rated from 1 [poor] to 7 [excellent])

Element 5: The instructor identified what I did well or poorly – and why (rated from 1 [poor] to 7 [excellent])

Element 6: The facilitator helped me see how to improve or how to sustain good performance (rated from 1 [poor]

to 7 [excellent]).

Secondary criteria (For the «November 2020» and «April 2021» periods):

- *The quality of the technical assistance*: the learner must answer the following question in the feedback grid: «The technical assistance throughout the progress of the online simulation was: very satisfied/satisfied/slightly satisfied/unsatisfied

- *The quality of the messages transmitted by the facilitator:* the learner must answer the following question: "The messages transmitted by the facilitator were relevant : very satisfactory/satisfactory/slightly satisfactory/unsatisfactory

- *Educational objectives*: the following question is asked: «Were the expected objectives of the topic covered during the online simulation achieved? The learner must choose one of the following: very satisfied/satisfied/slightly satisfied/ unsatisfied»

- *Participation with questions*: the learner must answer the following question: «Did you ask questions during the online simulation session? The learner must choose one of the following: > 4 questions / 3 to 4 questions/1 to 2 questions/no questions asked»

- *The quality of the facilitator's answers:* the learner must tick one of the following choices:

«The teacher's answers to your questions helped you to improve your knowledge of the subject in a way that was: a lot/fairly/slightly/poorly.

- *Change in behavior:* the following question is: did this online simulation session lead to a change in your learning? The learner must tick one of the following: a lot /fairly /a little/not at all.

- *Comparison of the online simulation session with traditional teaching:* The student must answer the following question «How do you compare this online simulation session with traditional teaching? The student should choose one of the following: Very superior/superior/ inferior/very inferior

- *Recommendation*: the student must answer the following question «Would you recommend this online simulation session to your colleague?» Give a score from 0 to 10, by selecting one of the following ten boxes:
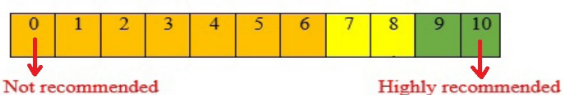
Learners can add further comments if they would like.

Learners' recommendations are measured with this scale. Its objective is to identify the three types of learners: Detractors (0 to 6), Passive (7 to 8) and Promoters (9 to 10) (6).

- Debriefing Assessment for Simulation in Healthcare (DASH) (5): DASH is a tool designed to help assess and develop debriefing skills. It assesses the strategies and techniques used by facilitators to conduct debriefing sessions by examining their behavior. It is based on evidence and theories of learning and change in experiential contexts.

Statistical Analysis

We compared the three periods of face-to-face teaching «October 2020» versus online teaching «November 2020» versus online teaching «April 2021» using Khi 2 test for qualitative variables and Analysis of Variance (ANOVA) for quantitative variables. We subsequently performed a two-by-two comparative analysis:

• October 2020» face-to-face teaching versus «November2020" online teaching.

• «October 2020» face-to-face teaching versus «April 2021»online teaching.

• «November 2020» online teaching versus «April 2021»online teaching.

This comparison used the appropriate statistical tests: Khi 2 test or Fisher's exact test for the comparison of qualitative variables, Student's t-test, or Mann Whitney U-test for the comparison of quantitative variables. A multivariate analysis (Logistic regression) was then carried out in order to identify the independent predictive variables of the choice of the pedagogical technique of online teaching. The identification level was set at 0.05.

Ethics

All learners signed a consent for image rights, video recording was taken for educational purposes.

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RESULTS

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We collected 614 learners: 169 in "October 2020", 318 in "November 2020 and 127 in "April 2021". It should be noted that one learner did not respond to the DASH in November 2020 and three learners in April 2021.

Comparison between three periods (October 2020 vs November 2020 vs April 2021):

The comparison between the three periods of face-to-face teaching in October 2020 versus online teaching in November 2020 versus online teaching in April 2021 showed better overall satisfaction, better technical assistance, more relevant messages and achieved educational learning objectives during the "October 2021" period as shown in the table1:

Table 1. Evaluation of face-to-face teaching in October 2020 versus online teaching in November 2020 versus online teaching April 2021

Variables	FTFT* Oct*20 (169)	OT* Nov*20 (318)	OT Apr*21 (124)	p
Overall satisfaction	99.4%	71.4%	91.1%	$<10^{-3}$
Educational objectives	98.8%	77.7%	90.3%	$<10^{-3}$
Change in behavior	99.4%	75.2%	85.5%	$<10^{-3}$
Recommendation (mean+/-SD)	9.57+/-0.67	6.78+/-0.63	8.11+/-2.16	$<10^{-3}$

FTFT: Face-to-face teaching / OT: Online teaching / Oct: October/ Nov: November/ Apr: April/ SD: Standard deviation

Comparison between two periods (October 2020 vs November 2020)

Overall satisfaction, educational objective achievement, behavior change, and recommendation were higher in the October 2020 face-to-face teaching period compared to the November 2020 online teaching period as shown in Table 2.

Table 2. Evaluation of face-to-face teaching in October 2020 versus online teaching in November 2020

Variables	FTFT* Oct*20(169)	OT* Nov*20 (318)	p
Overall satisfaction	99.4%	71.4%	$<10^{-3}$
Educational objectives	98.8%	77.7%	$<10^{-3}$
Change in behavior	99.4%	75.2%	$<10^{-3}$
Recommendation (mean+/-SD)	9.57+/-0.67	6.78+/-2.63	$<10^{-3}$

FTFT: Face-to-face teaching / OT: Online teaching /Oct: October /Nov: November / SD: Standard deviation

Comparison between two periods (October 2020 vs April 2021)

Table 3 also showed a better overall satisfaction in favor of the «October 2020» period compared to the «April 2021» period, as well as a better achievement of the educational objectives, with a change in behavior in favor of the «April 2021» period

Table 3. Evaluation of face-to-face teaching in October 2020 versus online teaching in April 2021

Variables	FTFT* Oct*20(169)	OT* Apr*21 (124)	p
Overall satisfaction	99.4%	91.1%	0.001
Educational objectives	98.8%	90.3%	0.001
Change in behavior	99.4%	85.5%	0.001
Recommendation (mean+/-SD)	9.57+/-0.67	8.11+/-2.16	0.001

FTFT: Face-to-face teaching / OT: Online teaching /Oct: October/Apr: April/ SD: Standard deviation

Comparison between two periods (November 2020 vs April 2021)

The comparison between the November 2020 online teaching and the April 2021 online teaching showed better overall satisfaction, better technical assistance, more relevant messages and achieved educational learning objectives for the April 2021 period. (Table 4).

As for the recommendation, learners found face-to-face teaching better than online teaching. The recommendation rate of online teaching in April 2021 was higher than online teaching in November 2020 as shown in Table 4:

Table 4. Online teaching in November 2020 versus online teaching in April 2021

Variables	November 2020 (318)	April 21 (124)	p
Overall satisfaction	71.7%	91.1%	$<10^{-3}$
Technical support	83.3%	94.4%	$<10^{-3}$
Relevant messages	92.5%	98.4%	$<10^{-3}$
Educational objectives	77.7%	90.3%	$<10^{-3}$
Did you ask any questions?	67.0%	62.1%	0.331
Did you find any answers?	94.3%	97.6%	0.150
Change in behaviour	47.8%	85.5%	0.016
Recommendation* (yes) (mean+/-SD)	6.78+/-2.64	8.11+/-2.16	<0.001

According to a scale [0 10]: 0: not recommended /10: highly recommended

The logistic regression revealed two independent factors that predicted the success in the «April 2021» OT: overall satisfaction and recommendation as noted in Table 5, i.e. learners were twice as satisfied in «April 2021».

Table 5. Online teaching in November 2020 versus online teaching in April 2021 Logistic regression

Variables	β	ES	Odds Ratio	95%CI	P
Overall satisfaction	0.766	0.395	2.152	[0.993 4.666]	0.052
Recommendation	0.183	0.063	1.200	[1.062 1.357]	0.004

Hosmer Lemeshow test p :0.241   %of well ranked : 71.9

Comparison of Debriefing Assessment for Simulation in Healthcare between three periods (October 2020 vs November 2020 vs April 2021)

In contrast, a comparison of these three time periods for the various DASH score items revealed a statically significant difference in favor of face-to-face teaching.

Table 6. Face-to-face teaching in October 2020 versus Online teaching in November 2020 versus Online teaching in April 2021

Variables (DASH)	OCT (169)	NOV* 20(318)	APRIL 21(124)	p
DASH 1	6.70+/-0.60	6.09+/-1.35	6.05+/-1.33	<0.001
DASH 2	6.74+/-0.63	6.15+/-1.24	6.21+/-1.18	<0.001
DASH 3	6.65+/-0.69	6.08+/-1.30	6.12+/-1.14	<0.001
DASH 4	6.72+/-0.68	5.98+/-1.04	6.17+/-1.04	<0.001
DASH 5	6.67+/-0.72	5.78+/-1.54	5.94+/-1.42	<0.001
DASH 6	6.75+/-0.70	6.12+/-1.30	6.01+/-1.34	<0.001

DASH: Debriefing assessment for simulation in healthcare Mean+/-Standard deviation
*For the November 2020 period, there were non-responses: 25 for DASH 1, 2 and 3 and 32 for DASH 4 ,5 and 6.

Knowledge Acquisition

Furthermore, knowledge acquisition was higher in April 2021 versus November 2020 as shown by the comparison of scores from the pre-test (18.66+/-3.95) to the post-test (21.47+/-3.92) with $p < 10^{-4}$.

DISCUSSION

Our comparative and retrospective study showed that face-to-face teaching was superior to online teaching using screen-based simulation in terms of overall satisfaction, educational objectives, change in behavior and recommendation. The April 2021 online teaching was higher than the November 2020 online teaching in terms of overall satisfaction and recommendation rate. This is probably due to the interactivity through the google forms questionnaire and the facilitator-guided demonstration by remote learners. The workshops carried out during three periods concerned the basic gestures.

Leighton (7) compared traditional clinical simulation (face-to-face simulation) with screen- based simulation. The CLECS 2.0 questionnaire was completed by 113 participants from three countries, and the score was better with traditional clinical teaching than with screen-based simulation (7).

In contrast, Warren (8) concluded from her systematic review that aimed to synthesize the best available evidence regarding the effectiveness of high-fidelity simulation in nursing education programs worldwide. The majority of studies compared high-fidelity simulation to online learning or traditional classroom teaching. These studies have shown that students are more satisfied with high-fidelity simulation-based education (8).

Faced with the situation imposed by the Covid 19 pandemic, how can we achieve the same learning results online as with the traditional method?

Online teaching can be effective. Indeed, Gong Haoran has proposed online games as a teaching method. (9).

David Drummond's randomized trial (10) that compared game-based learning with online learning in the form of a Power Point presentation showed that game-based learning is not better as a teaching method to online teaching. However, he concluded that some elements such as chest compressions are better taught through face-to-face simulation sessions (10).

Amy E Seymour-Walsh (11) reported on a literature review to show how to ensure continuity of teaching during and after the Covid 19 pandemic. She concluded that online teaching would be as effective or comparable to face-to-face learning but requires different expertise (11).

Brusamento (12), reported on a systematic review comparing the effect of digital instruction to traditional learning on knowledge. This systematic review (12) showed a small, statistically significant difference in favor of digital learning. The digital teaching group was more satisfied than the traditional learning group (12).

Blended learning can also be efficient. Elisabeth Coyne (13) concluded that blended learning using simulation videos allowed for greater interactivity in the teaching of clinical reasoning (13). Blended learning improved students' knowledge in all areas of knowledge and was often preferred by students because of its flexibility (13).

Anderson Luiz Carvalho Taroco Jr's systematic review included 14 articles. This systematic review emphasized the need for mixed teaching (theoretical and practical activities) for countries with limited palliative care measures (14).

Ellman (15) used online learning with interactive simulation to teach spiritual, cultural and interprofessional aspects of palliative care to students. A blended program with two components was designed: "online interactive" and "alive

dynamic simulation workshop". A quantitative analysis, of 309 questionnaires indicated that the students in all categories of health, concluded that the organized program achieved the five objectives that were set and gave a high score to this program with its two components: quality education and usefulness to the health professional (15).

Next question: Can online simulation be used to replace clinical sessions?

The professional organizations INACSL and SSH brought together the world's leading experts in simulation-based training for healthcare providers. These experts attested that virtual simulation has been used successfully for over a decade. In addition, research has repeatedly demonstrated that the use of virtual simulation (computer-simulated health care experiences) is an effective teaching method for improving student learning outcomes. (16,17) Given the current shortage of health care providers, we propose that regulatory agencies and policy makers be flexible in allowing the replacement of traditional clinical hours in a health care setting with virtually simulated experiences during the pandemic (18).

For those whose national legislation allows high-fidelity simulation to replace clinical sessions: Does virtual reality or virtual simulation count as high-fidelity simulation?

The answer to this question is based on the humanities definition of high fidelity simulation, according to the SSH dictionary (19), "high fidelity refers to simulation experiences that are extremely realistic and offer a high level of interactivity and realism for the learner," which includes virtual reality. Taveira-Gomes systematic review aimed to characterize recent studies on the development of software platforms and interventions in medical education. He concluded that studies in this area are very diverse, and many software systems are under development (20). Virtual reality is total visual immersion in an artificial, computer-generated environment. The system can also generate artificial sounds and other stimuli (21). Augmented reality is the overlay of a digital display on real-world surfaces, enabling depth perception. Currently available for smartphones and head-mounted display platforms (21).

Mixed reality is the overlay of digital displays combined with projected interactive holograms. The user views the real world while manipulating digital content generated by the device. There is increased freedom of control over the digital content through response to verbal commands and hand gestures.

In ophthalmology Deushler reported on a study using virtual reality, using a simulator in teaching the use of ophthalmoscope to students. For this purpose, he organized an "EyesiNet" platform for online teaching of ophthalmologic pathology, he concluded that the skills of direct ophthalmoscopy could be learned faster than indirect ophthalmoscopy (22).

Verhey (21) stated in his narrative review "As an advancement over traditional methods of computer-assisted surgery, virtual and augmented reality technologies for orthopedic training and practice hold great promise" and from an educational perspective, reality technologies offer a new method of live assessment and remote mentoring (21).

In our study when teaching online, during "November 2020", learners usually watch asynchronous online videos passively and easily lose their attention. Simply posting videos online and providing follow-up work does not automatically lead learners to achieve the intended learning objectives.

Students need instructions on what to focus on and how to apply the information to their practice.

In "April 2021" the second method of online teaching was introduced by adding structured interactivity. With interactivity built into the videos, facilitators can guide students' learning in a targeted way, encourage deeper thinking and ensure that they retain key points.

The systematic review by Chasset (2) demonstrated that resident medical education was greatly impacted by the COVID-19 pandemic, particularly in surgical specialties. Online courses have been the most common solution to social distancing constraints, although they are not very effective in improving clinical skills. Medical students' opinion of the educational tools was overwhelmingly positive (2).

The only limitation of our study was a historical comparison imposed by the evolution of the covid 19 pandemic.

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