

An E-Learning Platform to support Environmental Compliance – Part I: Needs Analysis and Design

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ABSTRACT

Current and emerging environmental legislation is driving organisations to become environmentally compliant thereby leading to improved environmental performance and reduced costs, time to market, regulatory concerns and future liabilities (Baxter 2001). To help achieve this compliance, the DeFESS project aims to research, develop and validate an e-learning platform to deliver training programmes in environmental design and management. This training platform will support them in building their understanding of the legal obligations regarding the integration of environmental needs into product design. In this paper, tools and methodologies to enable organisations to achieve and maintain environmental compliance are discussed.

1 INTRODUCTION

Whilst the incorporation of environmental attributes in a product design can initially result in increased cost, it can also result in reduced materials use, improved designs, reduced future liabilities, broader market access, the need for fewer inspections and improved public acceptance of the product (Philip and Willig 1997), (EPA 2007). Furthermore, from an organisational perspective, “the extent of worldwide participation in ISO environmental standards is a prime motivation for businesses of all sizes to conform to these standards as a condition for international trade (Baxter and DeMendonca 2001)”.

Funded under the Leonardo da Vinci Programme¹, the Design For Environment Skills for Suppliers (DeFESS) project² aims to develop training tools in environmental design and management to help small and medium sized enterprises reduce the environmental impact of their products, processes and services, reduce the cost of compliance and overcome emerging trade barriers driven by environmental legislation. This support of workplace development is important as research shows that organisations who invest in employee development and

¹ The Leonardo Da Vinci Programme is part of the European Commission’s Lifelong Learning Programme. Its objective is to improve the quality of training provision, develop the skills and mobility of the workforce, stimulate innovation and enhance the competitiveness of European industry (EU 2007)

² The DeFESS project will run until the end of September 2007.

training have significantly higher returns over the long term (Bassi and McMurrer 2004), (Cross 2004), (Conlon 2004). In this paper, the authors discuss the DeFESS planning and development cycle, the results accruing from a Pan-European survey and the features of the DeFESS platform as informed by the survey and a literature review.

2 THE DEFESS PLANNING AND DEVELOPMENT CYCLE

The DeFESS planning and development cycle (see figure 1) comprises:

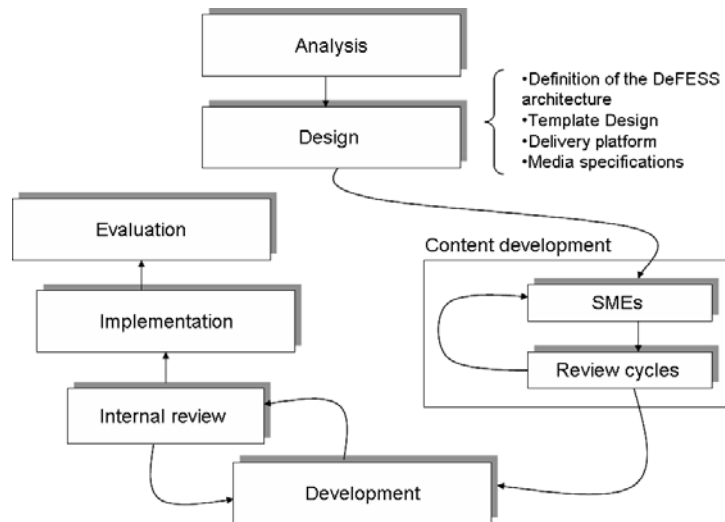


Fig. 1 The DEFESS Planning and Development Cycle (after Lee and Owens 2000)

- **Analysis:** In order to identify the problems and challenges facing organisations and determine the content and preferred features for an e-learning platform, a Pan-European survey of SMEs³ was carried out. This survey was composed of two stages:
 1. A questionnaire was circulated in the Czech Republic, Germany, Ireland, Poland, the United Kingdom and Turkey.
 2. Focus group meetings were held in Ireland, the United Kingdom and Turkey.
 The results of the questionnaire and the focus group meetings will be presented in Sections 3 and 4 respectively.
- **Design:** This planning stage of the DeFESS project involved:
 1. *Definition of the DeFESS architecture:* Based on the feedback from academic partners and the focus group meetings, the DeFESS platform comprises 6 modules⁴, with each module consisting of between 12 and 14 lessons.
 2. *Template design:* The delivery of each module is based on a series of module, lesson and slide templates (see figure 2). As the lead partner of the DeFESS project is an academic institution, the design of both the Module and Lesson templates was closely aligned with academic standards.

³ Small and Medium sized Enterprises

⁴ The module topics and content were endorsed by our focus groups

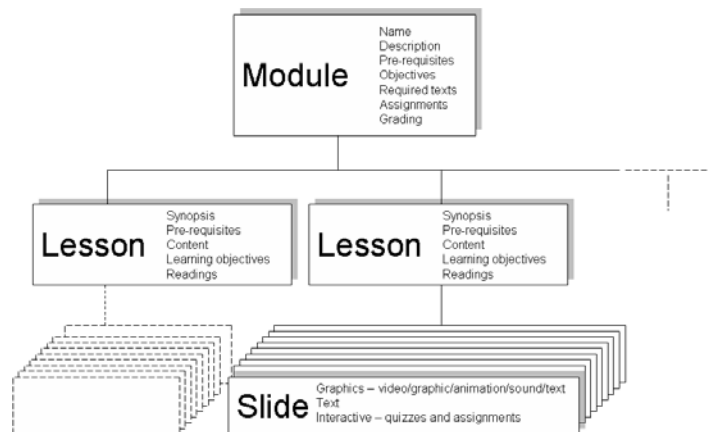


Fig. 2 The DEFESS Architecture

3. *Delivery Platforms* – MOODLE was selected as the delivery platform for the programme as it offers high availability, scalability, usability and promotes learning by doing, collaboration and self-directed learning (Munoz and Van Duzer 2005). Moodle⁵ represents an open source virtual learning environment (VLE) with social constructivism⁶ at its core (Moodle 2007).
4. *Media Specifications* – This stage involved determining the interface and functionality of the tool, the interfaces for the ‘End of topic’ and ‘End of lesson’ assessments, feedback formats, text design standards and text presentation styles. Research has shown that if the interface is attractive, there is a greater likelihood that users will have a positive perception of the system and in turn be more tolerant of usability issues (Preece 2002).
 - **Content development:** Using the templates specified earlier, this phase comprised content development and subsequent review (between the instructional designer and the subject matter experts⁷ regarding comprehensibility, consistency and difficulty level). “First rate writing, striking photos and outstanding graphics are key elements in making interfaces more enjoyable to use (Shneiderman 2004)”.
 - **Development:** During this stage, the lesson content is integrated into the e-learning framework. Animations and graphics are used where appropriate.
 - **Internal review:** The content is reviewed by the instructional designer, SMEs, internal experts and academics.
 - **Implementation and Evaluation:** These stages will involve the integration of the final commercial product within the MOODLE environment and its subsequent evaluation by external reviewers (experts and potential clients).

Two of the proposed modules have been completed. These will now undergo the internal

⁵ Modular Object oriented Dynamic Learning Environment

⁶ The belief that people learn best when they are engaged in the social process of constructing knowledge

⁷ SME

review process. As part of this process, a detailed questionnaire has been developed to assist the reviewer in evaluating the module and lesson structure, content, design, interaction, multimedia elements, information presentation and navigation.

3 THE DEFESS QUESTIONNAIRE

The goal of the DeFESS project is to provide relevant training programmes in environmental design and management. Consequently, a questionnaire was circulated to SMEs across Europe to identify their needs. This questionnaire was structured as follows;

- *Section 1: Organisation* – requested an overview of the organisation and its perspective on the environment.
- *Section 2: Design Process* – queried the organisation’s current design processes and its status of compliance with regard to environmental regulations.
- *Section 3: Training needs* – sought input on the modules (and related content) considered essential in a Design for Environment training programme.
- *Section 4: Features* – helped to identify the most desirable features of a training platform.

3.1 Results

Whilst in excess of 300 questionnaires were circulated, the response rate was disappointingly low with only 32 completed forms being returned⁸.

Table 1 Results from Section 4 of the DeFESS Questionnaire: Features

Desired Features	Rank ⁹	%	Mapping
‘I can see real life examples’	5	86.5	Section 5.3
‘The goals are clearly described’	5	82	Section 5.3
‘I get a recognised qualification’	5	48	Section 5.12
‘There is immediate feedback on quizzes and assessments’	5	31	Section 5.4
‘I can engage in problem based learning through simulations and animations’	5	31	Section 5.13
‘I can understand how everything fits together’	4	48	Section 5.9
‘I have access to on-line quizzes for self-testing’	3	52	Section 5.2
‘I can get involved in activities that encourage collaboration and the sharing of ideas’	3	43	Section 5.1
‘I can read detailed documents in a textual format’	3	43	Section 5.14
‘I am assessed at the completion of each module to determine my comprehension’	3	43	Section 5.2

⁸ Organisations in Germany and the Czech Republic were reluctant to complete the questionnaire as they viewed the content as commercially sensitive

⁹ 5 = critical, 4 = very important, 3 = important

In table 1, a summary of the main results accruing from Section 4¹⁰ are presented. Note that the final column in this table indicates a mapping of the 'Desired Features' to the features of the DeFESS platform (see Section 5).

4 FOCUS GROUP MEETINGS

Participants in the focus group meetings (held in Ireland, Turkey and the United Kingdom) included representatives from OEMs, suppliers, industry associations and trade bodies, academics, consultants and other intermediary and support bodies. The purpose of these meetings was to elicit more qualitative feedback concerning their views on emerging legislation and training needs. The focus group meetings in each of the three countries followed a similar two stage process:

1. The current thinking regarding the modules to be developed and the indicative content for each module was first described.
2. A focused discussion was then carried out with invited guests from industry. This session was guided by a facilitator whose role was to keep the discussions on track and provide the necessary focus when required. All observations and outputs from the brainstorming sessions were posted on paper sheets viewable by all. These meetings were beneficial in collecting multiple viewpoints and highlighting areas of consensus and conflict. They also facilitated first contact between the DeFESS developers and potential users.

Results from the Focus Group Meetings

Some of the conclusions which arose from the focus group meetings are as follows:

- SMEs recognise the importance of emerging environmental issues, alongside increasing customer demands, increasing competition and more demanding legislation.
- Requirements for environmental compliance are cascading from the primary organisations (OEMs) down the supply chain.
- 38% of the surveyed SMEs regard compliance as compulsory in order for them to remain competitive.
- Whilst organisations have a reasonable knowledge of emerging legislation, they have difficulty in implementing legislation requirements in their products & processes and in measuring their overall environmental compliance.
- Organisations would like a European wide DFE forum to be established.

Other conclusions were categorised into Training Needs, Preferred Frameworks/Tools and Preferred Modules¹¹. The conclusions from the Training Needs category are:

- A 65:35 weighting of applied versus theoretical should be used in module

¹⁰ The results from Sections 1, 2 and 3 of the questionnaire will be presented in a Part II of the paper

¹¹ The results from the Preferred Frameworks/Tools and Preferred Modules categories will be presented in Part II of the paper

development (see Section 5.2).

- Interactivity is important in eliminating the sense of isolation (see Section 5.1).
- Practical examples and case studies are vital (see Section 5.3).
- A recognised qualification on completion of the training is a ‘nice to have’ (see Section 5.12).

5 DEFESS PLATFORM FEATURES

Some of the primary features of the DeFESS platform (derived as a result of an analysis of the questionnaire responses, focus group meetings and literature surveys) are as follows;

5.1 *Collaboration*: Some of the lessons will require the user to engage in threaded discussions and group projects. Such collaboration is important as research shows that learning occurs when users work with their peers within a social environment to solve problems (Merriam and Caffarella 1998), (Cross 2004), (Morrison *et al.* 2004).

5.2 *Interactivity & Assessment*: Each lesson commences with a ‘Test Your Knowledge’ to ascertain the user’s knowledge of the topic being presented. Based on the result, he/she might decide that they are sufficiently expert in this topic and do not need to continue with the lesson. On completion of each subtopic and lesson, the user’s comprehension is assessed. In order to engage him/her more fully, techniques involving multiple choice answers, mix and match, rank in order of priority, hotspot, true/false, drag and drop, essays, case based problems, research, threaded discussions, chats and case studies have been incorporated (see figure 3).

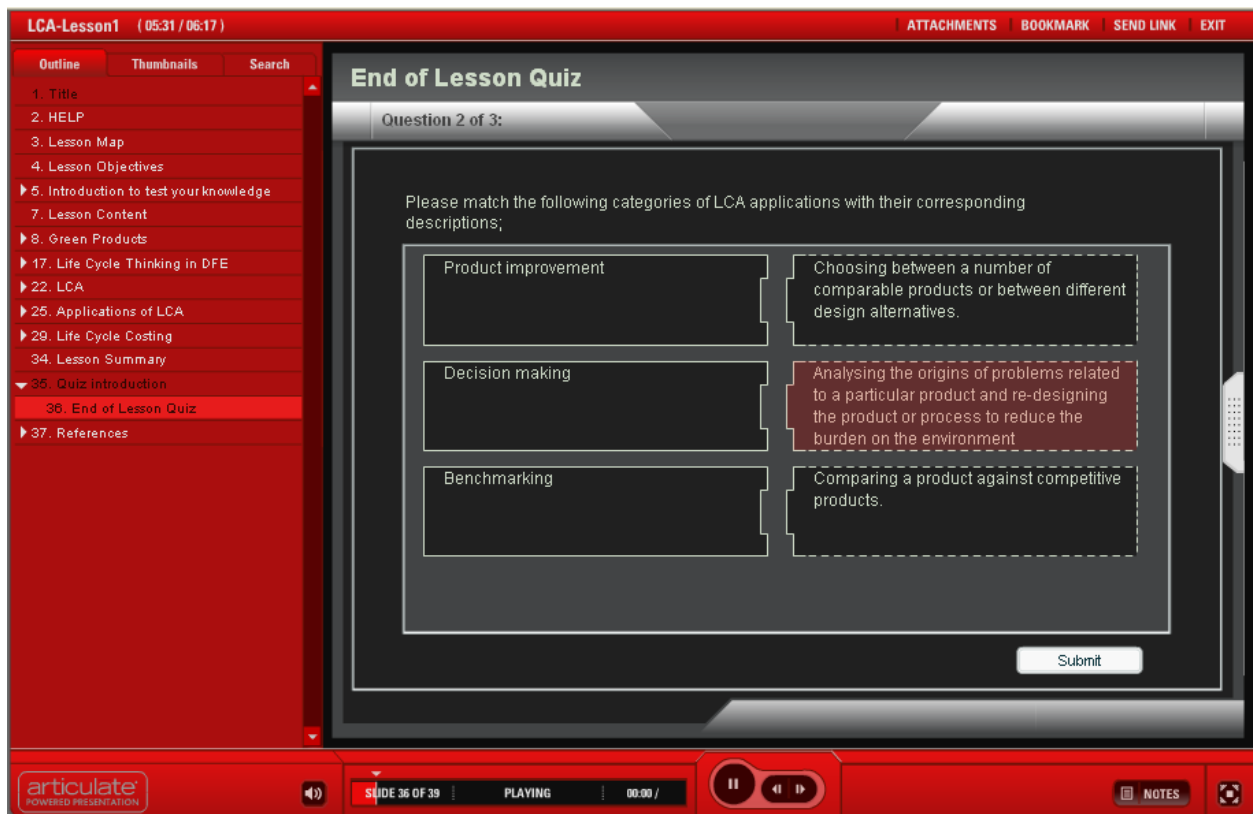


Fig. 3 Screen shot: Example of an ‘End of Lesson’ quiz

By increasing interactivity, the user is forced to think more deeply about the topic. This reflects the principles of Constructivism, which regard learning as playing a more active than passive role, with the user at the centre of the learning experience (Anderson *et al.* 2004), (Merriam and Caffarella 1998), (Cross 2004), (Morrison *et al.* 2004). Research shows that retention rates from the use of non-interactive methods range from 5% to 30% whilst interactive methods provide retention rates from 50% to 90% (Bruck 2005).

5.3 *Adult Learners*: As the main target audience for the DeFESS project are adults, the platform was designed to take into account (Conlon 2004), (Morrison *et al.* 2004):

- *Adults need to know the purpose of the material being taught* – DeFESS: Learning outcomes are clearly stated in the Module descriptor with Lesson objectives defined at the commencement of each lesson. This is vital for promoting learning and motivating the user to complete the lesson (Bostock 2005), (Hartley 1998).
- *Adults need to apply their life experiences to the learning situation* – DeFESS: practical, real-life examples are used where relevant.
- *Adults approach learning as a problem-solving exercise* – DeFESS: on completion of each sub-topic the user can assess his/her comprehension of the preceding content.
- *Adults learn best when the topic is of immediate and relevant value* – DeFESS: based on the feedback from the focus group meetings, the initial modules proposed for the platform were revised in order to reflect user needs.

5.4 *Usability*: To support effective learning, the following usability issues were considered¹² (Preece *et al.* 2002), (Shneiderman 2004), (Ceaparu *et al.* 2004), (Peng *et al.* 2004):

- *Effective – does it do what it is supposed to do?* DeFESS: feedback from the focus groups was used to guide the SMEs in content development.
- *Efficient – once the user has completed a lesson, has he/she gained an effective learning experience?* DeFESS: whilst efficiency will be tested in greater detail during the internal review and evaluation stages, different forms of quizzes were used to help the user ascertain whether or not he/she understood the content.
- *Learnability – is it easy to use?* DeFESS: clearly distinguishable icons and controls are consistently used throughout the platform to enhance learnability.
- *Memorability – How easy is it to remember how to use once it is learned?* DeFESS: each module, lesson and quiz follows a similar structure and layout.
- *Feedback* – DeFESS: feedback from the quizzes is immediate with the user being able to review each quiz on its completion. Effective and immediate feedback promotes learning (Cooperstein and Kocevar-Weidinger 2004).
- *Mapping* – DeFESS: the play, pause and rewind controls are mapped logically onto

¹² Initial usability tests will be carried out when internal reviews are undertaken. Whilst at this stage the DeFESS developers cannot identify how these usability factors are met, they were instrumental in driving the design of the platform

the outcome i.e. the configurations maps directly onto the direction of the arrows.

- *Match between system and the real world – DeFESS*: where possible, words and phrases familiar to the user are used rather than system-oriented terms.
- *User control and feedback – DeFESS*: the user has complete control over the manner in which he/she navigates. The only point at which they may be compelled to complete the interaction is during the end of lesson assessment.
- *Consistency and standards – DeFESS*: whilst each lesson follows a similar structure and layout, the interface has been designed so that it promotes recognition rather than recall, by using recognizable icons and consistently placed objects. As an example, whenever a green button appears on a graphic, the user knows that if he/she ‘mouses over’ this button, something will happen (for example, a more detailed explanation).
- *Aesthetic and minimalist design – DeFESS*: only those graphics which add to the learning experience are included.
- *Visibility – DeFESS*: functions are highly visible i.e. navigation, play/pause controls. At each point, the user can track his/her progress within the lesson content (this is highlighted in the panel on the left hand side of the presentation) (see figure 4). Furthermore, the user can view a synopsis of all content (in thumbnail form) or search within the lesson or the notes (see figure 4).

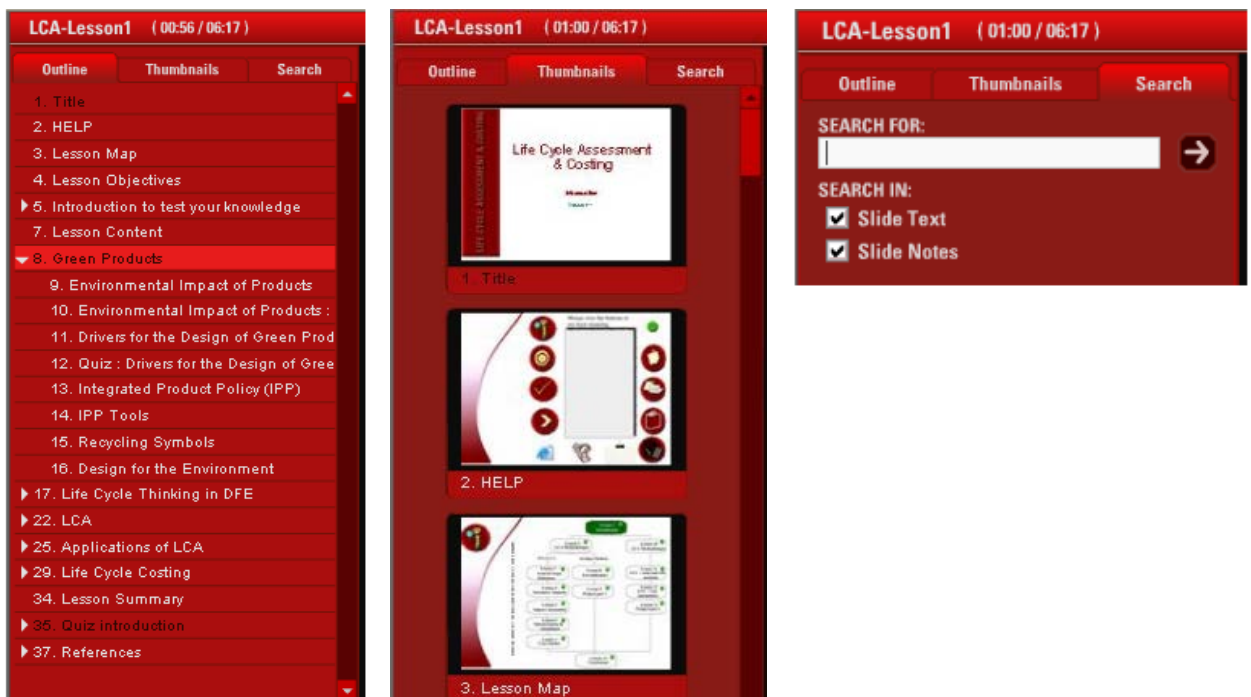


Fig. 4 Screen shot: Left hand navigation panel, Thumbnail view, Search

5.5 *Navigation*: Given that different users navigate in different ways, the system has been designed to support sequential and branched navigation.

5.6 *Learning*: Different people learn in different ways (Kolb 1984). Some users prefer to see text whilst others prefer to hear an audio version (Dilts and DeLozie 2000). DeFESS : the platform has been designed so that:

- Audio (which can be turned on/off) accompanies each screen of content.
- The audio is transcribed into easily accessible notes.
- Links are embedded within the content for users who want to explore and browse for further information (Bassi and McMurrer 2004).

5.7 *Content development*: The manner in which information is displayed can greatly influence how easy or difficult it is to understand (Preece 2002). As part of the instructional design process, the SMEs were asked to keep the style of writing more personalised than formal. Researchers have compared e-learning tools where the content is formal to those which use a more informal approach. The results show that participants in the personalised/informal group “produced between 20%-46% better than those in the formal group (Morrison *et al.* 2004)”.

5.8 *Illustrations*: Relevant illustrations are used to reduce the cognitive load.

5.9 *Lesson Map*: A lesson map at the beginning of each lesson provides a conceptual framework highlighting how the lessons are interlinked.

5.10 *Headings*: Headings are used to signal the change of topic within a lesson. They relate to the content on the left hand panel of the presentation.

5.11 *Information presentation*: The presentation of the content in a structured, clear and meaningful manner supports effective learning (Bostock 2005).

5.12 *Qualification*: Each module will be certified by a recognised third level institution.

5.13 *Simulations and animations*: The developers have found that the functionality of some tools is best described using animations and simulations.

5.14 *Documentation*: All screens with accompanying notes can be downloaded in PDF format by the users.

6 CONCLUSIONS

In order to remain competitive, improve environmental performance and reduce future liabilities, organisations need to comply with current and emerging environmental legislation and directives. The DeFESS project has been established to research, develop and validate an e-learning platform to deliver training programmes to help employees of SMEs comply with emergent environmental legislation and thereby use environmental superiority to both reduce cost and overcome trade barriers.

In this paper, the planning and development stages of the DeFESS project were described and the results of a Pan-European survey (consisting of a questionnaire and focus group meetings) were outlined with regard to their impact on both the content and the preferred features of an e-learning platform. On completion of the project, Part II of this paper will present an evaluation of the e-learning platform.

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