



# **Quality criteria for digital learning resources**

Version 1.0

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## Introduction

This document specifies guidelines for the evaluation of the quality of digital learning resources (DLR). The purpose of these criteria is to help ensure that digital learning resources used in Norwegian primary and lower secondary education are of sufficient quality. The quality criteria are intended as guidelines for the development and evaluation of DLR. The primary application for this document is as a basis for a specification of requirements for procurement, announcing competitive tendering and funding for development projects, as well as a support for developers of DLR. The quality criteria form a dynamic document, which will be updated and revised according to needs, and in the event of changes to underlying legislation, regulations and guidelines.

The criteria have been developed by assignment from the Ministry of Education and Research to the Directorate for Education and Training. The development of the criteria has been led by the Directorate for Education and Training, with assistance from the National Network for IT Research and Competence in Education (ITU) and the National Secretariat for Standardisation of Learning Technology (NSSL). As of 1 January 2010, the ITU and NSSL are part of the newly created Centre for ICT in Education, to which responsibility for the assignment has been transferred. The quality criteria have been developed in collaboration with interested parties in the education sector, by means of broadly diverse working meetings, conversations with individual parties and focus groups.

## Digital learning resources

The term “digital learning resources” is used in different ways and no generally agreed definition has been established. In the *Program for digital kompetanse 2004- 2008 (Programme for Digital Competence)* (1), DLR is described as “educational tools that can be used for teaching and learning purposes and that use ICT in order to promote learning via products, services and processes. Such resources may be linked with various media and forms of learning”. This document has been based on a more limited understanding of the term. The criteria are primarily intended for resources that have been developed for learning purposes. A further delimitation is that the criteria are aimed at content, not digital tools (such as text processors or learning platforms for example). However there is not always a clear distinction between content and tool; many digital learning resources have inbuilt functionality. The term DLR also embraces resources with different scope and complexity (granularity). In this document we mean resources that are composed of one or more individual files (e.g. image, video or sound clip) so as to represent an independent entity that is educationally meaningful. Such resources are often called learning objects. Our understanding of DLR also covers more comprehensive resources, in which several learning objects are placed together so that they can be included in larger parts of a sequence of learning or a teaching programme.

## Quality

The quality of a learning resource depends on context, such as time, place and human relationships. This means that quality is not only dependent on the properties of the learning resource. Quality in this context is also closely connected with how the resource is used, when it is used in the individual learning situation and in relation to whom.

Good quality cannot be ensured simply by following a set of criteria in developing the resource; quality is also created in the usage situation itself. This means that the use of the quality criteria does not in itself ensure DLR of sufficient quality, but that this is achieved through the specification of a number of requirements and recommendations for the DLR's properties.

The quality criteria are intended as a guideline. This means that this document cannot be used as a simple recipe for evaluating all types of digital learning resources; one must take into account the specific needs and framework that form the basis for the evaluation. A vital element in this is the technical equipment at the school where the DLR will be used. The perceived quality for users of the DLR is influenced by the hardware that is used, what programmes are available on the computer and the capacity of the network. Schools with low bandwidth may have problems with streaming sound and video or downloading large learning resources. Hardware that does not satisfy the requirements of a learning resource creates problems in that the resource will either not work or will run slowly. Often pupils do not have the possibility of installing software themselves. This can create problems if the browser is too old or a plug in is not installed. Suppliers of DLR should therefore specify what the learning resource's requirements are in terms of bandwidth, hardware and software, so that purchasers can balance the requirements against their technical infrastructure.

## Organisation

The quality criteria are organised into seven categories, as shown in Figure 1. Three of the categories - *the digital resource's characteristics, academic and educational orientation* and *user orientation* - describe quality criteria that are aimed at educational quality. These three categories are described in part 1 of this document. The categories are defined through a set of key questions, a brief description and some more detailed questions. These are intended to lead to reflection on quality in the relevant areas. Part 2 contains quality criteria of a more technical nature, with the four categories *accessibility, metadata labelling, parallel language editions* and *technical interoperability*. The criteria in part 2 are in the form of both requirements and guidelines.

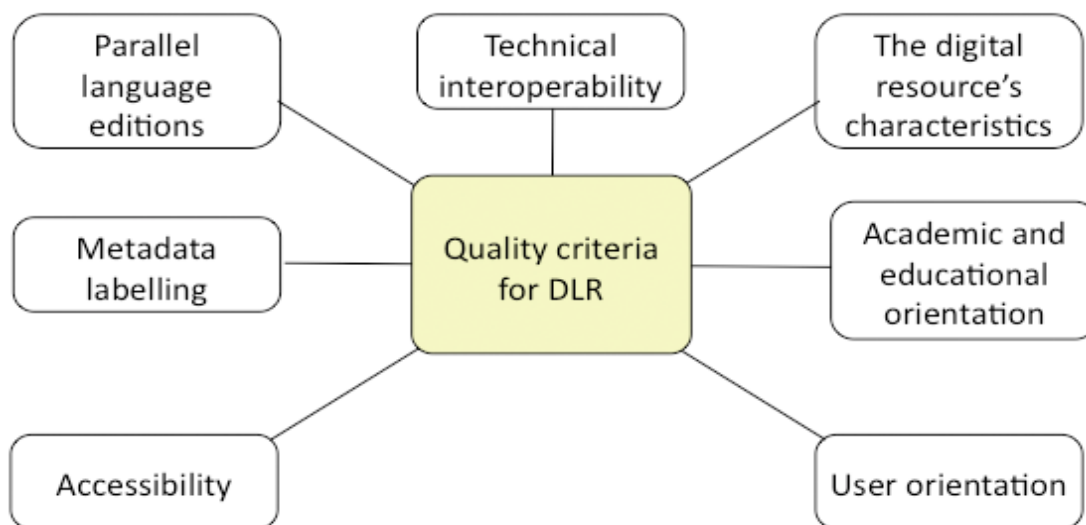


Fig. 1: The quality criteria

# Part 1

## Introduction

The digital learning resources, like other learning resources, are used in various connections, by different teachers and for different purposes. This means that a resource can have good educational quality in *one* context but not necessarily in another. Taking this understanding as a starting point, it is more appropriate to define and clarify *what* should be evaluated rather than formulating quality requirements.

Many general quality areas apply to all learning resources, whether they are digital or not. Structure, quality of language, use of illustrations, type and scope of assignments etc. are important areas regardless of whether the resources are offered in printed or digital form. The same applies to having a conscious attitude to gender role patterns, discrimination, objectivity and representivity. In this document, as far as possible, we have ignored general quality criteria for learning resources. The main emphasis has instead been on what is specific for digital learning resources.

This has resulted in quality criteria organised into three broad categories:

- *User orientation:*  
the interface between user and resource
- *the digital resource's characteristics:*  
possibilities and limitations of digital resources
- *academic and educational orientation:*  
the learning and evaluation potential

The categories are defined through a set of key questions, a brief description and some more detailed questions. These are intended to lead to reflection on quality in the relevant areas. On this basis, procurers, developers or users (Teachers and others) can evaluate the digital learning resource in accordance with their own needs.

## User orientation

Key question	Description	Detailed questions
Does the DLR promote involvement?	The resource should contribute to pupils being activated and motivated. The activity should have a clear academic direction.	a) What functionality helps to create involvement and how does design and structure help? b) How are images, graphics, video, sound etc. used to create involvement? c) What choices have been made so that the resource contributes to learning and not just activity?
Is the DLR inclusive and accessible?	The resource should be easy to use and self-instructing as far as possible. The resource should follow known patterns for navigation and retrieval.	a) How effectively can pupils get started on the academic content (not waste time finding their way)? b) How does the resource contribute to as many as possible being able to use it (ref. point on universal

		<p>design in part 2)?</p> <p>c) To what extent can the resource be adapted to the individual pupil and how does it facilitate good differentiation?</p> <p>d) How can the pupils' media skills be used and developed?</p>
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### The digital resource's characteristics

Key question	Description	Detailed questions
How does the DLR exploit the possibilities of the digital media?	Digital learning resources often contain different types of media such as text, images, video, animations and simulations. The various media types should be chosen and put together with education in mind.	<p>c) In what way can the user exploit the various media types in the resource?</p> <p>b) How does interactivity help to capture the pupil's academic interest?</p> <p>c) How does it ensure that the information given is updated?</p>
What possibilities does the digital learning resource give for adaptation?	The learning resource should be capable of being adapted to different situations and preferably enable individual parts of the resource to be used in different situations (modular usage).	<p>a) How does the digital learning resource allow individual parts to be used independently?</p> <p>b) To what extent does the resource allow the pupil to adapt the content to his or her own learning situation?</p>
How does the DLR allow for new possibilities in learning?	The use of various types of media, communications resources and good access to up to date information can allow for new possibilities and varied practice in teaching and learning.	<p>a) Does the resource facilitate communication between pupils, between teacher and pupil or with others?</p> <p>b) In what way does the resource challenge the pupils academically?</p> <p>c) To what extent is it linked to alternative sources and updated information?</p> <p>d) How are the specific qualities of the different types of media used in learning?</p> <p>e) To what extent is the resource innovative and how can it help to develop the academic content?</p>

### Academic and educational orientation

Key question	Description	Detailed questions
How is the DLR	The digital learning resource	a) How is the learning resource

<p>endorsed by the curriculum?</p>	<p>should have a connection with the current curriculum. It should be evident how various goals in the curriculum may be achieved by using the resource.</p>	<p>connected with the curriculum and competence targets.</p> <p>b) Is the learning resource suitable for reaching the goals that have been defined?</p> <p>s) Is the resource aimed at a particular age or target group? How has it been designed with a view to reaching target groups?</p>
<p>Does the DLR give the opportunity for evaluation that is adapted to the learning situation?</p>	<p>Some digital learning resources have inbuilt opportunities for evaluation, such as tests.</p> <p>It should be possible to use the resource for, or include it in, formative and/or summative assessment.</p>	<p>a) To what extent does the resource support different forms of evaluation?</p> <p>b) To what extent does the resource allow the pupils to assess their own performance?</p> <p>c) In what way can the resource help pupils with reflection after making an assessment?</p> <p>d) Does it allow pupils to give feedback and assessments to each other?</p> <p>e) How does the resource support pupils in further work after any assessment?</p>
<p>What learning situations is the DLR suitable for?</p>	<p>Different resources can function in one or more learning situations, for example as individual work, teacher-controlled activity, group work etc.</p> <p>The resource should include guidance for the teacher.</p>	<p>a) How does the digital learning resource facilitate use in different learning situations?</p> <p>b) How does the digital learning resource support collaborative learning?</p> <p>c) To what extent can pupils and teachers enter their own content into the resource?</p> <p>d) To what extent do any guidelines for teachers provide input for application?</p>

## Part 2

### Universal design

Digital learning resources provide good opportunities for adaptation to the individual learning needs of pupils within a wide range of competence areas - written, visual, audible etc. Designing accessible digital learning resources is about how to enable as many as possible to use the resource, regardless of functional ability. Pupils and students in the Norwegian education system have a statutory right to a learning environment adapted to their needs (2). The use of ICT is an integral part of teaching and the possibility of adapting digital resources to the needs of the individual is therefore vital. A precondition for this type of adaptation is that the digital learning resources have been designed in accordance with the principles of universal design. Universal design is the design of products and physical surroundings in such a way that they can be used by all people, to as great an extent as possible, without the need for special adaptation or design.

**Requirement:** Digital learning resources with web content shall as a minimum be designed in accordance with the Public Management and eGovernment's (DIFI) quality criteria as stated in "Kvalitet 2009: Kriteriesett del 1, tilgjengelighet" (Quality 2009: Criteria set part 1, accessibility).

The evaluation criteria for quality for official websites with regard to accessibility are (3):

- The website uses alternative captions for pictures
- Links are distinguished from the normal text
- Font size is scalable
- Data tables are available
- Frames are used in such a way as to reduce inconvenience
- Menu and search functions without expansions
- Sufficient contrast in the website
- Static content can be skipped
- The website distinguishes between form and content
- The main language is stated
- The HTML-code for the website is error free

It is further recommended that the DLR is also adapted for pupils who use alternatives to keyboard and mouse when using the resource. More information about this may be found in NAV's guidelines for developing multifunctional learning aids (4).

### Parallel language editions

The Education Act and its associated regulations state that learning aids shall be available in both forms of the Norwegian language (bokmål and nynorsk) at the same time and the same price. This also applies to digital learning resources.

**Requirement:** Digital learning resources shall essentially exist in both forms of the Norwegian language at the same time and the same price.

Section 9-4 (5) first paragraph of the Education Act states that "In subjects other than Norwegian, only text books and other learning aids that are available in both bokmål

and nynorsk at the same time and for the same price may be used". Thus, the pupil has an individual right to access to learning aids in either form of the language. This should also be understood as a requirement for school owners, when the school owner decides which learning aids are to be used in the different subjects.

Chapter 17 of the regulations to the Education Act expands on the content of section 9-4 first paragraph of the Education Act. Against this background, the following requirement is specified for digital learning resources: The requirement does not apply to Norwegian as a subject. The requirement applies to digital learning resources that are regularly used in teaching and that cover significant parts of the general goals of the curriculum or significant parts of the goals, learning material or main aspects of a subject in relation to that subject's curriculum. The requirement only applies to age cohorts of more than 300 pupils.

It is also an advantage if the DLR allows for general language conversion, so that one can more easily create versions for e.g. Sami, sign language etc.

### Metadata labelling

A digital learning resource should be described with metadata - data about data. The purpose of labelling digital learning resources with metadata is to make it easier to retrieve, reuse and manage the resources. A metadata specification states how one describes resources. By agreeing on a common specification for giving metadata we can permit the uniform description of resources and exchange of metadata between different systems.

**Requirement:** Digital learning resources shall be labelled in accordance with NORLOM version 1.1.

**Recommendation:** Digital learning resources should be classified in accordance with curricula with the aid of Grep.

**Recommendation:** Digital learning resources should be labelled with the conditions that apply to the use of the resource.

### NORLOM

In the Norwegian education sector, the NORLOM (7) specification is used to describe digital resources. NORLOM is a profile of the international LOM specification (IEEE 1484.12.1-2002, Standard for Learning Object Metadata), adapted to Norwegian education. The current version of NORLOM is version 1.1, published in October 2008. This replaces NORLOM version 1.0, which was published in March 2005.

The following information about a resource shall be stated in NORLOM version 1.1:

- Identifier: A permanent and globally unique identifier for the resource.
- Title: The name of the resource.
- Language: The main language used in the resource.
- Description: A text description of the content of the resource.
- Metadata identifier: A permanent and globally unique identifier for the metadata description (not the resource itself).
- Contributors: Identification of the persons or institutions that have contributed to the metadata description of the resource and what roles they have had in this work.

- Metadata form: Name and version of the specification used to create metadata for the resource.
- Metadata language: The language used in the metadata description of the resource.
- Location: Address (typically a URL) where the resource is located.
- Intellectual property rights and other limitations: Conditions for use of the resource.

A number of the required elements in NORLOM should be able to be generated by the tool used to register metadata.

It is recommended that the following information about a resource is stated in NORLOM version 1.1: Key words, version, contributors to the development of the resource, file format, file size, type of learning resource, intended user role, educational level, cost and topic classification.

### **Grep**

Grep (8) is a national database for subjects, curricula and teaching programmes in primary and lower secondary education. All the curricula determined by the Knowledge Promotion are entered into Grep. There is also administrative administration about subjects in primary, lower secondary and upper secondary education and training. Grep is not therefore a specification for metadata, but it can be used to label learning resources in accordance with subjects or competence targets in the curricula for primary and lower secondary education. The purpose of labelling a DLR in accordance with Grep is thus to make it easy to find resources that address specific elements in the curricula.

### **Conditions for use**

An important consideration when procuring a DLR is whether the conditions for use of the resource accord with the intended use in the learning situation. In addition to information about any cost of using the resource, there may be licence conditions about the possibility of changing the resource, sharing it with others etc. We recommend using NORLOM 1.1 for stating price and conditions for the use of DLR. The guidelines for NORLOM 1.1 (9) describe how to state this type of information.

### **Technical interoperability**

The purpose of the technical quality criteria is to ensure that digital learning resources can be used regardless of what operating system or browser is being used. The formats have been chosen because they are largely based on open standards, are widely available and have inbuilt support or can be used with freely available plug ins or software for most operating systems and browsers. Some of the formats suggested do not meet all these criteria, but have been included because they represent the best alternative for the individual purpose.

Requirements and recommendations in the technical quality criteria are based on the Standardisation Council's reference catalogue of IT standards in the public sector, version 2 (10).

<b>Requirement:</b>
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- Document format:
  - HTML 4.01 or XHTML 1.0 for digital learning resources designed as websites
  - PDF 1.4 – 1.6, PDF 1.7 or PDF/A for completed documents
  - ODF 1.1 for documents that can be edited
  - UTF-8 for HTML and XHTML - documents

**Recommendation:**

- Images and graphics:
  - JPEG for loss based compression of images
  - PNG or GIF for lossless compression of images
  - SVG 1.1 for scalable graphics
- Sound and video
  - MP3, AAC or Vorbis 1 encapsulated in Ogg for loss based compression of sound
  - FLAC 1.2.1 for lossless compression of sound
  - Video track coded in Theora 1.0 and sound track in Vorbis 1 encapsulated in Ogg, or video track coded in H.264 and sound track in AAC encapsulated in MP4 for video
- Rich internet applications
  - Flash, Silverlight / Moonlight or Java Applets
  - Adobe Air
- Style sheets:
  - CSS
- Mathematical expressions:
  - MathML
- Assignments and tests:
  - IMS Question and Test Interoperability 1.2.1
- Packaging:
  - IMS Content Packaging 1.1.4
- Communication:
  - IEEE 1484.11.2-2003
- Authentication:
  - FEIDE

## **Document format**

HTML (11) or XHTML (12) shall be used for structuring information, as text and images, in digital learning resources designed as websites. The character set standard ISO/IEC 10646 (13) represented by UTF-8 (14) shall be used for HTML and XHTML documents. When special reasons, such as retaining formatting, make it desirable to publish finished documents and documents for further processing in formats other than HTML and XHTML, the following format shall be used: PDF (15, 16, 17) for finished documents and ODF (18) for documents that can be edited. The availability of ODF is currently limited. It is therefore a temporary recommendation to parallel publish in one or more additional formats so as to ensure the general accessibility of the documents.

HTML and XHTML should follow WCAG (Web Content Accessibility Guidelines) (19) in order to make the content accessible. PDF and ODF documents can be made more accessible by following the guidelines of Lexdis (20) among others.

## **Images and graphics**

JPEG (21), PNG (22) and GIF (23) are recommended for images. JPEG offers loss based compression, while PNG and GIF offer lossless compression. The choice of loss based or lossless compression will depend on the content of the image and the way in which it will be used.

SVG (24) is recommended for scalable vector graphics.

Images, graphics and vector graphics can be made more accessible by following WCAG and the guidelines for SVG (25).

## **Sound and video**

MP3 (26) and FLAC (27) are recommended for sound. MP3 offers loss based compression and FLAC offers lossless compression. The choice of loss based or lossless compression will depend on the sound quality required. There is widespread support for MP3, but support for FLAC is more limited. For loss based compression, Vorbis (28) encapsulated in Ogg (29) or AAC (30) can be used as alternatives to MP3s.

Video track coded in Theora (31) and sound track in Vorbis encapsulated in Ogg, or video track coded in H.264 (32) and sound track in AAC encapsulated in MP4 (33) are recommended for video.

Note that there is limited support for Vorbis and Theora.

Sound and video can be made more accessible by following WCAG; they present for example subtitles, sight interpretation and sign language as alternatives for sound and video.

## **Rich internet applications**

Rich internet applications are software based on web standards. They have properties and functionality like traditional software, but can be run without installing the software. Flash (34), Silverlight (35), Moonlight (36) and Java Applets (37) are recommended for applications to be run directly in the browser. Adobe Air (38) is recommended for applications that run outside the browser (desktop applications).

The guidelines for ARIA (Accessible Rich Internet Applications Suite) (39) can make rich web content and applications more accessible. The guidelines focus particularly on dynamic content and advanced user interface controls.

### **Style sheets**

The use of CSS (40) as style sheets to distinguish structure and presentation in HTML and XHTML documents is recommended. The use of style sheets enables transforming of content so that it can be adapted to different purposes, such as screen readers. It is important that the content also has a readable structure when CSS is turned off.

### **Mathematical expressions**

MathML (41) is recommended for presenting mathematical expressions in HTML and XHTML documents. Presenting mathematical expressions by using MathML rather than images will make the expressions more accessible for screen readers and other assistive technology.

### **Assignments and tests**

Many digital learning resources include assignments and tests. Such assignments typically have descriptive text or images and the possibility for the user to respond to questions using various mechanisms. In order to ensure that this type of content can be exchanged between different systems, and to facilitate reuse, a standard format is needed for the design of digital tests.

IMS Question and Test Interoperability (QTI) (42) is recommended for digital assignments and tests.

### **Packaging**

Digital learning resources are often composed of different media types such as text, images and video. In order for the learning platform to be able to import and play the learning resource, it is important for the learning content to be organised in a set way and preferably packaged in one file.

IMS Content Packaging 1.1.4 (43) is recommended for packaging digital learning resources.

### **Communication**

If the digital learning resource is to be used in a learning platform, there will often be a need for exchanging information between the DLR and the learning platform. The DLR should therefore be designed in accordance with the standard IEEE 1484.11.2-2003 (44) (formerly AICC CMI001 Guidelines for interoperability).

### **Authentication**

If the digital learning resource requires logging on, it should be able to authenticate persons through the education sector's joint logging on system Feide (45).

## References

1. Program for digital kompetanse 2004- 2008:  
[http://www.regjeringen.no/upload/KD/Vedlegg/Grunnskole/Strategiplaner/program\\_for\\_digital\\_kompetanse\\_liten.pdf](http://www.regjeringen.no/upload/KD/Vedlegg/Grunnskole/Strategiplaner/program_for_digital_kompetanse_liten.pdf)
2. Lov om forbud mot diskriminering på grunn av nedsatt funksjonsevne (diskriminerings- og tilgjengelighetsloven): <http://www.lovdatab.no/all/tl-20080620-042-0.html>
3. Kvalitet på offentlige nettsteder: <http://kvalitet.difi.no>
4. Retningslinjer for utvikling av elektroniske læremidler:  
[http://www.udir.no/upload/laremidler/Alternative\\_betjeningsmater\\_elektroniske\\_laremidler\\_08.pdf](http://www.udir.no/upload/laremidler/Alternative_betjeningsmater_elektroniske_laremidler_08.pdf)
5. Opplæringsloven, kapittel 9 §4:  
<http://www.lovdatab.no/all/tl-19980717-061-010.html#9-4>
6. Forskrift til opplæringslova, kapittel 17:  
<http://www.lovdatab.no/for/sf/kd/xd-20060623-0724.html#map044>
7. Norsk LOM-profil for utdanningssektoren (NORLOM): <http://www.nssl.no/norlom/v1.1/>
8. Nasjonal database for fag, læreplaner og opplæringstilbud i grunnopplæringen (GREP):  
[http://skolenettet.no/moduler/templates/Module\\_Overview.aspx?id=22220&epslanguage=NO](http://skolenettet.no/moduler/templates/Module_Overview.aspx?id=22220&epslanguage=NO)
9. NORLOM 1.1 veiledning: <http://www.nssl.no/norlom/v1.1/>
10. Referanse katalog over IT-standarder i offentlig sektor, versjon 2:  
<http://standard.difi.no/forvaltningsstandarder/referanse katalogen-html-versjon>
11. HyperText Markup Language (HTML) 4.01: <http://www.w3.org/TR/REC-html40/>
12. Extensible HyperText Markup Language (XHTML) 1.0: <http://www.w3.org/TR/xhtml1/>
13. ISO/IEC 10646:2003. Information technology - Universal Multiple-Octet Coded Character Set (UCS):  
[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_ics/catalogue\\_detail\\_ics.htm?csnumber=39921](http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=39921)
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[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=42274](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42274)
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<http://www.w3.org/WAI/intro/wcag.php>
20. Lexdis – Ideas for e-Learning: <http://www.lexdis.org>
21. ISO/IEC 10918-1:1994 Information technology – Digital compression and coding of continuous-tone still images: Requirements and guidelines:  
[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=18902](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=18902)
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23. Graphics Interchange Format Version 89a, 1990: <http://www.w3.org/Graphics/GIF/spec-gif89a.txt>
24. Scalable Vector Graphics (SVG) 1.1 Specification: <http://www.w3.org/TR/SVG/>
25. Accessibility Features of SVG: <http://www.w3.org/TR/SVG-access/>
26. ISO/IEC 11172-3:1993 – Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 3: Audio:  
[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=22412](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=22412)
27. Free Lossless Audio Codec (FLAC): <http://flac.sourceforge.net/>
28. Vorbis 1 specification: <http://xiph.org/vorbis/>
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