Today, a world without the internet seems impossible to imagine. The ease with which information can be located and consumed is overwhelming, from abstracts and full text, through to presentations and complete lectures on video sites. Combined with the fact that almost all professions require lifelong learning to remain up to date, electronic media seems to be the preferred method for enabling education in the future. Classical education, in which a group of students listen to a lecture from a professor, will become more and more outdated and student driven learning (“flipping the classroom”) will become the new norm. In this kind of education, questions are formulated which, if correctly answered, yield points. Instead of a final examination over a large amount of material, students can “consume” small bits of information at a time and place they prefer and prove that they understood the material by taking an electronic test.

E-learning is a relatively new term and encompasses the design and/or creation of learning environments using information and communication technology (ICT), which is predominantly internet technology. Although it started at the end of the 1990s and it was thought that there would be an explosive growth period at the start of this century, the internet bubble has tempered expectations. Therefore, e-learning has followed the typical “hype cycle” of emerging technologies, where a first phase of over-enthusiasm gives way to a second phase of disillusionment, followed by a third/final phase of gradual improvement. It is this latter phase in which we find ourselves nowadays.

THEMES IN E-LEARNING

E-learning by means of ICT can be separated into several themes as follows: 1) formal and informal learning; 2) didactic learning; 3) asynchronous and synchronous learning; and 4) technology-enhanced learning.

Formal learning implies that education is intentional and systematically organised. Normally an organisation (e.g. school/educational institute) uses online courses and online examinations, or provides a digital environment on the internet and/or within the intranet of the institute to allow group work on projects students have in common. Informal learning implies that the initiative is normally taken by an individual or (project) group, for instance to search databases or use electronic forums to find answers.

Behaviourism is the classical way to educate, meaning that “standard knowledge” is transferred by a teacher in a manner whereby repetition and positive stimulation are important aspects. If a student passes an examination they can continue; however, if they fail they are “punished” and have to redo the cycle. In education, it has been advocated for decades that behaviourism should be replaced by so-called social
constructivism, in which personal responsibilities are encouraged and terms such as student-driven learning, group learning and computer-supported collaborative learning are standards. Although many e-learning projects started out on, or indeed still follow the path of behaviourism (meaning a digital course followed by a digital test), there is a gradual shift towards letting a student self-select which content is studied, when it is studied and how, such that they can tailor education to their own interests and needs.

Asynchronous learning is where a student follows their own time frame and feedback on questions or produced results is often at different times for each student. Synchronous learning is where a group of students, often not in the same place, follow an electronic, often interactive session at the same time, mostly with a moderator leading the session. Questions posed by one person can be answered directly and discussed by others during synchronous learning; however, each participant has to be available to take part in such an electronic session at the time it is scheduled.

The way e-learning is implemented might also depend on the amount of technology used. Formerly, a series of electronic lectures had to be followed with a digital examination, which was not motivating and many students did not reach the end of the course. Nowadays, a mixture of online learning and face-to-face learning is seen as optimal and has become known as “technology-enhanced learning” (figure 1). Computer simulations/simulators are very good teaching tools but are still time and/or cost intensive to produce and the enhanced model offers good value.

E-LEARNING AND RESPIRATORY MEDICINE

If we look more specifically at the respiratory field there are many sources where one can find information. The obvious internet search engines will of course give many hits when searching for information but the difficulty lies in determining the relevance of these results. They might range from professional material to the homework of primary school students and it is often not clear which is which. Therefore, general platforms like Wikipedia or those with a more medical focus, such as UpToDate®️, are used to give more assurance that information is of a professional standard. Otherwise, PubMed, the more-or-less standard database of all peer-reviewed medical articles, is used as a source for medical/respiratory science publications. Larger respiratory societies like the European Respiratory Society (ERS) and the American Thoracic Society (ATS) have their own websites and searching for “E-learning pulmonary” in Google gives hits not only for the educational resources of the ERS but also for other resources, such as the websites of the American College of Chest Physicians and the British Thoracic Society (BTS), which also have e-learning material available.

E-LEARNING FROM THE ERS

The e-learning resources available from the ERS are divided into several categories as follows: 1) My resources; 2) Events; 3) Publications; 4) Guidelines; 5) Topics; 6) E-learning; and 7) Respipededia (see figure 2).

The amount of information available within the ERS resources can look overwhelming; however, once a student is logged into their MyERS account they can bookmark material relevant to their interests which will then be available under the My Resources tab. Even session data, such as a browser history, can be stored in this fashion.

Events is a huge database of material presented at ERS international congresses, on courses, at conferences and at research seminars, as well as on ERS Live and Best of ERS (the last two mainly consisting of webcasts or slideshows with accompanying video clips of speakers giving important talks at conferences).

The publications section relates to all of the published output of the ERS, covering all articles published in any form. This ranges from magazines like Breathe to the ERS Handbook and ERS Monograph book series, as well as the European Lung White Book and journals such as the European Respiratory Journal, the European Respiratory Review, and ERJ Open Research.

The guidelines section is continually growing and aims to be a comprehensive resource listing of guidelines, statements and technical standards for respiratory medicine both from the ERS and from external resources.

**Figure 1.** Technology-enhanced learning blends face-to-face learning with online study for optimal results.
The topics section aggregates material assigned to particular subject categories. Essentially, it is a list of pulmonary topics and/or diseases and once the student has clicked on a topic of interest they are presented with an overview of all the different kinds of material available on that topic. The material within this overview is derived from past ERS events and publications, ranging from (key) journal articles to posters presented at ERS meetings.

The most relevant section of the ERS resource is of course the e-learning part. This is subdivided into a number of sections as follows: 1) Continuing medical education (CME) online; 2) Case reports; 3) Procedure videos; 4) CME tests; and 5) Simulators. It also contains the reference database of respiratory sounds and the ERS radiology image challenge. CME online consists of a series of modules on topics in respiratory medicine presented by experts from all over the world. These might include webcasts, articles or panel discussion videos and they culminate with the opportunity for the student to take a CME test and earn CME credits. Case reports deal, as the name implies, with pulmonary cases in both the adult and paediatric settings and again CME credits can be gained by following the course and scoring at least 75% in an online test. The procedure videos section mainly deals with pulmonary procedures, ranging from bronchoscopy and blood gas sampling to polysomnography and lung transplantation. The CME tests section presents an overview of all the CME tests which can be taken, as assembled from case reports, guidelines and *Breathe* and European Respiratory Journal articles, as well as from the ERS Monograph series. As training opportunities for skills-based procedures are becoming increasingly scarce, simulation-based education has been identified as one possible solution to this problem and the simulators section seeks to address this. A simulator course consists of pre-course questionnaires, videos and educational material, post-course questionnaires and a CME test.

The reference database of respiratory sounds describes 16 cases in which pulmonary sounds play a major role in obtaining the correct diagnosis, presented together with the opinions of an expert-panel. In the radiology imaging challenge some 66 cases are presented together with the opinions of an expert-panel. In the radiology imaging challenge some 66 cases are presented and more are added weekly. All this material can be accessed online at the time preferred by the student and almost all of it is designed to be consumed in pieces, making it easy to follow at the student’s own pace.

The last topic, Respedia, is designed to be a kind of Wikipedia but one that is dedicated to the respiratory field and is written by experts within it. Each article follows a structured format, from summary, epidemiology, aetiology, prognosis, diagnosis and risk stratification to management and prevention. Similar initiatives are emerging worldwide or are already functional (e.g. diapeda, ECGpedia or Neuropedia).

**OPTIMISING E-LEARNING**

An important question is whether e-learning is the ultimate solution for varied educational needs. Indeed, the fact that on average no more than 20% of participants finish massive open online college (MOOC) courses, often presented by the top teachers of top universities, shows that it is very difficult to keep the attention focused when using e-learning methods. Several tips to optimise completion rates of e-learning courses are as follows: 1) Material should be of short duration. For example, video clips should be no longer than 7 min in length and a mixture of video clips, presentation slides and documents is preferable over a series of clips. A key phrase here is “micro-learning”, where content is broken up into very small chunks which can easily be consumed when the student has (only) a few minutes to spare; 2) Certificates or other rewards (like CME credits) should be earned. Rewards make participants finish massive open online learning courses and they can be used during the course. This allows for breaks in each learning session and assures participants that they are on the correct path; 4) Make discussion platforms available and participate on such platforms if possible. Social interaction is often important for participants and during regular classes questions can be asked and discussions started, an option e-learning can lack. The inclusion of discussion opportunities...
in synchronous learning might replace this but will be more limited due to its focus on being available at a scheduled time; 5) Remind participants by a gentle email to continue where they left off if they have not finished a course.

**SUMMARY**

E-learning might be said to be the best way to educate these days, as it offers the advantage that the best material by the best teachers can be studied at a time and a place that the participant prefers. Instead of only privileged students being able to study at top universities with top teachers, the world can be opened up if these teachers give lectures which can be assessed through e-learning methods. Furthermore, since lifelong learning is now a necessity in many countries, with the concomitant requirement to earn enough CME credits each year, e-learning is perfectly positioned as a method of accomplishing this objective. To this end the ERS offers an increasing amount of e-learning materials which are optimised for the respiratory physician. It should be noted, however, that each educational system has its weak points and “pure” e-learning may not always be the best solution to all educational requirements. For example, a mixture of different approaches, known as “blended learning”, may well prove to be the most effective in certain cases. After all, while basic knowledge can be taught well via e-learning, it can prove worthwhile to mix this format up with in-person courses, where skills can be better taught and social interaction works better.

**CONFLICT OF INTEREST**

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**RECOMMENDED READING**


