
**Information technology —
Learning, education, and training
— Requirements for e-textbooks in
education**

*Technologies de l'information — Apprentissage, éducation et
formation — Exigences pour les livres de texte électroniques dans
l'éducation*

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 36, *Information technology for learning, education and training*.

Introduction

In the last few years, there has been a dramatic rise in the popularity of e-books, driven principally by the development of mobile devices including tablets and smartphones. A number of e-book formats have emerged to support this trend, the most prominent of which is EPUB 3, originally developed by the International Digital Publishing Forum (IDPF) and discussed in ISO/IEC/TS 30135 (all parts).

At the same time, standards for digital learning content have not made significant progress. Advanced Distributed Learning (ADL) produced the latest major revision of Shareable Content Object Reference Model (SCORM®) in 2004; the IMS Global Learning Consortium (IMS Global) produced the Common Cartridge specification in 2008; and both of these standards are based on the ISO/IEC 12785 series and the ISO/IEC/TR 29163 series. While the digital learning content area was stagnant, data-driven approach for usage of content has been growing rapidly. Progress in recent years includes the development of the Experience API (Tin Can API or xAPI) version 1.0, a specification released in April 2013 which is commonly considered the successor to SCORM.

While conventional e-books and the ISO/IEC 12785 series both support packaged content installed locally on a user's device or learning management system/virtual learning environment (LMS/VLE) on the web, considerable advances were in cloud computing and Service-Oriented Architectures (SOA). The latter approaches anticipate that much activity will be distributed across different servers accessed remotely using packaged content on user devices.

ISO/IEC/JTC 1/SC 36 has consequently identified a requirement for new standards for digital learning content that

- leverage common standards being used with digital publishing technologies for e-books,
- support packaged content for installation on a mobile device and usable off-line for learning activities, and
- support integration with cloud services, when this environment is available.

At the same time, the popularity of e-books raise a number of challenges for learning, education and training (LET) content. These challenges can be articulated as a series of comparisons (see [Table 1](#)).

Table 1 — Comparison major characteristics between e-book and learning content

e-Book characteristics	Learning content characteristics
Interpretation of an actual book as an aggregation of static text, graphics and pagination that can be flipped. ^a	Aggregated content by granularity of learning object, required with dynamic pagination (linear or multiple paths), and interactive digital media and activity such as assessment on the web.
General environment of e-book and player are locally installed and protected by strong copyright protection software such as Digital Rights Management (DRM).	General environment of learning content is on the web, in particular via LMS/VLE. Content is controlled and protected by authorization of the learning platform without using DRM.
Standards are dedicated profile for e-books content based on web specifications, such as HTML5, CSS and Java Script. Currently, EPUB 3 has taken a position as both a de-jure and a de-facto standard.	Standards are very diverse and heterogeneous per characteristics of content, service, or teaching and learning model. However, almost all standards have adopted web specifications including an e-book profile.
^a "Book" means complete aggregated content bound with a spine.	

The purpose of this document is to propose an approach which ensures that the benefits, advantages, and outlooks of both e-books and LET content are maximized. In particular, this document aims to identify the requirements for e-textbooks which are expected to adopt e-book technology in LET. The substantive parts of this document are presented in [Clauses 5](#) to [7](#).

[Clause 5](#) investigates LET stakeholder requirements as collected in 2012,

- summarizing information about e-textbook pilots submitted by NBLOs and interested parties, further details of which are included in [Annex A](#),
- summarizing conceptual use cases submitted by NBLOs and interested parties, further details of which are included in [Annex B](#),
- summarizing the LET requirements gathered or collected from the online survey sent to stakeholders, further details of which are included in [Annex C](#), and
- drawing out from these consultations key requirements for e-textbook functionality.

[Clause 6](#) reviews the technology/market capability as of 2013 (with some updates to 2015) by

- reviewing the available standards that support the requirements to functionality listed in [Clause 5](#), and
- drawing conclusions as to the best way to implement the required functionalities for potential e-textbook standards.

[Clause 7](#) makes specific recommendations for future standardization work to support e-textbook.

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Information technology — Learning, education, and training — Requirements for e-textbooks in education

1 Scope

This document makes recommendations that are intended to build consensus on which International Standards for e-textbooks can be developed. This document is a follow up to the collection of inputs from interested parties and aims to

- review the current state of the e-textbook market,
- summarize LET requirements for e-textbooks based on use cases and survey of interested parties,
- review existing data standards that are referenced by potential e-textbook standards,
- describe key terms and concepts that underpin any further discussion on e-textbook standards,
- propose a set of functionalities that will be required for e-textbook reader software,
- make recommendations for any modification to existing data standards, and
- make recommendations for any new data standards that might be needed.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

aggregation

process of combining e-textbook *components* (3.2) to form new *composite components* (3.3)

3.2

atomic component(s)

smallest unit of content component that can no longer be divided

3.3

composite component(s)

component (3.2) that is composed of at least two other content components

Note 1 to entry: A composite component is one of two types of content components forming part of the content structure of the e-textbook Information Model. The other is an atomic component.

3.4

digital content

usable information in an *e-textbook* (3.9), either as a single or multiple logical unit(s)

EXAMPLE Text, images, media, interactive items represented visually in digital form.

Note 1 to entry: Digital content will generally depend on appropriate software services that may be required to render or deliver other functionality associated with the digital content.

Note 2 to entry: A logical unit of usable (or re-usable) information is a logical package.

Note 3 to entry: A logical package may contain one or more logical units of digital content.

3.5

digital learning content

digital content (3.6) displayed within an *e-textbook* (3.9) including both static and interactive items for use in LET

3.6

digital content

single or multiple logical unit(s) of useable information in an *e-textbook* (3.9)

Note 1 to entry: A digital resource can be referenced via an unambiguous and stable identifier in a recognized identification system (e.g. ISBN, ISAN, UPC/EAN, URI).

3.7

e-book

structured *digital content* (3.6) in which searchable text is prevalent, and which is often seen as a metaphor of a printed book or pamphlet

Note 1 to entry: An e-book is usually an aggregation of digital content compressed into a single document, and from this perspective is regarded as a content package.

3.8

e-reader

computer hardware with appropriate software capable of loading and rendering an *e-book* (3.7) and providing functional support required to deliver *digital content* (3.6)

3.9

e-textbook

structured *aggregation* (3.1) of *digital content* (3.6) intended to support LET activities and which uses an *e-textbook reader* (3.12)

3.10

e-textbook fixed page

virtual surface of controlled size, and *fixed layout* (3.14), for the purposes of displaying *digital content* (3.6) of an *e-textbook* (3.9)

3.11

e-textbook flowable page

virtual surface whose size and geometrical properties can be adapted to the *e-textbook* (3.9) reader or user choices for the purposes of displaying *digital content* (3.6) of an e-textbook

3.12

e-textbook reader

hardware with the appropriate software capable of loading and rendering an *e-textbook* (3.9) and providing the functional support required to deliver *interaction* (3.14) and *learning support* (3.18)

3.13

fixed layout

digital content (3.6) that is attached to a particular position on an *e-textbook fixed page* (3.10)

3.14**interaction**

behaviour and data exchange within an *e-textbook* (3.9) context that occurs between a user and the *digital content* (3.6)

Note 1 to entry: Substantive changes do not include standard embedded video controls (start/stop/pause/fast forward, etc.) or changing presentation (e.g. increasing font size, highlighting, zoom, etc.).

3.15**ITLET system**

set of one or more computers, associated software, peripherals, terminals, human operations, physical processes, information transfer means, that form an autonomous whole, capable of performing information processing and/or information transfer

[SOURCE: ISO/IEC 20006-1:2014, 4.12]

3.16**learning device**

computer hardware capable of accessing an *e-textbook reader* (3.12) and running an *e-textbook* (3.9)

EXAMPLE Desktop computer, table, mobile phone or smartphone.

Note 1 to entry: Computer hardware used to support learning, education and training capable of accessing an e-textbook.

3.17**learning service**

processes or sequence of activities designed to enable learning

[SOURCE: ISO 29990:2010, 2.13]

3.18**learning support**

functionality that is initiated by *interaction* (3.14) with an external service or *digital content* (3.6)

EXAMPLE Assignments, reporting of results, learning activities dependent on communication between students and teachers, discussion forums.

3.19**media**

digital assets, which may include separately or bundled together, text, audio, video, image, pictures, animation, or graphics within an IT system.

[SOURCE: ISO/IEC/TR 24725-3:2010, 2.4]

4 Abbreviated terms

API	Application Program Interface
CMS	Content Management System
CSS3	Cascading Style Sheets ^{a, b}
DF	Disk free (UNIX)
DITA	Darwin Information Typing Architecture
DRM	Digital Rights Management
EPUB 3	Electronic publication, a free and open e-book standard by IDPF, also a multipart standard ISO/IEC 30135

ICT	Information and Communication Technology
IDPF	International Digital Publishing Forum
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IMS	IMS Global Learning Consortium, Inc.
IT	Information Technology
IT System	Information Technology System
ITLET	Information Technology for Learning, Education and Training
LCMS	Learning Content Management System
LET	Learning, Education and Training
LRMI	Learning Resource Metadata Initiative
LRS	Learning Record Store
LTI	Learning Tools Interoperability (IMS) (www.imsglobal.org/activity/learning-tools-interoperability)
LMS	Learning Management System
LOM	Learning Object Metadata
MLR	Metadata for Learning Resources
NBLO	National Body or Liaison Organization
OAinEPUB	Open Annotation in EPUB
OER	Open Educational Resources
Q&A	Question and Answer
QTI	Question and Test Interoperability (IMS specification)
REL	Rights Expression Language
SCORM	Sharable Content Object Reference Model
SOA	Services Oriented Architecture
SVG	Scalable Vector Graphics (W3C)
TEI	Text Encoding Initiative
W3C	World Wide Web Consortium
xAPI	Experience Application Programming Interface, also known as Tin Can API or Experience API
XML	eXtensible Mark-up Language

^a CSS (2015), Cascading Style Sheets, <http://en.wikipedia.org/wiki/CascadingStyleSheets#CSS3>.

^b W3Schools (2010), Cascading Style Sheets (CSS) Snapshot 2010, www.w3.org/TR/css-2010/, <http://www.w3.org/TR/css-2010/>.

5 Stakeholder inputs

5.1 Overview of e-textbook pilots submitted

When this document project was initiated in 2012, China and Korea submitted use cases describing pilot experiments in K-12, which included the use of e-textbooks before, during and after class. In case of Korean pilot, e-textbook (which they called digital textbook) services for teachers were set-up for the classroom environment (including learning models, lesson plans, etc.). The log-in status of students was checked automatically, student computer screens could be monitored by the teacher to see what they were learning, and students were given feedback from the teacher. In addition, assignments and assessments were used to report learning outcomes. E-textbook services were provided for students using tablet PCs instead of (traditional) paper-based textbooks. Digital textbook software was installed onto student devices. Various multimedia resources were used to motivate student learning, to facilitate the provision of the teacher feedback, to check assignments, and to improve the student's learning experience using new media.

In the Chinese pilot, e-textbooks were used in a technical environment equipped with projectors, electronic board, and learning platforms that integrated digital courseware, teaching tools and other teaching software. The teachers were responsible for preparing lessons, collecting resources in the learning platform before class. They taught, interacted, monitored student activity and provided feedback on the platform in class; and they provided supplementary instruction after class when this was required by students. Students used the platform to prepare for their lessons, to interact with other students and with the teachers during learning; and to review their learning and do further homework assignments after class.

5.2 Overview of conceptual model captured from use cases

Specific application scenarios are described from two aspects. The first part is based on use cases from different nations; the second part is based on the stakeholder survey conducted by project editors of this report from different countries and areas. The pilots were done between November 2012 and March 2013.

5.2.1 Technical scenarios for using e-textbooks

The main features of e-textbooks and how they worked by connecting tools and services within the learning device and/or from outside are highlighted by describing the application scenarios. Possible scenarios for using e-textbooks are illustrated in [Figure 1](#), where e-textbooks

- are used as a resource out of any learning, education and training context, using a generic e-book reader (as in left bottom),
- run on a mobile device using an education-specific plug-in (as in top left),
- run on an LMS/LCMS to support learning (as in bottom right), and
- can run on a tablet or other mobile devices as within an application scenario (as in top right).

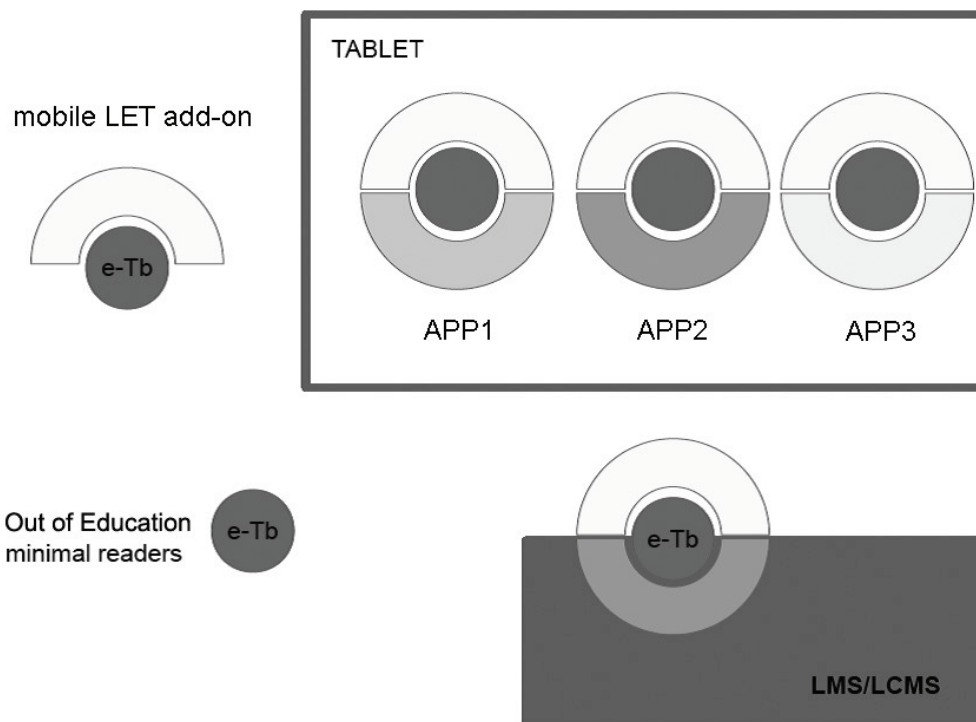


Figure 1 — Possible e-textbook scenarios

5.2.2 Educational scenarios for using e-textbooks

While e-textbooks are used in all LET environments (corporate training and lifelong learning), the four use cases from China, Korea, and the UK indicated that the most universal application of e-textbooks is for classroom teaching and learning. As such, e-textbooks are used

- to allow classroom teaching and learning in pre-school, K-12, and higher education in pre-school, K-12, and higher education,
- to allow learners to study anytime, anywhere both online and offline,
- to allow personal reading,
- to allow classroom learning and testing,
- to allow tool-supported practices, and
- to access service-supported activities such as assignments and collaborative learning.

Educational users of e-textbooks include the teachers, students, technologists, administrators, educational experts, and in some cases, parents.

The case studies on e-textbooks are summarized below and have been grouped according to how e-textbooks were used, i.e. teaching and classroom learning; exercises and testing; and informal learning activities.

a) Classroom teaching and learning

There were three use cases from Singapore, Korea and Taiwan that used e-textbooks for classroom teaching and learning. The use case “Chinese cartoon book for primary school digital textbook” (Singapore) successfully used an e-textbook for the teaching of Chinese. The teachers also used an e-textbook to assign exercises to students for completion in class.

The use case “Class using digital textbook led by the teacher” (Korea) used an e-textbook before, during and after class, for comprehensive teaching and learning processes.

A third use case “Highly interactive e-textbook intelligent learning classroom” (Taiwan) demonstrated the use of an interactive e-textbook in the classroom.

b) Classroom exercises and testing

Four use cases from China and the UK described the use of e-textbooks for classroom exercises and testing.

In the use case “E-textbooks for pupils — quizzes” (China) and the use case “Assessment within e-textbook” (UK), similarly, students accessed the quiz either by following a link from the e-textbook or by completing an embedded test within the e-textbook. Students were supported with learning tools within the e-textbook and were able to save their results (in a new exercise book). The quiz was analyzed by the teacher (or by an automated evaluation service), and the results were sent back for feedback, and also used for reporting (and statistics) to the class as a whole.

The use case “Learning tools within e-textbook” (China) illustrated the use of an e-textbook for the study of 9th grade mathematics. This use case employed a learning tool within the e-textbook that helped students measure the degree of an angle. The learning tool also allowed the students to finish the assignment and exercises quickly.

The use case “Shanghai HSJC e-Learning cloud service platform” described the use of learning activities that were supported by an e-textbook connected to external services rather than using learning tools embedded within the e-textbook. Students were able to access the external service to download the e-textbook after school to do assignments.

c) Informal learning activities

Use cases from the UK and Kenya indicated that informal learning activities take place mostly in the public service (sector), and in learning communities.

The use case “E-textbooks as the basis of a community of learners” (UK) focused on informal learning in tertiary and adult education. In this use case, participants developed their own e-textbook, shared it with a group, and collaboratively created an e-textbook adding to the shared knowledge of the group.

Finally, the use case “Kenya e-textbook use case” demonstrated how to provide ubiquitous access to digitized hard copy books from the Kenya National Library Service (KNLS).

5.3 Results of online survey

5.3.1 Overview

An online survey was undertaken by the project editors to gather input from interested parties on the international requirements for e-textbook standards. The survey questions were made available in Chinese, English, French, Japanese and Korean and its existence was advertised through a variety of liaisons, online communities, and at relevant trade shows and conferences. A total of 119 responses were received between February 2012 and March 2013.

Respondents considered six main areas of requirements:

- the most appropriate base content standard;
- education-specific metadata;
- annotations;
- interactivity and learning support;