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REVIEW ARTICLE

The Role of Online Education in Radiology

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ABSTRACT

Technology is the key enabler to scaling up radiologist education. Innovation and advancement in the field of information technology has revolutionized the medical education system and healthcare in general. Training programs in radiology aim to produce a competent, thinking, consistent and logical radiologist who can perform and interpret a variety of diagnostic and interventional imaging investigations and procedures and pursue research and teaching while embracing core medical ethics. These radiology teaching programs are just not restricted to traditional classroom-based education, rather online education has gained substantial momentum over the years. Online education refers to the process of teaching and learning through the use of electronic resources, devices and networks to promote development and improve the quality of education and training. Despite challenges, online radiology education provides many advantages to radiologists and radiologists-in-training in terms of accessibility, flexibility, access to quality sub-specialty education and convenience. The aim of this review is to share our experience and insights into the role of online education in the field of radiology.

Keywords: Radiology, Radiology education online, Radiology education programs, Online lectures, Radiology degree, medical students, Teaching, Virtual learning.

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INTRODUCTION

Radiology is a discipline of medicine that makes use of medical imaging to diagnose illnesses and direct treatment in humans. It covers all imaging modalities such radiography, magnetic resonance imaging (MRI), ultrasound (USG), computed tomography (CT), fluoroscopy, and nuclear medicine, which includes positron emission tomography (PET).[1] This field has expanded rapidly since the year 2000 due to progress in computer technology, which is closely associated with modern imaging techniques.

It is the need of the hour to train and produce competent and consistent radiology professionals who can keep up pace with the technological advancements in the field of radiology. The training program in radiology aims to produce a competent, radiologist who can effectively utilize the imaging technologies available to perform and interpret a variety of diagnostic and interventional imaging investigations as well as engage in teaching and research activities while at the same time abiding by medical ethics and consumer protection laws.[2]

In India, there are two medical governing bodies, Medical Council of India (MCI) (now replaced by the National Medical Commission) and National Board of Examinations [Diplomate of National board (DNB)] which run a radiology training course consisting of a post graduate 3-year program (Doctor of Medicine (MD) / Diplomate National Board (DNB) Radiology) or a 2-year Diploma in Medical Radio Diagnosis (DMRD). Radiology residents are imparted training in both conventional radiology and modern imaging techniques to make them well versed with the broad discipline of radiology including ultrasonography, color doppler, computed tomography and magnetic resonance imaging. There are currently 273 medical schools across the country that run radiology courses and out of 35,000 total medical students, currently 747 get to do 3-year postgraduate training in radiology every year, out of which 537 seats are under the MCI and 210 seats under DNB. In addition, there are about 253 seats in DMRD. Further, some radiologists pursue one or two years of additional subspecialty fellowship training after completing their residency.[3]

Radiology teaching programs are just not restricted to traditional classes, rather online education has gained substantial momentum over recent years.[4] Although the ideal method of information transfer in medical education is still up

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for debate, it is evident that online teaching has the potential to enhance and transform radiology education. Online education or e-learning refers to the process of teaching and learning through the use of electronic resources, devices and networks to promote development and improve the quality of education and training.[5] It involves a versatile and collaborative technology-enabled long-distance learning plan that facilitates continuous training and updates about the latest breakthroughs to ensure more precise and successful treatment and procedures.[6] The aim of this review is to share insights on the role of online e-education in the field of radiology based on our organization's 15-year experience in this space. The article also emphasizes the key elements, technologies and resources an ideal remote radiology education system should have.

Online radiology courses aim to deliver high-quality training to individual learners in Radiology seeking personal development. These radiology courses can be a helpful resource for anyone seeking professional improvement, skill acquisition, or perhaps a new career path. A wide range of online radiology programs are offered by various institutions, colleges and universities across the world, catering to different educational levels and goals, but mainly ensuring a) supplemental education for postgraduate residents and b) continuing medical education for practicing radiologists. Additionally, during the COVID-19 epidemic, the educational goals of academic radiology departments in the institutions globally were hindered significantly. The most effective approach for controlling the spread of COVID-19 by physical separation, restricted students from congregating in lecture rooms and laboratories.[7] Thus, academicians further supported and promoted tele-education in radiology as a need of the hour, exclusively utilizing the digital space with a combination of pedagogical approaches.

The other prominent advantages that online education has demonstrated in radiology are flexibility and accessibility. Online radiology programs offer students an opportunity to study at their own pace and schedule. This flexibility is particularly valuable for individuals who are already working in the field, such as postgraduate residents and practicing radiologists, providing them work-life integration. Moreover, technology advancements have facilitated the growth of web-based conferences and education, opening them up to students from all over the globe and fostering a diverse and global educational community.[8] Students located in various regions of the world, even from remote locations, can gain access and benefit from the expertise and knowledge of these educators. Furthermore, online education can be more cost-effective than traditional on-campus programs.[9] Students can save money on lodging, transportation, and other related expenses.

Due to advances in technology and imaging techniques, the field of radiology is consistently evolving. Online education allows radiology professionals to stay current with the latest developments through easily accessible updates and continuing education opportunities. Moreover, online education in radiology can open up opportunities for career advancement and specialization within the field. For example, individuals can pursue subspecialty areas such as cardiac radiology, nuclear medicine, or magnetic resonance imaging. Continuing Medical Education (CME) is a crucial aspect of preserving and expanding one's knowledge over time in radiology. For radiologic technologists and radiologic professionals, online courses offer a convenient way to fulfill continuing education requirements and stay updated with the latest advancements in the field. Many continuing medical education programs are held on a regular basis in various subspecialties and modalities to advance the knowledge and abilities of practicing radiologists.[2] Online education portals leverage learning management system (LMS), software application that manages, documents, monitors, reports, and delivers e-learning courses.[10] Moodle, the modular object-oriented dynamic learning environment, is a crucial open-source alternative among LMS platforms, and it is backed by a large and active community with various plugins and customization options. It provides educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments.[11] These web portals are also utilized by radiology departments of the hospitals, medical institutions, research centers and radiology service providers for internal training of the radiologists and technologists. Moreover, the online fellowship programs in radiology also available which provide an excellent opportunity for radiologists to gain advanced training and expertise in a specific area of radiology, which can enhance their career prospects and lead to more significant opportunities in the field.

To impart effective and impactful online education and training in radiology, the pedagogical approaches that should be followed by the educators on an ideal online education portal include:

- Live Interactive lectures: Live online lectures are the most common mode of delivering radiology education online. These lectures are taken live (synchronous) in which the speaker delivers the lecture in real-time, simultaneously interacting with the audience. The speaker can ask questions to the audience and vice-versa. These can be delivered *via* various video-conference platforms (VCPs) such as Zoom and Webex. In synchronous distance learning, students participate in virtual classes or live webinars at the same time with their teachers and peers.
- Asynchronous lectures: Pre-recorded lectures can be uploaded on the online portal which help learners to attend them as per their pace and convenience. more complex comprehensive LMS for radiology.
- Flipped classroom formats: The radiology learners can be asked to prepare before a meeting discussion by reviewing cases from the pre-recorded lectures and submitting their findings or reading an article, or doing both.
- Experiential learning: To enhance learning by practical experience, many online educators and experts use virtual labs. Interactive virtual reality (VR) simulations help students practice interpreting radiographic images and also gather hands-on experience. These have also

lowered the cost of a skilled and trained anatomist and the requirement for cadavers.[4]

- Other engaging elements: Besides live or pre-recorded lectures, educators also share course material in pdf or word format, multimedia lessons and discuss case studies.
- Assessments: Regular assessments of the registered candidates in the form of assignments or quizzes or online tests can be conducted.

However, despite the benefits of virtual learning, it is not always easy to implement.[2] Low internet bandwidth and technical difficulties are the barriers to use online courses for both students and teachers which lead to less engagement and disturbance during online lectures.[7]

For radiology students, residents and professionals, when considering online education in radiology, it is essential for them to research different programs, review their curriculum, accreditation status, and faculty credentials to ensure the quality and recognition of the education received and select the one aligns with their educational and career goals. Additionally, they should also make sure that they have access to the necessary technology and resources to succeed in an online learning environment, including a reliable internet connection and appropriate computer hardware and software.

Several online education portals in radiology are available world-wide. With an aim of imparting e- education in radiology and committing to train radiologists globally, an online portal named Radguru, available as www.radguru.net (Figure.1) was started by Teleradiology Solutions, a teleradiology service provider located in Bangalore. Initially in 2011, it was designed as a portal for conducting internal training of radiologists.[12] Later, on September 22, 2015, this radiology e-learning portal was launched world-wide officially to promote e-learning, sub-specialty education and continuing updates on radiological knowledge for radiology residents and practicing professionals. The chief guest, Professor Bipin Batra, Executive Director, National Board of Medical Examiners virtually launched the portal and the Inaugural Keynote Lecture was delivered by Prof Sneh Bhargava, MD, FRCR Former Director and Head of the Department of Radiology, All India Institute of Medical Sciences (AIIMS) on "Creating Radiologists for the 21st Century: The Future of Radiology Education." Radguru is supported by the Telerad Foundation, the not for profit division of Teleradiology Solutions.

On this portal, e-Learning lectures and regular training sessions are delivered by National and International academically active group of experts in radiology. The modular object-oriented dynamic learning environment (Moodle) software was installed on a server computer and customized for radiology education. Further, a comprehensive LMS for radiology has been implemented in the reading room to augment image interpretation and point-of-care education.

A large amount of content has already been curated under the 'Radguru' portal (Figure 2). The resource list is constantly updated and can be found online (https://www.radguru.net/). As per the statistics, a total of 2403 candidates across the world have benefited by registering through this portal (Figure 3).

Table 1: Number of speakers from different countries of the world who delivered lectures through Radguru portal

Country name	*Number of speakers*
India	414
USA	40
Canada	9
UK	6
Israel	6
Singapore	4
Italy	2
Thailand	2
Saudi Arabia	1
Australia	1
Spain	1
Turkey	1
Total	487

494 lectures including conferences/CME, from different radiologic subspecialties are being organized from 2011 till date (Figure 4). Lectures have been conducted by 487 highly qualified and experienced speakers from 9 different countries of the world i.e. India, USA, UK, Canada, Italy, Singapore, Spain, Turkey and Israel (Table 1). Among these 487 speakers, 136 were academic personnel working as Head of department, professors or assistant professors in various medical schools and universities while 358 are non- academic American Board Certified Radiologists or Consultant radiologists from various hospitals and medical centres. 210 lectures out of 494 were organized on topics related to emergency radiology.

The Radguru portal is highly user friendly. It can be accessed by the registered candidates by simply logging into it anytime and from anywhere through the mobile device or desktop. The home page displays the Calendar of Events, Schedule for the day, and notification of recent activities and uploads. The content is organized under specific topics making it easier for the user to access information quickly. A total of 308 tutorials have been posted on Radguru. Out of these, 72 tutorials are on musculoskeletal radiology, 68 on gastrointestinal radiology, 42 tutorials on chest radiology, 31 on neuro radiology and 21 on genitourinary radiology (Figure 5). Besides tutorials, e-lectures, interesting case presentations, short case discussions, Virtual CME/Panel discussions, web conferences and quizzes have been also organized through this portal.

With a view to keep in line with the latest and rapidly advancing technology, the Radguru portal undertakes training activities for radiologists and technologists either through its own speakers and resources or in collaboration with various radiological societies such as Society for Emergency Radiology (SER), Canadian Emergency Trauma and Acute Care Radiology Society (CETARS), Indian Radiological and Imaging Association (IRIA), Indian College of Radiology and Imaging (ICRI) and Diplomate of National Board (DNB). SER

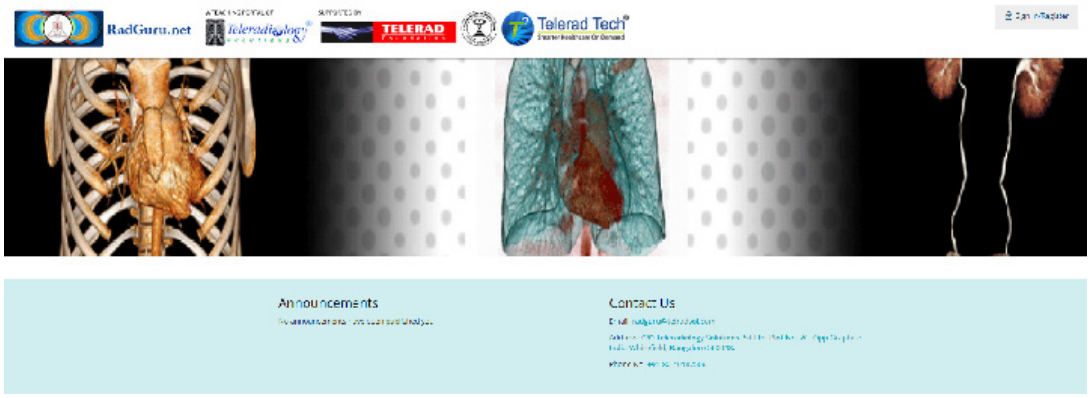


Figure 1: Webpage of RADGURU

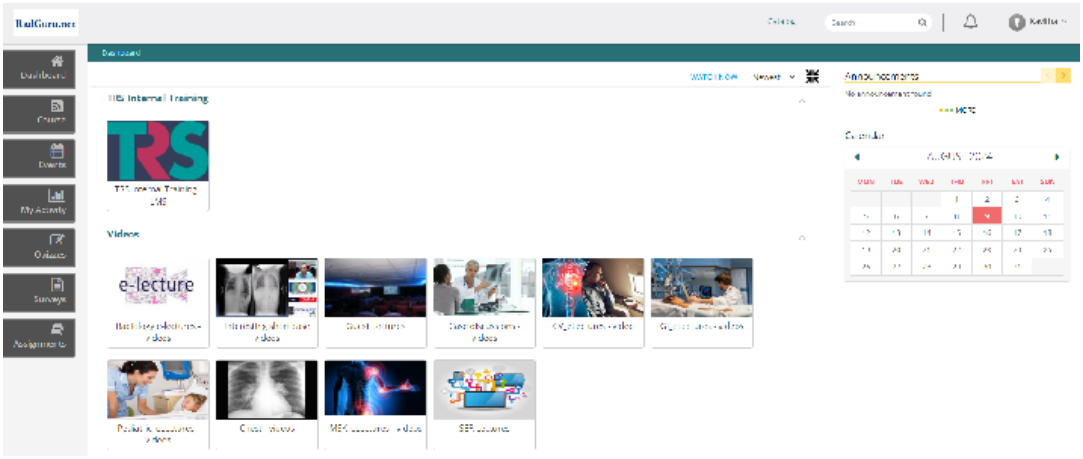


Figure 2: Dashboard of Radguru

series of e-classes based on the DNB curriculum are conducted every month through the Radguru portal. A one-year virtual fellowship in Emergency Radiology is also conducted in collaboration with the Society of Emergency Radiology.

During the COVID pandemic the Karnataka chapter of the IRIA monthly clinical meetings including academic activities were also conducted over this portal to ensure social distancing. The information on upcoming lectures, conference and webinars and other updates are shared through e-mails, twitter (https://twitter.com/radgurunet) and Facebook (http://www.facebook.com/pages/radgurunet/120092831399266?ref=hl) accounts.

Some technical challenges were faced during the preliminary stage of Radguru. Initially from 2011 to 2018, the lectures were organized through WebEx application which required Transport Layer Security (TLS 1.2). The users who had Windows 7,8, 10 operating system and older versions of web browser, were required to enable TLS 1.2 for internet connectivity. The speakers and the users were not technically acquainted. Even step by step instructions were sent to the speakers on how to login to the system and several test runs used to be carried out everytime before the e-lecture. Speakers faced problems in screen sharing, and the audio and video connections were not clear. The participants also needed to

Figure 3: Geographic distribution of Radguru users

register and login to the Radguru portal to attend the e-lectures. But 2018 onwards, the e- lectures were re-organized through Zoom application which provided seamless and smooth connectivity. Users can join the lecture from anywhere through a single zoom link shared to them through an e-mail or WhatsApp. The lectures are informative and interactive. The users can directly resolve their queries by simply asking or posting the questions in the comment box in the zoom app during the lecture. Moreover, a link to fill-out the online feedback form is shared with the participants to obtain their feedback about the lecture (Figure 6).

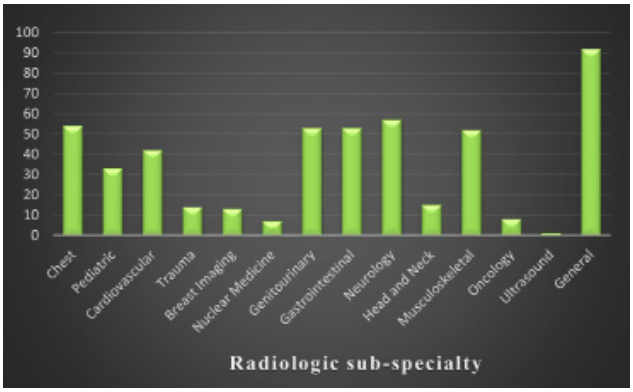


Figure 4: Distribution of e-lectures conducted under different radiologic sub-specialty

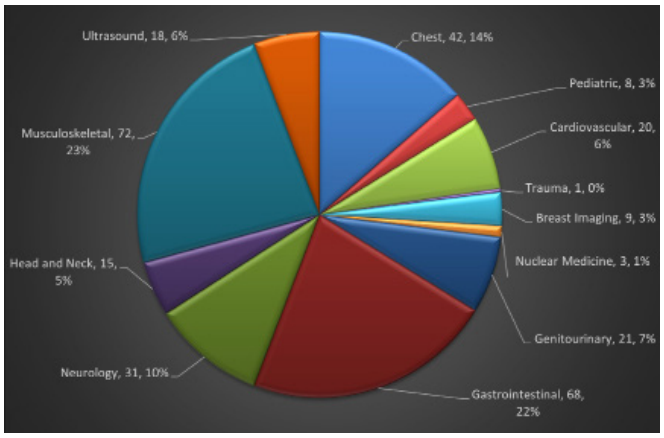
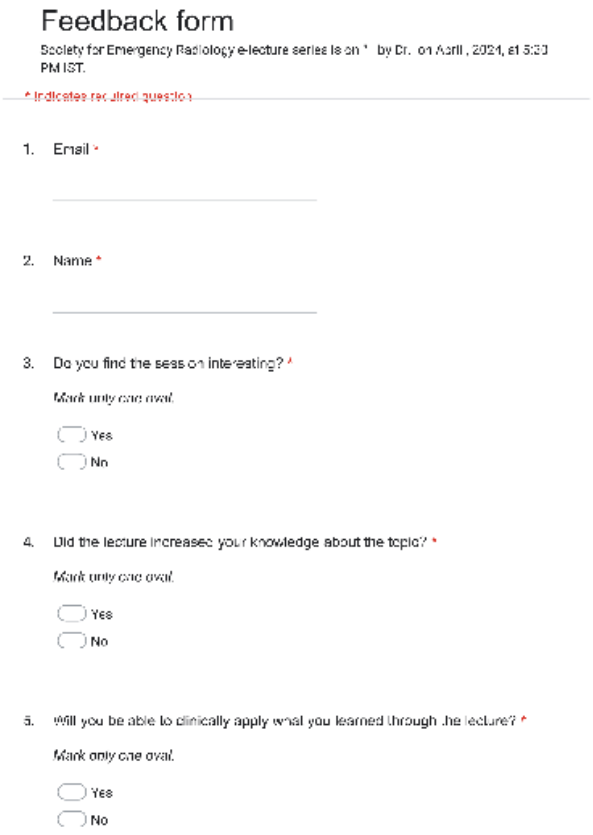


Figure 5: Distribution of number of tutorials on different radiologic subspecialties curated under Radguru portal


Feedback form

Society for Emergency Radiology e-lecture series is on * by Dr. on April , 2021, at 5:30 PM IST.

* Indicates required question

1. Email *

2. Name *

3. Do you find the session interesting? *

Mark only one oval.

Yes
No

4. Did the lecture increased your knowledge about the topic? *

Mark only one oval.

Yes
No

5. Will you be able to clinically apply what you learned through the lecture? *

Mark only one oval.

Yes
No

Figure 6: Feedback form to be filled-out by the participants after the e-lecture

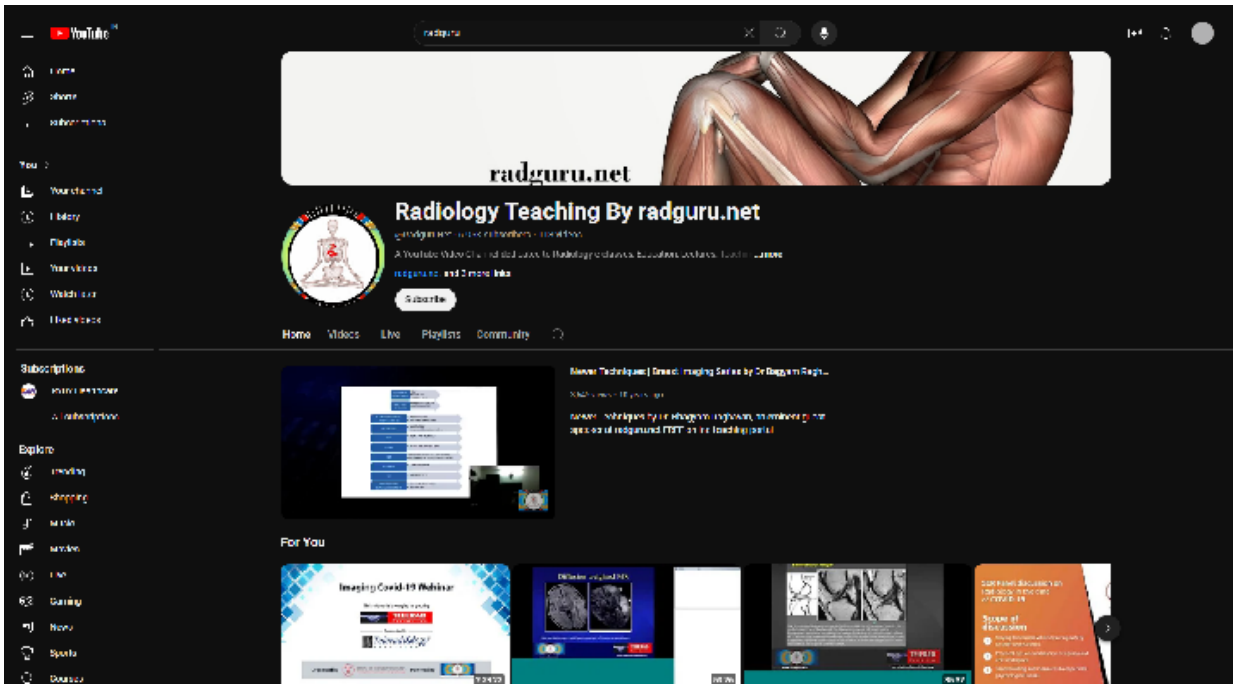


Figure 7: Radiology teaching channel on YouTube

There is also a radiology teaching channel on YouTube by Teleradiology Solutions (www.youtube.com/trsradiology) where teaching videos of Interesting Cases, and Guest Lectures are regularly uploaded (Figure 7).[13]

CONCLUSION

The innovation and advancement in the field of science and information technology has revolutionized the medical education system and healthcare. Technology is the key enabler to scale up radiologist education. Online teaching through web- portals has transformed radiology education system by rendering advantages to radiologists in terms of accessibility, flexibility, sub- specialty education and training. Secure and economical internet, proper infrastructure deployment, technological advancements, and the provision of well-informed technical support are still the pre-requisites. Radguru, an online education portal has played a prominent role in bridging the gap both in healthcare access and education, especially during the shortfall of radiologists and particularly of educators.

Take Home Points

- Technology is the key enabler to scaleup radiologist education.
- Online education in collaboration with radiology societies in India and abroad helps to promote education and practice of diagnostic radiological and imaging modalities and to educate practicing radiologists of the latest developments in the field of radiology, imaging and radiation medicine.
- An online portal named Radguru, available as www.radguru.net (Fig. 1) was started by Teleradiology Solutions, a teleradiology service provider with an aim of imparting e- education in radiology and committing to train radiologists globally. 494 Lectures have been conducted by 487 highly qualified and experienced speakers from 9 different countries of the world. The users can register and login to get access to the tutorials, interesting case presentations, short case discussions, Virtual CME/Panel discussions, web conferences and quizzes.
- Online education portal can be an excellent platform to provide sub-specialty education in radiology. These web portals can also be leveraged by radiology departments of the hospitals, medical institutions, research centres and radiology service providers for internal training of the radiologists and technologists.
- Online fellowship programs in radiology provide an excellent opportunity for radiologists to gain advanced training and expertise in a specific area of radiology.

REFERENCES

1. https://en.wikipedia.org/wiki/Radiology
2. Arora R. The training and practice of radiology in India: current trends. Quant Imaging Med Surg. 2014 Dec;4(6):449–50.
3. https://www.amrita.edu/program/bsc-medical-radiology-imaging-technology/
4. Biswas SS, Biswas S, Awal SS, Goyal H. Current Status of Radiology Education Online: a Comprehensive Update. SN Compr Clin Med. 2022 August 11;4(1):182.
5. Department of Radiology, Shaukat Khanum Memorial Cancer Hospital and Research Centre, Raza R, Siddiqui K, Department of Radiology, Shaukat Khanum Memorial Cancer Hospital and Research Centre. Virtual Learning in Radiology during COVID-19 PandemicOpportunity or Challenge? J Pathol Res Rev Rep. 2021 September 30;1–2.
6. Chellaiyan V, Nirupama A, Taneja N. Telemedicine in India: Where do we stand? J Family Med Prim Care. 2019;8(6):1872.
7. Darras KE, Spouge RJ, De Bruin ABH, Sedlic A, Hague C, Forster BB. Undergraduate Radiology Education During the COVID-19 Pandemic: A Review of Teaching and Learning Strategies. Can Assoc Radiol J. 2021 May;72(2):194–200.
8. Chen D, Ayoob A, Desser TS, Khurana A. Review of Learning Tools for Effective Radiology Education During the COVID-19 Era. Acad Radiol. 2022 Jan;29(1):129–36.
9. Den Harder AM, Frijlingh M, Ravesloot CJ, Oosterbaan AE, Van Der Gijp A. The Importance of Human–Computer Interaction in Radiology E-learning. J Digit Imaging. 2016 Apr;29(2):195–205.
10. https://www.techtarget.com/searchcio/definition/learning-management-system
11. http://moodle.org
12. https://www.radguru.net
13. www.youtube.com/trsradiology