Virtual medical campus: the increasing importance of E-learning in medical education

Abstract

In 2002, along with the integration of a new, integrated curriculum in human medicine, the Virtual Medical Campus Graz was installed. It accompanies the whole curriculum with electronic materials tailored to the needs of the students and the forthcoming examinations. To date, more than 15,000 learning objects have been developed, and students download up to 200,000 learning objects per month. Particular emphasis is placed on Web-Based Training materials, but video and simulations are also included. In part, transfer of basic knowledge is mediated by electronic learning materials, replacing several hours of classroom attendance. Face-to-face education, in turn, is focusing increasingly on small-group clinical teaching.

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Introduction

Nowadays, most medical faculties offer some kind of e-learning. The Medical University of Graz introduced an e-learning environment in 2002, together with the introduction of reformed curricula in human and dental medicine. The Virtual Medical Campus Graz supports the whole of the curricula and provides learning objects of different kinds [1]. Most of the material is created by teaching staff – but also by students – of Graz University. So far, more than 15.000 learning objects have been installed, and each month students of the medical university download up to 200,000 learning objects [2].

One might speculate whether widespread use of e-learning is only driven by technological developments, or whether there is a didactic rationale to support its use. The relevance of computer technology for the ever-increasing importance of e-learning is undisputable. Starting with CD-ROMs in the early 1990s, modern ICT today provides all the necessary tools including texts, still images, animation, video, simulation, forums, chat, whiteboard, voice-over-ip, any kind of interactivity and even video conferencing.

There are, however, also reasons related to the changing landscape of medical faculties that support the importance of e-learning. University hospitals nowadays are characterized by fewer inpatients, shorter hospital stays and a spectrum of diseases that does not necessarily cover the needs of modern curricula with their main emphasis on common diseases. Thus medical education is facing problems with regard to the availability of appropriate patients at the appropriate time in the curriculum as well as a lack of continuity in patient follow-up. Furthermore, ethical doubts have been raised as to the acceptability of "using" patients for teaching purposes, particularly for practising clinical skills.

E-learning can help to resolve these problems. It can present suitable patient cases by means of images, text, videos and simulations at the exact time when a particular case is required in the curriculum. E-learning can facilitate interactive training, enabling students to gain competencies before actually using them in encounters with real patients. Furthermore, the interactive features of various types of e-learning programs may in part replace individual face-to-face tutoring.

Variety of learning objects

There exists a wide variety of learning objects. Though some of them are considered outdated, they are still in regular use and still have merit. Presentation and visualization belong to the stone age of e-learning, providing texts, still images and occasionally an animation or video sequence. Drill-and-practice programs present exercises without any additional information, and their utility for medical education is doubtful. In contrast, tutorial systems offering choices, branching and immediate elaborate feedback [3] are in common use. Although dating back to the concepts of Skinner and Thorndike [4], they continue to be applied successfully albeit in more sophisticated ways. Intelligent tutorial systems are very ambitious formats – and presently their use is rather limited because of their complicated structure. The most popular types of learning objects are simulations and micro-worlds. In the context of medical education, micro-worlds designed according to the principles of Schank's goal-based scenarios, are of particular importance [5]. Students take on the role of physician, they are embedded in a cover story of a virtual hospital or private office, where they are confronted with patients with particular problems. Students can conduct certain scenario operations – mainly asking questions, conducting physical examination or ordering diagnostic tests – and they have to make a diagnosis and probably also propose a management strategy.

Another potential application of micro-worlds is laboratory medicine, where certain in vitro techniques can be performed in virtual labs. Learning objects can be focused

on individual learners to a greater or lesser extent. From a communication science point of view, they provide individual communication, with the computer program being a student's only partner. This approach renders these types of programs very efficient, once the objects have been created, but they carry the risk of isolating students and impairing the development of interpersonal skills. Communicative tools have therefore gained increasing importance in addition to the established types of learning objects [6]. Collaborative learning is community building: it draws attention to interpersonal skills and encourages sharing of problems and solutions between peers. Collaborative e-learning is very popular in behavioural and social sciences. In medical education, which usually takes place in brick-and-mortar universities, with e-learning being an additional tool, the importance of collaborative e-learning is less impressive. When students live in the same city and meet several times a week 'in the real world', there is little advantage to be gained from connecting them in the early afternoon via information and communication technology.

In postgraduate education, however, collaborative learning and sharing of views and experiences is equally essential but more difficult to accomplish in real time. The postgraduate 'International Dermoscopy Diploma' course offered by the Medical University of Graz in collaboration with the University of Queensland, Brisbane, may serve as an example. This course is entirely based on e-learning, and participants are enrolled from all continents. During one year, they share critical cases and discuss solutions with experts – a setting that would be impossible to reproduce in face-to-face learning.

As far as learning objects are concerned, there is some discussion about granularity. In order to improve re-usability, individual assets such as single frames, images, video clips or text paragraphs can be stored and retrieved. Though the concept is fascinating, its feasibility appears to be limited, because arranging assets in meaningful ways is at least as time consuming as it is to create them. It seems more practical therefore to aim for re-usability of large-scale materials only, such as total learning objects, sequences of learning objects, entire courses or materials covering a whole scientific specialty.

Frame-based education

The concept of frames, offering a little bit of information, followed by a simple question and the possibility to write an answer or to choose one of several answer options, dates back to the concepts of Skinner and Crowder [4], [5], [6], [7]. They are alleged to be embedded in the behaviourist learning paradigm and are generally considered to have been superseded by more sophisticated approaches. Computer screens, however, are actually very similar to 'frames', and most modern medical e-learning-systems are based on such frames represented by computer screens. This phenomenon is so widespread that one might speak of 'frame-based education'. Obviously, frames can contain any type of asset, and user interaction goes far beyond entering answers in gaps or selecting from multiple options. Nevertheless, even such very simple functions can be used for higher level problem solving, and elaborate feedback can render them close to tutorial systems and in line with cognitive learning theory.

Remarkably, even case-based learning systems can be frame based. Casus, for example, which has gained widespread use in German medical faculties, breaks down complex case stories into more or less successive frames [8]. The information given and the interaction required closely resemble the type of clinical reasoning that takes place in real practice, and in this way a situated learning experience is provided despite the simplicity of the individual frames. Key features in particular can be tested and presented in an informal and stimulating way, using systems that are in fact nothing more than simple drill-and-practice programs.

At the Medical University of Graz, we have particular experience in using frame-based systems, mostly of the web-based training type [9]. We have found that this method is very efficient in transferring certain facts and procedural knowledge. In our opinion, this shows that it does not make too much sense to divide e-learning formats into intrinsically good and bad ones. More important than the format as such is what the authors make out of it. One and the same e-learning format may present content of high or low quality. From this it can be concluded that in the development of e-learning objects the emphasis should be not only on the types of objects and e-learning formats that are used, but also and perhaps even more importantly on the skills and abilities of the authors.

How to integrate e-learning in everyday learning

When we started the Virtual Medical Campus Graz, we found ourselves facing the following situation. While e-learning was already firmly established internationally, learning in the Graz medical school was still mainly based on face-to-face teaching and on textbooks. In order to deal with this situation, we decided early on that only material of immediate relevance to our students should be incorporated into the e-learning system. So we encouraged and supported our teachers to create learning objects that fitted the needs of the curriculum. This implied that the contents were also congruent with the requirements of the existing examinations. Our analyses and questionnaires showed that the main motivation for using electronic learning materials was that they met curricular needs, whereas quality and format of the learning objects was of secondary importance.

The most attractive feature of e-learning is the direct relationship between the contents and formats of the learning objects on the one hand and the examination formats that are used on the other hand. In this context,

the development of e-examination has the potential to minimize organizational workload and to optimize quality in the management of exams for large groups of students.

Educational research in medical e-learning

Teaching and learning formats have traditionally been based on theoretical considerations and design models. This is true for face-to-face formats, but also for e-learning. In recent years, however, awareness has grown that teaching and learning strategies should be evaluated in much the same way as is customary for other scientific medical innovations [10]. E-learning offers several advantages compared to face-to-face teaching with respect to opportunities for evaluation and assessment. The main advantage is that almost all materials used in an e-learning process are stored and digitally available. This applies not only for the learning objects themselves, but also for chats, forum discussions, tests and examinations. This means that not only the whole teaching and learning process but also several outcomes of that process can be easily retrieved and submitted to content analysis and statistical procedures, while evaluation questionnaires can be added as appropriate.

For more complex tasks, experimental testing of certain e-learning approaches may be required. Several studies in our university have revealed that different e-learning formats are effective tools for delivering knowledge to students, ranging from web-based training objects to interactive simulations [11]. Future development of e-learning should be guided by continuing educational research, and decisions about design and implementation should preferably be based on scientific data instead of on more or less theoretical models.

Pedagogical impact of medical e-learning

Among staff members there has been some reluctance to implement e-learning. The most common concerns relate to the fear that e-learning will diminish the importance of traditional textbooks and of face-to-face teaching. It has turned out, however, that in many topics enrichment with e-learning materials has had a positive impact on lectures and clinical practice, while textbooks nevertheless continue to be used as comprehensive reference resources. Moreover, most e-learning formats are very suitable to provide a bridge between systematically oriented textbooks on the one hand and the transfer of knowledge to clinical practice on the other. The most important feature of e-learning in this respect is interactivity, requiring learners to make active decisions and simultaneously enabling scaffolding appropriate to the level of students.

E-learning has the potential to harmonize medical education in different countries. It is time consuming and costly to create high quality e-learning content, and sharing of content between different universities can reduce this burden and increase efficiency. Besides more efficient utilization of e-learning materials, content sharing enables the sharing of experiences across borders and cultures, which is likely to enhance insight and knowledge while at the same time fostering globalization of the academic community.

Content sharing is in part impaired by the different business models that have been implemented in different universities. From an academic point of view, the approach of open educational resources should be preferred. The program DOIT (Dermatology Online with Interactive Technology), initially created by the Department of Dermatology, University of Zurich, may serve as a good example [12]. It covers the whole range of dermatology, has been translated into several languages, and provides open access worldwide.

In recent years, medical curricula have been reformed in many universities and have become more tightly structured compared to the previous more optional character of traditional medical education. E-learning enables reliable delivery of theoretical content that is considered indispensable for a particular curriculum, and this, in turn, allows more individual freedom for teachers and learners in lectures, bedside teaching and clinical practice.

Last but not least e-learning may serve as an ideal tool for stimulating active involvement of students in teaching and learning. In our university, participatory design has been implemented as a project bringing together e-learning experts, teachers and students to develop electronic learning materials. The teachers provide the necessary expertise of their discipline and the e-learning experts give technical and pedagogical support. The most important part is played by the students, however, who elaborate a particular topic and design the resulting materials according to the specific requirements of the learning community.

Conclusion

In summary, based on our experience with the Virtual Medical Campus Graz, we think that e-learning has become an indispensable additional learning tool in medical education. Further developments will have to focus on optimizing authoring strategies, on continuous outcome research, on active student involvement in content creation and on open content sharing between institutions.

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References

1. Smolle J, Staber R, Jamer E, Reibnegger G. Aufbau eines universitätsweiten Lern- Informationssystems parallel zur Entwicklung innovativer Curricula - zeitliche Entwicklung und Synergieeffekte. In: Tavangarian D, Nölting K (Hrsg). Auf zu neuen Ufern - E-Learning heute und morgen. Münster/New York/München/Berlin: Waxmann, 2005. S.217-226.

2. Staber R, Smolle J, Bauer P, Hye F, Thallinger S, Neges H, Reibnegger G. Virtueller Medizinischer Campus Graz: eine e-Learning Umgebung wird 5 Jahre alt. GMS Med Bibl Inf. 2007;7(3):Doc43. Available underr: http://www.egms.de/static/de/journals/mbi/2007-7/mbi000095.shtml.

3. Musch J. Die Gestaltung von Feedback in computergestützten Lernumgebungen: Modelle und Befunde. Z Päd Psychol. 1999;13:148-160.

4. Skinner BF. Teaching machines: from the experimental study of learning come devices which arrange optimal conditions for self instruction. Science. 1958;128(3330):969-977. DOI:10.1126/science.128.3330.969

5. Schäfer A, Claßen J. Prometheus - Ein interbasiertes Lernmanagementsystem für die medizinische Aus- und Weiterbildung. GMS Z Med Ausbild. 2006;23(1):Doc04. Available underr: http://www.egms.de/static/de/journals/zma/2006-23/zma000223.shtml.

6. Stromso HI, Grottum P, Hofgaard Lycke K. Changes in student approaches to learning with the introduction of computer-supported problem-based learning. Med Educ. 2004;38(4):390-398. DOI:10.1046/j.1365-2923.2004.01786.x

7. Hoth WE. From Skinner to Crowder to chance: A primer on teaching machines. Engl J. 1961;50:398-401. DOI:10.2307/810827

8. Fischer MR, Aulinger B, Kopp V. Implementierung von Computerlernfällen in das Curriculum der Inneren Medizin. GMS Z Med Ausbild. 2005; 22(2):Doc12. Available underr: http://www.egms.de/static/de/journals/zma/2005-22/zma000012.shtml.

9. Smolle J. Computer-based Training (CBT) in der Humanmedizin: eine inhaltsanalytische Kohorten-Studie am Beispiel der Allgemeinen Tumorpathologie. GMS Zeitschrift für Medizinische Ausbildung 2007;24(2):Doc110. Available underr: http://www.egms.de/static/de/journals/zma/2005-22/zma000012.shtml.

10. Schmidt HG, Cohen-Schotanus J, Arends LR. Impact of problem-based, active learning on graduation rates for 10 generations of Dutch medical students. Med Educ. 2009;43(3):211-218. DOI:10.1111/j.1365-2923.2008.03287.x

11. Smolle J, Smolle-Jüttner FM, Reibnegger G. Educational measurement im medizinischen eLearning. Begleitende Effektivitätsmessung im Rahmen freier Wahlfächer. In: Merkt M, Maryberger K, Schulmeister R, Sommer A, van den Berk I (Hrsg). Studieren neu erfinden - Hochschule neu denken. Münster/New York/München/Berlin: Waxmann, 2007. S.350-360.

12. Bader U, Cipolat C, Burg G. Dermatology online with interactive technology (DOIT). Curr Probl Dermatol. 2003;32:176-181. DOI:10.1159/000067375

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