Videconferences in Radiology: Italian multicentric experience on e-learning

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1. With the dawning of the new millennium, information technology (IT) has become for education and teaching a pillar supporting new teaching strategies, and with it, the term e-Learning has been coined [reference 1-3]. E-Learning is short for "electronic learning" and refers to the possibility of offering teaching and/or education via the Internet or World Wide Web [reference 4, 5].

2. In this ambit, the aim of our work was to design, implement and evaluate an e-Learning programme in favour of trainee radiologists enrolled at the many Specialty Schools located throughout Italy, in the spirit of "sharing culture"; the project was called: "Let's Specialise Together".

3. Once a common educational programme and time slot had been identified and planned, the programme was delivered via Internet-based video-conferencing once a week for 2-h lectures. Each lecture was followed by interaction between the teaching staff and trainees at the individual sites. The universities involved were Trieste, Udine, Verona, Milano Bicocca, Novara, Varese, Genova, Sassari, Rome "Campus", Rome "Cattolica", Chieti, Foggia, Catania, Modena and Firenze (Fig 1).
Fig. 1: The universities involved in the project "Let's Specialise Together" were Trieste, Udine, Verona, Milano Bicocca, Novara, Varese, Genova, Sassari, Rome "Campus", Rome "Cattolica", Chieti, Foggia, Catania, Modena and Firenze

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Methods and Materials

Planning of project

Phase 1:

The initial planning phase of the project involved the presentation of the project and aggregation of the participants. An e-mail was sent on 11 May 2009 informing all Directors of the Italian Specialty Schools of Radiology of the desire to establish an e-Learning project for the 2009/2010 academic year in the form of single-topic teaching seminars. The imaging features of the various organs and systems, in the context of “Oncological Disease”, were then proposed as teaching topics. Once participation in the project had been acquired, a lesson calendar was drawn up, with seminars beginning on 21 October 2009 and ending in July 2010. Each Director of the Specialty Schools were then asked to provide a topic in-line with the teaching aims of the entire project (Fig 2).

Each Specialty School was also asked to provide a referee to take on the role of “network tutor” for the implementation of the entire project [6-13]. To guarantee involvement of the residents, it was decided that the network tutor should be enrolled at the school.

Coordination of the entire network was entrusted to the Novara network tutor resident.

Phase 2:

On September 2009, a preliminary meeting was held at the Piemonte Orientale University of Novara attended by all “network tutors” of the participating Specialty Schools. The meeting was characterised by a thorough analysis of the technical and teaching challenges of the project (Fig 3). This one-off meeting also served to establish the organisational network. The meeting was followed by six online meeting rooms aimed at ironing out the technical and connection problems. For the purposes of assessing the effectiveness of the project, a common multiple-choice questionnaire was devised and approved, to be completed at the end of every lecture at each of the locations (Fig 4). The trainee radiologists evaluated the lessons on the basis of a preordered, four-point scale: 1. Unsatisfactory, 2. Satisfactory, 3. Good, 4. Excellent. The questionnaire sought information regarding number of participants in the classroom, overall assessment of the teaching content, interruptions without reconnection of the Internet service, transient interruptions of the Internet service and Audio/Video quality. At the end of the series of
lessons random suggestions on how to improve the project on the whole were requested from some of the residents.

**Technical aspects:**

From the technical point of view, the entire e-Learning process was managed by a system administrator with expertise in this sector (Exit srl), and the online meeting space Microsoft Office Live Meeting was chosen for presenting the lessons. Microsoft Office Live Meeting allows participants to access an online meeting space via the Internet. It requires installation of a software application on all participant's computers and provides real-time interaction with participants who may make presentations, launch projects, brainstorm, modify files or collaborate through the use of a virtual whiteboard (Fig 5). The programme was chosen for its speed, the excellent Audio/Video quality and the voice compression characteristics, which guarantee easy listening even in the presence of microinterruptions in the connection.

In terms of hardware, the minimum requirements for connection and participation in the lessons were the following:

- Personal Computer with a 500-MHz processor or above (1 GHz recommended)
- Operating System Windows XP SP2 or SP3 or above (Vista or Windows 7)
- At least 256 MB of random access memory (RAM) (512 MB recommended)
- Dedicated DirectX video card compatible with 64 MB of random access memory (RAM)
- Webcam
- Audio card, microphone, speakers/headphones
- Videoprojector or other peripheral device for video reproduction, plasma or liquid crystal display (LCD) screen, with super video graphics array (VGA) resolution of at least 800×600 (super VGA 1,024×768 recommended)
- Fast Internet connection, asymmetric digital subscriber line (ADSL)

In order to receive the content, the computers used in the various locations required the following programmes in addition to Microsoft Office Live Meeting:

- Internet browser (Interned Explorer (IE) 6 or above, Mozilla Firefox 3.x, Apple Safari 3.x)
- Sun Java 1.6.0_11 or above
- Microsoft Office Power Point 2002 or above
- Adobe Flash Player 9 or above.
With regard to the server, a HOSTED service external to the organisation was used, i.e. hosted on a Microsoft Multimedia Server, thus acquiring the guarantee of optimal performance. In addition to the part of the server (HOSTED), the programme was completed with a software "client" to be installed on all computers participating in the meeting and which could be automatically installed at the first invitation to participate. The "client" was extremely lightweight, free and constantly updated thanks to the Windows update facility. A typical lesson delivered during the online series of seminars first involved creation by the system administrator of a virtual conference room. The participants were assigned to the conference room and the relative access credentials for the e-Learning process were generated.
### Table 1: E-Learning project “Let’s Specialise Together: Teaching Programme for the 2009/2010 Academic Year” (Oncological Disease, Integrated imaging: Imaging features, Integrated imaging features and differential diagnosis)

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<thead>
<tr>
<th>Lessons</th>
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<td>Bonomo, Lorenzo</td>
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<td>Lesson 3:</td>
<td>16 Dec 2009</td>
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<td>Storto, M. Luigia</td>
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<td>13 Jan 2010</td>
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<td>Colosimo, Cesare</td>
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<td>Catania</td>
<td>Eitorre Gian, Carlo</td>
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<tr>
<td>Lesson 7:</td>
<td>10 Feb 2010</td>
<td>Rome</td>
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<td>24 Feb 2010</td>
<td>Modena</td>
<td>Torricelli, Pietro</td>
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<td>Lesson 9:</td>
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*US, ultrasound; MRI, magnetic resonance imaging*

**Fig. 2:** E-Learning project "Let's Specialise Together: Teaching Programme for the 2009/2010 Academic Year" (Oncological Disease, Integrated imaging: Imaging features, Integrated imaging features and differential diagnosis)

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Fig. 3: The preliminary meeting was held at the Piemonte Orientale University of Novara attended by all "network tutors" of the participating Specialty Schools. The meeting was characterised by a thorough analysis of the technical and teaching challenges of the project.

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**Fig. 4:** For the purposes of assessing the effectiveness of the project, a common multiple-choice questionnaire was devised and approved, to be completed at the end of every lecture at each of the locations.

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Results

Lessons:

After identifying and planning a joint teaching programme (Fig 2), the technical approach to e-Learning in the online meeting space involved an Internet connection on Wednesday afternoons and a 2-h lesson, followed by more traditional interaction with the trainee radiologists at the individual locations.

Overall 18 lessons were held for a total of 36 h of teaching. With regard to the overall attendance of the Specialty Schools to the entire teaching programme, there were absences by the schools in 9% of lessons: three were absent for one lesson, one for seven lessons, one for four lessons and one for six lessons. The absences were due to local reasons within the individual Schools and were independent of the e-Learning process (Fig 6).

Overall 7,405 residents attended the lessons, with a mean attendance per lesson of 411.3 trainees. With regard to residents' overall opinion of the course content, 80% found the course Excellent, 19.7% Good and 0.3% Satisfactory; no trainee expressed an Unsatisfactory opinion (Fig 7).

Interruption of Internet service:

An interruption to the Internet service without reconnection occurred only on one occasion at one location due to a storm, whereas 1.5% of connections experienced transient interruptions limited to a few minutes and did not significantly disrupt learning.

There were 13 transient interruptions to the Internet service for a total of 33 min out of an overall total of 2,160 min of Internet connection (Fig 8).

Audio/Video Quality:

With regard to residents' opinion of Video quality, and especially of the detail of the radiological images presented in slides and moving pictures, 71% gave an Excellent assessment, 24.5% Good and 4.5% Satisfactory; no trainee expressed an Unsatisfactory opinion (Fig 9).

Audio quality was rated as Excellent by 72% of residents, Good by 24% and Satisfactory by 4%; no trainee expressed an Unsatisfactory opinion (Fig 10).
With regard to lesson location, there was only one case of connection and file uploading problems that made it impossible to transmit the lesson from that location. In this case, the lesson was nonetheless delivered by another location (Novara), which at the beginning of the project was nominated as "active reserve", ready to intervene and compensate for any technical problems at the location of the scheduled lesson.

**Costs:**

The overall costs of the entire series of seminars included the services of a company specialised in Webcasting and were equal to 5,000 euro.

The cost of each lesson was therefore 277 euro, whereas the cost for each school was 333 euro. It should be pointed out that the per-lesson cost for each school was 18 euro. This cost analysis does not include the purchase of hardware and software, which each school had to make in the event this equipment was not already available. The additional cost is difficult to estimate given the variety of prices and possible configurations, but it seems reasonable to suggest a minimum amount of 700-800 euro.

**Suggestions:**

In order to improve the project, 20 random suggestions were requested from the residents who participated in the course.

The following main themes were touched on:

- Keep the lesson to 1h to avoid a drop in attention.
- Present relevant clinical cases at the end of each lesson. The cases could be presented by the residents at the teaching location for that lesson.
- Provide a final test on the topic covered.
- Cover a complete topic each year with special emphasis on imaging characteristics; here emergency medicine was the most proposed topic for a possible future series of seminars.
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Fig. 7: Residents attended the lessons and resident's general opinion about it
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**Fig. 10:** Residents' opinion about Audio quality, and especially of the detail of voice's Teacher.

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Conclusion

The e-Learning process has by now become a common feature on the educational scene. It is able to overcome barriers to the spread of culture and thanks to its low costs enables cultural exchange and sharing. This initial Italian project was carried out in a spirit of cooperation and experimentation.

The teaching faculty were highly satisfied with the outcome, and the trainee radiologists demonstrated enthusiasm and satisfaction. The innovative nature of e-Learning is a useful complement to the traditional educational and training activity (theoretical and practical) of each school, which is irreplaceable. In each school, the Director and his/her group of lecturers have the task of guaranteeing that the residents achieve an adequate standard. In a manner similar to postuniversity refresher courses, teaching by video conferencing can be used to improve the overall quality of resident training.

The possibility of having the various faculty boards recognise study credits [CREDITI FORMAZIONE UNIVERSITARIA (CFU)] associated with an e-Learning project in the setting of specialty-school teaching is a further teaching/institutional goal that could prove to be a valid aid for the teaching body.

Based on our experience, whereas e-Learning in Radiology has - in our opinion - become established and compulsory, there is the need for adequate legislation that on the one hand protects online teaching and on the other allows study and continuing medical education (CME)
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