Digital Diagnostics. 2021. Article in Press.
DOI: https://doi.org/10.17816/DD53701

Students opinion about E-Learning in a Master course in Interventional Radiology: a survey among participants

Emanuele Neri[1], Laura Crocetti[2], Giulia Lorenzoni[2], Roberto Cioni[2], Adrian Brady[3], Davide Caramella[1]

[1] Department of Translation Research and New Technologies in Medicine and Surgery, University of Pisa, Italy

[2] Unit of Interventional Radiology, Pisa University Hospital, Pisa, Italy

[3] Radiology Department, Mercy University Hospital, Cork & University College, Cork, Ireland.

Abstract

Objectives: To evaluate the opinion of students about Tele-education in a post-graduate University Master in Interventional Radiology.
Methods: The core curriculum of the Master is divided into 3 e-Learning modules and 2 e-Learning plus Hands-on Training modules. E-Learning is delivered through a webinar platform that allows to perform a synchronous training providing real-time lectures that are recorded for streaming on a dedicated website. The Hands-on Training is provided on site, assisting interventional radiologists in interventional procedures on patients. An online survey of 12 questions has been prepared to determine the quality of training. Students indicated their level of agreement regarding the impact of eLearning and Hands on Training using a 5-point scale. The mean score of the level of agreement was calculated.
Results: The series include 16 participants. The 62.5% work in a public non-academic Hospital and 80% have already performed >300 interventional procedures as primary operator.
The main advantage of the eLearning module was considered the capability to facilitate the attendance to lectures (68.8%) followed by the low cost training (18.8%), with a good agreement between participants. No students scored the statements as less than 3. The Master fulfilled the learning expectations in 81.3% of cases with a good agreement between participants.
Conclusions: The participants were highly satisfied and would recommend the Master to other colleagues. The blended type of education of our Master received high appreciation and could be a model to be follow in the future, also in IR.
KEYWORDS: Interventional Radiology, Education, Surveys and Questionnaires, Learning, Informatics
KEY POINTS:

- The post-graduate Master course of our University is the first blended course in Interventional radiology education in which hands-on training with face-to-face time in the Interventional suite is enhanced by online learning.
- The purpose of this article is to evaluate the impact of tele-education in Interventional Radiology on Master course participants.
- An online survey among Master course participants was prepared and structured in 12 questions to determine the quality of this training.

Digital Diagnostics. 2021. Article in Press.
DOI: https://doi.org/10.17816/DD53701

Abbreviations and acronyms:

IR: Interventional Radiology
UEMS: Union of European Medical Specialists
CIRSE: Cardiovascular and Interventional Radiological Society of Europe
EBIR: European Board of Interventional Radiology
SIRM: Società Italiana di Radiologia Medica e Interventistica
CME: Continuing Medical Education

Introduction

The clinical importance and contribution of Interventional Radiology (IR) has grown substantially in recent decades, with ever-expanding applications and image-guided therapies, especially in the vascular and oncologic fields. Correspondingly, the demand for interventional radiologists is growing.

In 2009 the Union of European Medical Specialists (UEMS) recognized IR as a distinct specialty of radiology [1]. A particular objective of the "UEMS Specialist Division–Interventional Radiology" has been to establish standards for the required knowledge and training of interventional radiologists [2]. However, the processes and requirements for accreditation and certification of IR training vary from country to country. To assist in the unification and standardization of international IR training and certification in Europe, the "Cardiovascular and Interventional Radiological Society of Europe" (CIRSE) created a comprehensive examination for professional interventional radiologists in 2010 (The European Board of Interventional Radiology, EBIR) and a "European Curriculum and Syllabus for Interventional Radiology" in 2013 [3]. Appropriate provision and certification of training, and clinical practice are now important requirements for IR in order to ensure a certain standard which will enhance patient care and safety [4]. For these reasons, it is imperative that radiologists in training acquire a minimum skill set and knowledge base during their basic radiology (Levels 1 & 2) training, which can be integrated with an advanced training fellowship to achieve good interventional competence [5].

Training in IR relies on a traditional and practical apprenticeship to gain technical skills in minimally invasive interventional procedures. However, in combination with traditional face to face teaching, the continuous evolution of information technology offers new e-learning tools that have been already successfully adopted in medical education for distance learning courses [6]. Such learning technology is aimed at delivering training or educational content quickly, effectively and economically, integrating learning materials, tools, and services into a single solution. Perhaps the most obvious advantage of e-learning is that it overcomes physical distances, with the possibility to learn at any time from any location without having to travel or spend time away from work [7]. Distance learning is important particularly for teaching settings in which faculty expertise varies across sites, and for post-certification further training, catering for radiologists with limited time and opportunities for travel to teaching centers. Added to this is the possibility of making the course format homogeneous for all participants with a standard format, both in teaching and in learning assessment.

A typical e-learning technology is the asynchronous web-based system (allowing the student access teaching resources at any time of their choosing) which allows great flexibility in timing of participation. Such technology allows rapid access to material suitable for radiological education, allows students to skip information they already know and move on to less familiar issues, and has the capacity to be easily and quickly updated. However, it is a one-way process with no interaction, unlike face-on-face learning. On the other hand, synchronous learning is based on a real-time education with the simultaneous communication between multiple users. The main advantage of this model is the ability to improve communication and interaction between students and teachers, promoting online collaborative learning and discussions.

In interventional radiology, electronic communication provides great potential for education by disseminating new techniques and procedures and by creation of an opportunity for spreading knowledge about this ever-growing specialty around the globe. Up to now this learning method has not yet been widely used in IR training programs.

At our University a Master in Interventional Radiology course was started in 2017, with the aim of providing interventional postgraduate training to radiologists. The Master is focused on body endovascular interventions. Accredited direct hands-on training is provided on site in the interventional suite. Lectures are provided through webinars with video conferencing software. The purpose of the study was to evaluate the opinion of students about Tele-education in Interventional Radiology.

Digital Diagnostics. 2021. Article in Press.
DOI: https://doi.org/10.17816/DD53701

MATERIALS AND METHODS

Master curriculum and training format

At present in Italy the radiology residency program consists of 4 years' training, which includes some participation in interventional radiological procedures. However, it is acknowledged by the Italian Society of Diagnostic and Interventional Radiology (SIRM) that the training in interventional procedures is not adequate to achieve core interventional skills. Therefore, SIRM has promoted among its members the development of post-graduate academic training courses in interventional radiology, which could integrate with already-existing radiology training programs. Since the 4 year Training program is not enough to provide even a complete interventional radiology training, the Master is foreseen as a complementary training to fulfill the gap caused by this rules. In view of this goal, in September 2016 our University launched the post-graduate Master in Interventional Radiology course. The access to the Master is limited to Board certified radiologists.
The Master course lasts one year, at the end of which all trainees must produce a thesis in order to receive certification of training. The maximum number of course participants is 40, with a minimum of 8.
The core curriculum of the course is divided into 3 e-Learning modules:

1. Theory of Interventional Radiology (which includes the basic on "how to perform" the procedure, the clinical indication, the expected outcomes, etc.)
2. Radiation Protection in Interventional Radiology
3. CT and MR planning of interventional procedures

There are also 2 e-Learning and Hands-on Training modules:

1. Endovascular interventions (vascular applications excluding Neuro interventions)
2. Interventions in Oncology

The Endovascular interventions module focuses on puncture technique, closure devices and different endovascular procedures such as aortic aneurysm repair, limb revascularization, uro-gynecologic and venous interventions and IR in emergency care.
The Oncology module includes embolization (including chemo- and radio-embolization) and ablation techniques, with a special focus on liver tumours.
Each module is weighted in CME (where 1 CME = 6 hours of training).
eLearning is delivered through 26 CME (156 hours) of teaching via a webinar platform (https://www.gotomeeting.com/) during a period of 7 months from November to May.
Each lesson is taught by different trainers from the local University, on one day per week, with a specific program delivered to all participants at the beginning of the course.
The eLearning platform facilitates synchronous training, providing real-time lectures at a defined time-slot (3 hours per day).
Each delegate connects through a PC client to the webinar server. The teacher is able to share the screen of his/her desktop, and interact with the delegates through audio-video tools. Each delegate can interact with the teacher via the same facilities. All lectures are recorded and made available for asynchronous streaming on a dedicated website, with restricted access for the trainees.
The participation of the students at the webinars is verified by checking the time of their entrance to and exit from the chatroom of the webinar.
Each student is asked by the teacher to interact during the webinar, but no tests need be completed at the end of each session. The software allows a 2-ways interaction with the teacher asking the students to participate and answer questions. Frequency and quality of interaction was valued as prove of attendance and understanding of the teaching content.
A moderator (the Master Chair) regularly attends the session in order to regulate the interaction between teachers and students, stimulate questions and answers, and verify attendance.

The Hands-on Training is provided with 7 CME (42 hours), on site, in the Interventional Radiology Unit of the University Hospital.
All physicians in training take part in the daily activity in the Interventional suite for at least one week. During this time they can actively participate in all procedures performed on live patients, not only as

observers but also with the opportunity to perform the procedure with support from and teaching by skilled Radiologists.
The Interventional Radiology Unit has 2 fluoroscopy suites; therefore no more than 4 students per week can participate simultaneously and they must agree the timing of their specific week of training with the Master Chair. Beyond this week, additional hands-on training can be provided upon request by the students.
At the end of the course each student produces a thesis on a chosen topic of interventional radiology, that is discussed during a dedicated session of thesis defense.

Survey among participants

To determine the quality of this training, an online survey among Master course participants was prepared, using open access Google Form software and structured in 12 questions about the student's professional background in IR, personal motivations for participation in the course, and their level of agreement with regard to the impact of eLearning and hands-on training on their clinical practice (Table 1).
The survey was launched through the mailing list of Master course participants and respondents were able to access the online Google form for responses for 1 week.
Students indicated independently their level of agreement with questions about the impact of eLearning and Hands-on Training, using a 5-point Likert scale, as follows:

1. Strongly disagree with the statement;
2. Disagree somewhat with the statement;
3. Undecided;
4. Agree somewhat with the statement;
5. Strongly agree with the statement.

The mean score of the level of agreement was calculated. A mean score of 4 was considered to represent "good" agreement between respondents, a score of 5 "complete" agreement.
All responses were automatically processed by the form and presented as charts on a Google spreadsheet.

Results

Sixteen out of 16 (100%) students of the University Master in Interventional Radiology course who had provided their names and affiliation addresses were invited to complete the survey. Not all of 16 answered every question; hence, the number in each table may not total 16 responses.
The attendees came from different Italian regions and only one participant was a local Radiologist. The majority of them (62.5%) work in public non-academic Hospitals, all as Staff Radiologist.
Before attending the Master course, all participants were already members of CIRSE and 80% of them had already performed a substantial number of interventional procedures (>300) as primary operator.
The most common motivation for participating in the Master course was a personal desire to acquire or improve the individual's interventional competence (75% of students); 25% were motivated also by the need for a trained Interventional Radiologist in their Imaging Department. In 12.5% of cases, students attended the Master course because of a belief that the interventional skills acquired during their Radiology Residency were inadequate.
Regarding the eLearning module of the Master course, the majority of participants (68.8%) considered the main advantage to be the capability to facilitate remote lecture attendance; 18.8% chose the low-cost system and 12.5% the facilitation of teacher-student interaction as the principal benefit.
The level of agreement (on a Likert scale) with the statements regarding the eLearning module of the Master course and the Interventional skills and practice is summarised in Table 2. No trainees scored the statements as less than 3 on the 5-point rating scale, indicating that all of them agreed to some extent with all statements, but the level of support differed. In particular, facilitation of off-site attendance of lectures and the low-cost system of the e-learning module of the Master course were scored particularly highly in terms of agreement.
The Master course fulfilled the learning expectations in 81.3% of cases with a good agreement between participants (mean score 4.25 ± 0.775), and 93.8% of participants would recommend the Master course to other colleagues.

Digital Diagnostics. 2021. Article in Press.
DOI: https://doi.org/10.17816/DD53701

Discussion

Over the years, there has been a worldwide growth in IR post-graduate courses to ensure the provision of more trained IR practitioners with competent knowledge and practical skills. Some of these take the form of one or more years of full-time Fellowship training, working exclusively in IR. Others involve shorter periods of training, with variable opportunities for hands-on work and varying amounts of formal didactic teaching. Accreditation and certification for IR training varies from country to country, with different learning methods and tools used to develop advanced interventional competencies.

In 2001, Rösch [8] stated that tele-education was becoming an essential part of interventional education to help "the growing number of interventionalists around the world to expand and improve standards of their treatment".

Our post-graduate Master course is the first blended course in Interventional radiology education in which hands-on training with face-to-face time in the Interventional suite is enhanced by online learning. It is designed to offer a feasible middle ground between e-learning (which can teach theory but cannot provide direct training in the manual skills required in IR) and full-time practical IR Fellowship-level training (which cannot be accessed by already-qualified radiologists with existing work commitments, who want to upgrade and expand their skills).

A recent large meta-analysis by the United States Department of Education [9] concluded that blended learning was significantly more effective than fully face-to-face or online courses and is an important emerging mode of instruction in specialist education.

One of the reasons we decided to adopt this type of education method was to promote students' participation with real-time distance learning.

All participants were already staff radiologists in their own hospitals at the time of the course, with on-going work commitments. The use of an e-Learning method was one way in which course participation by these already-employed radiologists could be facilitated in a timely and cost-effective manner [10, 11].

All participating radiologists could learn from any location without having to travel or spend time away from their base hospital. The majority of course participants considered the main advantage of the course structure to be the capability to facilitate lecture attendance from their home base, followed by the low cost of the course resulting from its e-learning structure.

The deployment of digital imaging networks, teleradiology, and Internet services strongly suggests that e-learning will become an important method of education in radiology, particularly for young physicians and students who are comfortable using these new technologies and require to be easily and quickly updated [7].

However, the tele-education method is not without its disadvantages.

In 2007, Cook [12] analyzed the pros and cons of this new type of learning, pointing out that the main disadvantages are related to social isolation and the de-individualized instructions due to an absence of face-to-face contact between teachers and students. This is particularly true in case of an asynchronous system, which offers flexibility in the timing of participation to the detriment of the direct interaction between teacher and student that is still seen as a necessary component of education.

The platform of our Master course was explicitly designed to overcome these limitations.

Several studies [9, 13-14] report that online instruction cannot completely replace traditional education, while a combination of e-learning and face-to-face lectures is the preferred type of education, at the best convenience of the students**.**

Our platform provides a synchronous tele-education system in which all participants are connected in real-time, and can interact directly with the academic staff online if they have questions or doubts. Teachers take on the role of facilitators, monitoring and guiding the discussion as needed and providing or helping students to find additional resources, as in a traditional classroom.

All lectures are recorded, facilitating the repetition and temporal spacing required for enduring learning, giving the students the opportunity to learn or revise the subject in their own time and at their own speed.

In our survey, participants rated this type of e-learning module positively with quite good agreement between respondents regarding the benefit of facilitated teacher-student interaction.

However, personal contact between the course participants and teachers is still an important ingredient in the learning situation; online courses are not universally accepted, with a percentage of students preferring traditional lecture-based courses**.**

This is a limitation of the tele-education module, which could be overcoming with some modifications.

Not all e-learning approaches are equally efficient, and e-learning success depends also on the provided content. For this reason, teachers must learn the necessary technological skills and teaching strategies to

create effective educational online environments and they must prepare proper material to obtain the desired e-learning results [15].
Moreover, personal contact between teachers and students can be provided by hands-on training with face-to-face contact. To ensure this element is provided for, our Master course combines online learning with traditional hands-on training in the Angio suite with the opportunity to watch expert interventionalists in action in their own suites, working with their own teams, and with the possibility to interact with them and participate actively in performance of procedures.
Regarding the hands-on training in the Department of Interventional Radiology, not all participants agreed that it increases their interventional skills. This is probably due to the limited number of hours of the hands-on training module of the Master course at present; this time availability may need to be increased as the course develops, bearing in mind that practical hands-on training is a key component of IR teaching.
Overall, the participants who took part in the survey were highly satisfied with the course and would recommend the Master to other colleagues.

Conclusion

Distance learning represents an educational technique which occupies a significant place in real-life medical teaching, especially in postgraduate and continuing medical education. Our Master courser has shown that this type of education can be implemented in the Interventional Radiology scenario, providing an opportunity for spreading knowledge about this ever-growing subspecialty around the globe.
Overall, the study suggests that the blended type of education of our Master course is a feasible contribution to IR training, received high appreciation among participants and could be a model to be followed in the future.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest
All authors declare that they have no conflict of interest

Research involving Human Participants and/or Animals
The research is not involving Human Participants and/or Animals

Informed consent
Not applicable.

References

1. Union Européenne des Médecins Spécialistes (2009) UEMS. Medical Specialties. Available via https://www.uems.eu/about-us/medical-specialties. Accessed 24 Jan 2017.
2. Mahnken AH, Bücker A, Hohl C, Berlis A (2017) White Paper: Curriculum in Interventional Radiology. Fortschr Rontgenstr. 189:309–311.
3. Tsetis D, Uberoi R, Fanelli F, et al. (2016) The Provision of Interventional Radiology Services in Europe: CIRSE Recommendations. CardioVascular and Interventional Radiology 39:500–6.
4. Lee MJ, Belli A-M, Brountzos E, Morgan R, Reekers JA (2014) Specialty Status for Interventional Radiology: The Time is Now. CardioVascular and Interventional Radiology 37:862.
5. Siragusa DA, Cardella JF, Hieb RA, et al. (2013) Requirements for Training in Interventional Radiology. Journal of Vascular and Interventional Radiology 24:1609–12.
6. Xiberta P, Boada I (2016) A new e-learning platform for radiology education (RadEd). Computer Methods and Programs in Biomedicine 126:63–75.
7. Pinto A, Brunese L, Pinto F, Acampora C, Romano L (2011) E-learning and education in radiology. European Journal of Radiology 78:368–71.
8. Rösch J (2001) Tele-education in Interventional Radiology. CardioVascular and Interventional Radiology 24:295–6.

9. U. S. Department of Education (2010) Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies. U. S. Department of Education, Washington DC. Available via https://www2.ed.gov/rschstat/eval/ tech/evidence-based-practices/finalreport.pdf. Accessed 3 Jan 2017.
10. Sparacia G, Cannizzaro F, D'Alessandro DM, D'Alessandro MP, Caruso G, Lagalla R (2007) Initial experiences in radiology e-learning. Radiographics 27:573–81.
11. Ruiz JG, Mintzer MJ, Leipzig RM (2006) The impact of e-learning in medical education. Acad Med. 81:207–12.
12. Cook DA (2007) Web-based learning: pros, cons and controversies. Clinical Medicine 7:37–42.
13. Nkenke E, Vairaktaris E, Bauersachs A, et al. (2012) Acceptance of technology-enhanced learning for a theoretical radiological science course: a randomized controlled trial. BMC Medical Education 12.
14. Santos GN, Leite AF, Figueiredo PT, et al. (2016) Effectiveness of E-Learning in Oral Radiology Education: A Systematic Review. J Dent EDuc. 80(9):1126-39.
15. Ellaway R (2011) E-learning: Is the revolution over? Medical Teacher 33:297–302.

Digital Diagnostics. 2021. Article in Press.
DOI: https://doi.org/10.17816/DD53701

Table Legends

Table 1: Online Survey to determinate the quality of Training of the IR Master course.
The level of agreement in questions 5 to 11 was indicated using a 5-point scale, as follows: 1, strongly disagree with the statement; 2, disagree somewhat with the statement; 3, undecided; 4, agree somewhat with the statement; 5, strongly agree with the statement.

QUESTIONNAIRE

1. Which is your role in the Imaging Department?	Chair Staff Radiologist
2. Interventional procedures performed as primary operator before attending the Master course	None Less than 50 50-300 300-1000 More than 1000
3. Reasons for attending the Master course (more than 1 answer possible)	Personal motivation only (to acquire or improve interventional competences) Personal motivation and need for interventional radiologists in the Imaging Department No specific personal motivation but forced by the need for interventional radiologists in the Imaging Department No opportunity or inadequate interventional training during Radiology Residency Other
4. Which of the following statements do you agree with regard to the eLearning module of the Master?	It facilitates attendance during lectures It is low-cost since the student does not move to the learning center It facilitates teacher-student interaction Other
5. The eLearning module of the Master course facilitates attendance during lectures	Score 1 to 5
6. The eLearning module of the Master course is low-cost, as the student does not move to the learning center	Score 1 to 5
7. The eLearning module of the Master course facilitates teacher-student interaction	Score 1 to 5
8. The hands-on training in the Department of Interventional Radiology increased your interventional skills	Score 1 to 5
9. The Master course has enhanced your job opportunities	Score 1 to 5
10. The Master course attendance has changed your local interventional practice	Score 1 to 5
11. In summary, did the Master course fulfil your learning expectations?	Score 1 to 5
12. Would you suggest that your colleagues should apply for the Master course?	Yes No Maybe

Table 2: the mean score of the level of agreement of the statements regarding the eLearning module of the Master and the Interventional skill and practice.

QUESTIONS	Mean Scores	Std dev
The eLearning module of the Master course facilitates attendance during lectures	**4.56**	.629
The eLearning module of the Master is low-cost, as the student does not move to the learning center	**4.88**	.342
The eLearning module of the Master course facilitates teacher-student interaction	3.81	1.424
The hands-on training in the Department of Interventional Radiology increased your interventional skills	3.56	1.209
The Master course has enhanced your job opportunities	3.69	1.401
The Master course attendance has changed your local interventional practice	3.4	.828

CORRESPONDING AUTHOR:

Prof. Emanuele Neri
Department of Translation Research on New Technologies in Medicine and Surgery, University of Pisa
Phone: 0039-050-992509; e-mail: emanuele.neri@med.unipi.it