

# Recommendations for the development of e-modules for the continuing professional development of European dentists

A. Kavadella<sup>1</sup>, A. E. Kossioni<sup>1</sup>, K. Tsiklakis<sup>1</sup>, J. Cowpe<sup>2</sup>, A. Bullock<sup>3</sup>, E. Barnes<sup>2</sup>, S. Bailey<sup>4</sup>, H. Thomas<sup>2</sup>, R. Thomas<sup>2</sup>, T. Karaharju-Suvanto<sup>5</sup>, K. Suomalainen<sup>5</sup>, H. Kersten<sup>6</sup>, E. Povel<sup>6</sup>, M. Giles<sup>7</sup>, D. Walmsley<sup>8</sup>, U. Soboleva<sup>9</sup>, A. Liepa<sup>10</sup> and I. Akota<sup>9</sup>

<sup>1</sup> School of Dentistry, The National and Kapodistrian University of Athens, Athens, Greece,

<sup>2</sup> School of Postgraduate Medical and Dental Education, Cardiff University, Cardiff, UK,

<sup>3</sup> School of Social Sciences, Cardiff University, Cardiff, UK,

<sup>4</sup> Child Health Group (PenCRU) [formerly at 3], Peninsula Medical School, Exeter, UK,

<sup>5</sup> Institute of Dentistry, University of Helsinki, Helsinki, Finland,

<sup>6</sup> Academic Centre for Dentistry, Amsterdam, The Netherlands,

<sup>7</sup> Association for Dental Education in Europe, Dublin, Ireland,

<sup>8</sup> Dental School, University of Birmingham, Birmingham, UK,

<sup>9</sup> Faculty of Dentistry, Riga Stradins University, Riga, Latvia,

<sup>10</sup> Dental School, Cardiff University, Cardiff, UK

## Keywords

continuing professional development; dentists; e-learning; e-modules.

## Correspondence

Argyro Kavadella  
Athens Dental School  
Thivon 2 Goudi  
Athens 11527  
Greece  
Tel: +302102829387  
Fax: +302102829387  
e-mail: akavad@dent.uoa.gr

**Accepted:** 14 February 2013

doi: 10.1111/eje.12039

## Abstract

**Aims:** To provide evidence-based and peer-reviewed recommendations for the development of dental continuing professional development (CPD) learning e-modules.

**Methods:** The present recommendations are consensus recommendations of the DentCPD project team and were informed by a literature research, consultations from e-learning and IT expert, discussions amongst the participants attending a special interest group during the 2012 ADEE meeting, and feedback from the evaluation procedures of the exemplar e-module (as described in a companion paper within this Supplement). The main focus of these recommendations is on the courses and modules organised and offered by dental schools.

**Results and discussion:** E-modules for dental CPD, as well as for other health professionals' continuing education, have been implemented and evaluated for a number of years. Research shows that the development of e-modules is a team process, undertaken by academics, subject experts, pedagogists, IT and web designers, learning technologists and librarians. The e-module must have clear learning objectives (outcomes), addressing the learners' individual needs, and must be visually attractive, relevant, interactive, promoting critical thinking and providing feedback. The text, graphics and animations must support the objectives and enable the learning process by creating an attractive, easy to navigate and interactive electronic environment. Technology is usually a concern for learners and tutors; therefore, it must be kept simple and interoperable within different systems and software. The pedagogical and technological proficiency of educators is of paramount importance, yet remains a challenge in many instances.

**Conclusions:** The development of e-courses and modules for dental CPD is an endeavour undertaken by a group of professionals. It must be underpinned by sound pedagogical and e-learning principles and must incorporate elements for effective visual learning and visual design and a simple, consistent technology.

## Introduction

Continuing professional development (CPD) is an essential element of the dentist's professional life, obligatory in many European countries (1). E-learning, on the other hand, is an educational methodology rapidly growing, because of its perceived advantages: consistent training, increased learner convenience and flexibility regarding time and space, individualised learning, lower costs, ease of delivery and updating, multiple media, opportunities for communication and cooperation between learners–educators and learners themselves (2–5). The 'virtual classrooms', particularly in the area of dentistry and dental CPD, are rapidly expanding (2, 6), creating new challenges and opportunities for both learners and educators. The provision of electronic courses and modules for health and dental professionals' CPD has been implemented and evaluated in a number of investigations (7–12). Results are positive regarding learning achievements, convenience and cost-effectiveness, yet a number of factors, including pedagogy, communication, adaptability and quality, should be further explored in order for this educational medium to meet its full potential.

This study proposes recommendations for the organisation of electronic courses and modules in the area of dental CPD. These recommendations support the comprehensive framework for the provision of continuing education for graduate European dentists, a framework developed under the DentCPD European project (13), aimed at facilitating convergence of dental CPD at a European level. The recommendations for e-modules complement the 'Guidelines for the Organisation of CPD Activities for the European Dentist' and 'The development of an exemplar e-module for the CPD of European dentists', which are companion papers within this Supplement.

## Aims

The aim of this study is to provide evidence-based and peer-reviewed recommendations for the development of dental CPD learning e-modules. These recommendations apply to courses and modules delivered at distance through e-learning, provided by university dental schools or other educational institutions offering continuing dental education.

## Materials and methods

Developed as part of the DentCPD project, the recommendations were informed by: (i) a contextual literature research, herein included; (ii) an extensive literature inventory of CPD for dentists in Europe (14); (iii) a survey of existing (EU and global) practices in dental CPD (1); (iv) documents developed by distance and e-learning experts; (v) consultations with an IT expert and learning technologist; (vi) discussion with participants attending a special interest group (SIG) during the annual ADEE meeting in August 2012; and (vii) feedback from the evaluation procedures of the exemplar e-module (companion paper in this Supplement).

The recommendations for the development of e-modules are structured around 4 headings. In the first, we set out the organisation framework and distil three main recommendations. This is followed by a section focused on pedagogy from which we

identify six key recommendations. A section on the educational material follows, encompassing the learning objectives (outcomes), the development, structure and content, and the visual design of the web page, resulting in a number of detailed recommendations for each element. Finally, the issue of technology is addressed. Each area is supported by a series of recommendations.

## Results and discussion

### Organisational framework

The development, delivery, administration and support of e-courses for health professionals (as for other professionals) is a multiprofessional task, usually undertaken by a dedicated department within a University Dental School or other tertiary education institution (15). A team of professionals typically include academic staff and content experts, learning technologists and instructional designers, librarians and information specialists, multimedia and visual designers, educational consultants, IT experts and programmers, and distance and e-learning experts (15, 16). The core individuals in the development team are the author(s), graphic designer, web developer, programmer and instructional designer (16). Other team members contribute to other stages of the endeavour, including delivery and evaluation. It is possible a single educator, with content expertise and training in the use of the learning platform, could undertake all roles, although this has obvious disadvantages (16).

In addition to the obvious contributors to the e-learning projects (subject experts and the educational and IT consultants), the role of health information professionals and librarians is increasingly recognised as key to the development of online learning (15, 17). This has led to a call for the personal development of librarians and health information professionals in learning/e-learning and teaching theories (15). Training is also advised for the educators (academic staff) and the authors of e-courses' content in online and adult education. The pedagogical proficiency of educators in dental CPD programmes contributes significantly to the overall quality of the programme (18, 19).

It seems that the knowledge boundaries between cooperating professionals in the multidisciplinary team are gradually disappearing, as each professional interacts with the others and acquires additional knowledge and skills outside their primary field. This presents new opportunities and challenges in the organisation and delivery of quality e-courses for continuing dental education.

### Recommendations

- A multidisciplinary team approach is recommended for the organisation of dental e-courses, including academics and subject authors, educational consultants, adult and e-learning specialists, IT experts and librarians.
- Librarians and health information professionals would benefit from education in e-learning and learning theories.
- Educators and authors should enhance their knowledge and skills in online and adult learning.

## Pedagogy

### Adult learning principles

Our knowledge of how adults learn is incomplete. It is clear that all adults do not learn in the same way. Many authors have argued that adults have special characteristics that affect how they learn. Knowles (20) and Rogers (21) highlight the key characteristics of adult learners:

- *Adults need to know the purpose of their education.* Adult learners put more effort into a task if they know how they will benefit from it. The perceived usefulness of a CPD course is a strong determinant of the learner's intention (22). Thus, it is important that the benefit of the educational material is expressed in terms that demonstrate practical application to their professional and personal lives. Employing case-based studies or scenarios is a means of linking the course to the learners' professional practice (10, 23).
- *Adults bring with them a set of experiences, attitudes and values,* in which they have invested emotionally. A carefully structured course would allow the learners to direct and construct their own learning, resulting in increased engagement, more positive attitudes, better command of information and ultimately more efficient knowledge 'acquisition' (24).
- *Adult learners usually enter education with intentions, which tend to be associated with their perceived needs.* In a cross-case analysis of healthcare professionals' CPD, a variety of expectations and motivating factors were reported by professionals: many were motivated by a desire to undertake something novel; others wanted to improve their skills or overcome isolation (25). Similarly, students in a CPD health-related course reported three principal reasons for registering: to expand their knowledge; to improve their practice skills; and to improve services to patients (9). Other personal reasons for registering for educational programmes include personal development and career progression (9), licensure requirements and expansion of clinical practice (8). Within this context, linking the learning material with the learners' intentions and needs increases both the usefulness of the course and the engagement and motivation of the learners.
- *Adults have already developed their learning styles.* In Kolb's original work (1984), four basic *learning styles* are defined: activists, reflectors, theorists and pragmatists (26). Gardner's theory of *multiple intelligences* suggests that each person possesses different forms of intelligence (linguistic, musical, logical-mathematical, spatial, body kinaesthetic, intrapersonal and interpersonal) to varying degrees (26). Learning styles can be an important predictor of success in a learning environment (27) and can influence the educational outcome (21). Using a variety of educational techniques and delivery methods for the teaching material may accommodate learners' different learning styles/multiple intelligences: texts and hypertexts, case studies, problem-solving scenarios, chat rooms, discussion boards, online lectures, links to specialist websites, audio, video, self-assessment tests and exercises (9).

### Recommendations

- The developers of distance learning materials should be mindful of likely learning needs of their adult learners and address different learning styles through the educational methodology, organisation and delivery of the material.
- Educational activities within the course that address real life professional situations create 'authentic learning' and are considered beneficial for the success of the course and useful to the learners.

### E-learning principles for a pedagogical design

Keegan (28) described 'distance education' as an educational form that is characterised by distance between the educator and the learner; the intermediation of an educational institution in the process; the usage of technical means for transferring knowledge; the existence of two-way communication between educator-learner; and the possibility for occasional face-to-face meetings.

E-learning (as well as online learning, virtual learning, computer-assisted learning, web-based learning, etc.) is a method of distance education that utilises electronic and/or technological resources for delivering the educational materials. The prefixes *e-*, *web-*, etc. define the means or the tools for transferring information and not the pedagogical principles or the learning outcome. Where it is underpinned by sound pedagogical principles, e-learning in the health sciences, particularly for continuing education, can be valuable and offers several advantages over traditional face-to-face teaching (15). These include the following: flexibility in time and place; adaptation to individual needs; presentation of procedures in different formats; the possibility for interaction and communication at a moment that is relevant for the learner; adaptation of learning materials across countries; and the ease of keeping the material up to date (9, 11, 23, 29). Barriers to the successful implementation of e-learning include the following: (i) barriers related to the development and provision of e-learning material, such as the initial costs for course development, poor design packages, inadequate technology, resistance to change, need for face-to-face contact, unrealistic time frames, outdated material; and (ii) barriers related to learners participation, such as the alienation, lack of relevant skills, excessive workload and lack of support (17, 19, 30, 31). These barriers may be overcome by structured strategies and targeted interventions by the organising institution. The face-to-face contact is an important aspect of dental continuing education particularly for learning skills and practical procedures. Blending learning that combines the online learning with face-to-face meetings can provide opportunity for the dentists to practise (hands-on) specific clinical procedures (18). A growing tendency for blended learning has been reported in the literature (6, 32).

Whilst developing an e-course or module, collaboration is needed in the design process between content, pedagogy and

technology (17). The pedagogical design of e-courses requires evidence-based decisions on specific procedures, instructions and regulations in every step of the process, starting from the choice of the learning objectives, followed by the choice of the content and assessment methods. A comprehensive pedagogical design of a distance learning course or module would include instructions on the study management, clear identification of the aims and expected outcomes, simple texts and referrals to personal experiences, emphasis on the key points of the content, case-based studies, self-assessment activities providing feedback, fragmented content and learner-friendly writing, interaction possibilities and an opportunity for the learner to provide feedback on the course (10, 33). Moreover, a pedagogically sound content would be motivating, up-to-date and allowing the learner to set their own pace (3, 17).

### Recommendations

- The organisers of e-courses should have adequate knowledge of the benefits and challenges of the e-learning methodology and develop relevant strategies to exploit or address them.
- Blended learning, combining online learning with hands-on experiences, is recommended for many dental CPD courses; thoughtful planning of the activities is essential for a successful outcome.
- The pedagogical design of dental CPD e-courses should take into account the adult learning principles and the e-learning theories, in order to create an efficient, rich, meaningful and interactive learning environment.
- E-courses should be clearly structured and orientated, enhancing interactivity and collaboration, promoting knowledge construction and application, and providing means for self-assessment and feedback.

### Basic elements of e-learning educational material

The educational material is the most important element of distance and e-learning, as it replaces or complements the teacher/educator (34). Face-to-face teaching includes the element of interactivity between teacher–learners in real time, where the teacher may modify the material in response to students' reactions or feedback (9). This 'live' interaction is substituted in e-learning by the educational material and the specific components that make it 'interactive'. The educational material plays a central role, as it not only constitutes the main body of information and knowledge, but also contains the educational strategy itself, the pedagogy and the learning methodology on how to work on the information to understand and internalise it.

### Learning objectives (learning outcomes)

The formulation of learning objectives (outcomes) is important because they identify distinct and clear goals for learners, whilst informing them about the subject they study, as well as the pos-

sible difficulties/challenges and the standards to be achieved. It is recommended that all dental CPD courses should have clear learning objectives, provided in advance (before the enrolment of the participants), to allow prospective participants to choose the activity best matching their learning needs (18). Good learning objectives (outcomes) should be specific, measurable, achievable, realistic, clear and precise (35, 36). Learning objectives are useful for the educators too as they can clarify their educational intentions, inform selection of relevant content, shape the teaching approach and the means of assessment, and finally focus the evaluation of the effectiveness of the materials (35).

The learning objectives (outcomes) are usually expressed in terms of expected knowledge, skills and attitudes, at the beginning (introductory section) of the module (29). The usual format is as follows: 'at the end of the chapter or module you will be able to describe/define/name/design/select/perform/apply...'

### Recommendations

- The learning objectives (outcomes) of the e-course should be formulated and be communicated to the participants in advance of their registration and again in the introductory section of the e-module.
- Learning objectives (outcomes) should be clear, measurable and achievable, realistic and precise.

### Development and structure of the educational material

The educational content is developed by an expert (or team of experts) on the field. The content author is a key person in the development team. Ideally, the material should be peer-reviewed and piloted before its implementation, particularly when the material is intended for a broad, diverse audience (3, 7, 9, 37, 38).

The content author could create totally new material to be delivered online, which is both costly and time-consuming, or redesign and adjust existing material to make it suitable for online delivery. The second option is the usual one, although it relies on the ability of the author to integrate the existing content in the virtual learning environment; the endeavour could result in information overload, poorly designed material, lack of integration with other learning tools and difficult quality control (31).

Students are neither appreciative of nor engaged or motivated by online materials that appear to have been developed with little thought, resembling conventional written texts uploaded on the Web (23). Developing quality online material could be a more difficult and time-consuming task than traditional teaching, as it requires thoughtful, disciplined working, strict time frames and a critical management of the content (9). Authors should identify the relevant textbooks, references and resources; select and combine them; formulate the objectives (outcomes); develop the assessments and tests; select the most appropriate teaching media; and link all these components into an integrated learning unit (16, 39).

Such learning units have recently been named 'learning objects', as opposed to the 'information objects', implying that the materials do not simply contain information, but they encourage discussion and reflection as well (9). Learning objects are sustainable digital content, reproducible, that could include text, interactive activities, self-grading exercises, examinations, related websites, discussion boards, chat utilities, simulations, etc. (16, 36, 40).

The structure of the educational material refers to the way the various components of the material are organised to form an efficient learning resource. The material is usually organised in a modular format, that is, divided in small subunits, the 'modules' (5, 12, 29, 38, 41). All modules must be designed in the same structural way, yet each must be independent of the others, so that the overall structure offers the necessary flexibility to the learners, who could access them independently, according to their individual needs and pace (12, 17, 41). A material of limited extent, comprising a single scientific entity/topic or addressing a specific educational purpose/need could constitute one single module (7, 11). Each module constitutes a 'learning object', including all the tools and components necessary for a comprehensive learning experience.

### Recommendations

- The educational content must be developed by an expert on the topic (or a group of experts in order to achieve consensus) and should be peer-reviewed.
- A cost-effective and time-saving way for content development is to use the already existing resources, which are modified, enriched and adjusted to the online environment, in an interactive and pedagogically sound manner.
- The teaching material should be divided into smaller modules, each one constituting a comprehensive learning unit/object. Modules should be consistent in their structure and design, yet independent, to promote flexibility and navigation possibilities for the learners.

### Content characteristics and format

The educational content should comprise specific characteristics, outlined in a number of studies and documents (5, 17, 26, 36, 38), in order for it to be evaluated positively by the learners (9). The self-assessment activities and tests could range from multiple-choice questions to assignments and case-based problems or scenarios related to clinical practice. They must be achievable and realistic, motivational, related to the content and the objectives (outcomes), promoting reflection and critical thinking and offering constructive feedback (5, 17, 35, 42).

A pre-course evaluation of knowledge and attitudes is recommended (8, 18, 29, 39) to establish the pre-existing knowledge level of the participants in relation to the content to be delivered. A post-course evaluation will (i) reveal the effectiveness of the education and (ii) serve as a validation instrument for official CPD appraisal. Post-course assessment is reported

to be appreciated by learners and health professionals in particular (23). Assessment activities must be relevant to the content and the objectives (outcomes) and have clear criteria and grading procedures, realistic time frames and clear instructions and guidelines (36, 38).

An important issue, particularly for material intended for health (including oral health) professionals, is the issue of patient rights, where personal documents (radiographs, intra-oral photographs, pathology images, dental history) are included in the content; informed consent must be acquired in such cases (3).

An equally sensitive issue, to which serious consideration must be given, is the use of copyrighted material in the content and the copyright of the new e-material itself (3, 16, 35). Content developers must explore the different copyright options before launching the module (e.g. <http://creativecommons.org/>). In addition, the name, email and credentials of the author(s) should be visible on the module's web page, as well as the date of the initial launching and any updates of the module/content (3, 36, 38).

### Recommendations

#### 1 Structure

- Table/menu of contents.
- Introduction including an overview of the module, the targeted learners (dental professionals) and an estimated overall study time.
- Objectives (learning outcomes).
- Topics divided into subtopics (chapters).
- Reading instructions, directions and necessary clarifications/explanations.
- Summary of the key points at the end of each subtopic.
- Links to websites for additional information/online library.
- A facility whereby learners can ask the course authors questions (e.g. email, online help).
- Communication tools: discussion boards, chat rooms, conferencing, etc.
- Evaluation questionnaire.
- A personal learning log.
- An option for printing the module (or the core parts) in hard copy.
- An option for printing a Certificate of Completion.
- Blended learning: clear information on the linking of the e-module with the face-to-face sessions.

#### 2 Content characteristics

- Relevant, coherent, clear and consistent.
- Accurate and current.
- Illustrated by examples/case studies when new information is presented.
- Mandatory reading/activities clearly delineated from the optional ones.
- Accurate, current and content-relevant external resources.
- Planning for regular update of the material.

- A copyright statement in relation to both the author and the sources used.
- 3 Navigation
- Logically and sequentially organised.
  - Easy to use and to navigate.
  - Accurate references to other parts of the material.
- 4 Assessment
- Pre-test.
  - Self-assessment tests, case studies, clinical problems with feedback.
  - Clear assignments and timelines.
  - Post-test.
- 5 Principles
- Interactive
  - Appropriate to the learners' characteristics (ability and maturity level) and experiences.
  - Promote critical thinking and application to practice by suitable activities.
  - Variety of supportive media (images, videos, audio, slides presentations, etc.).

## Visual design

### General principles

For health professionals, the presentation of materials in the electronic environment is an important element of the learning process (23); therefore, the course providers – and particularly the designers and programmers – must pay particular attention to the interface design of the online material. Interface design refers to the page layout, the visual arrangements, the position and use of illustrations–graphics–colours, the interlinking of audio–video animations and text, the navigation features, and in general, all supporting features of the visual presentation of the e-content (26, 36, 43).

Online learners are required to develop specific psychological processes (visual perception, attention, understanding, motivation, memory, imagination, decoding habits, critical thinking) to assimilate and interpret the visual content. *Visual perceptual learning* is a reading activity that differs from the traditional linear text reading, as it requires from the learners a complex reception of the visual content, with the aim to interpret it, understand it and integrate it with their existing knowledge (44, 45). Therefore, the design of the material should include the necessary features (which constitute the visual perceptual language) to enable this process. Through this language, the learner should identify the relevant information, distinguish the informative elements from the cognitive ones, separate the symbolic meanings from the non-symbolic, develop a critical position and an ability to select new sources of information, and transfer the information into their personal experiences (42, 44).

The appropriateness of the colours, the text, images and animations; the availability and characteristics of video, 3D applications and audio material; and the navigational structure are amongst the quality criteria for evaluation of e-learning courses and modules (3, 36, 42). The arrangement of the information on screen and its presentation affect the orientation, duration and the degree of learner's attention (46). The

general layout of the screen must be attractive, appropriate for the content and the intended learners and facilitate learning (36, 42). Complicated, confusing, rigid and difficult to navigate environments cause frustration to the learners and affect negatively the learning outcome (17, 23, 47). The rules for interface design, proposed by Vilamil-Casanova and Molina (48), are still relevant and proposed in the present document, supplemented by additional ones:

### Recommendations

- Make the layout attractive and appropriate.
- Provide easy/obvious navigational options.
- Keep cognitive load low.
- Avoid dividing attention.
- Use media to direct attention.
- Keep important information visible.
- Encourage rehearsal.
- Use concrete words and multiple media.
- Keep it simple!

### The text

The advantages of electronic text (hyperdocument) are manifold and include the following: (i) the possibility of simultaneous connection and presentation in another form of the educational material (images, audio, video, animation); (ii) the ability to link to other sources of information online; (iii) the facility to provide feedback to the learner; (iv) ease of searching and browsing; (v) ease of updating; and (vi) possibility of cheap and affordable options to meet the needs of the learners (customisation) (49). The first three are important for the educational process, creating what is defined as *interaction* between learner and content.

In the structure of electronic text, the elements that affect it include the way to navigate and the form of its presentation. Research shows that when the electronic document is in a printed page (page format), it is easier to read than the process of scrolling (26, 50). The entire content of a page must be visible without the user having to adjust the screen horizontally. Blinking text and animated images are used to attract the learners' attention, but after some time, they may disturb them and oblige them to stop reading (44). The use of windows that open and close in the text (pop-up windows, embedded text) do not distract the learner from reading, providing that their appearance is manipulated by the reader, and they do not appear automatically on screen (26, 44). Easily identifiable signs and images can serve as hyperlinks. For example, the image of the book shelves or the drawing of a film camera not only refer the students to additional material (written or video) but they also orientate them within the electronic text and associate the specific symbol to the particular type of material (42, 46, 51). These navigational icons or cues must be used consistently throughout the material (26). The function of these symbolic icons must be either explained or clearly evident to the learners (26, 38).

When designing the visual layout, several aspects need to be considered, including the following:

- Length of the text.

- Density of lines.
- Font size.
- Time of the text on screen.
- Text introduction on the screen.
- Text combination with other media (video–audio).

It has been reported that those who are frequent Internet users, do not read web pages word by word. Their eyes scan the text and stop on the specific words or sentences that create interest. This behaviour is characteristic of approximately 79% of Internet users (52). Therefore, the designers must produce a text that can be scanned using highlighted key words (bold characters, coloured, different size, distinctive position), bullet lists and intertitles to label content. In addition, electronic texts use not more than half the words used in the equivalent printed text, and each paragraph must contain one single core piece of information, presented in the first sentences: readers focus on the first few sentences of a paragraph and frequently overlook the rest of the content (26, 42, 44, 52).

### Recommendations

- Keep it simple!
- Clear, elegant and balanced text.
- Standardised and consistent style and use of terms.
- Direct writing style and supportive-encouraging tone.
- Good sense of direction in the content.
- Short sentences and brief paragraphs.
- Position based on importance.
- Grouping elements based on their significance.
- Highlighting text units, key words and concepts.
- Numbers and bullets used for priority lists or sequences.
- Defined abbreviations and symbols.
- Correct and consistent spelling and grammar.
- Fonts and spacing that enable reading.
- Bold lettering, used rarely, to highlight important information.
- Underlining used to mark hyperlinks, not to apply emphasis.
- Use of headings and sub-headings.
- Consistent use of frames to summarise or group elements.
- Politically correct text and writing style convey no unethical statements, ideas or comments (e.g. race, ethnicity, gender, religion).

### Colours and multimedia

*The colours.* Colour can be used to highlight important material, and it can facilitate the organisation of content, promote interaction and enable navigation (26, 42, 46). The combination of colours in the learning materials has proved to be an important element for developing creativity, memory, intelligence and imagination; in addition, colours enhance the students' learning achievements (44). Different colours have different effects: some colours facilitate relief from tension and increase concentration, whilst others have a positive influence

on the creation of mental associations, memorising knowledge, etc. (26, 44).

Colours are used to support the electronic text, the illustrations and the background of the screen. At the text level, colours increase the precision and the rapidity with which information is perceived and memorised. Psychological research into chromatic contrasts has determined the following order, from the highest to the lowest, in the intensity of chromatic contrasts for text from the point of view of their legibility and preference in the learning process (44):

- 1 black on a yellow background;
- 2 green on white;
- 3 red on white;
- 4 blue on white;
- 5 white on blue;
- 6 black on white;
- 7 yellow on black;
- 8 white on red;
- 9 white on green;
- 10 white on black;
- 11 red on black;
- 12 green on red.

It is recommended that red and blue – colours that lie at the extreme end of the visible spectrum – should be avoided as text or in detailed picture, as they are the most difficult colours to perceive (36). For illustrations, the use of colours may increase the importance of the information presented. The reader receives, processes and interprets a coloured illustration much faster and more efficiently than an illustration in grey tones. Maps, graphs, tables or histograms are better highlighted when colours are used and become more legible and less dull (26, 36, 42).

At the background level, colours may influence behaviour by triggering emotions, intentions and attitudes: red is stimulating, orange is optimistic and joyful, yellow is intimate and warm, green is safe and calm, white is clean and robust, etc. (26, 44). Attention must be given to cultural diversities regarding the meaning of colours, as it may be different in different cultures (in China, white is the colour of death) (26).

*The multimedia.* Multimedia applications may include images, video, audio, graphics, animations, simulations, 3D illustrations, etc. The educational value of multimedia lies in their ability to increase learners' motivation and to efficiently represent information (26, 42). Multimedia tools should support the educational objectives, be relevant to the content and be of the highest possible quality, considering the technical constraints of the users (36). As the dental educational content is mainly visual by its nature, multimedia techniques could be used to display it (36).

Sound is used to provide information that cannot be conveyed with other media and to enhance the capabilities of the other media, such as the graphics and videos (26). Animation and video can contribute in many areas such as attracting interest; effective presentation of information by using animated symbols, diagrams and animated graphics; and visualisation of scientific facts. Animation or simulation can be more valuable than video, when introducing general concepts,

where no detail is needed (26). The thoughtful integration of graphics, sounds, images and animations enables the learning and recalling processes and creates an interactive learning environment.

### Recommendations.

- Colours can highlight important text or particular text units.
- The contrast between text and the background makes the text legible.
- Graphic elements such as diagrams, tables and photographs illustrate or clarify information presented in the text.
- Consistent use of coloured symbols can orientate the learner.
- Background colours trigger emotions; they must be used thoughtfully and be in harmony with to the content and the objectives of the course.
- Multimedia contribute to the interactivity and increase learners' motivation.
- Multimedia applications must be of high quality and support the objectives (learning outcomes) and the content.

### Technical aspects

The technical infrastructure of the e-modules must be robust, reliable, accessible and user-friendly (53). Technology variables include the hardware, software, connectivity, the media and the mode of delivery (40). The e-module programming may be performed using an open-source code-based programming language, such as (16):

- Hypertext Markup Language (HTML)
- Java
- Javascript
- Perl
- Extensible Markup Language (XML)
- PHP
- MySQL

Open-source material may reduce the costs for many design elements, such as videos, tests and self-assessment questions, animations, graphical illustrations, etc. The IT literacy of learners should be considered when sophisticated applications are designed, which require a certain level of IT knowledge. An introductory face-to-face session may guide the learners in the technical aspects of the module (9), particularly when there are older lifelong learners amongst them, who are not very familiar with computers, the Internet and advanced technological features. Students not confident in the use of ICT may experience an initial period of disorientation during the first sessions of the electronic environment (54). For the technologically novice learners, adequate support is needed, so that they can solve the problems they encounter (through email, 'help' button), locate the suggested external links and resources, and keep abreast of the course (55).

As it is virtually impossible to design a page that is displayed in the same manner on different computer screens (due to variations in software, memory capabilities, analysis, etc.), it is preferable to design a simple page layout – in terms of colours, graphics, animations and screen composition – that will most probably be displayed similarly on all computers (38).

Another consideration is the 'size' (i.e. speed and memory demands) of the educational page and its elements. Whenever the text is complemented by images or videos, the time for loading the page is increased and the space required is increased, as well; therefore, it is recommended that the images, videos and animations should have an adequate size to be both didactically useful and technologically manageable (26, 36). A similar concern occurs when the distance learner may have to have two or three windows opened simultaneously, in a situation where they study the main course and at the same time explore other suggested sites and communicate with colleagues through a chat room: the technological structure of the module must enable the learner to perform all these tasks with a minimum of difficulty (44).

Apart from the learners/students technological literacy, consideration must be given to the tutors/educators' IT capabilities. Optimal delivery of e-learning courses requires expertise in programming, materials development, detailed pedagogy and technical support, all the above lying outside the traditional competencies of many academics (6). Tutors need technological support to overcome their fears for the new technology and understand the potential of e-learning (6, 31, 56). They need to understand their own abilities regarding the basic IT skills (managing documents, web browser functions, emailing) and seek complementary training, probably within their institution (6, 16). They need training in communicating and collaborating online, through emailing, fora, conferences, chat rooms and other media that create and support virtual learning communities. Finally, they need considerable time to convert conventional materials into electronic ones, to complement them with additional features and online resources and to organise the structure and pedagogical framework of the e-courses (17). Online educators need to be both pedagogically and technologically appropriately trained (53).

### Recommendations

- Open-source material may be used for the design of the e-module, to reduce costs.
- The design of the e-page must be cross-browser consistent.
- The IT literacy of learners must be taken into account when designing complex educational material.
- Some learners may need more technological support, particularly in the beginning of their studies.
- Online educators need training to overcome their 'technophobia', understand the opportunities of the e-environment and master the necessary technology.
- Keep the technology simple!



## Conclusions

The development of e-courses and modules, for dental CPD, requires a multiprofessional approach: members of the developing team could be academic staff and content experts, learning technologists, librarians, IT specialists, web designers and distance learning experts. Adult learning and e-learning principles must underpin the development of the e-course, as well as a sound pedagogical framework, that promotes interactivity and creativity and addresses the learners' needs. The module's learning objectives (learning outcomes) must be formulated at the start and communicated to prospective participants; they must be clear, measurable and achievable.

The module must be learner-friendly; interactive; promoting individual learning, flexibility, critical thinking opportunities for cooperation; and providing feedback to the learners. The educational content must be developed by an expert on the topic, using and modifying the existing resources; the whole content must be divided into smaller learning units, independent but structurally consistent. Content must be relevant, accurate, current, easy to navigate, regularly evaluated and updated, and supported by various media. The visual design of the module's web page must be attractive, appropriate and uncomplicated. The text must be written in a way to facilitate reading, enable the learner-content interaction and guide the learner through the learning process. Colours, graphics and animations should be used accordingly to complement or replace the content, in an educationally useful manner. Technology is a major concern, for both the learners and the educators: it should be simple, supportive and consistent with different systems and browsers. Educators in e-learning courses must be adequately trained in pedagogical and technological issues.

## Acknowledgements

This project has been funded with support from the European Commission (509961-LLP-1-2010-1-UK-ERASMUS-EMHE). This study reflects the views only of the authors, and the Commission cannot be held responsible for any use that may be made of the information contained therein.

## Conflicts of interest

The authors declare no conflicts of interest.

## References

- Bullock A, Bailey S, Cowpe J, et al. Continuing professional development systems and requirements for graduate dentists in the EU: survey results from the DentCPD project. *Eur J Dent Educ* 2013; 17 (Suppl. 1): 18–22.
- Mattheos N, Stefanovic N, Apse P, et al. Potential of information technology in dental education. *Eur J Dent Educ* 2008; 12 (Suppl. 1): 85–92.
- Nattestad A, Attstrom R, Mattheos N. 4.1 Web-based interactive learning programmes. *Eur J Dent Educ* 2002; 6 (Suppl. 3): 127–137.
- Feeny L, Reynolds PA, Eaton KA, Harper J. A description of the new technologies used in transforming dental education. *Br Dent J* 2008; 204: 19–28.
- Eaton KA, Hammick M. Distance learning materials for dentists—a users guide to quality. *Br Dent J* 2003; 194: 253–256.
- Eaton KA, Reynolds PA. Continuing professional development and ICT: target practice. *Br Dent J* 2008; 205: 89–93.
- Barber CM, Frank T, Walsh K, Burton C, Bradshaw L, Fishwick D. Knowledge and utilisation of occupational asthma guidelines in primary care. *Prim Care Resp J* 2010; 19: 274–280.
- Evans k, Gallatin A, Taylor C, Brodnik MS. Self-directed characteristics of participants in online CE programs. *Radiol Technol* 2008; 80: 11–19.
- Innes A, Mackay K, McCabe L. Dementia studies online: reflections on the opportunities and drawbacks of eLearning. *J Vocat Educ Train* 2006; 58: 303–317.
- Fehrenbach MJ, Baker-Eveleth L, Bell N. Online continuing education for dental hygienists: DH Forum. *J Dent Hyg* 2001; 75: 45–49.
- Kinghorn S. Delivering multiprofessional web-based psychosocial education: the lessons learnt. *Int J Palliat Nurs* 2005; 11: 432–437.
- Conole G, Hall M, Smith S. An evaluation of an online course for medical practitioners. *Educ Tech Society* 2002; 5: 66–75.
- Harmonisation and standardisation of European dental schools programs of continuing professional development for graduate dentists. <http://www.dentcpd.org>.
- Barnes E, Bullock A, Bailey S, Cowpe J, Karaharju-Suvanto T. A review of continuing professional development for dentists in Europe. *Eur J Dent Educ* 2013; 17 (Suppl. 1): 5–17.
- Bury R, Martin L, Roberts S. Achieving change through mutual development: supported online learning and the evolving roles of health and information professionals. *Health Info Libr J* 2006; 23 (Suppl. 1): 22–31.
- Anderson T, Elloumi F. Theory and practice of online learning (e-book), (n.d.). Available online at [www.cde.athabasca.ca/online\\_book](http://www.cde.athabasca.ca/online_book)
- Childs S, Blenkinsopp E, Hall A, Walton G. Effective e-learning for health professionals and students – barriers and their solutions. A systematic review of the literature – findings from the HeXL project. *Health Info Libr J* 2005; 22 (Suppl. 2): 20–32.
- Suomalainen K, Karaharju-Suvanto T, Bailey S, et al. Guidelines for the organisation of continuing professional development activities for the European dentist. *Eur J Dent Educ* 2013; 17 (Suppl. 1): 29–37.
- Clark GT. Web-based continuing dental education in California. *J Calif Dent Assoc* 2003; 31: 611–619.
- Knowles MS. *The adult learn: a neglected species*. Houston, TX: Gulf, 1990.
- Rogers A. *Adult education*. London: Routledge, 1999.
- Venkatesh V. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Inform Syst Res* 2000; 11: 342–365.
- Carroll C, Booth A, Papaioannou D, Sutton A, Wong R. UK health-care professionals' experience of on-line learning techniques: a systematic review of qualitative data. *J Contin Educ Health Prof* 2009; 29: 235–241.
- Curran VR, Hoekman T, Gulliver W, Landells I, Hatcher L. Web-based continuing medical education (II): evaluation study of computer-mediated continuing medical education. *J Contin Educ Health Prof* 2000; 20: 106–119.
- Sandars J, Langlois M, Waterman H. Online collaborative learning for healthcare continuing professional development: a cross-case analysis of three case studies. *Med Teach* 2007; 29: e9–e17.
- Beale R, Sharples M. Design guide for developers of educational software. British Educational Communications and Technology Agency (Becta) 2002. Available at: <http://www.idemployee.id.tue>

- nl/g.w.m.rauterberg/lecturenotes/0H420/EDUCdesignguide[2002].pdf.
- 27 Terrell SR. Supporting different learning styles in an online learning environment: does it really matter in the long run? OJDLA 2005; VIII: 1–9. Available at: <http://www.westga.edu/~distance/ojdl/summer82/terrell82.pdf>.
  - 28 Keegan D. On defining distance education. *Distance Educ* 1980; 1: 13–36.
  - 29 Kulier R, Hadley J, Weinbrenner S, et al. Harmonising evidence-based medicine teaching: a study of the outcomes of e-learning in five European countries. *BMC Med Educ* 2008; 8: 27. Available at: <http://www.biomedcentral.com/1472-6920/8/2>.
  - 30 Sutton F, Ellituv ZN, Seed R. A survey of self-perceived educational needs of general dental practitioners in the Merseyside region. *Prim Dent Care* 2005; 12: 78–82.
  - 31 Schonwetter DJ, Reynolds PA, Eaton KA, de Vries J. Online learning in dentistry: an overview of the future direction for dental education. *J Oral Rehab* 2010; 37: 927–940.
  - 32 Lain D, Aston J. Literature review of evidence on e-learning in the workplace. Available at: <http://www.employment-studies.co.uk/pubs/report.php?id=01580>.
  - 33 Race PH. *The open learning handbook: promoting quality in designing and delivering flexible learning*. London: Kogan Page, 1993.
  - 34 Keegan D. *Foundations of distance education*. London and New York: Routledge, 1996.
  - 35 Training educators to design and develop ODL materials. Commonwealth of Learning (COL), 2008. Available at: [http://www.col.org/SiteCollectionDocuments/Training\\_Educators\\_March08\\_pdf.pdf](http://www.col.org/SiteCollectionDocuments/Training_Educators_March08_pdf.pdf).
  - 36 Guidelines for the design of educational software. ANSI Standards Committee on Dental Informatics – Working Group Educational Software Systems. Available at: <http://www.dental.pitt.edu/informatics/edswstd/title.htm>
  - 37 Oliver R, Paganelli C, Cerny D. 4.3 towards a global superstore of quality-assured modularized learning programmes. *Eur J Dent Educ* 2002; 6 (Suppl. 3): 147–151.
  - 38 Wright CR. Criteria for evaluating the quality of online courses. 2003. Available at: <http://elearning.typepad.com/thelearnedman/ID/evaluatingcourses.pdf>.
  - 39 Harvey J (ed.). *Evaluation cookbook*. Edinburgh: The Learning Technology Dissemination Initiative, 1998. Available at: <http://www.icbl.hw.ac.uk/ltidi/cookbook/>
  - 40 Attwell G (ed.). *Evaluating e-learning -a guide to the evaluation of e-learning*. Evaluate Europe Handbook Series Volume 2, 2006. Available at: <http://creativecommons.org/licenses/by-ncsa/2.0/de/>.
  - 41 Irving MJ, Irving RJ, Sutherland S. Graseby MS16A and MS26 syringe drivers: reported effectiveness of an online learning programme. *Int J Palliat Nurs* 2007; 13: 56–62.
  - 42 Wakefield MA. *Universal design for learning guidelines version 2.0*. Center for Applied Special Technology (CAST) 2011. Available at: <http://www.cast.org/udl/>.
  - 43 Sandars J, Lafferty N. Twelve tips on usability testing to develop effective e-learning in medical education. *Med Teach* 2010; 32: 956–960.
  - 44 Istrate O. Visual and pedagogical design of eLearning content, *eLearning Papers* (No 17), 2009. Available at: <http://www.elearningpapers.eu>
  - 45 Lu ZL, Hua T, Huang C-B, Zhou Y, Doshier BA. Visual perceptual learning. *Neurobiol Learn Mem* 2011; 95: 145–151.
  - 46 Hannafin MJ, Hooper S. An integrated framework for CBI screen design and layout. *Comput Hum Behav* 1989; 5: 155–165.
  - 47 Clarke A, Lewis D, Cole I, Ringrose L. A strategic approach to developing e-learning capability for healthcare. *Health Info Libr J* 2005; 22 (Suppl. 2): 33–41.
  - 48 Villamil-Casanova J, Molina L. *An interactive guide to multimedia*. Indianapolis, IN, USA: Que Corporation, 1996: 124–129.
  - 49 Egan DE, Remde JR, Gomez LM, Landauer TK, Eberhardt J, Lochbaum CC. Formative design evaluation of SuperBook. *ACM Transaction Inform Syst* 1989; 7: 30–57.
  - 50 Pilot A, Roussey J, Thumin O. Effects of screen presentation on text reading and revising. *Int J Hum Comp Stud* 1997; 47: 565–589.
  - 51 Shneiderman B. Designing information-abundant websites: issues and recommendations. *Int J Hum Comp Stud* 1997; 47: 5–29.
  - 52 Nielsen J. How users read on the web, 1997 (e-article). Available at: <http://www.nngroup.com/articles/how-users-read-on-the-web/> and at: <http://www.useit.com/alertbox/9710a.html>.
  - 53 Swedish National Agency for Higher Education. *E-learning quality. Aspects and criteria for the evaluation of e-learning in higher education*. Report 2008:11 R. Stockholm. Available at: <http://www.eadtu.nl/e-xcellencelabel/files/0811R.pdf>
  - 54 Browne L, Mehra s, Rattan R, Thomas G. Comparing lecture and e-learning as pedagogies for new and experienced professionals in dentistry. *Br Dent J* 2004; 197: 95–97.
  - 55 Anthony D, Duffy K. An evaluation of a tissue viability online course. *ITIN* 2003; 15: 201–228.
  - 56 Kruse K. *The benefits and drawbacks of e-Learning*. 2004. Available online at: [http://www.itsmcampus.com/downloads/The\\_Benefits\\_and\\_Drawbacks\\_of\\_e.doc](http://www.itsmcampus.com/downloads/The_Benefits_and_Drawbacks_of_e.doc). Originally published at [www.e-learningguru.com/](http://www.e-learningguru.com/)