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COLT: A New Weapon to Disseminate Knowledge

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Chapter

COLT: A New Weapon to Disseminate Knowledge

Bernard C. Rossier, Michelle Rossier and Jean-Pierre Kraehenbühl

Abstract

Too few researchers receive adequate pre- or postgraduate training to conduct a rigorous scientific study. In the digital age, new tools are emerging, and the development of distance education could improve this worrying situation. In this context, Health Science e-Training (HSeT), a nonprofit Swiss foundation, has developed new pedagogical concepts and tools under customized online training (COLT). For the ADMIRE Cost network, we have used an article-based e-learning (ABL) tool that allowed the students to learn how to read in depth and critically a scientific article and to rigorously address the problem of scientific reproducibility. The evaluation of the program by the students and the tutors has been quite positive. In conclusion COLT was well adapted to the needs of the ADMIRE Cost Action, a European network in which students from countries separated by thousands of miles can work at distance under the online supervision of tutors and then meet in a face-to-face session to maximize their learning experience and the interactions between peers and tutors.

Keywords: distance learning, article-based e-learning (ABL), customized online training (COLT)

1. Introduction

The quality and reproducibility of preclinical and clinical biomedical research have recently been strongly questioned [1, 2]. The causes are multiple: deficient experimental protocols, inappropriate methods and statistical analysis, and incorrect data interpretation. The fundamental problem, however, is deeper: too few researchers receive adequate pre- or postgraduate training to conduct a rigorous scientific study. The quality of education has been debated for centuries and criticized by teachers as well as by the taught. In the digital age, new pedagogical concepts [3, 4] are emerging, and the development of distance education could improve this worrying situation. Benjamin Franklin has found the formula that summarizes the stakes of the problem (**Figure 1**). This review summarizes how the use of new distance learning tools has improved the learning and teaching experience of an educational program proposed to the students (MD, PhD, MD-PhD students, postdoctoral fellows) of the ADMIRE Cost European network.

Figure 1.
Benjamin Franklin (1706–1790) was an American polymath and one of the founding fathers of the USA. Franklin was a leading author, printer, political theorist, politician, freemason, postmaster, scientist, inventor, humorist, civic activist, statesman, and diplomat. He pioneered and was the first president of the academy and College of Philadelphia which opened in 1751 and later became the University of Pennsylvania. His interest in education is emphasized by this famous quote. (Text and image adapted from Wikipedia https://en.wikipedia.org/wiki/Benjamin_Franklin).

2. COLT: a new pedagogical tool

We have developed customized online training (COLT), a new pedagogical tool. The distance learning module targets a specific audience: pre-graduate (bachelor, master) or postgraduate students (master of advanced studies, diploma of advanced studies, certificate of advanced studies). Each distance learning module is adapted to the target audience according to the requests of the institution. A matrix combines problem-based learning (PBL) and cross-disciplinary approaches. The latter offers online "classical" biomedical disciplines (anatomy, histology, physiology, pharmacology, genetics, etc.) and self-learning/self-assessments. The distance learning is completed with classroom work (courses, seminars, practical work) in the so called "blended" teaching. All these features are housed on a website as described below.

3. ADMIRE: cost distance website and learning program

3.1 General features of the website

We opened a training website (https://admire.biomedtrain.eu) for the ADMIRE network.

Intended audience: the public part of this website is intended as general information to all those interested in the ADMIRE Cost e-learning program. The private part of this website supports many portals, i.e., (i) a portal for the 31 students registered for the entire course, (ii) a portal for the teachers and organizers with access to meeting agendas and related documents regarding the organization of the module, and (iii) a portal for the seven teachers with examples of various e-learning activities developed by HSeT in the module.

Intended mission of the website: the intended mission of the portal was to provide (i) organizational and teaching information to the teachers and learners during the 2016 and 2017 sessions, (ii) e-learning and e-teaching content in the module, (iii) several evaluation tools (self-assessment or quizzes) for the students, (iv) several online teaching activities such as "article-based learning" or "case-based learning",

and (v) a forum as a communication tool between students or between student and teachers.

Mandatory activities: recently published articles in the field of the ADMIRE network selected by the tutors in an annotated article-based learning (ABL) format had to be read critically and in depth by students (individually or in groups).

Optional activities: (i) case-based learning (CBL) which uses a web application that drives the learner through intriguing clinical cases to be solved, and (ii) histology practical: a histology practical on the structure of the kidney using a virtual microscope.

3.2 Main goal

The main goal was to study basic principles of the mechanisms of action of aldosterone in classical and nonclassical target cells relevant to the treatment of patients suffering from cardiovascular diseases linked to aldosterone-mineralocorticoid receptor (MR) signaling pathways. The principles necessary to understand an article from the scientific literature were reviewed.

3.3 Learning objectives

At the end of this e-training module, the trainees were asked to:

- describe the basic concepts underlying the aldosterone-MR signaling pathways in classical (kidney, colon) and nonclassical (vessels, heart, brain) target cells or organs

- describe and apply the basic concepts to solve questions included in ABLs

- critically read, present, and discuss a scientific paper.

3.4 Typical pedagogical scenario of a blended ADMIRE cost e-learning module

The general organization and timeline of a typical pedagogical scenario designed for the ADMIRE Cost network are shown in **Table 1**. The individual and team work was organized along a well-defined timeline spanning in this case which is 1 month. Mandatory and optional activities were clearly delineated. Online activities started on Day 1 by the registration of the students, a demonstration how the website works, and an initial quiz to determine the initial level of knowledge of the class.

3.5 Article-based learning (ABL)

Five papers [5–9] were selected by the tutors to represent the most interesting and timely questions about the mineralocorticoid receptor signaling pathways.

Individual work: each student had to read the *annotated* version of the article and to consider the "thought questions" associated with each section of the article (e.g., abstract, introduction, results, discussion, material, and methods). Annotations enhance the student's understanding of terms and concepts of the paper with links to other helpful resources. If a student was not familiar with the article's topic, he (she) was recommended to read the "related content" section. Most of the links in the annotated version of the article are links to this section.

Step	Students	Tutors
1. **Online** Day 15		**Website open to tutors**
2. **Online** Day 1	**Website open to students** • Registration • How does the website work • Initial quiz	
3. **Online** Day 1 to Day 15	**Mandatory activities** *Individual assignments* • Read five articles • Read their assigned article-based learning (ABL), and answer the thought questions • Self-learning/self-assessments (online resources) • Interactions with students and tutors through forum	Interactions with students through forum
4. **Online** Day 1 to Day 30	**Optional activities** • Case-based learning (CBL) • Renal histology (annotated) (virtual microscope)	Interactions with students through forum
5. **Online** Day 15 to Day 30	**Mandatory activities** *Team assignments* Each group of students (5–6) work on specific team assignments • Preparation of their presentation for the face-to-face session	Interactions with students through forum
6. **Face-to-face** Day 30	**Plenary session** Students and tutors • Each group presents its ABL • General discussion led by tutors	
7. **Online** Day 30	• Final quiz • Module evaluation questionnaire	Module evaluation questionnaire
8. **Online** Day 31 to Day 40	Reporting from HSeT/tutors to the students about • Their individual and team assignments • Their results to the quizzes • Their feedbacks (course evaluation)	

Table 1.
Typical pedagogical scenario of a distance "blended" learning module.

Team work: each group of students had:

1. to identify the strength and weaknesses of their paper

2. to identify the main unanswered question(s) raised by the article

3. to propose experimental strategies to address these questions left open

4. to address the issue of scientific reproducibility

5. to rate the quality of the article on a scale from 1 to 5 (1 = poor; 2 = fair, interesting but many flaws in the experimental design and data presentation; 3 = good, worthwhile reading despite many mistakes and flaws; 4 = excellent,

must be read by scientists in this field; 5 = outstanding, goes beyond its specialized field, establishes new paradigms)

6. to prepare an oral presentation for the face-to-face session.

3.6 Related content and self-assessments

Content directly related to the ABL topics was available. For instance, related to the paper by Choi et al. [5], the students had access to a number of pages dealing with hypertension together with self-assessment quizzes. Having completed the quiz, the student received a feedback explaining why she or he did not check the right answer and a link to the corresponding page from which the question was issued.

3.7 Online resources

The online resources covered important aspects of renal and cardiovascular anatomy, histology, cell and molecular biology, genetics, physiology, and pathophysiology.

3.8 Optional activities

Optional activities included CBL entitled "Ms Long QT" and "The Walker's Cramp" allowing the students to study the problems of arrhythmias and atherosclerosis, respectively. The students could also familiarize themselves with the microscopic structure of the kidney thanks to a virtual microscope and relate the structure of the organ to its function.

3.9 Distance tutoring (forum) and monitoring

A general forum allowed general interactions between students and tutors from Day 1.

Group forums were open to students for their team work and the preparation of their presentation. They could interact with their group tutor from Day 15 to Day 30.

3.10 Students and tutors

Forty-two students from 11 countries (Denmark, France, Germany, Hungary, Ireland, Italy, Poland, Scotland, Slovenia, Spain, and Turkey) attended the 2016–2017 courses supervised by seven tutors.

3.11 Face-to-face sessions

There were two face-to-face sessions one in Dublin on March 1, 2017, and one in Paris on November 17, 2017, attended by 26 and 16 students, respectively.

3.12 Evaluation of the work of the students

Online quizzes were carried out in the first day of the course and compared to the results obtained at the end of the face-to-face return session, allowing to objectively quantify the progress made by each trainee. The initial quiz on Day 1 (fall 2016) (maximum possible score, 120 points) was carried out by 14 students with a mean score of 61% (range, 35–85%). According to our experience, this score indicated already a rather good level of knowledge in this specific field,

not surprisingly taking in account that all student came from laboratories highly specialized in the field of mineralocorticoid receptor signaling pathways. The final quiz on Day 30 (spring 2017) showed a mean score of 68% (range, 52–90%) indicating an improvement of 7 points and a narrowing of the range. According to our previous experience, we expected 10–15 points of improvement, but the explanation may reside in the student's motivation probably not optimal for reasons described below. The tutors could evaluate the class performance for each question and determine the specific weaknesses (questions with correct answers <25%) and the strengths (questions with correct answers >75%) of the class.

3.13 Evaluation of the e-learning module by students and tutors

The students and the tutors evaluated the online course. Both gave a positive evaluation. The benefits were obvious for both students and teachers.

The evaluation of the answers by the students (17 respondents) was scored on a qualitative scale (no, rather no, rather yes, yes, no opinion) and was overall quite positive for the website navigation (**Figure 2**), the online resources and self-learning tools, and the ABL individual and team assignments.

Some of the most interesting individual comments and suggestions are:

"I would incrementally allow access to the online resources- allowing for a gradual accumulation of the material. I think this would make studying this material seem less of a mountain to climb and if each resource came with an email to state that it was available it would remind the users that the material is there. I think this would promote a wider utilization of these superb learning materials..."

"I think the self-assessments were too difficult and not linked to the resources provided. Sometimes after reading the resources provided and selecting the answers based on the resources you would get the wrong answer. I think the multiple choice should only have one answer not multiple correct answers as this made it very confusing to answer..."

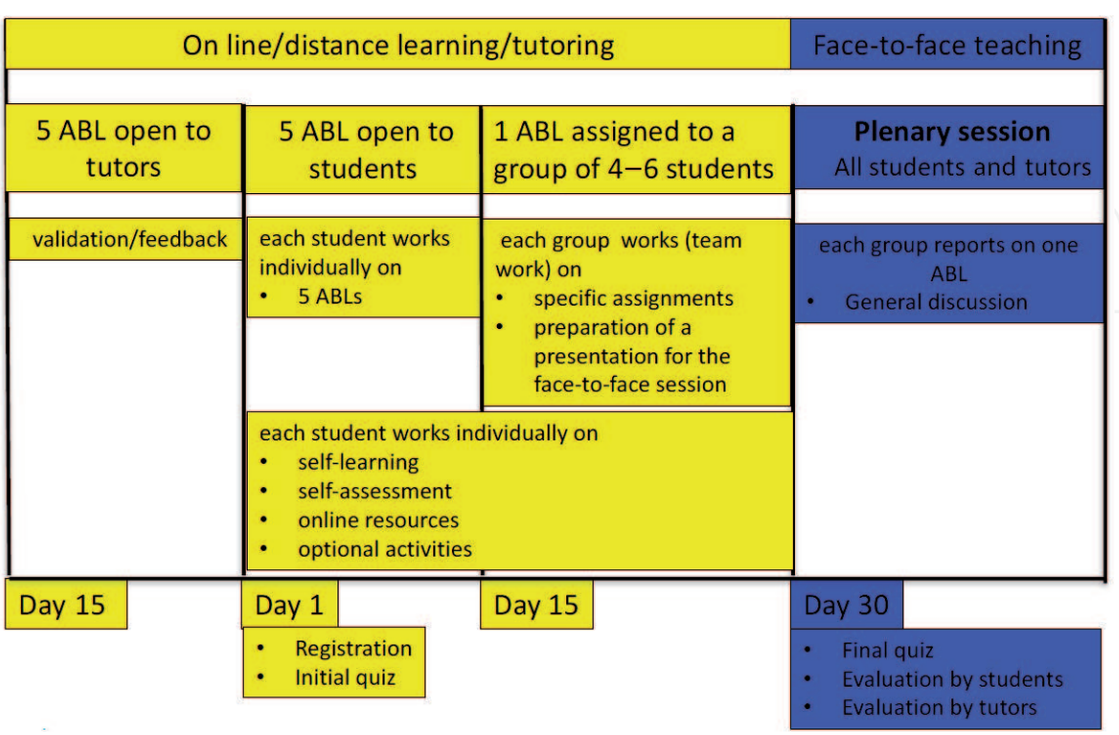

Figure 2.
Evaluation of the e-learning module navigation by the students.

"I would add video lessons to make easier the comprehension of the most complex issues with a global correction of every question we had to answer, it would have help us for oral presentation..."

"In my opinion, should be perform in more time. It is really well organized, but at least from my point of view we need more time to do all the quizzes/assesments and read the articles..."

"I will be happy to see more interaction with tutors..."

"Overall, I have found the e-learning website very useful, user-friendly and well-organized. The approach taken to teach the course was very fruitful as it was helping people from various background of the field. The course has given me the very best introduction to the field in the beginning of each topic then it was progressing and enabling to gain in-depth knowledge of the field. For improving the website, I would not put the quizzes not to the very end and I would rather put each quiz at the end of each topic and/slide show not let the student proceed to next chapter/topic until each session is completely finished. This will further "pressurize" the e-learning and keep the students more actively on the website..."

Most of the remarks, criticisms, and suggestions made by the students and the tutors have been considered for further improvements of the module.

On the positive side, "*We have to work more but we learn more*..." is a common remark from students of various backgrounds taking different modules (COLT format).

"I would like to maintain my access to the website after the end of the e-learning module..." is also a frequent request that we take a sign of success. Our policy has always been to grant this access as long as the student wishes.

4. Discussion

A number of new forms of distance learning/teaching have emerged during the last 10 years [10, 11]. Many universities and institutions around the world are examining the potential of online technology to develop new and more efficient teaching methods and, ideally, to decrease costs.

4.1 MOOCs

The most prominent and visible e-learning courses are "massive open online courses" (MOOCs). There has been a lot of talk about MOOCs, an "educational buzzword" according to John Daniel [12]. Are the MOOCs going to transform higher education and science as suggested by Mitchell Waldrop [13]? The first MOOC was created in Canada in 2008 (G. Siemens and S. Downes) based on the theory of *connectivism*, which favors collaboration and interaction between participants, hence the acronym cMOOC [14]. The activities of a cMOOC typically comprise four elements: (1) to gather/compile the interesting contents, (2) to archive them in a personal document by sharing it by a blog, (3) to appropriate the contents by explaining its own understanding, and (4) to spread the personal work. To succeed in a cMOOC, it is obviously necessary for a participant to do more than read and watch videos and requires his or her active participation (involvement). A cMOOC is considered to work when it feeds on itself through the contributions and contents of the participants, even beyond the course [15]. In 2011, S. Thrun (Stanford) launched a first distance course on the Coursera platform on the theme of artificial intelligence, open to all and accessible worldwide. The success was considerable: more than 160,000 students enrolled.

This course was offered in parallel with the classic one given locally to Stanford students. This is the beginning of xMOOCs (x referring to the MITx platform launched in December 2011 by MIT). The xMOOCs are more traditional in their pedagogical approach (the so-called behaviorist). The market is dominated by three course providers (Udacity, Coursera, and edX). The teaching materials include short video courses, online exercises and tests, student interactions (forum), and online peer reviews (Coursera). Some platforms (Coursera) even allow the analysis of free text responses. Following the success of xMOOCs from major American universities, several initiatives have emerged in Europe and Asia. Some projects come from French-speaking universities (i.e., EPFL in Switzerland and University of Geneva, using the Coursera platform, or the University of Lyon 1 in collaboration with the Catholic University of Louvain who has developed their own open-source LMS platform). In February 2014, the Class Central site [16] which lists the available MOOCs included 476 courses, 70% of which use the Coursera platform. Forty-four percent of the courses came from computer science and mathematics and only 24% from science, health, and medicine. As of 2018, the Class Central site listed over 2700 courses, a very rapid increase since 2014. The current limits of xMOOCs are (1) the small percentage of students who finish the course and obtain certification (5–15% in general), which however in absolute value often represents several thousand students; (2) low penetration on the African continent and in countries that do not have optimal access to the web; and (3) the difficulty of checking exams allowing accreditation. There is also a risk of cultural "imperialism" imposing the concepts of some elite institutions, a threat to cultural diversity.

4.2 Inverted classroom or flipping the lecture

Teachers have also used online lectures open to their students to "flip" their class. In other words the students must follow the online lectures and carry out the associated assignments and quiz before a face-to-face session with the teacher focusing on discussing the points that have been the least understood during the online session. This model may be cost-effective and efficient and does not require that the recorded lecture be made publicly available avoiding the problem of copyrights that is encountered with MOOCs.

4.3 COLT and SPOCs

There are other approaches to developing distance education, tailored to the needs and culture of each training institution, and that could (it is fashionable) be grouped under the acronym COLT described above. How to read a scientific article? How to write a scientific article? How to write a research grant application? How to design and perform a clinical trial? These are topics that can be treated very effectively with the COLT approach. This model of teaching obviously only affects a small number of students, but at present many institutions in Switzerland, Europe, the USA, and Africa have used such a type of teaching in collaboration with HSeT. Interestingly a recent report from the University of Princeton strongly favors a similar approach they termed "small private online courses" (SPOCs). In summary, MOOCS and COLT represent two different but complementary approaches. The first should arouse the interest of a very wide audience for a theme, while the second allows the deepening and accreditation of knowledge acquired by a target audience, admittedly small but most often highly motivated.

4.4 Economic challenges of digital distance education

The economic challenges of digital distance education could be significant and, of course, influence access to education and training around the world. In fact, the economic model of the MOOCs is still very vague, and J.R. Young [17] has summarized the situation prevailing in the USA: "it is following a common approach of Silicon Valley start-ups: build fast and worry about money later." No one will deny that Google, Facebook, and others have been particularly successful in adopting this strategy. As far as COLT is concerned, it falls within the usual framework of academic teaching and does not require any additional resources, provided that this approach replaces conventional teaching and does not add to it.

4.5 Perspectives and future improvements

As mentioned, the motivation of the students could has been higher provided they could obtain not only a certificate attesting their attendance to the course but a certain number of European Credit Transfer and Accumulation System (ECTS) credits if the final examination is passed. ECTS is a standard means for comparing the "volume of learning based on the defined learning outcomes and their associated workload" for higher education across the European Union and other collaborating European countries. Ideally a European university (some have shown some interest) might be asked to take the lead (leading house) and propose to the European students a certificate of advanced study (CAS) in the field of aldosterone and its receptor. The CAS will be officially accredited by the university and the number of ECTS attributed precisely defined. One unsolved difficulty encountered by all universities is to determine the equivalence between an ex cathedra hour of teaching and the time spent by tutors to teach the students online.

5. Conclusion

In conclusion COLT is well adapted to a European network in which students from different countries can work online under the supervision of their tutor and then meet in a face-to-face session to maximize the learning experience and interactions between students and tutors.

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