

Effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction

EmanArafa Hassan⁽¹⁾, AzzaAbdElrazekBaraka^(2,3,4)

- (1) lecturer of Critical Care and Emergency Nursing Department, Faculty of Nursing, Alexandria University, Egypt
- (2) Assistant Professor of Critical Care and Emergency Nursing Department, Faculty of Nursing, Alexandria University, Egypt
- (3) Assistant Professor of Critical Care and Emergency Nursing, College of Nursing, King Saud bin Abdulaziz University for Health Sciences, Al-Ahsa, Saudi Arabia
- (4) King Abdullah International Medical Research Center, Al-Ahsa, Saudi Arabia

Abstract

Background: Virtual classroom and online learning are generating popularity all over the world as a result of COVID 19 crisis. Virtual classroom is one of the most important applications of information technology that provides the learner with unlimited access to educational materials at any time and from any place. Students were more interested in addressing various motivating and challenging environment and teaching methods to construct a diverse atmosphere. **Objective:** To evaluate the effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction. **Research question:** What is the effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction? **Study design:** A causal-comparative pretest/ posttest research design was used to conduct this study. The study was conducted at Faculty of Nursing, Alexandria University. Four tools were used in the data collection. Tool I: Students' readiness to E-learning survey, tool II: predictors of students' satisfaction in e-learning survey, tool III: students' self-assessment of their learning experiences survey, tool IV: students' achievement record. **Subject:** A purposive sample of 345 undergraduate students who accepted to participate in the research and met the inclusion criteria. **Results:** The virtual classroom had highly statistically significant effect on increasing students' interaction, learning satisfaction and level of achievement mean score $p < 0.001$. The ability of self-regulated learning in virtual classroom had a highly significant influence on students' learning satisfaction $p = 0.04$. **Conclusion:** Virtual classroom was highly statistically significant effective method of learning and improving the studied students' satisfaction and level of achievement mean score. **Recommendation:** assess the students' needs towards virtual classroom for enhancing cooperative learning environment and improving the required equipment and internet availability to the students and staff members.

Keywords: virtual classroom, critical care, emergency nursing students, achievement and learning satisfaction.

Introduction

In the last 50 years, a rapid growth in the education levels has been observed all over the world. Coronavirus disease (COVID-19) represents the greatest challenge that educational systems have ever faced (Daniel, 2020, Davis, et al., 2019 & Sun, et al., 2020). So, many governments recommended that educational institutions to shift immediately to online teaching and distance education.

According to the recent data of UNESCO (2020), the COVID-19 crisis has

prompted country-wide school closures in more than 191 countries around the world. These decisions influenced 91.3 % of the students worldwide, enrolling nearly 1.5 billion students (Drane, et al., 2020).

Technology-based learning has become one of the vital learning resources for both teachers and students to share and acquire knowledge (Davis, et al., 2019 & De Oliveira, et al., 2018). E-learning began in the 1980s and defined by the European Commission in 2001 as the use of multimedia technologies and the internet to enhance access to services and improve the

quality of learning and cooperation. It incorporates the use of the internet and other important technologies to generate learning materials and manage courses in educational institutions (UNESCO, 2020; Zhou, et al., 2020). It encompasses a wide range of applications, learning methods and procedures (Somayeh, et al., 2016).

In the recent decades, the continuous increase in the developments of different sciences has greatly increased the burden of the learning process. So, the traditional method of teaching which is teacher-centered approach does not fulfill the required objectives at this required time. Also, by the global response to COVID 19, Chinese government offered a quarter of a billion full-time students to continue their studies through the online platforms in Wuhan. Many universities as Zhejiang University had successfully introduced virtual classrooms to manage more than 5,000 courses online (Li & Lalani, 2020; Naderi & Aein, 2014). The use of web-based instruction for educational purposes is becoming more popular and widespread at this time. More universities were encouraging faculty staff to create virtual classroom to cope with this pandemic (UNESCO, 2020). Thus virtual classroom is one of the most interactive and enriching means of distance learning available today which includes a formal delivery of instruction in a separate time and geographic location.

Virtual classroom has many benefits include the ability of the learners to study at any time and from any place. It entails the delivery of knowledge, training, and motivating the students to interact with each other, as well as share and appreciate different viewpoints. It facilitates collaboration and strengthens the bonds that support learning. Several studies had reported the advantages and benefits of incorporating e-learning technology into universities (Davis, et al., 2019; De Oliveira, et al., 2018 & Zhou, et al., 2020). Arkorful (2014) also discussed that one of the benefits of E-learning and virtual classrooms were their ability to concentrate on the learners. It also facilitates learner-to-learner relationships through the use of discussion forums. With the synchronous virtual classroom, an instructor can evaluate students' levels of knowledge and tailor the course material appropriately and provide immediate feedback. Also, the external

motivation and encouraging students' participation in virtual classroom can increase the students' retention, achievement and completion rates (Rosenfeld, 2018). According to Gamage et al. (2014). The virtual classroom provides additional opportunities for interaction between the students and teachers during content delivery. Virtual classroom has a cost effective benefit in decreasing the needs for the students to travel. It provides learning opportunities to a large number of students without requiring a large number of buildings. Asynchronous learning is an advantage of using virtual classroom that allows self-pacing as students can learn at their own pace and speed. As a result, it improves the students' satisfaction and reduces their stress (Leong, et al., 2012). Even so, according to Olmstead (2013), group discussion and peer communication were not always possible in virtual classrooms, the high cost of creating a virtual instruction network, the necessity of having a computer and the requisite skills were also among its limitations.

Yılmaz (2015) evaluated nursing students and reported that traditional classroom education is tiresome and the force to learn at certain predetermined time limits actual learning. In contrast, learners have access to educational content at any time in virtual instruction, which increases the efficacy of instruction. Thoms & Eryılmaz (2014) revealed the advantages of virtual class room among students as easy accessibility, easily use, the freedom of navigation, the high quality of images and the possibility of repeating the practice.

Significance of the study:

Cooperation and interactions between students and educational staff during the virtual class room are crucially significant and last for a long period of time. Evidences showed that students were more engaged and motivated in challenging learning environment and learning methods and interested in learning in an innovative and dynamic environment (Gamage, et al., 2014). So, a balance should be maintained between the students' expectations and the educational methods. However limited studies on the efficacy of virtual education were rarely reported. Thus, this study was done to assess the effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction.

Aim of the study:

To evaluate the effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction.

Research question:

What is the effect of virtual classroom on critical care and emergency nursing students' achievement and learning satisfaction?

Research methods

Research design:

A causal-comparative pretest/ posttest research design was used to conduct this study. The independent variable is the total virtual classroom strategy. The dependent variable is students' achievement and learning satisfaction.

Setting:

This study was conducted at Faculty of Nursing, Alexandria University from March to September 2020.

Sample:

A purposive sample of 345 undergraduate students enrolled in the second and third years accepted to participate in the research and met the inclusion criteria. Inclusion criteria were the students aged 18 years or older and students who were enrolled in critical care and emergency nursing courses for the first time. Exclusion criterion was the students who were transferred from another university which depends mainly on e-learning courses.

Recruitment:

Study surveys were sent out to all students who had been registered in critical care and emergency nursing courses which included emergency nursing and emergency medicine (second year), critical care nursing and critical care medicine courses (third year). The surveys were sent through their four groups on social media (whatsapp). The researchers used whatsapp groups because it was recommended by the students' team leaders.

Tools:

Four tools were used to collect the data. Tool one was "student' readiness to e-learning". It

was a valid and reliable instrument for assessing readiness for e-learning. It was adopted from Watkins et al. (2008). It consisted of two parts. The first one included demographic characteristics of the students. The second part was a students' self-assessment for their readiness to e-learning. It composed of six categories that were valid and reliable in prior work; technology access (3 items, 5 points Likert scale, $\alpha = 0.95$), online skills and relationships (9 items, 5 points Likert scale, $\alpha = 0.95$), motivation (3 items, 5 points Likert scale, $\alpha = 0.88$), online audio/video (3 items, 5 points Likert scale, $\alpha = 0.90$), internet discussions (4 items, 5 points Likert scale, $\alpha = 0.74$), and importance to your success (5 items, 5 points Likert scale, $\alpha = 0.86$). The five points Likert scale scored from 1 which was completely disagree to 5 which was completely agree.

Tool two was a valid and reliable instrument about predictors of student satisfaction in e-learning experience. It was adopted from Kuo et al. (2014). It was used to assess the factors that affected students' satisfaction in e-learning experience. It composed of five categories that were valid and reliable in prior work; learner-learner interaction (8 items, 5 points Likert scale, $\alpha = 0.93$), learner-instructor interaction (6 items, 5 points Likert scale, $\alpha = 0.88$), learner-content interaction (4 items, 5 points Likert scale, $\alpha = 0.92$), internet self-efficacy (8 items, 7 points Likert scale, $\alpha = 0.93$), and self-regulated e-learning (12 items, 7 points Likert scale, $\alpha = 0.79$). The five points Likert scale scored from 1 which was completely disagree to 5 which was completely agree. The seven points Likert scale scored from 1 which was completely disagree to 7 which was completely agree.

Tool three was learning satisfaction. It was adopted from Kuo et al. (2014). It was a students' self-assessment tool for their satisfaction with learning experience. It was a valid and reliable tool in a prior study. It included 5 items rating on 5 points Likert scale with reliability $\alpha = 0.93$. The five points Likert scale scored from 1 which was completely disagree to 5 which was completely agree.

Tool four was students' achievement. This tool was developed by the researcher after review of literature. Validity of this tool was ensured by five experts of professor of critical care and emergency nursing and lecturer of nursing

education, Faculty of Nursing, Alexandria University. Its reliability was done. It was found to be $\alpha = 0.87$ which was acceptable. It included students' grades out of ten marks before and after traditional classroom. Also, it included students' grades out of ten marks before and after virtual classroom.

Data collection:

Before implementation of virtual classroom

Assessment of students' satisfaction with traditional classroom experience using tool three and readiness for e-learning surveys using tool one were done at the beginning of social distance during corona virus outbreak in March 2020. They were used to collect data before beginning of virtual classroom and after stopping of traditional classroom. In traditional classroom, students attended class at the faculty of nursing. Each nursing course class was two hours per week and each medical course class was one hour per week. The e-learning strategy was used before application of virtual class for only assignments submission and formative quizzes consisted of ten objective questions after each traditional lecture using "Moodle" learning management system.

Implementation of virtual classroom

Virtual classroom was conducted from 14 March to 30 April 2020. The virtual lectures were uploaded in the same learning management system that students were using before. It was Moodle version 18. Virtual lecture was conducted through PowerPoint presentation video converter. The video of the lecture was divided into four videos with maximum time for each one was 15 minutes. A formative electronic quiz consisted of ten objective questions was opened after each lecture. A fixed weekly time for student-teacher discussion chat about the lecture topic was announced and conducted.

After implementation of virtual classroom

At the end of the semester predictors of student satisfaction in e-learning surveys were collected from the participated students using tool two to assess their learning satisfaction and factors that affect their satisfaction. Students' grades were evaluated using tool four after the traditional and virtual classroom through Moodle quizzes.

Ethical consideration

Research ethical committee approved the study prior to its implementation. Students' participated based on voluntary basis. Anonymity and confidentiality of the collected data were ensured and the right to withdraw from the study was enforced.

Statistical analysis

Data were analyzed using SPSS program version 25. Categorical data were presented in number and percent, while continuous and normally distributed data were presented in mean and standard deviation. Paired sample t test was used to compare students' achievement and satisfaction between before and after use of virtual classroom. Stepwise multiple regression analysis was used to identify variables affecting students' satisfaction after the use of virtual classroom.

Results

Table (1) presented frequency and percentage distribution of characteristics of the participated students. The majority (93.3%) of them aged from 20 to 25 years. More than half (59.1%) of them were females. The majority of them were single (96.2%). Students who participated in the study composed of 42.3% enrolled in the critical care nursing II course, 37.4% enrolled in the emergency nursing course, 18.8% enrolled in the emergency medicine course, and 1.4% enrolled in the critical medicine course. The highest frequent (49.9%) range of hours spent online/week was 11-15 hours, while the lowest frequent (1.4%) range of hours spent online/week was less than 5 hours.

Table (1): Frequency and percentage distribution of characteristics of the participated students (n=345)

Characteristics	No. (n=345)	%
Age		
20-25 years	322	93.3%
26-30 years	23	6.7%
Gender		
Male	141	40.9%
Female	204	59.1%
Marital status		
Single	332	96.2%
Married	13	3.8%
Enrolled courses		
Emergency nursing	129	37.4%
Emergency medicine	65	18.8%
Critical care nursing II	146	42.3%
Critical medicine	5	1.4%
Hours spent online/week		
Less than 5 hours	5	1.4%
6-10 hours	33	9.6%
11-15 hours	172	49.9%
16-20 hours	112	32.5%
Above 20 hours	23	6.7%

Table (2) showed students' readiness mean scores to e-learning before the use of virtual classroom. The mean students' score to technology access was 12.87 ± 1.70 . The mean students' score to online skills and relationships was 37.65 ± 4.60 . The mean students' score to motivation was 7.87 ± 2.20 . The mean students' score to online audio video was 6.60 ± 1.99 . The mean students' score to internet discussion was 14.39 ± 2.89 . Finally, the mean students score to importance of success was 21.76 ± 9.32 .

Table (2): Students' readiness mean scores to e-learning before the use of virtual classroom (n=345)

Readiness assessment scale	Minimum scale score	Maximum scale score	Mean students score
Technological access	3	15	12.87 ± 1.70
Online skills and relationships	9	45	37.65 ± 4.60
Motivation	3	15	7.87 ± 2.20
Online audio video	3	15	6.60 ± 1.99
Internet discussions	4	20	14.39 ± 2.89
Importance to your success	5	25	21.76 ± 9.32

Table (3) showed students' interaction, internet self-efficacy, and self-regulated learning mean scores during the use of virtual classroom. The mean score of learner to learner interaction was 31.21 ± 5.87 . The mean score of learner to instructor interaction was 23.73 ± 7.11 . The mean score of learner to content interaction was 13.28 ± 3.29 , while the total mean interaction score was 69.11 ± 16.38 . The mean internet self-efficacy score was 41.86 ± 16.82 , and mean self-regulated learning score was 50.16 ± 28.37 .

Table (3): Students' interaction, internet self-efficacy, and self-regulated learning mean scores during the use of virtual classroom (n=345)

Interaction, internet self-efficacy, and self-regulated learning scales	Minimum scale score	Maximum scale score	Mean students score
Learner-learner interaction	8	40	31.21 ± 5.87
Learner-instructor interaction	6	30	23.73 ± 7.11
Learner-content interaction	4	20	13.28 ± 3.29
Total interaction	18	90	69.11 ± 16.38
Internet self-efficacy	8	56	41.86 ± 16.82
Self-regulated learning	12	84	50.16 ± 28.37

Table (4) illustrated students' learning satisfaction mean scores before and after the use of virtual classroom. There was a significant ($P < 0.001$) improvement in the mean score of the students' overall satisfaction after the virtual classroom (3.70 ± 0.91) than before it (2.51 ± 0.71). Also, there was a significant ($P < 0.001$) improvement in the mean score of students' satisfaction with the level of interaction that happened in the course after virtual classroom (3.25 ± 0.84) than before it (2.34 ± 0.82). Similarly, there was a significant ($P < 0.001$) improvement after virtual classroom (3.74 ± 1.01) than before (2.59 ± 1.75) regarding the mean score of the future willing to take a fully virtual classroom again. Finally, there was a significant ($P < 0.001$) improvement in the total satisfaction mean score after the use of virtual classroom.

Table (4): Students' learning satisfaction mean scores before and after the use of virtual classroom (n=345)

Satisfaction items	Before virtual classroom	After virtual classroom	t	P
	Mean \pm SD	Mean SD		
Overall, I am satisfied with this virtual class.	2.51 \pm 0.71	3.70 \pm 0.91	23.48	< 0.001*
This virtual class contributed to my educational development.	4.08 \pm 0.86	4.07 \pm 0.87	0.15	0.88
This virtual class contributed to my professional development.	3.88 \pm 0.83	3.88 \pm 0.83	0.14	0.89
I am satisfied with the level of interaction that happened in this virtual class.	2.34 \pm 0.82	3.25 \pm 0.84	15.14	< 0.001*
In the future, I would be willing to take a fully virtual classroom again.	2.59 \pm 0.68	3.74 \pm 1.01	18.01	< 0.001*
Total satisfaction mean score	15.39 \pm 1.75	18.64 \pm 1.90	18.67	< 0.001*

t: is paired sample t test, SD: standard deviation, statistically significant at $p \leq 0.05$

Table (5) showed students' achievement mean scores in the four courses before and after the virtual classroom. There was a significant ($P < 0.001$) improvement of students' grades out of 10 marks. Students mean grades before virtual classroom was 6.87 ± 1.44 , while it increased after the virtual classroom to 8.52 ± 1.37 .

Table (5): Students' achievement mean scores in the four courses before and after virtual classroom (n=345)

Mean students' grades out of 10 marks		Mean differences of students' score	t value	P
Before virtual classroom	After virtual classroom			
6.87 \pm 1.44	8.52 \pm 1.37	1.63 \pm 1.52	-20.17	< 0.001

t: is paired sample t test, statistically significant at $p \leq 0.05$

Table (6) presented the variables affecting students' satisfaction after the use of virtual classroom. Among the eight independent variables, one was considered to have critical relationship with students' satisfaction with p-values less than 0.05. This factor is self-regulated learning. Self-regulated learning had a positively significant influence on students' satisfaction after the use of virtual classroom ($\beta = 0.11$, $p = 0.04$).

Table (6): Variables affecting students' satisfaction after the use of virtual classroom (n=345)

Independent variables	Dependent variable: Satisfaction		
	β	t	P
Age	0.04	0.77	0.44
Marital status	0.023	0.42	0.68
Hours spend online per week	0.06	1.18	0.24
Enrolled course	-0.04	-0.82	0.41
Readiness for e-learning	0.08	1.63	0.10
Classroom interaction	0.05	0.92	0.36
Internet efficacy	-0.06	-1.29	0.19
Self-regulated learning	0.11	2.05	0.04*

Stepwise multiple regression analysis, statistically significant at $p \leq 0.05$

Discussion

COVID-19 represents the greatest challenge that educational systems have ever faced. Many governments rapidly shifted from traditional classroom to online teaching and virtual classroom. The current study findings showed that using the virtual classroom can improve the studied students' interaction; self-regulated learning and internet self-efficacy mean scores. This was enhanced by the flexibility to learn at any place and collaboration between students to share their experiences. This was in agreement with Brophy (2014); Gamage et al. (2014); Davis et al. (2019) & Yılmaz (2015) that illustrated that virtual classroom increase students' interactivity and collaborativeness and enhance the learning environment make it attractive for students' active learning.

The current study results showed a significant improvement in the mean score of the studies students' overall satisfaction and the level of interaction mean scores after the virtual classroom than before it. Also, there was a significant improvement regarding the mean score of the future willing to take a fully virtual classroom again. This may be due to students' ability to self-regulate learning and the collaborative environment that increase their professional development. These findings were in agreement with Brophy (2014) & Gamage et al. (2014) that showed a high level of students' motivation and satisfaction regarding e-learning and virtual classroom. Davis et al., (2019)

& Yılmaz (2015) found that virtual classroom was highly desirable for students due to the flexibility of recorded sessions and so their abilities in stopping, replaying, controlling the speed to learn at their own pace and at any place. On the other hand, Khatoniet al. (2011) reported a decreased level of students' motivation in virtual classroom than traditional learning and considered traditional classroom as the most preferable method for students. This may be due to decreased facilities and supplies.

The current study findings revealed highly statistically significant improvement of the students' mean grades after the virtual classroom than before it. This was mostly related to the students' ability to learn faster during the online attractive learning and also their ability to learn at their own pace, accelerating, and re-reading abilities. This was agreed with Li & Lalani. (2020) that found more knowledge retaining during the online learning from 25 to 60% compared to only 8-10% in the traditional classroom. Similarly, Moazami et al. (2014); & Soltanimehr et al. (2019) showed a significant improvement and a significant high mean score of theoretical test after the virtual classroom than that in the traditional classroom group. Meckfessel et al. (2011) found that the failure rate among students who had virtual class room was decreased from 40 to 2% compared with traditional classroom. Davis et al. (2019), Sendra-Portero et al. (2013) & Yılmaz (2015) demonstrated that virtual education is a successful alternative method instead of traditional method of teaching

as it was accompanied with high level of students' achievement. This may be due to the flexibility of creating recorded virtual sessions that positively affected the students' success.

On the other hand Hugenholtzet al. (2008) reported that there was no significant difference between virtual and traditional learning methods regarding continuous medical education. Also, Nourian et al. (2012) evaluated the effectiveness of virtual classroom with traditional classroom and reported that both were equally effective teaching methods. However, Khatoni et al. (2011) illustrated that traditional learning was preferable method of teaching than virtual classroom. This could be due to lack of infrastructure, lack of equipment and facilities, a variance in students' motivation and interest in the presented subject and lack of group discussion.

The current study presented the variables affecting students' satisfaction after the use of virtual classroom. It highlighted that self-regulated learning had a positively significant influence on students' satisfaction after the use of virtual classroom. This was observed also through their improvement in the mean grades and achievement after the virtual classroom. This was in agreement with Davis et al. (2019) & Yılmaz (2015) that found a positive relationship between the students' satisfaction and their ability to self-regulate learning through virtual classroom and so, there was increased flexibility in learning and increased students' success and level of achievement. However, Tutwiler (2019) showed that the new technology and virtual classroom may be insufficient in fulfilling the students' needs for self-learning and according to their own pace.

Limitations of the study

- Decreased number of students who accepted to participate in the study.
- Inequality in students' computer availability, and internet availability and speed.
- The study was applied on theoretical virtual classes rather than the clinical courses. This may be due to its different nature in teaching and assessment.

Conclusion

The virtual classroom had highly statistically significant effect on increasing the students' satisfaction; interaction and level of achievement mean scores. The ability of self-regulated learning in virtual classroom had a high significant influence on the studied students' satisfaction.

Recommendation

- Revision of the online courses to cope with the nature of virtual classroom sessions.
- Improve the infrastructures, equipment, and internet availability and its speed for both educational staff and students.
- Assess the students' needs in relation to the virtual classroom to increase their participation and collaboration with each others and with the educational staff.
- Replicate the study on a large sample size and include the practical courses in addition to the theoretical courses in the study.

References

- Arkorful, V. (2014).** The role of e-learning, the advantages and disadvantages of its adoption in Higher Education. *International Journal of Education and Research*, 2 (12), 397.
- Brophy, J. (2014).** *Motivating students to learn* Routledge. 3rd edition, NEW YORK & LONDON. Available at https://bera-journals.onlinelibrary.wiley.com/doi/abs/10.1111/bjet.12260_6
- Daniel, S. (2020).** Education and the COVID-19 crisis. *Prospects*, 49, 91–6. Available at <https://doi.org/10.1007/s11125-020-09464-3>
- Davis, N., Gough, M., & Taylor, L. (2019).** Online teaching: Advantages, obstacles and tools for getting it right. *Journal of Teaching in Travel & Tourism*, 19(3), 256–63.
- De Oliveira, M., Penedo, A., & Pereira, V. (2018).** Distance education: advantages and disadvantages of the point of view of education and society. *Dialogia*, 29, 139–52.
- Drane, C., Vernon, L., & O'Shea, S. (2020).** The impact of 'learning at home' on the educational outcomes of vulnerable children

- in Australia during the COVID-19 pandemic. Centre for Student Equity in Higher Education, Curtin University, Australia.
- Gamage, D., Fernando, S., & Perera, I. (2014).** Factors affecting to effective eLearning: Learners Perspective. *Scientific Research Journal (SCIRJ)*, 2 (5).
- Hugenholtz, N., De Croon, E., Smits, P., VanDijk, F., & Nieuwenhuijsen, K. (2008).** Effectiveness of e-learning in continuing medical education for occupational physicians. *Occup Med*, 58:370–2.
- Khatoni, A., Nayery N, Ahmady, F., Haghani H. (2011).** The effect of web based and traditional instructions on nurses' knowledge about AIDS. *Iran J Med Educ*, 11:140–8.
- Kuo, Y., Walker, A., Schroder, K., & Belland, B. (2014).** Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet and Higher Education*, 20, 35–50.
- Leong, S., Laughlin P, O'Connor O, O'Flynn S, Maher M. (2012).** An assessment of the feasibility and effectiveness of an e-learning module in delivering a curriculum in radiation protection to undergraduate medical students. *J Am Coll Radiol*, 9:203–9.
- Li C & Lalani F. (2020).** The COVID-19 pandemic has changed education forever. This is how. *World economic forum*. Available at <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/>
- Moazami, F., Bahrapour, E., Azar, MR., Jahedi, F., & Moattari, M. (2014).** Comparing two methods of education (virtual versus traditional) on learning of Iranian dental students: a post-test only design study. *BMC Med Educ*, 14 (1).
- Meckfessel, S., Stühmer, C., Bormann, K-H., Kupka, T., Behrends, M., & Matthies, H. (2011).** Introduction of e-learning in dental radiology reveals significantly improved results in final examination. *J Craniomaxillofac Surg*, 39:40–8.
- Naderi, Z., & Aein, F. (2014).** Factors affecting classroom participation; the viewpoints of students in ShahreKord University of Medical Sciences in 2013. *Iranian J Med Educ*, 14:188–94.
- Nourian, A., Bagheban, A., Ebnahmadi, A., & Khoshnevisan, M. (2012).** Comparison of E-learning and traditional classroom instruction of dental public health for dental students of ShahidBeheshti dental school during 2010-2011. *J Dent Sch*, 30, 174–83.
- Olmstead, C. (2013).** Using Technology to Increase Parent Involvement in Schools. *Techtrends tech trends*, 57, 28-37. Available at <https://doi.org/10.1007/s11528-013-0699->
- Rosenfeld, G. (2018).** A comparison of the outcomes of distance learning students versus traditional classroom students in the community college. Ph.D. thesis, Florida Atlantic University.
- Sendra-Portero, F., Torales-Chaparro, O., Ruiz-Gomez, M., & Martinez-Morillo M. (2013).** A pilot study to evaluate the use of virtual lectures for undergraduate radiology teaching. *Eur J Radiol*, 82:888–93.
- Soltanimehr, E., Bahrapour, E., Imani, M., Rahimi, F., Almasi, B. & Moattari M. (2019).** Effect of virtual versus traditional education on theoretical knowledge and reporting skills of dental students in radiographic interpretation of bony lesions of the jaw. *BMC Medical Education*, 19:233.
- Somayeh, M., Dehghani, M., Mozaffari, F., Ghasemnegad, S., Hakimi, H. & Samaneh B. (2016).** The effectiveness of E-learning in learning: A review of the literature. *International Journal of Medical Research & Health Sciences*, 5 (2) :86-91.
- Sun, L., Tang, Y., & Zuo, W. (2020).** Coronavirus pushes education online. *Nature Materials*, 19(6), 687.
- Thoms, B. & Eryilmaz E. (2014).** How media choice affects learner interactions in distance learning classes. *Computers & Education* 75:112–26.
- Tutwiler, M. (2019).** Exploring The relationship between attentional capture and prior

knowledge in a science-based multi-user virtual environment: an individual growth model analysis. *Journal of Science Education and Technology*, 28(4), 299-309.

UNESCO. (2020). 10 recommendations to ensure that learning remains uninterrupted. Available at <https://en.unesco.org/news/covid-19-10-recommendations-plan-distance-learning-solutions>.

Watkins, R., Leigh, D., & Triner, D. (2008). Assessing Readiness for E-Learning. *Performance Improvement Quarterly*, 17(4), 66–79.

Yılmaz, O. (2015). The effects of “live virtual classroom” on students’ achievement and students’ opinions about “live virtual classroom” at distance education. *Turkish Online Journal of Educational Technology*, 14 (1).

Zhou, L., Wu, S., Zhou, M., & Li, F. (2020). 'School's Out, But Class's On', The Largest Online Education in the World Today: Taking China's Practical Exploration During The COVID-19 Epidemic Prevention and Control As an Example. *Best Evid Chin Edu*, 4(2), 501–19.