# Checklist for a Didactically Sound Design of eLearning Content

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**Tags**

checklist, instructional design, didactic, formative evaluation, feedback

The design of elearning content requires several areas of educational psychology to be integrated. In order to enhance the design process, checklists can be used as a means of formative evaluation. We present a checklist for the design and formative evaluation of elearning modules.

It covers the content, segmenting, sequencing and navigation, adaptation to target audience, design of text and graphics, learning tasks and feedback, and motivation. In the context of a project on designing elearning modules on renewable energies, this checklist was successfully used for providing formative feedback to the developers.

## 1. Introduction

The design of e-learning content is a challenging task in the course of which many wrong decisions can be made. The consequences of these decisions might reach from only minor impacts on learning to severe interferences with learning success (e.g., Mayer & Moreno, 2002). In order to avoid wrong decisions, several domains of educational psychology have to be integrated in the course of e-learning content design.

The ADDIE approach of instructional design (e.g., Branch, 2009) describes these areas of educational psychology. Its acronym stands for the different phases the development of e-learning content should go through. These are the Analysis, Design, Development, Implementation and Evaluation phase. During the Analysis phase, instructional goals have to be identified, the target audience has to be determined and available resources have to be analyzed. In the Design phase, the instructional design is conceptualized. During the Development phase, all content (e.g., text, graphics, etc.) is produced. The Implementation phase comprises the first use of the developed content in the destined environment, for example in the company it was developed for. The Evaluation phase refers to the assessment of the quality of the resultant e-learning product (c.f. Branch, 2009; Niegemann et al., 2004).

Checklists are a widespread means for the evaluation of didactical software (Niegemann et al., 2008). There are several different checklists for a broad range of uses: from the evaluation of software designed for a specific subject to broad checklists for every possible intention (e.g., Graeber, 1992; Pritchard, Micceri, & Barrett, 1989; c.f. Meier, 1995). For example, the checklist EPASoft (Graeber, 1992) was designed for the evaluation of instructional software before purchase, before and after usage. Following this checklist, software is evaluated in four main areas: with regard to didactics, to the medium, to the teacher and to the student. Criteria with regard to didactics are the importance of goal and content, the display of contents, methodic approach and inclusion of the medium. Criteria referring to the medium are the usability, sequence control, visual design and usage of the capacity of the computer. Further criteria cover the teacher's preparation, realization and evaluation of classes. A last

area of criteria refers to the student. These are understandability, flexibility, adaptivity of the program and consequences for the student.

However, the validity of checklists with regard to the choice of software is questionable (Fricke, 2000; Tergan, 1998). Fricke (2000) states several critical points for using checklists:

- a lacking interrater reliability and therefore a lacking objectivity,
- a low practical significance of the criteria,
- differential method effects regarding the criteria: the criteria interact with for example learner characteristics,
- the usage of the software in the institutional context is rarely considered.

However, checklists can also be integrated into the process of formative evaluation. In this sense, the checklist has the function of a guideline (Fricke, 2000). However, checklists are often not based on instructional theories but are a bunch of different criteria gotten from practice (Fricke, 2000). By a return to instructional theories, an unsatisfying buildup of more or less valid practical criteria can be evaded (Fricke, 2000).

Therefore, it was the aim of the present research to develop a checklist that is based on instructional design theories and empirical results and that can be used for formative evaluation during the design process of e-learning content. Therefore, we derived check questions from current theory and empirical research on the topics of content/segmentation/sequencing, navigation, adaptation, design of text and graphics, learning tasks and feedback, and motivation. These topics were chosen because of their importance in e-learning design which is reflected by current textbooks on e-learning (e.g., Niegemann et al., 2008; Niegemann et al., 2004; Rey, 2009).

The resultant checklist is based on two assumptions. First of all, it assumes a development procedure following the ADDIE model (Niegemann et al., 2004). This checklist is meant to help during design and serve as a means of (formative) evaluation. Therefore, we assume the step of analysis to have taken place. This includes that the target audience is specified and that learning objectives are defined. The second assumption is that the e-learning module is developed on the basis of a more traditional instructional design theory (e.g., Gagné, Briggs, & Wager, 1988; Reigeluth, 1999). In the case of situational approaches (e.g., Cognition and Technology Group at Vanderbilt, 1993; Collins, 1991; Schank, Berman, & Macpherson, 1999), several of its criteria will not apply neatly although it can also be used in this context.

In the remainder of this paper, we present criteria for a didactically sound design of e-learning immediately followed by the respective check questions. Then, we will provide a short discussion of its application in our project.

## 2. Checklist scopes

### Content

Central element of all e-learning modules is the content presented. Apart from its correctness, both the content units and the content breadth should be in line with demands of the target audience or customer (c.f. Hannafin & Peck, 1988). This includes that it is in line with the defined learning objectives. Therefore, the first check questions are the following:

1. Is the e-learning module correct with regard to content?
2. Is the e-learning module in line with the learning objectives regarding content units and content breadth?

### Segmenting, sequencing and navigation

Segmenting refers to dividing the content into small learning units (e.g., screen pages), while sequencing means the ordering of these learning units (c.f. Reigeluth, 1999). Both of them are important for an optimal learning outcome: Too long learning units may impede motivation and make it difficult for the learner to keep track (especially on a computer screen). Too small learning units might interfere with coherence.

The sequencing of learning units is important for the learner to construct knowledge. First, for some learning units the learner will need prior knowledge to understand it. However, this cannot be taken for granted. Therefore, it is necessary to convey this prior knowledge before the actual learning unit (learning prerequisites, Gagné et al., 1988). Second, also for non-dependent information it is useful to order it from the general to the specific (c.f. Reigeluth, 1999), for example from the abstract to the concrete, or first giving an overview before detailing certain aspects.

A design question that is closely related to segmenting and sequencing is the design of the navigation. It is of tremendous importance that the learner always knows where she is within the e-learning module. Thereby, we avoid the phenomenon of the learner being „lost in hyperspace“ (e.g. Edwards & Hardman,

1989). Therefore, a successful navigation design includes highlighting the actual position and displaying close learning units. Additionally, it is important to find meaningful menu entries: Headings covering the content of the following learning unit are better suited than formal headings like „chapter 1“ (Hartley & Jonassen, 1982; Niegemann et al., 2008). The target audience has to understand the headings before they learn this chapter, and the heading should rise correct expectations about the content of the learning unit. Therefore, unknown abbreviations and technical terms should be avoided.

3. Is the content segmented adequately (neither too wide nor too narrow)?
4. Is the sequencing well structured?
5. Is the navigation bar in balance between too many and too little sublevels and are the menu items well chosen?

## Adaptation to target audience

Different target audiences call for different designs of e-learning modules. For example, students want to be addressed in a different way than longtime business company employees. This is true both with regard to diction and the general level of the e-learning module and the prior knowledge we can assume (Reigeluth, 1999). While, for example, a student might benefit from the translation of a technical term into more colloquial speech, an employee might need the technical term to understand an explanation since it might be more meaningful to her than the translation (expertise reversal effect, c.f. Kalyuga, Chandler, & Sweller, 1998).

6. Is the e-learning module suitable for the target audience (with regard to diction, level, prior knowledge,…)?

## Design of text and graphics

Text and graphics are basic elements of an e-learning module and therefore have to be readable and understandable. This includes an appropriate font size and font family (sans serif: e.g., Ballstaedt, 1997), a clearly arranged screen design and a suitable color scheme. For example, children prefer colorful pages (c.f. Yen, 1985), which is not suitable for adults. Apart from these more formal criteria that cover the readability of text and graphics, texts and graphics have to be understandable. Concerning texts, this covers linguistic simplicity, a clear arrangement with meaningful accentuation, conciseness, coherence and stimulation (Groeben, 1972). Apart from that, it has to be regarded how text and graphics are related to each other. The following principles of multimedia learning (Mayer, 2001) can be applied as rules of thumb: To integrate graphics can enhance learning (multimedia principle). Text explaining a graphic has to be placed as closely to the graphic as possible (contiguity principle). A graphic has to convey knowledge (coherence principle). When it is used purely in a decorative way, it might be seductive.

7. Are texts and graphics readable (font size, font family, screen design, color scheme)?
8. Are texts understandable (simplicity, clear arrangement, conciseness, coherence, stimulation)?
9. Are graphics understandable?
10. Are graphics used when possible, are they relevant for learning or seductive, is explaining text positioned as closely as possible?

## Learning tasks and feedback

Learning tasks are tasks that contribute to the learner's active knowledge construction and her metacognitive and motivational processes during learning (Proske, Körndle, & Narciss, 2012). Learning tasks can serve several functions during the learning process (Proske, Körndle, & Narciss, 2004a):

- Learning tasks can prepare the learner and activate prior knowledge at the beginning of the learning process.
- Learning tasks can support learners during the learning process by repeating and elaborating the learning content.
- Learning tasks at the end of the learning process help the learner to control his learning outcome.

According to Proske, Körndle, and Narciss (2004b), learning tasks have four dimensions: content, cognitive operations, interactivity, and formal aspects. The dimension of content covers the content unit the task refers to. Cognitive operations refer to operations which are necessary to solve the task, for example to remember, to understand, to apply, etc. They are usually organized in taxonomies (e.g., Anderson & Krathwohl, 2001; Bloom, 1956; Körndle, Narciss, & Proske, 2004). Interactivity comprises feedback on the task solution (e.g. informative tutorial feedback that helps the learner to complete the task: Narciss, 2008) and instructional information available during the task (e.g. hints). Formal aspects cover, for example, the form of the expected solution behavior, e.g. ticking check boxes, filling in text fields etc. (Körndle et al., 2004).

Therefore, the design of learning tasks is closely related to the aspired learning objectives. Learning tasks serve the purpose to achieve the learning objective respectively to control its achievement. Therefore, the difficulty of the learning tasks has to be of such a level that the target audience can solve the

tasks with the information from the e-learning module and their prior knowledge. Additionally, the task content and the necessary cognitive operations have to be consistent with the defined learning objectives.

As a consequence, this includes informative tutorial feedback (Narciss, 2008) and hints about how the learner in spite of a first error can achieve a task solution if she possesses the necessary knowledge (c.f. zone of proximal development, Vygotsky, 1978). Therefore, feedback and hints have to be designed in such a way that they do not give the solution away but that they provide enough help for the learning process. If the learner nevertheless does not solve task, the provided solution can serve as a worked example and in this way enhance learning (Atkinson, Derry, Renkl, & Wortham, 2000; van Gog, Kester, & Paas, 2011).

11. Are there learning tasks to activate knowledge, to repeat and elaborate knowledge, and to control knowledge?
12. Are task content and cognitive operations chosen according to the learning objectives?
13. Is the level of task difficulty appropriate for the target audience and the learning objectives?
14. Is there interactivity in such a way that the learner can complete the task successfully or at least benefit from a worked example in the solution?

### Motivation

Keller (e.g. 1983) developed a very practical model for motivational design. Following its main categories, it is called ARCS:

*Attention*. This category refers to arousing and sustaining curiosity and attention (Keller, 1983). Strategies to attain this are, for example, including surprising or paradoxical events, confronting the learner with questions or problems and providing variation (Keller, 1983; Niegemann et al., 2004)

*Relevance*. In this category, it is important to connect the content to personal needs and motives of the learner (Keller, 1983). This includes mentioning the relevance of the learning goals for the personal development of the learner, e.g. in the company, or providing opportunities to satisfy the need for achievement, e.g. by competitive games, or for affiliation, e.g. by opportunities to communicate with others (Niegemann et al., 2004).

*Confidence*. Strategies in this category seek to develop the learner's confidence in success (Keller, 1983). For example, the confidence can increase because of experience with success. Additionally, requirements for success should be made clear. Personal control as well as attributional feedback also can foster the learner's confidence (Keller, 1983).

*Satisfaction*. This category refers to helping the learner to experience satisfaction, for example by providing an opportunity for applying the new knowledge in a real or close-to-reality context, e.g. in simulations. Then, learners can see the natural consequences of their actions (Niegemann et al., 2004). Other strategies to support satisfaction is to provide learners with a positive outcome of their actions, and to ensure equality (Niegemann et al., 2004).

15. Does the e-learning module enhance motivation by supporting attention, relevance, confidence and satisfaction?

## 3. Discussion and Conclusions

In the previous sections, we presented a checklist on the design of e-learning content which is based on theory and empirical results on instructional design. The check questions do not have to be answered with yes or no only. Moreover, strengths and weaknesses of an e-learning prototype can be pointed out. Thereby, the checklist becomes a valuable feedback instrument.

This checklist was used in a project on e-learning for renewable energies. In this project, several e-learning modules on renewable energies were created. The e-learning modules are used for vocational training and professional development. The checklist served both as a tool of formative evaluation and of feedback. After a prototype of the e-learning module was created, the content developers received feedback on it by means of this checklist. It proved useful not only to indicate the check questions to be answered with "no" or indicating further need of improvement but also to indicate positive examples of these areas. For example, not only to indicate which text had to be reworked but also to indicate a text fragment that was how it should be.

In the context of our project, the resulting e-learning modules were evaluated with a sample of learners. The results show that most of them were enhancing learning and learning motivation. This can as well be seen as partly a result of the usage of this checklist. Therefore, this checklist can serve both developers during the development of e-learning modules and didactic consultants for the evaluation of e-learning modules and providing feedback to the developers.

This checklist provides information and guidance for the development and formative evaluation of e-learning content. However, it is only a first step in the process of evaluation, as checklists

are quite subjective (Fricke, 2000). Therefore, they should not be used as sole means of evaluation.

## *Appendix*

*All check questions:*

Content

1. *Is the e-learning module correct with regard to content?*
2. *Is the e-learning module in line with demands with regard to the kind of content and its breadth?*

Segmenting, sequencing and navigation

3. *Is the content segmented adequately (neither too wide nor too narrow)?*
4. *Is the sequencing well structured?*
5. *Is the navigation bar in balance between too many and too little sublevels and are the menu items well chosen?*

Adaptation to target audience

6. *Is the e-learning module suitable for the target audience (with regard to diction, level, prior knowledge,…)?*

Design of text and graphics

7. *Are texts and graphics readable (font size, font family, screen design, color scheme)?*
8. *Are texts understandable (simplicity, clear arrangement, conciseness, coherence, stimulation)?*
9. *Are graphics understandable?*
10. *Are graphics used when possible, are they relevant for learning or seductive, is explaining text positioned as closely as possible?*

Learning tasks and feedback

11. *Are there learning tasks to activate knowledge, to repeat and elaborate knowledge, and to control knowledge?*
12. *Are task content and cognitive operations chosen according to the learning goals?*
13. *Is the level of difficulty appropriate for the target audience and the learning goals?*
14. *Is there interactivity in such a way that the learner can complete the task successfully or at least benefit from a worked example in the solution?*

Motivation

15. *Does the e-learning module enhance motivation by supporting attention, relevance, confidence, and satisfaction?*

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## Edition and production

Name of the publication: eLearning Papers
ISSN: 1887-1542
Publisher: elearningeuropa.info
Edited by: P.A.U. Education, S.L.
Postal address: c/Muntaner 262, 3r, 08021 Barcelona (Spain)
Phone: +34 933 670 400
Email: editorial@elearningeuropa.info
Internet: www.elearningpapers.eu