Accessible Information Processing

# Accessible Content and e-Learning

**Dirk Koester**
Medieninformatik (diploma)
6th semester
Hochschule Bremen

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

# Contents

## Foreword

*"A computer should be adapted to the needs of the user, not the other way round."*

**David Banes**, AbilityNet

This document is the result of an assignment concerning accessibility and e-Learning. It refers to the course *"AIP—Accessible Information Processing"* which was lectured in summer 2007 at the University of Applied Sciences, Bremen. It goes without saying that a document about accessibility should at least accomplish certain accessibility standards. Therefore, for the first time I made use of the alternative text function for images. All embedded images in this document come along with describing text so that screen readers should be able to read out alternative text. I tested it with Adobe Acrobat's built-in screen reader and the result was acceptable—a more sophisticated screen reader most likely does a better job. Moreover, I included bookmarks for a better navigation and used a clearly legible Sans Serif font.

Finally, I'd like to express my gratitude to all colleagues of my company who were most helpful in supplying me with knowledge about e-Learning technologies and current standards.

## Preface

Latest studies have covered that approximately 20% of world population face a disability that may interfere with the use of a computer for educational purposes. The need for universally designed products is commonly acknowledged, and today's e-Learning solutions often range from "leaving much to be desired" to products designed, developed, and delivered according to accessibility.

# 1. e-Learning – General Overview

By definition, e-Learning comprises all kinds of learning where multimedia technologies are used to enhance the learning process. Hence, e-Learning is not only related to higher education and corporate training—it encompasses learning at all levels, both formal and non-formal, that uses an information network like the Internet, local area network or extranet. The underlying idea of a "machine aided learning" is by no means that modern. Even in the late 16th century, Italian engineers conceived the prototype of a so called "learning machine", and after World War II, the first machines for educational purposes were utilized. One example is the "Geromat III" (Germany, 1964) which was used to train groups of employees more effectively—this can be considered as a forefather of modern HD-Control *(Human Development Control)*.

However, it was the progress of the internet that made e-Learning become so popular as it is, and today's e-Learning industry is estimated to be worth over 38 billion euro. Moreover, virtually all American higher education institutes nowadays offer online classes.

## 1.1. Terms, Technologies, Advantages, and Disadvantages

When talking about e-Learning and connected technology, we must distinguish between ***Computer Based Training (CBT)*** and ***Web Based Training (WBT)***. While CBT describes stand-alone software especially designed for learning purposes, WBT on the other hand is usually placed on a web server, thus enabling learners to make use of additional services like chats, discussion boards or online tutors. In higher education, the term ***Virtual Learning Environment (VLE)*** is often used to describe software which helps teachers to manage e-Learning content. It is by no means uncommon that students in a

traditional class can be assigned both print-based and online materials, have online mentoring sessions and are subscribed to a class e-mail list. That kind of learning model where traditional classroom practice is combined with e-Learning is also called ***Blended Learning (BL)***. Likewise VLE, a ***Learning Management System (LMS)*** is software used to organize online-courses—but not restricted to higher education. The forms of organization range from registration to certification. Learning Management Systems all contain communication technologies to a certain extend: blogs, wikis, chats, screen casts, e-mail, and discussion boards. As for technologies, we can distinguish between synchronous and asynchronous communication technologies. The latter requires no participants engaged at the same time (e.g. blogs and bulletin boards) and synchronous technologies are dependent on at least two participants communicating face-to-face (e.g. chats, virtual classrooms or videoconferencing).

In the course of time, multiple forms of e-Learning have been emerged: the ***Virtual Classroom*** enables synchronous learning for students and teachers at different places. The term ***Web Based Collaboration*** depicts the teamwork on a task over the internet. And another manifestation is called ***Rapid e-Learning*** and can be described as the acceleration of the learning process in general. The main concept is to clearly define structures and targets, thus making the provision of learning content a fast and lucrative matter. Many larger companies profit from Rapid e-Learning and the involved reduction of cost.

Unlike previous opinion where e-Learning was considered as the principal form of 21st century education, it has been proven that it cannot replace traditional learning. Nevertheless, many advantages of e-Learning are commonly acknowledged and accepted. The flexibility as well as the ability to work at any place where an internet connection is available makes e-Learning a valuable education. Interactivity and the visualization of abstract content broaden the learning experience and suit to users who have difficulty with traditional

education. Another benefit are the reduced expenses of e-Learning for larger organizations. By using simulation-based learning content, it is possible to train employees for special software environments—without carrying the error risk of the real environment. Beyond any doubt, the initial cost of an e-Learning implementation is quite high, but as more learners make use of the system, the cost of training goes down exponentially.

Concerning disadvantages, it is clear that learners firstly have to learn how to cope with a learning system before they can utilize it. Critics point out that the lack of face-to-face interaction and the feeling of isolation make e-Learning no longer "educational" in a philosophical sense. According to supporters, this argument is not convincing as audio and video-based web-conferencing can easily substitute human face-to-face interaction. All in all, there are virtually no adducible objections speaking against e-Learning. In higher education as well as in corporate training, e-Learning is a good supplement to traditional learning—flexible, cost-effective and modern.

## 1.2. Current Standards

Given a growing market with a great deal of e-Learning solutions available, it becomes more and more necessary to have certain standards which guarantee communications between client side content and a host system. Without reasonable standards, interoperability could not be guaranteed and migrating learning content from one platform to another would be quite laborious to accomplish.

Therefore, various consortia from Europe and the United States started to set up standards for interoperability between learning platforms. Most of these standards focus on technical aspects and neglect didactical concepts.

Meanwhile, most consortia agreed on consolidating their results in order to make standards established. The underlying idea is that only the ***IEEE*** has the right to suggest and establish standards at relevant organizations like the ***ANSI (American National Standards Institute)***. The following figure illustrates the relation between the committees in question.

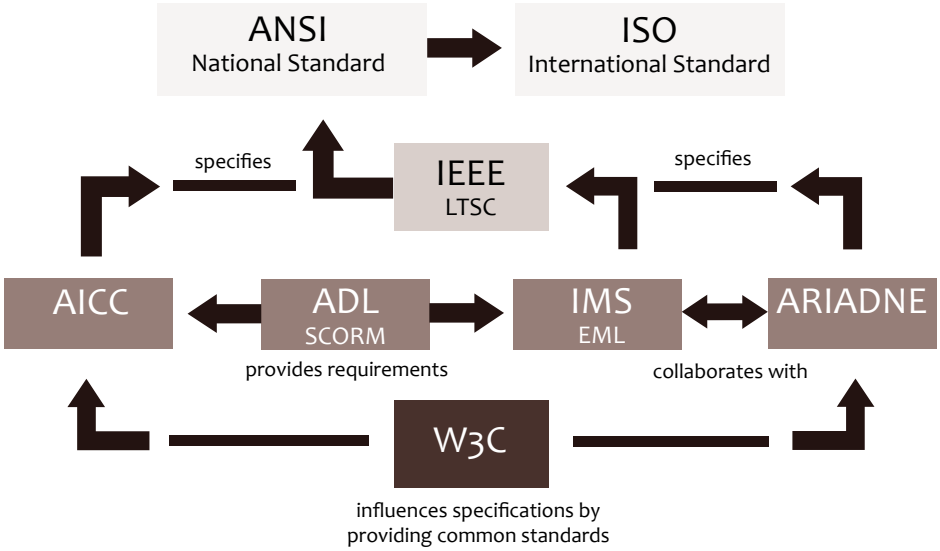


**Figure 1:** Cooperation between committees — Source: **www.imsproject.org** (modified and redesigned)

The most prominent standard is probably the ***Sharable Content Object Reference Model (SCORM)***. The latest version is called SCORM 2004 (3rd Edition) and was published in 2006. SCORM is a collection of standards and specifications for web-based e-learning. It provides easy exchange, common access and reusability of learning content. SCORM also defines how content is to be packaged into ZIP files. SCORM is mostly influenced by the elaborations of IMS, IEEE and AICC.

To achieve the required interoperability, SCORM 2004 consists of the following four documents based on IEEE standards for API and content object-to-runtime environment communication.

(1) ***Overview***—SCORM history and introduction.
(2) ***Content Aggregation Model (CAM)***—describes what kind of resources can be used in a learning object, furthermore how content is to be packaged. A resource can be a file or an URL *(Uniform Resource Locator)*. It is also possible to include XML *(Extensible Markup Language)* metadata.
(3) ***Run-Time Environment (RTE)***—RTE describes runtime API and defines interfaces for interoperability between CAM and the corresponding Learning Management System.
(4) ***Sequencing and Navigation (SN)***—describes how the sequence of the presentation can be changed by the navigation of the user.

SCORM is a specification of the ***Advanced Distributed Learning Initiative (ADL)***. In 2003, the U.S. Department of Defense mandated that all its e-learning purchases must conform to SCORM standards. As a result, a testing initiative had been started and by August 2005, ADL had validated 178 SCORM-conformant products.

The ***Aviation Industry CBT Committee (AICC)*** is an international association of technology-based training professionals. The AICC develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies. The objectives of the AICC range from developing guidelines to provide an open forum for CBT training technologies discussion. For such technologies, the term *„AICC Compliant"* implies that a training product complies with *one or more* of the AICC Guidelines. If a product was self-tested, the AICC recommends the use of *"Designed to AICC Guidelines"*—and *„AICC Certified"* if it was certified by an AICC-authorized Test Lab.

The ***IMS (Instructional Management Systems) Global Consortium*** is a consortium of suppliers that focus on the development of XML-based specifications for learning resources. These specifications are used to define how metadata addresses content packaging and an LMS should communicate with back-end applications, content objects, or libraries. All in all, the current standard consists of the subparts *Metadata*, *Content Packaging*, and *Learning Design (i.e. pedagogical approaches)*.


**Figure 2:** IMS Content Package

The last organization to mention is the ***IEEE (Institute for Electrical and Electronics Engineers)*** as an international organization that develops technical standards and recommendations for electrical, engineering, computer and communication systems. Within the IEEE, the ***Learning Technology Standards Committee (LTSC)*** provides specifications for e-Learning. Probably the most convincing standard is the ***Learning Object Metadata (LOM)*** specification to describe learning objects, enable exchange as well as to automatically compose personalized lessons—with security and authentication support.

To summarize, current e-Learning standards of the mentioned organizations predominantly concern metadata, content packaging, and learner profiles. Critics point out that didactical concepts should be more integrated into current standards. However, *metadata* proves to be the weak point of e-Learning if labeling and indexing are implemented inconsistently. *Content packaging* is important for transferring courses and content from one learning system to another. Without proper content packaging, it would be impossible for different tools to access content. And *learner profiles* are crucial for assessments and certifications. Standards regarding learner profiles contain personal data, learning plans, and learning history, so that systems can communicate learner data to the content, such as scores or completion status.

## 1.3. History, Pioneers, and current e-Learning Solutions

What today is called e-Learning had for a long time been called *"distance education"*. Historically, this can be traced back to the 18th century, to the beginning of print-based correspondence education. At that time, ***Isaac Pitman***, the inventor of shorthand, is generally recognized as the first person to use correspondence courses—he began teaching shorthand, using Great Britain's Penny Post in 1840. The next remarkable step took place more than a hundred years later. In 1954, the ***University of Houston*** offered the first televised college classes—mostly aired at night so that working students could also watch them. Six years later, the ***University of Illinois*** developed ***PLATO (Programmed Logic for Automated Teaching Operations)***, one of the first systems enabling teachers to create lessons and gather information about the learner's progress. Moreover, students were able to communicate with teachers through online notes.

Due to development of new technologies and delivery systems, the 1970's and 1980's brought significant changes in distance learning. It became feasible to shift away from one way communication methods to two way interactive distance learning programs. Great Britain's ***Open University*** became the first autonomous institution to offer college degrees through distance education. In 1989, ***Lancaster University*** launched the *"MSc in Information Technology and Learning"*—which is now the world's longest continually running Masters program based on virtual learning methods.

Finally, the mid 1990's and the progress of the internet exerted the big impact on e-Learning. It was a time of growth, and the result is a whole stockpile of e-Learning solutions currently available—WBT, LMS, VL, more or less sophisticated. It would be a good idea to take a closer look at some well-tried solutions—commonly accepted and recommended.


To start with one of the global players, ***Blackboard Inc.*** offers a LMS called ***Blackboard Academic Suite™*** which is said to be one of the most comprehensive e-Learning solutions available. Universities worldwide use it to supply e-Learning—particularly Universities like the "FU Berlin" or "RRZ University Hamburg" consider Blackboard as a good means to improve the learning experience. Over 2200 education institutions in more than 60 countries use Blackboard products for e-Learning. To satisfy user demands, the Blackboard Learning System offers a rich set of assessment capabilities, various tools to create web-based learning content as well as a great deal of synchronous and asynchronous communication technologies. Needless to say, that Blackboard products are fully compliant to IMS, AICC, and SCORM.


Europe's higher education e-Learning flagship is apparently ***ILIAS***—an open source LMS for developing and realizing web-based e-learning. By 2006, about 1800 universities, academies, and training facilities installed ILIAS to manage e-Learning—the "Académie de Bordeaux", inter alia, with more than 60.000 users. ILIAS offers a broad variety of assessment tools to verify the learning success of learners (i.e. self assessment tests). Besides, it can be used to create and administer courses; it supports podcasts and online surveys, and is one of the few LMS including special user profiles combined with Google Maps™. ILIAS is fully compliant to SCORM, AICC, and IMS.


Since 1997, Cisco's ***Networking Academy*** offers online courses in over 150 different countries to teach students and in-transition workers how to design, build and maintain computer networks. Learners access online course materials, and by completing Cisco's online exam, guided by an instructor, learners achieve the in demand CCNA™ certificate. Bremen's University of Applied Sciences cooperates with Cisco and offers courses for CCNA™ exams.

# 2. Accessibility and e-Learning

Rumor has it, the Web increases by more than 3 million new pages a day. Although this is a rough estimate, fact remains that the Web grows at enormous speed. It becomes clear why accessibility plays an important role when creating websites. But how does this affect the "educational Web"? The demand for accessible e-Learning is on the increase, that is for sure, and there is no need to reinvent the wheel. It suggests itself to map well-tried accessibility features from the Web to e-Learning as many aspects coincide closely with each other.

## 2.1. Why Accessibility?

Generally speaking, the demand for information technology accessibility regulation became more apparent when outmoded shell-based applications were replaced by systems with a ***Graphical User Interface (GUI)***. Since a GUI is strongly connected to a mouse, certain motor skills are required to fully control the system. Physically impaired users, who had yet been facing considerable problems, were thenceforth confronted with new barriers. Additionally, more complex graphics and a higher resolution made interaction with the computer increasingly difficult for visually impaired users. Especially blind and deaf users feared that the increasing use of multimedia would leave them behind as multimedia can also be a barrier to those who cannot see or hear properly.

It becomes clear that impaired people face particular barriers if the content has not been made accessible. People with a disability have difficulty in receiving or interpreting output from the computer, giving commands or entering data into the computer and comprehending the information as presented. Most learners with dyslexia or visual impairment have difficulty in reading or comprehending text. Others have difficulty with regimentation, structure

or memory, they may find material difficult to navigate, poorly structured or complex, or the interface may be inconsistent. Learners with limited motor skills may not be able to use a keyboard or mouse, and most online services cannot be used by deaf people because either the service is based on sound without subtitles or sign language is not supported.

## 2.2. Accessibility by Law

For a long time, websites had been designed for the sake of impressing the mainstream surfer. Complex screen layouts and graphics without alternative text were mostly to be found. Accessibility was ignored and it took some years until the first designers cared about accessibility. On the one hand, accessibility regulations for federal websites aroused the interest to provide universally designed products; on the other hand, it became clear that alienating disabled people is not right.

Early in 1998, the ***World Wide Web Consortium (W3C)*** launched the ***Web Accessibility Initiative (WAI)***. The W3C was created to develop common protocols that enhance the interoperability and promote the evolution of the Web. The Web Accessibility Initiative focuses on expanding the protocols and data formats to make the Web itself more accessible. In addition, the ***International Program Office (IPO)***, which was created to oversee the WAI, is responsible for creating guidelines, educating the industry, and establishing international partnerships.

The guidelines of the W3C are not binding, but certain countries developed guiding principles—mostly based on W3C guidelines—which are binding for governmental websites or educational institutions. In the ***United Kingdom***, the ***Disability Discrimination Act (DDA)*** was enacted in 1995 and

grants equal treatment to people with disabilities. According to this law, service providers are not allowed to treat disabled persons less favorably for a reason related to their disability. Concerning education and e-Learning, the ***Special Educational Needs and Disability Act (SENDA)*** became law in 2001. The law affected all education and training provided by all further and higher education institutions. This Act makes it unlawful for an institution to turn disabled persons away from a course, or mark them down in an assessment, because they had dyslexia or were deaf. Furthermore, if an impaired person is at a substantial disadvantage, the education provider is required to take all reasonable steps to compensate the disadvantage—e.g. to change policies, practices, course requirements, work placements or even physical features of a building.

Likewise the DDA, the ***United States*** have also set up a law to protect disabled people from discrimination—the ***Workforce Rehabilitation Act***—with the slight difference that it was enacted much earlier in 1973. In 1998, the ***"Section 508"*** amended the Act and established binding guidelines for technology accessibility. Regretfully, these standards are only obligatory to U.S. Federal agency sites. In fact they do not even apply to the Congress. Nevertheless, the "Section 508" is most helpful in providing accessible guidelines for all information technology (see 2.4. "Accessibility Guidelines"). They cover not only web accessibility; they can suitably be used for software in general, documentation as well as e-Learning.

A similar law like "Section 508" is obliging for internet and intranet presences of governmental offices in ***Germany***. The ***BITV*** (*Enactment for Information Technology Free of Barriers)* came into law in 2002. Binding guidelines for further and higher educational institutions are not provided. Moreover, the BITV is not obliging for federal institutions in all states, i.e. Lower Saxony does not have an enactment for accessible websites yet.

## 2.3. Assistive Technology and Universal Design

A good way to increase access to learning resources is to make use of computerized equipment which is often called ***Assistive Technology***[1]. This equipment or software is used to maintain or improve the functional capabilities of disabled persons. As each disabled individual encounters particular difficulties, this technology has to be well matched to the user. Assistive Technology in general includes hard- and software devices such as text scanners, screen readers, hearing aids as well as speech recognition or thought organization software. The built-in accessibility features of Microsoft‘s operating system Windows XP offer some free solutions for common accessibility problems, i.e. the „Sticky Keys“ option to emulate key-combinations for one-fingered or mouth stick users. Other options vary from contrast enhancement to visualization of system sounds. Even though this is a good approach to satisfy the demands of impaired users, there are still impairments that can only be lightened by sophisticated assistive, adaptive and enabling technologies.

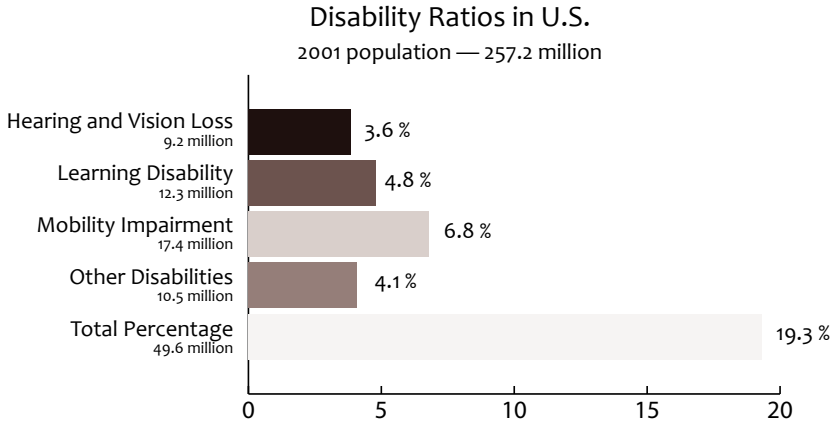


**Figure 3**: U.S. disability statistics—Source: Center for Desease Control, **www.gdc.gov** (redesigned)

[1] The ***World Wide Web Consortium*** defines Assistive Technology as *“Software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities”.*

**Figure 4**: Braille Display

For ***blind*** and ***partially sighted users***, access to web-based content is dependent on specialized assistive technology. For this purpose, tactile devices such as stand-alone *Braille displays* and *Note takers with Braille displays* have been developed. Furthermore, *electronic reading aids* are able to scan displayed text and send it to a *speech synthesizer.* For partially sighted users, *screen magnification software* comes in handy as selected content is enlarged—this also restricts the amount of viewable area on the screen, so that larger monitors often make sense.

**Figure 5**: Mouse Pen

***Physically disabled users*** can utilize alternatives for keyboard and mouse. A *Trackball*, a *Mouse Pen* or a *Foot Mouse* is a good option for users who cannot deal with a standard mouse. *On-Screen Keyboards* and so-called *Switches* do the same for users who cannot control a normal keyboard.

**Figure 6**: Cochlear Implant

***Hearing disability*** is separated into deaf and hard of hearing. The majority of deaf users who were not born deaf are not acquainted to use sign language—they use lip-reading combined with hearing aids or Cochlear Implants. Learners fluent in sign language may choose automatic computer generated and animated Signed English from electronic text as the best and most flexible means of support. However, this solution is hardly supported by current e-Learning systems. Therefore, it is crucial to provide multimedia content not only in audio format but also in a visual medium (i.e. subtitles).

Learners with ***dyslexia*** often suffer from various impairments dependent on the severeness—a *short-term memory* requires repetition or reviewing of information, slower *visual processing skills* result in sluggishly interpreted

text and a poor time management and organization due to *concentration disruption* often causes stress and displeasure. To overcome these problems, certain assistive technology has been developed. *Recording systems* are most helpful for videoconferencing, so that users can re-listen to what has been said in order to make accurate notes. Scheduler systems remind the user about events and reminders will appear at set times on the desktop. Further assistance might be the use of *spellcheckers* to prevent phonetic errors.

All in all, Assistive Technology is a good approach to meet the demands of impaired users. Unfortunately, technology can still fail to deliver results if inclusive design principles are ignored—and these principles are nothing less than ***Universal Design,*** defined as *"the design of products and environments that can be used and experienced by people of all ages and abilities, to the greatest extent possible, without adaptation"*.

To achieve Universal Design, accessibility must be integrated from the beginning of the design process, making products convenient to all people. Good examples are low-floor buses or the "undo" command found in most software products. The ISO 20282-1 and ISO 20282-2 standards, which are still under development, try to manifest design standards for a wide range of products.

## 2.4. Guidelines for Accessible e-Learning

Guidelines for accessible e-Learning are available in abundance. Most of them overlap or are based on the Web Content Accessibility Guidelines of the W3C. However, it is worth taking a closer look at some selected and most prominent "guideline packages".


The ***JISC (Joint Information Systems Committee)*** set up guidelines for accessible e-Learning documents. These guidelines were produced as part of the JISC-funded project X4L Healthier Nation and give advice on how e-Learning documents should be made accessible.

The first rule is to start with a ***summary*** so that learners can tell if the content is relevant or not. The next step is to use a ***heading for every section***, making sure that it describes clearly what the section is about—HTML heading tags are important as they are used by screen readers for navigation. To summarize information, it is always good to ***use lists and bullet points***. Here it is important not to use more than eight points in a list—punctuation is also required because otherwise screen readers would read all bullet points as a continuous sentence. The last step is to ***choose a proper font and font-size***. For screen reading, Serif fonts look messy and are much harder to read. Therefore, Sans Serif *Verdana, Arial* or *Trebuchet* with a font-size of at least 12pt *(better 14pt)* are always a good choice.

If a text section contains links, the author should remind that users dependent on screen readers cannot benefit from poorly labeled links. A sentence like "*for more information click here*" can be quite disturbing if the hearer has no idea what '*here*' means. Another point is to avoid underline for emphasis —on one side it will be mistaken for a link, on the other side it makes a document looking spoiled if too many sentences are underlined. If these guidelines are not ignored, a certain degree of accessibility has already been accomplished.


The ***Educational Development and Technology Centre (EDTeC)*** at the University of New South Wales conceived guidelines for higher education e-Learning. The first guideline refers to the ***correct use of graphics, visual cues and icons***. Graphics and icons should be

chosen well, because they are supposed to describe the information to what they link. They should not be used if they do not fulfill any purpose. Moreover, it is important that illustrations always include a text equivalent. ALT tags are a good means to ensure that alternative text is supplied.

Many e-Learning systems in higher education come along with downloadable documents. In most cases, these documents are provided as PDF *(Portable Document Format)*. Fortunately, many accessibility features are compatible with the Acrobat Reader. Therefore, authors should not forget to ***make PDF accessible***. It is not difficult to do that, it only requires some extra effort. While it is quite easy to make PDF accessible, PowerPoint slide shows are evidently problematic. To make them fully useable for Assistive Technologies, they have to be converted to HTML. As this is not the best solution, EDTeC suggests accompanying slide shows by an audio narrative. Although this alternative does not make the slight show accessible for screen readers, the impaired learner will be able to hear the lecturer narrate the content.

The ***proper use of colors and contrast*** plays an important role when content is to be made accessible. Warm colors for foreground or background are no good option; the same applies to complimentary colors (i.e. red and green). Strong contrast between foreground and background is important, so it is always safe to use black and white. Besides, it is not a good idea to include more than three or four colors into the color scheme. Needless to say, that color is a bad means to convey information—or as one of the W3C guidelines emphasizes: *"Don't rely on color alone"*.

The last guideline to mention refers to multimedia content. If video or audio is used in a system, it may be important to ***provide some equivalent information*** for those who cannot access the visual or auditory content. This comprises subtitles for video as well as a text document to accompany audio.

England's ***National Learning Network (NLN)*** was first launched in 1999 and is a national partnership program designed to increase the uptake of e-Learning across post-16 education. NLN offers virtually the same guideline set for accessible documents and design principles like the previously mentioned institutions.

What makes NLN outstanding is that NLN additionally has a special set of ***pedagogical rules***. Over the last years, a good deal of research has gone into teaching and learning theories. And it is finally confirmed that learners learn in different ways. Henceforth, it seems necessary that tutors maximize the learning potential of their students through making adjustments to their teaching style. The following excerpt of pedagogic criteria is expected to be met when material is created:

- *"Learning objectives should be clearly stated."*
- *"Content should take the learner from the known to the new in appropriately sized stages."*
- *"Content should follow a clear strategy to achieve learning."*
- *"Content should help the learner to reflect on, review and digest new learning and not just regurgitate facts."*
- *"Content should demonstrate how new knowledge and skills can be applied to real problems."*
- *"Content should be accurate, valid, up-to-date and without errors."*
- *"Material should stimulate and motivate the learner."*
- *"Materials should include activities and keep the learner involved."*
- *"Materials should accommodate different preferences in learning style."*
- *"Materials should provide useful and supportive feedback based on the learners' responses."*
- *"Language should be appropriate for the target audience."*
- *"Design should stimulate responses from the learner."*

For assessments and activities, NLN conceived special suggestions. The reason is that learners are often excluded due to inappropriate design.

- *"Drag-and-drop should be usable by mouse or keyboard."*
- *"Multiple choice questions can be difficult for learners to engage with."*
- *"Too much scrolling is to be avoided."*
- *"Information only available in graphic format is to be avoided."*
- *"It is always good to provide alternative activities, i.e. never ask blind people to draw a spider diagram."*
- *"Timed response should be avoided. However, if timed response is required, the user/tutor should be able to modify the timing parameters."*

The background of ***"Section 508"*** has already been commented, and now it is time to take a closer look. Section 508 comprises a great set of standards, so only those guidelines are listed which have not been mentioned yet. The first relevant paragraph deals with ***software applications and operating systems***.

- *"When software for a system with a keyboard is produced, all functions shall be executable from the keyboard."*
- *"Applications shall not disrupt or disable activated accessibility features."*
- *"On-screen indication of the current focus shall be provided that moves among interactive interface elements as the input focus changes."*
- *"Sufficient information about a user interface element including the identity, operation and state of the element shall be available to assistive technology."*
- *"When animation is displayed, the information shall be displayable in at least one non-animated presentation mode at the option of the user."*
- *"Software shall not use flashing or blinking elements having a flash or blink frequency greater than 2 Hz and lower than 55 Hz."*

Another relevant paragraph addresses ***Web-based intranet and internet information and applications***.

- *"Documents shall be organized so they are readable without requiring an associated style sheet."*
- *"Row and column headers shall be identified for data tables."*
- *"Frames shall be titled with text that facilitates frame identification and navigation."*
- *"A method shall be provided that permits users to skip repetitive navigation links."*

Germany's ***BITV guidelines*** are basically based on the Web Content Accessibility Guidelines 1.0 (1999) of the W3C. The guidelines consist of 14 demands, divided into Priority 1 and Priority 2. Even though most guidelines primarily address web content, there are still some left which can be mapped quite comfortably to e-Learning solutions.

- *"Markup languages (HTML, CSS) shall be used according to their formal definitions."*
- *"Each visual content (text, video…) has to be understandable, even if it is seen without color."*
- *"Tables are only used to illustrate tabular data and shall not be used as a means to define the layout."*
- *"When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required."*
- *"Web-based applications shall be made, that all functions can be controlled independently of the input device."*
- *"The usability of outmoded Assistive Technology is to be provided if the effort is justifiable."*
- *"Linguistic anomalies are to be indicated."*

To sum up, most of the guidelines were originally conceived for creating websites, but they also suit to educational solutions. However, there are still aspects (especially didactical) which need special matched guidelines. Oddly enough, I nowhere encountered one of my handy considered guidelines for creating documents. Strictly speaking, they are more design guidelines, but they also intersect with accessibility principles. Enter the author's standards.

***(1)*** If a document should include charts, graphs or images containing text, it is most beneficial to embed vector data instead of bitmap data. The reason is not only that it looks more professional, it is also "scale-friendly" which means that vector data does not look messy when magnified.

***(2)*** If it is by no means possible to use vector format, then embedded images should not be compressed by *JPEG* unless they are photographs. It is commonly assumed that JPEG has a good compression rate making documents with embedded images much smaller in size. Well, that is not exactly true as it always depends on the image itself. If the image contains many regions with equal colors (like charts), run-length compression algorithms (i.e. ZIP) do a much better job. These algorithms are lossless and part with typical JPEG artifacts (soiled edges). The following example with a dummy chart illustrates this.

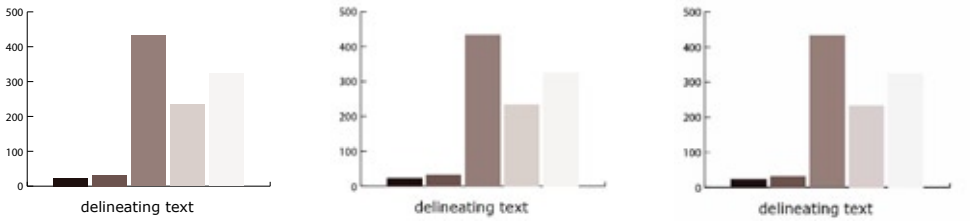


**Figure 7**: Different qualities dependent on the embedded format. The left one uses vector data (30 kb), the middle one is a bitmap based on indexed colors and ZIP-compressed (3 kb) and the right one is pure JPEG (8 kb).

# 3. Experience from Practice – Interview at engram

In order to compare theory with practice, I questioned my colleagues at **engram**[2] where I work as a freelancer. The 1990-founded multimedia company is well known for its Content Management Systems, multimedia and e-Learning technology. The most prominent products are certainly the ***Web-Layouter*** (CMS) , the ***WBT-Layouter*** (WBT) and the ***engram Learn Platform*** (CBT, LMS). Today, more than 20.000 employees of the German "Sparkasse" are being trained with the WBT-Layouter and the engram Learn Platform.


The ***WBT-Layouter*** is a powerful editing system, designed for constructing learning programs quickly and comfortably. The finished learn modules are playable in the browser without any additional programs and can be made available via a CD, any particular web server or learn platform. The transfer of data with a learn platform will be supported by SCORM, no matter whether the engram Learn Platform or another SCORM platform is used.


The ***engram Learn Platform*** is a Learning Management System to organize inner-operational online-courses as well as providing knowledge within a company. Additionally to administration functions, the engram Learn Platform contains various communication technologies (e-mail, discussion board, chat, and videoconferencing) to enable easy communication between tutors and learners. The WBT-Layouter is a good means to create own learning content which can be integrated most easily into the engram Learn Platform.

[2] **engram** GmbH, Otto-Lilienthal-Strasse 6, 28199 Bremen, **www.engram.de**

**WebLayouter 4.0**

The ***WebLayouter*** is a Content Management Software which was firstly published in 1997 as a simple tool for creating websites. In the course of time, it became a powerful visual CMS—easy to use, flexible and accessible. Since version 4.0, the WebLayouter supports multi-user environments making it easy for multiple editors to work at common projects.

As I am more or less acquainted with the products in question, I know that accessibility was a topic which had occasionally been discussed internally. So I wanted to know more about the accomplishment of guidelines. What I found out is that the ***WebLayouter*** is fully compliant to ***BITV***. As for e-Learning products, the ***engram Learn Platform*** and the ***WBT-Layouter*** only fulfill slight accessibility standards. The WBT-Layouter offers a spellchecker and alternative text for images. The Learn Platform is developed according to accessible design guidelines (proper use of color, contrast etc.) but it does not provide accessibility functions for multimedia content yet. However, it is aimed that all further versions of engram's e-Learning products will be fully compliant to ***BITV***.

I was wondering why accessibility for e-Learning did not draw the same attention like CMS products. After all, the WebLayouter has been accessible since version 3.1. … It dawned on me that CMS software is commonly expected to be accessible. Although the market for e-Learning products is growing, the obviousness to develop accessible e-Learning products has likely not come to general awareness yet. To confirm my theory, I asked three of my colleagues about their opinion … and the gist of it: *"We know that extensive accessibility features for e-Learning products can no longer be neglected … However, the effort and the cost to implement these features in time is a real challenge … Well, we are working on it!"*

## 4. Conclusion

It is common knowledge that today's business world with its elevated competition requires companies to continually update their skills. Business cycles are getting shorter and knowledge is nowadays considered as a highly competitive advantage—and to provide knowledge, human resources must be trained in order to develop skills.

Corporate e-learning is now the biggest growth market, still not exploited, but with a quantum of challenges for current vendors. The majority of larger business firms use e-Learning as a means to educate their employees, as opposed to smaller firms, which on the one hand are gaining ground, but on the other hand still do not have the same courage to deploy e-Learning. For that reason, manufacturers of e-Learning have to decide whether to create individual e-Learning solutions, mostly utilized by larger companies, or standardized one-to-many solutions. Either way, it won't be easy to remain competitive if solutions will not be adapted to a changing e-Learning market. The process of learning is being transformed by technological developments and the digitalization of our society. Multi-channel communication and mobile e-Learning will be the buzzwords of tomorrow. Wireless solutions enable underdeveloped and remote areas quickly to take advantage of various web-based services—learners can anytime and anywhere, using a Personal Digital Assistant or even smaller devices, train skills, do assessments, and communicate with tutors.

Even though current standards help manufacturers to provide technologically appropriate products, the lack of good content is still a major issue in e-learning. The didactic preparation of content often leaves much to be desired. Furthermore, content is strongly connected to cultural customs—standardized WBT's which are accepted in Europe will most likely not work in the U.S. This is another reason why current manufacturers will face further challenges.

Finally, e-Learning practitioners, no matter if they are manufacturers, training facilities or higher education institutions, should not forget to take care of accessibility and inclusion. If courses are not designed to work with assistive technology, or impaired employees can not be certified because of inappropriate assessment design, then this means nothing less than exclusion. And it is also clear that excluding people with disabilities from e-Learning cannot be fully corrected by standards or guidelines, not even by governmental intervention. It is far more a matter of attitude, the desire to do the right thing when deploying e-Learning—and designing to meet the needs of impaired users can also improve the productivity of all users. So its up to developers, designers, educators and corporate leaders to create e-learning environments that satisfy the needs of all people. And that should not be too hard to implement—the technology is available and costs are manageable.

Global players like Adobe and Microsoft are continually improving their products to comply with Section 508, the United Kingdom is a pioneer in establishing accessibility principles in higher education, and most of currently recognized Learning Management Systems are created according to accessibility. Nevertheless, the vigilance to include universal design principles has not come to general awareness in all countries yet. As far as I can judge, I would say that accessibility was much earlier a topic in the United States than in Germany. After all, a growing interest concerning accessibility can be noticed, and it remains to be seen whether Germany's BITV will someday also improve higher education and not only internet presences of governmental offices.

## 5. References

All sources which have been used to create this elaboration are mentioned and linked in alphabetical order.

*"Access All Areas: disability, technology and learning"* — Lawrie Phipps, Allan Sutherland and Jane Seale, TechDis, July 2002, ISBN 1-904190-18-9

*"Accessibility"* — The Joint Information Systems Committee, Healthier Nation Project 2003

*"Assistive Technologies for Online Training Delivery for People with Disabilities"* — Rhonda Daniell, Australian Flexible Learning Framework, August 2003

*"e-Learning Accessibility and Section 508 Report"* — Joe Pulichino, The eLearning Guild, January 2005

*"e-Learning Interoperability Standards"*— Geoff Collier and Robby Robson, Sun Microsystems white paper 2002

*"E-Learning Standards aus didaktischer Perspektive"* — Hartmut Häfele, Münster 2002

*"Guidelines for Accessible Online Courses"* — Elaine Pearson, Tony Koppi, EDTeC, April 2001

*"Paving the Way"* — Anne Fessi, Joyce Martin , National Learning Network 2003