TECHNICAL REPORT

ISO/IEC TR 18120

First edition
2016-08-15

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

Reference number
ISO/IEC TR 18120:2016(E)

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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.

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).

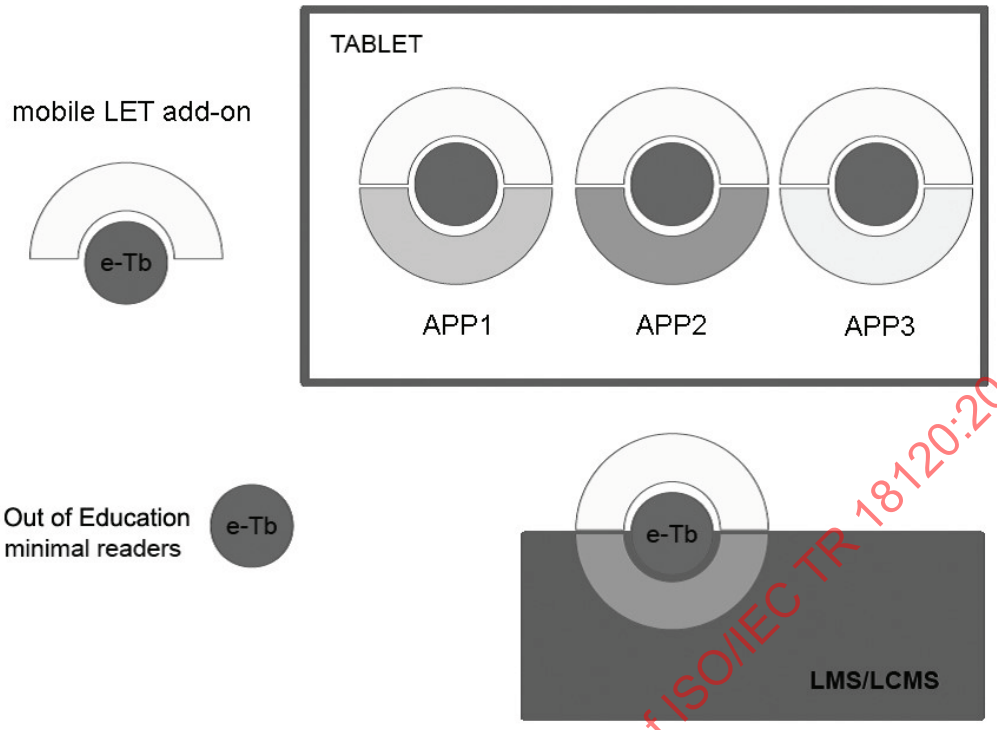

Figure 1 — Possible e-textbook scenarios

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;

— remixing of content;

— rights and DRM.

The conclusions of the survey are presented below. Full details of the survey are analyzed in Annex C.

5.3.2 Base content standard

The most appropriate base content standard was identified to be EPUB 3 [current issue as ISO/IEC/TS 30135 (all parts)], including all of its referenced standards (HTML5, XML, MathML, SVG, ChemML, etc.).

Particular communities of practice specified several other standards that are considered to be optional. These include varieties of the IMS Content Packaging (particularly the ISO/IEC 12785 series), DITA, TEI and DocBook (www.docbook.org).

It was recommended that a general mechanism be developed to allow such standards to be incorporated into local profiles.

The survey and analysis used in this document were completed before IMS Global and the W3C-initiated EPUB whose focus was to produce a standard profile for e-textbooks. As a result, the implications of EPUB are addressed only partially in this document. Currently the EPUB profile addresses many of the issues and features discussed in 5.3.3 to 5.3.7.

5.3.3 Metadata

Respondents identified a small range of core metadata that are widely supported, including

— title,

— description,

— author information, and

— rights information.

The use of keywords also provides strong support, though at a slightly lower level than the four metadata elements noted above.

A wide range of other requirements were mentioned, though in none of these cases did the survey indicate a consensus.

The most widely recognized and supported metadata formats were Dublin Core (see ISO 15836) and LOM (see IEEE 1484.12.1-2002), although there was no clear consensus on a single specification.

It should be noted that only one of the metadata fields in the LOM that commanded general support is specific to education, i.e. *[insert the name of the field]*.

NOTE According to EDUPUB alliance projects, LRMI (www.lrmi.net) based on Dublin Core and schema.org are adopted rapidly by textbook publishers in North America and Europe.

5.3.4 Annotations

There was strong support for the ability to annotate e-textbooks, including the addition of bookmarks, notes and hyperlinks and the highlighting of text.

Some respondents argued for a more inventive approach to annotations, including

— the export of annotations to discussion sites or between e-textbook users,

— the ability to collapse and expand different e-textbook sections, as an alternative to the use of highlighter tools, and

— the inclusion of annotations that were drawn or handwritten.

It has been noted that annotations have been proposed in EPUB 3 standards.

NOTE When the survey and its analysis were conducted, W3C's Open Annotation was just being developed. IDPF and W3C have since announced the development of an Open Annotation profile called Open Annotation in EPUB (OAinEPUB), which addresses many of the issues on annotations presented above. IDPF issued a draft specification in July 2015, which can be found at http://www.idpf.org/epub/oa/.

5.3.5 Interactivity and learning support

There was a strong sense that interactivity would be an important characteristic of the e-textbook. It was felt that HTML5 provided a good technical platform for presenting interactivity.

It was recognized that interactivity would often require online connectivity, for a variety of reasons including

— reporting of activity outcomes,

— streaming of media, and

— communication with the teachers and peers.

It was also recognized that there was a tension between these requirements and the paradigm of the e-book that is meant to be useable off-line.

5.3.6 Reorganization and re-sequencing

There was support for the requirement to reorganize e-textbook content in order to meet different learning objectives, to respond to different learning environments, and to combine materials from different sources, both commercial and Open Educational Resources (OER).

At the same time, respondents were cautious about the technical, pedagogical and intellectual property difficulties that might be encountered when content was remixed.

5.3.7 Digital rights

Respondents supported the need for a simple, lightweight rights expression language such as Creative Commons. A minority, composed mainly of commercial publishers, required a more complex approach to Rights Expression Language (REL) that would encode the interlocking rights of their various content suppliers.

It was widely recognized that some suppliers would want to use DRM technology. While a significant minority supported the development of a single DRM specification, there was no consensus on what that approach would mean in practice. The majority supported a permissive approach.

5.4 Summary of potential benefits of an e-textbook standards

E-textbooks have many benefits for interested parties in both the e-learning and digital publishing communities including the learners, the teachers, LET managers, publishers, and service providers.

For learners, the benefits of e-textbooks include:

— providing support for (traditional) learning activities;

— accessing learning resources and digital content;

— collaborative learning;

— personalized learning.

For teachers, e-textbooks act in assistive and supportive roles helping to realize the statement "students are the centre of education". E-textbooks also have the potential of providing support for traditional teaching activities, conventional teaching management, learning measurements, and scientific research.

For LET managers, the LMS that delivers e-textbooks has the potential to provide

— course information management,

— learner information management;

— teacher information management,

— teaching and learning process information management.

For publishers, e-textbooks have the potential of providing e-book basic and extended information.

For service providers, e-textbooks have the potential of providing services for

— content and resources,

— teaching and learning management,

— user management, and

— copyright management.

6 Key requirements for e-textbooks

6.1 Foundational e-book and packaging standards

6.1.1 Requirement for foundational e-book and packaging standards

An e-book is a structured document consisting of an aggregation of searchable digital content including text, images, audio/video and interactive items which is transmitted and/or accessed via an IT system.

The purpose of any report or standard that may be created in standards development organizations focused on e-textbooks will be to address specific functionalities that are required in e-book that are intended specifically for use in education. Standards development organizations should take care not to duplicate work being done elsewhere in the creation of generic standards for e-books. This document, therefore, assumes the need to identify a generic format for e-books, preferably one that already has international recognition, which can be used as a foundation for any education-specific specifications and standards that may need to be created.

6.1.2 Current standards environment for e-books and content packaging

EPUB 3 (ISO/IEC/TS 30135 series)

The ISO/IEC/TS 30135 series is a republication of EPUB 3, a free and open e-book standard developed by IDPF. EPUB was approved as a "Recommended Specification" by IDPF membership in October 2011. The latest version of the EPUB specification is 3.0.1 issued in June 2014.

The relationship between EPUB 3 and the ISO/IEC/TS 30135 series is defined in the IDPF website, http://idpf.org/epub/30:

"In 2014, these specifications (with the exception of the changes in the document) were republished by the International Standards Organization as ISO/IEC/TS 30135, parts 1–7. Each of these seven ISO specifications is identical to its IDPF equivalent, for example, ISO/IEC/TS 30135-1 is exactly the same content as the EPUB Overview. So, the IDPF names and ISO numbers may be used interchangeably."

The ISO/IEC/TS 30135 series provides profiles to create e-books and related digital publishing, which adopt HTML5 and other web specifications (e.g. CSS3 and JavaScript). In addition, EPUB 3-based content

can also be rendered in a browser using ReadiumJS on Chrome™, as well as dedicated applications on mobile devices in a disconnected environment.

EPUB 3 is one of the most important standards to be considered for any application of an e-book.

Note The EPUB Alliance formed in 2011 is originally a collaboration between IDPF, IMS Global, and the W3C, but now includes the Book Industry Study Group (BISG), the DAISY Consortium and the Readium Foundation. The EPUB Alliance's mandate is: "to work to ensure that the existing standards maintained by the EDUPUB Alliance organizations avoid conflicts and become ever more interoperable as they evolve" (http://idpf.org/edupub).

The W3C contribution to EPUB 3 is the Open Annotation in EPUB, while IMS Global incorporates Caliper Analytics™, and Question and Test Interoperability (QTI)® and Learning Tools Interoperability (LTI)® in the context of EDUPUB.

This means that EPUB 3 is already in a position to be adopted as a base format for e-textbooks."

HTML5

HTML5 is the latest version of the HTML standard produced by the W3C and is an entirely new specification targeted to web applications. It became a W3C Candidate Recommendation in December 2012 and can be used for animation and interactivity, in combination with CSS3 and JavaScript. Its core aims have been to improve HTML to support the latest multimedia, while keeping it easily readable by humans and consistently understood by computers and devices (web browsers, parsers, etc.). As mentioned above, HTML5 is a core specification as a normative reference in the ISO/IEC/TS 30135 series.

IMS Content Package (ISO/IEC 12785 series)

The format described in the ISO/IEC 12785 series is a content packaging format, originally developed by IMS Global. It is an aggregation format, comprising a variety of other file formats, predominantly HTML, packaged for distribution and installation on a variety of other systems. Although developed in the late 1990s, before the widespread adoption of the e-book, the IMS Content Package is structured in a similar way to the ISO/IEC/TS 30135 series. It has been used within the educational community and was incorporated into the ISO/IEC/TR 29163 series, SCORM produced by ADL from the US Department of Defense, and within the IMS Common Cartridge specification.

PDF

Portable Document Format (PDF) is a file format used to represent documents in a manner independent of application software, hardware, and operating systems. Originally developed as a proprietary format by Adobe Systems, PDF is now published as an open standard ISO 32000-1.

6.1.3 Market conditions for e-books and content packaging

The survey results in Annex C (surveyed in 2012) shows that a variety of e-book standards have been supported by different readers on corresponding operating systems including Symbian, Android, Mac OS, Windows Mobile and Linux. It also lists a number of e-book readers that were available in the market at the time of the survey.

NOTE 1 The list of available e-book readers is not claimed to be exhaustive.

Content, platforms, services and applications are expected to evolve in order to support e-textbook functions. Such evolution may be encouraged if the use of the term "e-textbook reader" can be clearly identified with systems that support functions that are recognized as meeting education-specific requirements.

NOTE 2 Before 2015, there were only a limited number of e-book standards (EPUB 3, PDF and Amazon Kindle). Since then, there has been a proliferation of e-book-type mobile applications for rich text format for magazines, children's books and gaming.

6.1.4 Key recommendations for foundational e-book and packaging standards

The ISO/IEC/TS 30135 series is expected to be the leading base format standard, as it is the most appropriate and technically able to support the interactivity necessary for e-textbooks. It is expected that the ISO/IEC/TS 30135 series will upgrade to EPUB 3.1, and as such, is positioned to be the primary base standard for any potential e-textbook standards. As noted above, the work of the EPUB Alliance is already moving in this direction. Standards organizations developing standards related to e-textbooks need to consider all interoperability issues associated with legacy e-book formats. While any new development must accommodate technical interoperability, e-textbook standards must also take into consideration the interoperability requirements of regional communities of practice. The following advantages are identified:

— support convergence among different communities of practice by providing a common framework by which such local profiles can be declared;

— encourage innovation by allowing for the experimental inclusion of specialized content formats;

— take a pragmatic view of market conditions amongst different communities of practice, which are unlikely to adopt a standard which makes no accommodation for large amounts of legacy content relevant to local market conditions;

— develop guidelines or requirements for e-textbook readers.

6.2 Metadata

6.2.1 Key requirements

EPUB 3 provides minimal support for Dublin Core *title, language and identifier* elements, but it has limited education properties. Uniform practice should be encouraged so that e-readers can extract consistent information about the e-textbooks that they render.

Metadata that are not specific to education should, as far as possible, be presented in formats that are consistent with generic practice, so as to avoid the fragmentation of the generic market for e-books.

Additional metadata schema, such as MLR defined in the ISO/IEC 19788 series, is also supported.

Extension mechanisms should be available to support the development of new types of education-specific and other forms of specialized metadata.

There are particular requirements for metadata to

— support accessibility,

— map content to different curricula, and

— declare different technical prerequisites for interactivity and learning support.

6.2.2 Current standards environment

There are a number of metadata schemas that are commonly used in the education community, including

— Dublin Core,

— LOM (IEEE 1482.12.1:2002),

— MLR [ISO/IEC 19788 (all parts)], and

— LRMI (schema.org).

The situation is complicated by the multitude of different profiles that exist, particularly of LOM and the lack of consistency of implementation.

Outside of the education community, the only metadata specification commonly implemented is Dublin Core.

Other specifications and profiles are published by a wide range of communities of practice. The DAISY consortium (www.daisy.org) uses Dublin Core, while other publishing communities often reference the ONIX specification, published by EDItEUR.

6.2.3 Market conditions

E-book readers that operate in horizontal markets are unlikely to prioritize education-specific metadata specifications. This document has not conducted an investigation of metadata profiles implemented by current e-book readers.

6.2.4 Key recommendations

Standards development organizations should consult closely and regularly with liaison organizations in order to avoid the duplication or divergence in the education community of approaches to metadata. Standards development organizations should create a profile of common generic metadata fields, based on the ISO/IEC 19788 series, including

— title,

— description,

— author,

— keywords, and

— licensing.

Standards development organizations should also consult closely and regularly with relevant liaison organizations in order to

— produce guidelines for tagging e-textbooks content at different levels of granularity, thereby supporting a model of "chunked" content,

— develop appropriate accessibility standards, which are of particular importance in education. These should as far as possible be consistent with developments in horizontal markets,

— support the tagging of e-textbooks and other content for different curricula: this is a key education-specific requirement to which there is no widespread consensus at the current time,

— make guidelines or requirement for e-textbook readers and instances, specifying appropriate functions which e-readers should provide in respect of tagged e-textbook content, and

— provide a guidance document on the use of generic extension mechanisms and local profiles to incorporate other metadata elements, where a requirement for such elements is perceived in the local communities of practice.

6.3 Annotations

6.3.1 Key requirements

Students and teachers should be able to annotate text by adding bookmarks, notes and hyperlinks and by highlighting text/s. It should also be possible to "collapse" chunks of content that are less important to the student. Some users, especially those using more complex typefaces, support the addition of drawn annotations.

There is considerable interest in exploring new approaches to exporting annotations into discursive environments, although this raises technical and rights issues regarding the amount of original content that can accompany an exported comment or note.

6.3.2 Current standards environment

W3C's Open Annotation is known as a representative for web-based content. IDPF has incorporated this specification in its OAinEPUB specification. The objective is to provide a profile which optimizes the e-book content and the reading environment. W3C's Open Annotation is geared more to generic applications while OAinEPUB is designed specifically for e-textbook use.

NOTE The EPUB Alliance has included OAinEPUB in the set of EPUB profiles for annotations. See www.idpf.org/epub/oa for further details.

6.3.3 Market conditions

The survey results in Annex C (surveyed in 2012) shows that annotations are commonly implemented by e-book readers as internally available functionality, without generally supporting the sharing or export of such annotations.

6.3.4 Key recommendations

Standards development organizations should consult closely and regularly with liaison organizations in order to call for technical demonstrations of ways in which annotations can be shared and exported into other environments, prior to further standards work in this area. In consultation with W3C and IDPF, standards development organizations should achieve this goal with the help of existing output.

6.4 Reorganization and re-aggregation

Users must be able to reorganize the content of e-textbooks and use parts within sequences and learning designs created by external tools and third-party specifications. In e-learning, these requirements have been resolved along with sequencing content block.

6.4.1 Key requirements

E-textbooks are used to support instructional processes that vary widely, depending on the nature of particular learning objectives and the individual needs of students, and learning environments in which they are used. It is, therefore, important that the content of e-textbooks can be remixed so that teachers can

— change the order in which different units are addressed,

— add new material that supplements the standard content supplied by an original publisher, and

— incorporate materials supplied by an original publisher into new LET.

It is therefore required that there be new ways to remix the content of e-textbooks and re-sequence learning activities.

With said requirements defined, teachers and students may conduct the reorganizing and re-sequencing either manually (by teachers, students) or automatically, by adaptive learning management software.

6.4.2 Current standards environment

For organizing and aggregating resources, EPUB and IMS Content packaging are used both for packaging and repackaging of content.

EPUB 3

EPUB 3 (see also the ISO/IEC/TS 30135 series) is a free and open e-book standard developed by IDPF. EPUB 3 is designed for reflowable content, meaning that an EPUB reader can optimize text for a particular display device. EPUB 3 also supports fixed-layout content. The format is intended as a single format that publishers and conversion houses can use in-house, as well as for distribution and sale.

It supersedes the Open E-Book Publication Structure (OEBPS) also known as the Open E-Book (OEB) standard.

IMS Content Package

IMS Global is a non-profit organization which helps to define technical standards for various aspects of e-learning including LET content. The IMS Content Packaging specification makes it possible to store chunks of material in a standard format which can be re-used in different systems, without having to convert the material into new formats. The IMS content package in Moodle (https://moodle.org) enables such content packages to be uploaded and included in Moodle courses. There are various options for displaying content with a navigation menu or buttons etc. The main difference between an IMS content package and a SCORM package is IMS is mainly for "static" content. However, SCORM does allow tracking of questions/answers and reports a "grade" at the end.

The latest version of IMS Content Packaging (v1.2) was published as ISO/IEC 12785 (all parts). IMS Content Packaging describes data structures that can be used to exchange data between systems that wish to import, export, aggregate, and disaggregate packages of content. IMS content packages enable exporting content from one learning content management system or digital repository and importing it into another, while retaining information describing the media in the content package and how it is structured, such as a table of contents or which web page to show first. The IMS Content Packaging focuses on the packaging and transport of resources but doesn't determine the nature of those resources. This is because the specification allows adopters to gather, structure, and aggregate content in an unlimited variety of formats.

6.4.3 Market conditions

Although there is a wide recognition that new approaches are required for the flexible re-sequencing and reorganizing of content, there is at present no widely recognized technical solution that has been shown to work in a distributed environment.

The survey (undertaken in 2012) and analyzed in Annex C shows that the existing specifications and technologies for e-books at that time had limited educational features, and did not meet the requirement for the reorganization and aggregation of content.

6.4.4 Key recommendations

The user survey also indicated some apprehension about the complexity in any process that involves the remixing of content due to

— the potential to disrupt the original intention and logical sequence presented in the original e-textbook,

— the potential to overlook the digital rights of the original publisher, in the context of commercial content, and

— the possibility of undermining the technical integrity of an original publication, when remixed in different environments.

A key prerequisite for the development of coherent new approaches to sequencing is the clear identification of content "chunks" that can be referenced and which the original publisher has authorized to be used in different contexts and sequences. The learner or teacher should be able to select specific chunks they want to use rather than using the entire e-textbook. Such chunks should be fully marked-up with appropriate metadata, including metadata that indicates important relationships between different chunks in the original e-textbook.

Therefore, it is recommended that standards development organizations should

— produce a specification for identifying and tagging content chunks within an e-textbook,

— produce a standard that specifies the requirement for the chunking of e-textbook content, and helps to inform the purchasers of e-textbooks of the flexibility with respect to chunking offered by different e-textbooks, authoring systems and readers, and

— issue a call for contributions to identify new approaches to the re-sequencing of such content chunks.

6.5 Interactivity and learning support

6.5.1 Key requirements

E-textbooks need to support different kinds of rich media and interactive controls. Interactivity may be delivered

— natively within HTLM5 already supported by the ISO/IEC/TS 30135 series,

— by plug-ins or extensions that are able to interpret specialized file formats such as IMS QTI and LTI, and

— by embedded widgets.

Interactivity delivered in the context of learning, education and training may require the runtime reporting of data back to learning management systems.

Some types of interactivity may require the streaming of other types of runtime data, such as

— streaming video,

— interactions between players in multi-player game,

— communications or screen-sharing with the teacher or other remote tutors, and

— interactions being managed by an embedded widget, being controlled from a remote server.

The integration of an e-book in a highly interactive learning environment presents challenges to the assumption that it will always be possible to use an e-book in an off-line environment.

6.5.2 Current standards environment — www.w3.org/TR/html

HTML5

The W3C HTLM5 recommendation issued as a specification in October, 2014, represents a milestone in the development of HTML but far from being the end of the road, improvements are already well underway. It is possible that future versions will no longer be published as a monolithic specification but rather as a set of smaller modules. In mid-2012, a new editing team was introduced at the W3C to take care of creating the HTML5 Recommendation, which can be used for animation and interactivity combining with CSS3 and JavaScript and prepare a working draft for the next HTML version (W3C). HTML5 is a core reference specification of the ISO/IEC/TS 30135 series.

IMS Question and Test Interoperability

IMS Question and Test Interoperability (www.imsglobal.org/question/index.html) addresses the need to share test items and other assessment tools across different systems. It builds upon envisioned workflows which include authors, assessors, candidates, tutors and so on. The question and test system itself holds an assessment engine which reads a repository of questions and tests, and information on eligibility and performances. It then evaluates the responses producing scores and feedback. It describes how questions, tests and their results can be described in XML so that they can be used in different systems.

IMS Learning Tools Interoperability

IMS Learning Tools Interoperability (www.imsglobal.org/activity/learning-tools-interoperability) allows the seamless connection of web-based, externally hosted applications and content, or Tools (from simple communication applications like chat, to domain-specific learning environments for complex subjects like math or science) to platforms that present them to users. In other words, if you have an interactive assessment application or virtual chemistry lab, it can be securely connected to an educational platform in a standard way without having to develop and maintain custom integrations for each platform.

xAPI

xAPI (http://www.adlnet.gov/tla/experience-api), sometimes known as the Tin Can API (https://tincapi.com/overview), allows learning content and learning systems to speak to each other in a manner that records and tracks all types of learning experiences".

The Advanced Distributed Learning Initiative (ADL) (www.adlnet.org) has taken on the roles of steward and facilitator in the development of the xAPI. The xAPI is seen as one piece of the ADL Training and Learning Architecture, which facilitates learning anytime and anywhere. xAPI is a brand new specification for learning technology that makes it possible to collect data about the wide range of experiences a person has (online and offline). xAPI also captures data in a consistent format about a person or group's activities from many technologies. Mobile learning, simulations, virtual worlds, serious games, real-world activities, experiential learning, social learning, offline learning, and collaborative learning are just some of the ways that digital content can now be recognized and communicated well with the xAPI. All actions can be recorded with the xAPI, and when an activity needs to be recorded, the application sends secure statements in the form of nouns, verbs and objects to a Learning Record Store (LRS) of xAPI.[34]

IMS Caliper Analytics™

The purpose of the IMS Caliper Analytics™ (www.imsglobal.org/activity/caliperram) is to define a standard for enabling the collection of rich contextual data about learning interactions and data IMS Learning Sensor API™ (https://dvcs.w3.orgt/hg/dap/raw/default/sensor-api) for capturing and reporting this data. Main component of IMS Caliper Analytics™ is IMS Learning Metric Profiles to establish an extensible, common format for grouping learning activity data gathered across multiple learning environments such as session, reading, annotation, assessment, assignments, and media usage, etc. Also IMS Caliper Analytics™ defined specification and developed open API, namely IMS Learning Sensor API™ (https://dvcs.w3.orgt/hg/dap/raw/default/sensor-api), as well as IMS Caliper Analytics™ Event Store in terms of reference model for data storing to learning analytics.

6.5.3 Market conditions

The survey (undertaken in 2012) and the results analyzed in Annex C below show that at that time most e-book readers supported media types of image and audio. However, they had little ability to control sequencing. No e-book reader provided high levels of interactivity needed to support learning.

NOTE The EDUPUB Alliance has recently been focusing on developing interactive profiles for e-textbooks. The EPUB 3 EDUPUB Profile was issued as a specification in July 2015. It aims to encourage adoption by global e-textbook publishers. See http://www.idpf.org/epub/profiles/edu/spec/ for further details.

6.5.4 Key recommendations

HTML 5 (which is a core normative reference of the ISO/IEC/TS 30135 series) is recommended as the primary means of delivering rich interactivity in e-textbook media.

It is recognized that IMS QTI is commonly used as a format for encoding multiple-choice quizzes. ISO/IEC JTC 1/SC 36 recommends that standards development organizations should issue a call for

technical demonstrations showing how IMS QTI can best be integrated into and harmonized with the ISO/IEC/TS 30135 series.

NOTE Many of the IMS QTI requirements have been integrated into the EDUPUB Profile developed by the EDUPUB Alliance. Further work is required to monitor the acceptance and use of this component.

ISO/IEC JTC 1/SC 36 recommends that standards development organizations should issue a call for technical demonstrations to show how file formats not within the scope of generic e-book standards can be incorporated in e-textbooks and supported by extensible e-textbook readers. In the light of such trials, standard organizations should discuss with IDPF what further standardization work might be desirable in order to support the use of non-standard file formats. Liaisons and other interested parties are invited to submit to standards development organizations evidence from pilot implementations that demonstrate effective approaches to the management of remote connections, when using interactive e-textbooks in environments in which connection to the Internet is intermittent.

Technology demonstrators may focus on one or more of the following scenarios:

— the reporting of outcome data to LMSs/VLEs, LRSs or other remote servers;

— the initialization of activities with contextual data about the student or the learning context;

— the streaming of remote video;

— the management of embedded widgets that depend on remote application servers;

— the runtime exchange of data in multi-player or collaborative environments; and,

— the export of annotations to appropriate environments.

Technology demonstrators should

— manage caching and the local installation of components to maximize the functionality offered by e-textbooks when off-line,

— ensure that no essential data is lost as a result of being off-line,

— manage user expectations and progression appropriately,

— minimize the technical complexity of content development, and

— show the relevance of the demonstration for future standardization work.

6.6 Digital rights

6.6.1 Key requirements

There are two possible components of a digital rights strategy,

— the expression of digital rights in an appropriate REL, and

— the enforcement of digital rights by a DRM.

Commercial suppliers may wish to use a DRM system to protect their rights, while suppliers of Open Education Resources (OER) will not. Even commercial publishers may be wary of DRM if it presents an obstacle to use, particularly in a classroom environment where the inability of even a minority of students to use a resource may be disruptive.

Both commercial publishers and suppliers of OER will want their authorship and rights to be acknowledged in appropriate metadata. While suppliers of OER are likely to be satisfied with a lightweight system such as Creative Commons, this may not meet the needs of commercial publishers, who frequently have to recognize a complex network of interlocking rights belonging to different content owners.

6.6.2 Current standards environment

There are a number of proprietary DRM solutions available, as listed in C.8.5.

6.6.3 Market conditions

The market is still characterized by strong competition resulting in a wide range of DRM proprietary solutions. Users, especially in education, are often more inclined to support Open Educational Practices and Open Educational Resources rather than implementation of DRM systems.

6.6.4 Key recommendations

Standards development organizations should not expect to produce a standardized approach to DRM in the short-to-medium term, but should allow any appropriate DRM system to be used in the context of any future e-textbook standards.

Standards development organizations should consult with IDPF regarding the development of a profile for the appropriate use of REL with e-textbooks that will meet the requirements of both commercial education publishers and informal and OER producers. The specification should also provide for the mark-up of appropriate content chunks with rights information.

NOTE 1 IDPF and the Readium Foundation (readium.github.10/overview.html) have initiated a new project titled “Lightweight Content Protection (LCP)” which aims to provide relatively portable secure rights protection and management.

NOTE 2 The Korean NB has approved the need for DMR e-book interoperability standards in 2014.

Standards development organizations should produce a standard that will ensure that purchasers and users of e-textbooks can understand clearly the respective rights and obligations of author, user, publisher and other intermediaries in any e-textbook; and that they should understand clearly the implications of any DRM system that is being used. Other possible interested parties include, but not limited to, service provider, distributor, etc.

7 Recommendations for future work

7.1 General

This subclause summarizes the main recommendations contained in the arguments presented in Clause 6.

7.2 Recommendations for e-textbook standards

There are different conceptions of e-textbooks and the part that they are likely to play in LET. Some people see e-textbooks as remaining faithful to the metaphor of the book; others see this as emerging modality supporting new functionality, allowing flexible organization, interactivity and integration within a wider learning ecosystem.

It would be desirable for suppliers, practitioners and other interested parties to share a common understanding of these different approaches to e-textbooks and for different e-reader and e-textbook players/stakeholders to advertise transparently the level of interactivity and adaptability that they support.

To this end, it would be helpful if standards development organizations could produce a standard that differentiated between e-reader and e-textbook players/stakeholders according to the level of functionality that they support.

7.3 Recommendations for technical works combined with IDPF and other organizations

Given that the ISO/IEC/TS 30135 series is based on the EPUB 3 administered by the IDPF, any core development of underlying standards needs to be conducted under the auspices of that organization. ISO/IEC JTC 1/SC 36 recommends that LET stakeholders support the following priorities:

— adopt a core metadata profile of generic information, sufficient for the basic needs of the LET community and likely to be supported by the majority of e-textbook devices including e-readers;

— define a method of "chunking" e-textbook content, allowing such chunks to be externally referenced by, for example, assignment, sequencing and learning design services; and allowing for the definition of relationships among different content chunks and the underlying the underlying page structure;

— in association with the W3C's Open Annotations, contribute to the finalization of an IDPF's OAinEPUB specification that will serve the requirements of the LET community for annotations that are persistent and shareable.

NOTE The EDUPUB Alliance issued an EDUPUB Profile specification in July 2015 which was initiated in 2013. See http://www.idpf.org/epub/profiles/edu/spec/ for further details. ISO/IEC JTC 1/SC 36 has been an active participant, including co-hosting a workshop at its Oslo Plenary in 2014.

7.4 Recommendations for supporting education-specific standardization

E-textbooks constitute one part of a wider digital ecosystem for learning, education and training. With respect to a number of standardization requirements, it is important that solutions are not developed for e-textbooks that differ from solutions that are required elsewhere in the digital ecosystem for LET. To this end, standards are required in a number of areas that are important for e-textbooks but should not be seen as being confined to e-textbooks.

In particular, the development of e-textbooks highlights the need for further work to create standards for the education community that

— provide guidance regarding the tagging of e-textbook components and other types of digital content so that they can be associated with different competency frameworks and curricula including using already developed International Standards, such as the ISO/IEC 19788 series,

— provide guidance regarding how to improve the accessibility of e-textbooks and other types of digital content including using already developed International Standards, such as ISO/IEC 24751 (all parts),

— allow different types of e-textbook components (both interactive and static) to be re-sequenced and otherwise re-mixed, preserving the DMR associated to each component, and

— provide guidance regarding the use of learning analytics to track usage of e-textbooks by learners and instructors including using International Standards that are still under development, such as ISO/IEC TR 20748.

7.5 Calls for technical demonstrations

Several desirable requirements for e-textbooks cannot be progressed reliably without technical demonstrations. These include:

— advanced uses of annotations, including export and sharing;

— interoperable launching of interactive e-textbook components, passing launch parameters to customize the behaviour of the activity;

— reporting outcome data from interactive e-textbook components, caching such data as required when the e-textbook is being viewed off-line;

— incorporating non-standard data formats such as IMS QTI, either by importing into the native format specified in the ISO/IEC/TS 30135 series or by the use of plug-ins and other widgets.

Standards activity could usefully be undertaken in these areas, once effective technologies had been demonstrated.

Annex A
(informative)

E-textbook pilots submitted by NBLOs

A.1 Chinese pilot

Table A.1 — Development and application of e-Schoolbag in Shanghai

Name of the Use Case	Development and application of e-Schoolbag
Name of the Organization	Shanghai e-Generation Network Information Co.
Scope	Target: Elementary and middle schools Pilot school: Haihua Primary School, Luwan District, Shanghai, China Subject: English and Mathematics
Description	Pilot form: Open course, seminar Course content: English lessons for Grade 2, Math lessons for Grade 3 Pilot goal: To validate the feasibility and effectiveness of the application of e-Schoolbag in instruction. Before class: Preparing and previewing lessons During class: Teaching, interaction, practice, and instant feedback After class: Reviewing and doing homework Other: Recording, assessing and sharing the whole situation of teaching and learning
Level of participant(s) addressed	Students of two classes and related teachers
Description or list of the technologies used	Classroom equipment: Ordinary classrooms equipped with projectors, electronic whiteboards, acoustics, Local Area Network (LAN) environment Teacher's equipment: Laptop Students' equipment: Netbooks and Handwriting pen Content format: e-Schoolbag platform developed by Shanghai e-Generation Network Information Co. (content format embedded in audio/video, FLASH, WORD, PPT, etc.), courseware, teaching tools, teaching software and other formats such as Small Web Format (SWF) files

Table A.1 *(continued)*

Name of the Use Case	Development and application of e-Schoolbag
Scenario Sequence	**Step1: Before class — preparing and previewing lessons** — The teacher prepares lessons and collects resources with e-Schoolbag platform. — The teacher shares professional resources and experiences with other teachers and researchers in the selected region, with the platform providing the functions of communication and interaction. — The students preview lessons through the e-Schoolbag platform. **Step2: During class — teaching, interaction, practice, and instant feedback** — The teacher instructs through the e-Schoolbag teaching platform. — The students practice during class through the e-Schoolbag student platform. — The teacher and students interact with each other through e-Schoolbag platform. — The teacher can monitor and track students' learning record by e-Schoolbag teaching platform, and can instantly get knowledge of students' learning situation in long term according to the analysis report provided by the system. — The e-Schoolbag student platform will track and record all the instructional and learning process for students' review at home. Students can also know the gap in certain field and make study plans according to the system evaluation results and the comprehensive suggestion by teachers. **Step3: After class — tracking and reviewing** — The teacher gives assignments for students, and track students' learning status at home through e-Schoolbag teaching platform. — The students do assignments and extra-curricular practice with instant assessment for students and parents to know the result; the platform will push individualized learning content to students based on the results.
Primary Actor(s) and Role(s)	Teacher — prepares and teaches lessons; acquires students' study status Student — attends classes; interacts, shares individualized study Researcher — develops e-Schoolbag teaching management system
End goal of activity	— To overcome the weak points of traditional teaching, especially in resource sharing, interaction and instant feedback. — To validate the feasibility and effectiveness of the application of e-Schoolbag in instruction.
Trigger(s)/ Pre-condition(s)	— The platform provides multimedia exercise courseware provided by the platform. — The teacher monitors the whole class through the screen monitoring function of the platform. — The teacher adjusts and projects different screen of students. — The platform provides extra-class exercises for students learning at home.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	Teachers have not yet realized the real role of the e-Schoolbag and think it adds to their burdens.
Who is using what is described in this use case?	Widely used in elementary and middle school.

A.2 Korean pilot

Table A.2 — Class using digital textbook led by teacher in Korea

Name of the Use Case	Class using digital textbook led by teacher
Name of the Organization	Korea Education and Research Information Service (KERIS)
Scope	Target: Elementary and middle schools No. of schools: 135[a] Subject: Korean, English, and Mathematics
Description	— Setting up the classroom environment (learning model, lesson plan, etc.). — Checking login status of students. — Monitoring screens of students to see what they are learning. — Giving students feedback from teacher on their work and assignments. — Checking learning outcome using prepared assessment set.
Level of participant(s) addressed	Well-trained teacher to use ICT in education.
Description or list of the technologies used	Content description: HTML4, CSS2, XML, XHTML, SVG, and MPEG[b] Digital Publishing: EPUB 2.01 ≥ 3.0[c] Learning technologies: IMS Content Packaging, Metadata (KEM; Korea Educational Metadata), IMS Common Cartridge, IMS Basic Learning Tools Interoperability, IMS Questions & Test Interoperability, Sand SCORM 2004 Accessibility technologies: W3C WAI

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Table A.2 *(continued)*

Name of the Use Case	Class using digital textbook led by teacher
Scenario Sequence	**Step 1: Before the class** — Update the digital textbook from the server. — Check the digital textbook content and platform. — Set up class environment such as bookmark, pen size and colours, and learning tools. — Choose the lesson plan and teaching-learning model for appropriate context. — Download motivation resources from repository and link to digital textbook. — Review assignments which are submitted by the students on the learning support system. — Review the content of the digital textbook to use in class, using panorama function. — Check log-in status of students. **Step 2: During the class** — Set the learning objective with students, and play appropriate motivation resources. — Use various multimedia resources to deliver direct/indirect learning experience opportunities. — Give students feedback through formative tests/quizzes. — Monitor the students' screens to see what they are learning and provide coaching, when needed. — Launch some students' assignments on the electronic board and give students feedback. **Step 3: After the class** — Use a prepared assessment set in the support system to check the learning outcome. — Assign homework to students. — Answer students' questions on the Q&A menu in the support system. — Automatically save assessment results and managed outcome. — Search lesson plans which are registered by co-teachers and customize lesson plans for them, and link the subject to the digital textbook. — Access wireless Internet and search learning resources, and then link useful resources to the digital textbook.
Primary Actor(s) and Role(s)	Teacher — prepares, modulates, monitors, and counsels
End goal of activity	— To generalize new media as alternative legacy (paper-type) textbook. — To develop new teaching-learning models for the 21st century skill. — To cut-down private tutoring cost and resolve education divide.

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Table A.2 *(continued)*

Name of the Use Case	Class using digital textbook led by teacher
Trigger(s)/ Pre-condition(s)	— Digital textbook viewer (player) for teacher. — Download digital textbook content to PC and/or device. — Design lesson plan and developing sub-materials.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— Cost of device to be used. — Evaluating learning outcome and how to measure. — Visual Display Terminal (VDT) syndrome or decreased interaction with human. — Developing teaching-learning model for new media. — Harmonizing different domains technologies and standards.[d]
Who is using what is described in this use case?	Elementary and middle school teachers and students

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Table A.3 — Class using digital textbook led by students in Korea

Name of the Use Case	Class using digital textbook led by students
Name of the Organization	Korea Education and Research Information Service (KERIS)
Scope	Target: Elementary and middle schools No. of schools: 135[a] Subject: Korean, English and Mathematics
Description	— Using tablet PCs rather than legacy textbooks. — Installing digital textbook software to students' devices. — Using various multimedia resources to motivate students to learn. — Receiving teacher's feedback and check assignments. — Improving learning experiences using new media.
Level of participant(s) addressed	Normal elementary and middle school students to use ICT
Description or list of the technologies used	Content description: HTML4, CSS2, XML, XHTML, SVG, and MPEG[b] Digital publishing: EPUB 2.01 ≥ 3.0[c] Learning technologies: IMS Content Packaging, Metadata (KEM; Korea Educational Metadata), IMS Common Cartridge, IMS Basic Learning Tools Interoperability, IMS Questions & Test Interoperability, Sand SCORM 2004 Accessibility technologies: W3C WAI

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Table A.3 *(continued)*

Name of the Use Case	**Class using digital textbook led by students**
Scenario Sequence	**Step 1: Before the class** — Launch the digital textbook on a tablet PC and check teacher's notice for current lessons. — Review what students learned and check their learning progress. — Check sub-materials which are registered by the teacher. — Enjoy video/audio chatting with friends and discuss subjects related to their lessons. — Customize user interface, including screen skins and menu for personalized use. **Step 2: During the class** — Highlight on the digital textbook what students need to mark up such as underlining, bookmarking, and highlighting. — In case of an English class, students can follow native English speakers pronounce words using a voice recognition software and record their pronunciations for comparison. — Submit answers for prepared assessment set by teachers using the digital textbook. — Save notes and memoranda generated by students. — Take photo and send data to teacher in fields study **Step 3: After the class** — Lunch the digital textbook on the student's PC in their home. — Download notes and memoranda generated by the student during the class from support system located in school. — In case of field studies, students can import photos which are taken by them and make a report using these sub-materials. — Check student's e-Portfolio such as learning history and award records.
Primary Actor(s) and Role(s)	Student — learns and develops digital literacy
End goal of activity	— To generalize new media as alternative legacy (paper-type) textbook. — To develop new teaching-learning models for the 21st century skill. — To cut-down private tutoring cost and resolve education divide.

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Table A.3 *(continued)*

Name of the Use Case	Class using digital textbook led by students
Trigger(s)/ Pre-condition(s)	— Digital textbook viewer (player) for teachers. — Download digital textbook content to PC and/or device. — Choose subject on digital textbook player.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— Cost of device to be used. — Evaluating learning outcome and how to measure acquired data. — Visual Display Terminal (VDT) syndrome or decreased interaction with human. — Developing teaching-learning model for new media. — Harmonizing different domains technologies and standards.[d]
Who is using what is described in this use case?	Elementary and middle school teachers and students

[a] These pilot schools are specified by the government.

[b] HTML5 and CSS3 were adopted in 2011.

[c] EPUB is adopting BOENJHSBUFEGSPNMBHBDGPSNBU now.

[d] Include digital publishing, learning technology, and content presentation such as Augmented Reality (AR) and 3D.

Annex B
(informative)

Conceptual use cases submitted by NBLOs

B.1 Scenario of teaching and learning in class

Table B.1 — E-textbooks for teacher of the use case

Name of the Use Case	E-textbooks for teacher
Name of the Organization	Distance Education College, East China Normal University (ECNU) and Shanghai Engineering Research Centre of Digital Education Equipment
Scope	Teachers can teach Grade 3 pupils English, and use the functions of e-textbooks such as marking, tagging, linking, etc.
Description	Using many functions of e-textbooks to make some revisions on original digital learning resources, teachers can provide learning resources which match course's characteristic learning purpose to help pupils in performing their learning tasks. They can organize reading in class, provide learning resources, and assign in-class quizzes for pupils. At the same time, teachers can share some of new learning resources. Pupils can perform learning tasks by e-textbooks.
Level of participant(s) addressed	English teaching for Grade 3 pupils
Description or list of the technologies used	— E-textbook client and server — E-textbook OS and management software — E-textbook format standards and application software of e-textbooks — Storage and management software for e-resources — E-learning environment
Scenario Sequence	— The teacher highlights the keywords by tagging on e-textbooks. Teachers choose some keywords, select the mark style, and add the content of tagging (such as *), then save them. — The teacher labels the keywords for pupils by tagging function. — The teacher selects the keywords, and adds label content (could be formed by various media resource), then save them. — The teacher can provide explanatory materials (could be composed of various media contents) for keywords by hyperlinks, then save and share them. — The teacher selects targeted content blocks, and adds hyperlinks contents (action) for them. — The teachers add an in-class quiz for target object, then pupils can take this quiz after learning. — The teacher selects words, and adds in-class quiz links or other meaningful content (such as in-class quiz, feedback and so on).

Table B.1 *(continued)*

Name of the Use Case	E-textbooks for teacher
	— The pupils click a quiz, and accomplish the test, then submit their answers. The system will display the teacher's answer, and provide feedback information. The e-textbook clients will send result to the teacher at the same time. — Original resources and the individual revision will be saved as a new revision learning resource. The new revision learning resource will be sent to the pupils. — The teacher will revise all the content, and save as a new version, meanwhile name it, and set the attribute of the new "textbook" (the scope of sharing, the right of operation), then sent to the pupils by net.
Primary Actor(s) and Role(s)	Teacher (content editor/assembler) Pupil (user/navigator/adaptor)
End goal of activity	— Help pupils on their English learning, and achieve individual learning tasks by e-textbooks. — New resources can be shared and reused. — The user of learning resources could know resources revision information and lifecycle.
Trigger(s)/ Pre-condition(s)	— The teacher prepares a lesson (the digital resources) and sets learning goals. — E-textbook devices and their application are grasped by teachers.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— Devices, software and learning resources which meet standards of e-textbooks. — Ensure network connectivity and synchronization between all users' e-textbooks.
Who is using what is described in this use case?	Widely used by teachers and pupils

Table B.2 — E-textbooks for pupils — Words Study

Name of the Use Case	E-textbooks for pupils — Words Study
Name of the Organization	Distance Education College, East China Normal University (ECNU) and Shanghai Engineering Research Centre of Digital Education Equipment
Scope	Grade 3pupils learn words in English books by using markers and bookmarks of e-textbooks.
Description	When learning words, pupils use the multi-functionality of e-textbooks to mark new words and keywords, generate their own vocabulary notebooks. Then they can share their notebooks with each other, or quote words from other's notebooks (the teacher's or other classmates) to enlarge or refine their notebooks.
Level of participant(s) addressed	English teaching for Grade 3 pupils
Description or list of the technologies used	— E-textbook clients and servers — E-textbook OS and management software — E-textbook format standards and application software of e-textbooks — Storage and management software for e-resources — E-learning environment

Table B.2 *(continued)*

Name of the Use Case	**E-textbooks for pupils — Words Study**
Scenario Sequence	— The pupils highlight new words and keywords by tagging them on the e-textbooks. — The pupils choose target words and select the mark style, and add the content of labels (* &), then save them. — With the bookmark, pupils add labels for marked words, and then classify these labels which had already been named; — The pupils select the words with the same label, and then classify and show them according to the sequence of letters (random, time, difficulty). — The pupils create their own vocabulary notebooks by using existing word labels. — The pupils select words of different categories and group them together to save as their own vocabulary notebooks. They name, set attributes of these words (sharing scope and operating permissions) and shared object scope, then share them to teachers through server. — The pupils quote the vocabulary notebooks from the teacher's and other learners to expand and modify their own notebooks. — The pupils select the content blocks from other notebooks available (either the teacher's or the classmates') and add them to that of their own. Then they modify and sort them out according to time, difficulty, content and so on.
Primary Actor(s) and Role(s)	Teacher (content editor/assembler) Pupil (user/navigator/adaptor)
End goal of activity	— Through the related function of e-textbooks, the pupils fulfil the task of learning words. — The pupils create their own vocabulary notebooks. — The pupils can share their vocabulary notebooks, and also can refer to and cite words of the teacher or other classmates.
Trigger(s)/ Pre-condition(s)	— The pupils can use e-textbooks and related equipment proficiently. — The pupils have access to the vocabulary notebooks of the teacher and other classmates, then add them into their own.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— The level of pupils' understanding of new words and keywords. — Using standard e-textbooks equipment, software and learning resources. — Ensuring the synchronization between the network and the content of all application objects.
Who is using what is described in this use case?	Widely used by teachers and pupils

B.2 Scenario of exercise and test

Table B.3 — Assessment within e-textbooks

Name of the Use Case	**Assessment within e-textbooks**
Name of the Organization	—
Scope	User of an assessment within an e-textbook, typically as a knowledge check test or as a diagnostic test to determine which topics need to be covered.
Description	A knowledge check assessment allows the reader of the e-textbook to check they have understood a chapter or section of the e-textbook. A diagnostic assessment allows the reader to determine how much he/she knows already and so which sections of the e-textbook he/she needs to navigate to learn more.
Level of participant(s) addressed	Applies to all participants, particularly tertiary and adult
Description or list of the technologies used	Many different technologies can be used but it is often useful for the assessment to be hosted on a remote web server as this allows the results to be stored and collated across readers to identify patterns and trends.
Scenario Sequence	**Knowledge check** — The student reads a section of the e-textbook. — The student sees the knowledge check, embedded in the page of the e-textbook. — The student answers the questions. — The student submits his/her answers. — The student gets feedback and learns whether he/she has understood the section. **Diagnostic test** — The student is directed to the diagnostic test, perhaps at the start of a series of sections of the e-textbook. — The student answers the questions and submits his answers. — The student gets feedback as to which topics he/she already knows and which areas he/she needs feedback on. — In some cases, the navigation within the e-textbook is then impacted to allow navigation only to the portions needed. — In some cases, the student is identified and might see reports on their results later on.
Primary Actor(s) and Role(s)	Student (Reader) Instructor
End goal of activity	The assessment helps the learning process.
Trigger(s)/ Pre-condition(s)	Assessment must be created and relevant to the topics.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— Interoperability — Management of results — Instructor review
Who is using what is described in this use case?	Very widely used

B.3 Scenario of informal learning activities

Table B.4 — Kenyan e-textbook use case

Name of the Use Case	Kenyan e-textbook use case
Name of the Organization:	Kenya National Library Service
Scope	Currently, the e-textbook is used within the Public Library headquarters in one branch where the national lending department is mandated to store at least a copy of e-textbooks from all the publishers. The e-textbook can be accessed within the library.
Description	Kenya National Library Service (KNLS) is digitizing all hardcopy books to e-textbooks to ensure that they are widely accessible from anywhere. Users log into the database through an IP address which is integrated to the system's web query (net opacs or online public access catalogue) interface. The users use their library membership number to access the e-textbooks stored in the library management system.
Level of participant(s) addressed:	Participants include primary, secondary, tertiary, adult, including persons with disability (VIP).
Description or list of the technologies used:	— Library management system (Amlib) — Jaws software for VIPs (EPUB, XML, SQL)
Scenario Sequence	**Procedure to access the e-textbook** — Sign in to the online interface using the server IP address. — Query the applicable e-textbook stored in the databases.
Primary Actor(s) and Role(s)	System administrator — ensures that e-textbook requests are queried simultaneously in the SQL database Librarian — uploads the e-textbook in the corresponding categories Library user — accesses the e-textbook
End goal of activity	E-textbooks in the library are for all learners who require information. The project goal is to ensure that textbook information can be disseminated to users and learners including but not limited to education curriculum and informative readership..
Trigger(s)/ Pre-condition(s)	— Library user queries the database for the e-textbook. — System checks which hardware is being used, i.e. mobile or computer, and relays the information using the necessary application platform. — The user can then access database and the e-textbook queried.
What issues or challenges have been encountered during the implementation and use of the e-textbooks?	— Need to train implementers on e-textbooks and how to handle them. — Limited access to Internet, either through PCs or mobile phones with Internet connectivity. — Integration of the system to the worldwide web.
Who is using what is described in this use case?	All public library users

Annex C
(informative)

Survey of stakeholder requirements

C.1 Introduction

C.1.1 Methodology

NOTE This survey was conducted in 2012 and the result was completed in 2013. All data represented in this Annex and interpretation pertaining to C.9 was written in 2013.

The survey was conducted using an online questionnaire, which was advertised to interested parties in the participating countries, to associated formal standards development organizations, at education technology exhibitions and to appropriate web-based communities.

The questionnaire was provided in English, French, Chinese, Korean and Japanese.

Partial responses to the questionnaire were discarded before results were collated.

C.1.2 Graphs

Several questions invited responses using a Likert-type scale, with four substantive options (e.g. "Core", "Useful option", "Possible option" and "Not appropriate") as well as "Don't know". The results for these questions are presented as stacked column graphs, showing only the four substantive options.

Superimposed on these graphs are two lines:

a) A solid red line shows the an overall rating for each column, calculated by Formula (C.1), where $n(o1)$ represents the number of respondents that chose option 1. The formula produces a value between 0 and 1.

$$\frac{3n(o1)+2n(o2)+n(o3)}{3\left[n(o1)+n(o2)+n(o3)+n(o4)\right]} \tag{C.1}$$

For example, if one person chose each of options 1 to 4, the formula would be resolved as follows:

$$\frac{3+2+1}{3\times 4}=\frac{6}{12}=\frac{1}{2}=50\,\% \tag{C.2}$$

b) A dotted black line shows the total response level for each part of the question, representing those respondents who gave a substantive response to the question as a percentage of the total number of respondents who completed the questionnaire.

Respondents who have failed to give a substantive answer to a question may have

— missed out the question,

— answered "Don't know", or

— have automatically skipped a section, for example after they had declared that they were not familiar with technical standards or that they had little interest in a particular subject.

Variations in response level for different parts of the same question are likely to indicate a response of "Don't know".

C.1.3 Main conclusions

This Clause gives details of the responses given to the survey. The conclusions that have been drawn from the survey are included in 5.3.

C.2 Respondents

C.2.1 General

There were a total of 119 complete responses to the questionnaire.

C.2.2 Membership of an organization

Respondents were asked whether they represented an organization, whether they belonged to an organization that they did not represent, or whether they were speaking in an individual capacity.

About one third of the respondents represented an organization and two thirds belonged to an organization.

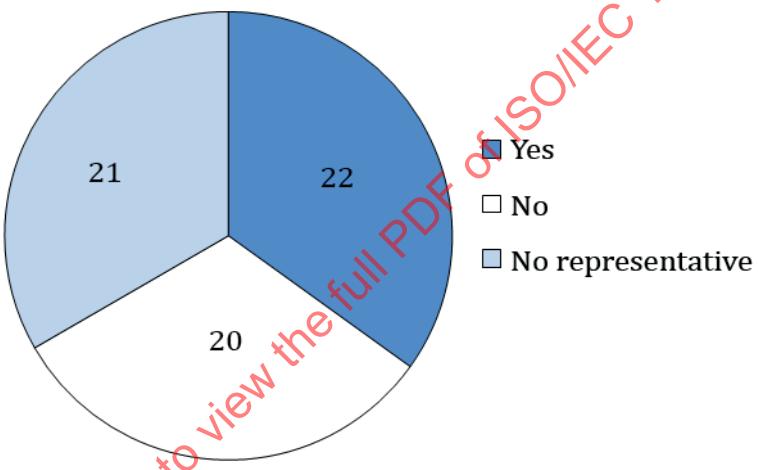

Figure C.1 — Membership of an organization

C.2.3 Geographical area of operations

Respondents were asked about the area of operations of their organizations.

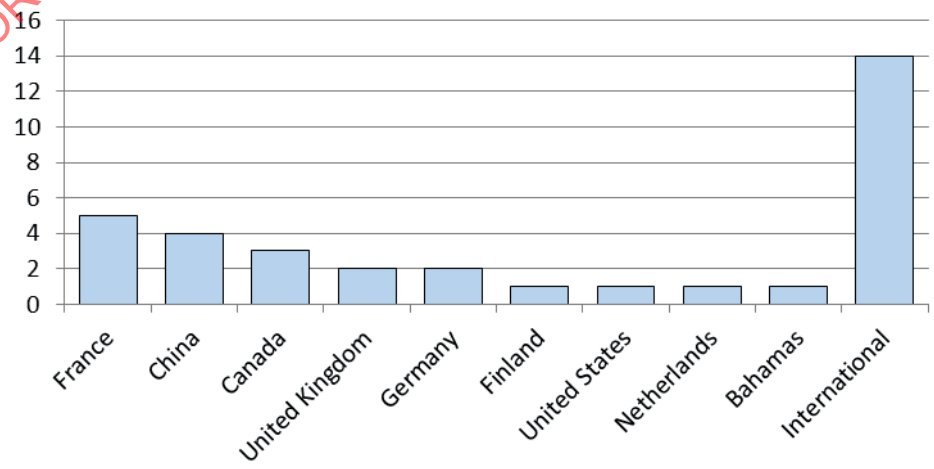

Figure C.2 — Areas of operations

A total of 34 respondents, of whom 14 belonged to organizations which operated internationally and 20 operated predominantly in a single country, answered this question.

Respondents that were active internationally were asked about their levels of activity in different global regions.

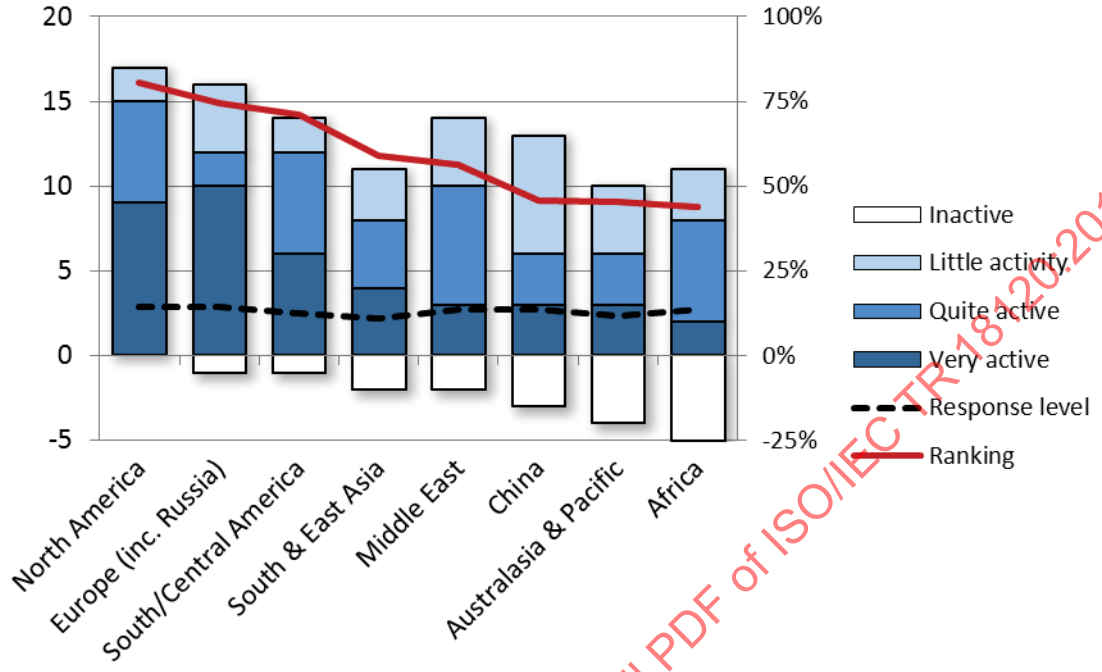

Figure C.3 — Areas of international activity

Table C.1 — Areas of international activity

	North America	Europe (inc. Russia)	South/ Central America	Middle East	South and East Asia	Africa	China
Very active	9	10	6	3	4	2	3
Quite active	6	2	6	7	4	6	3
Little activity	2	4	2	4	3	3	7
Inactive	0	1	1	2	2	5	3
Response level	14 %	14 %	13 %	13 %	11 %	13 %	13 %
Ranking	80 %	75 %	71 %	56 %	59 %	44 %	46 %

The areas that reported the most international activity were North America and Europe, although this may reflect the fact that of the 14 respondents that classified their organizations as international, 11 were answering the English language questionnaire.

C.2.4 Type of organization

Respondents that belonged to an organization were asked about the type of organization that they belonged to.

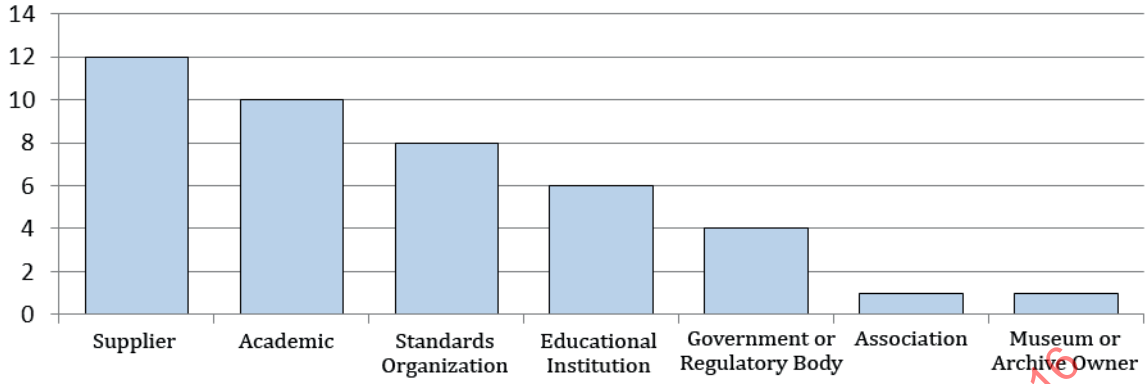

Figure C.4 — Types of organization responding

A total of 42 respondents answered this question. The most common type of organization was education technology suppliers (12), followed by academic institutions (10), standards development organizations (8), education institutions (6), and government or regulatory bodies (4).

C.2.5 Type of services supplied

Where appropriate, respondents were asked about the type of products that their organizations supplied.

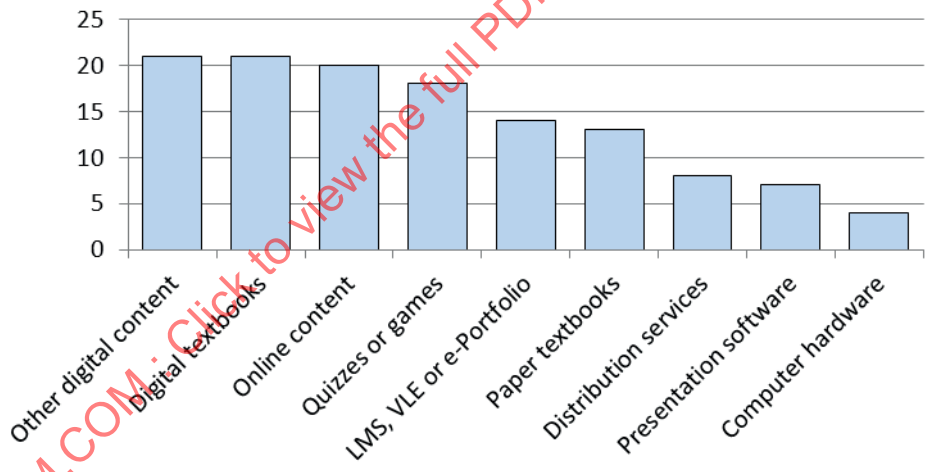

Figure C.5 — Types of product supplied

A total of 33 respondents answered this question, supplying a total of 126 different categories of products or services.

The most common types of products were different forms of digital learning content: unspecified (21), followed by digital textbooks (21) and online (20). Eighteen out of 33 respondents supplied explicitly interactive content (quizzes and games) and 14 out of 33 supplied software systems such as Learning Management System (LMS), Virtual Learning Environment (VLE) or e-Portfolios.

C.2.6 Level of knowledge of technical standards for learning

Respondents were asked about their personal level of knowledge about technical standards for learning.

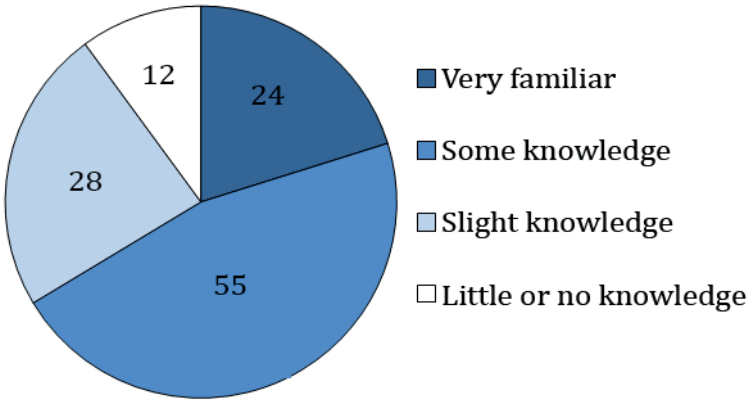

Figure C.6 — Level of knowledge of technical standards for learning

All 119 respondents answered this question. Over half claimed to be very familiar or to have some knowledge of technical standards for learning; and a small minority claimed to have little or no knowledge.

C.3 E-textbook fundamentals

C.3.1 Basic content specifications

ISO/IEC 18120 is based on the assumption that an e-textbook standard will be based on a single, foundational content standard. Respondents were asked what they saw as the strongest candidates for this basic specification.

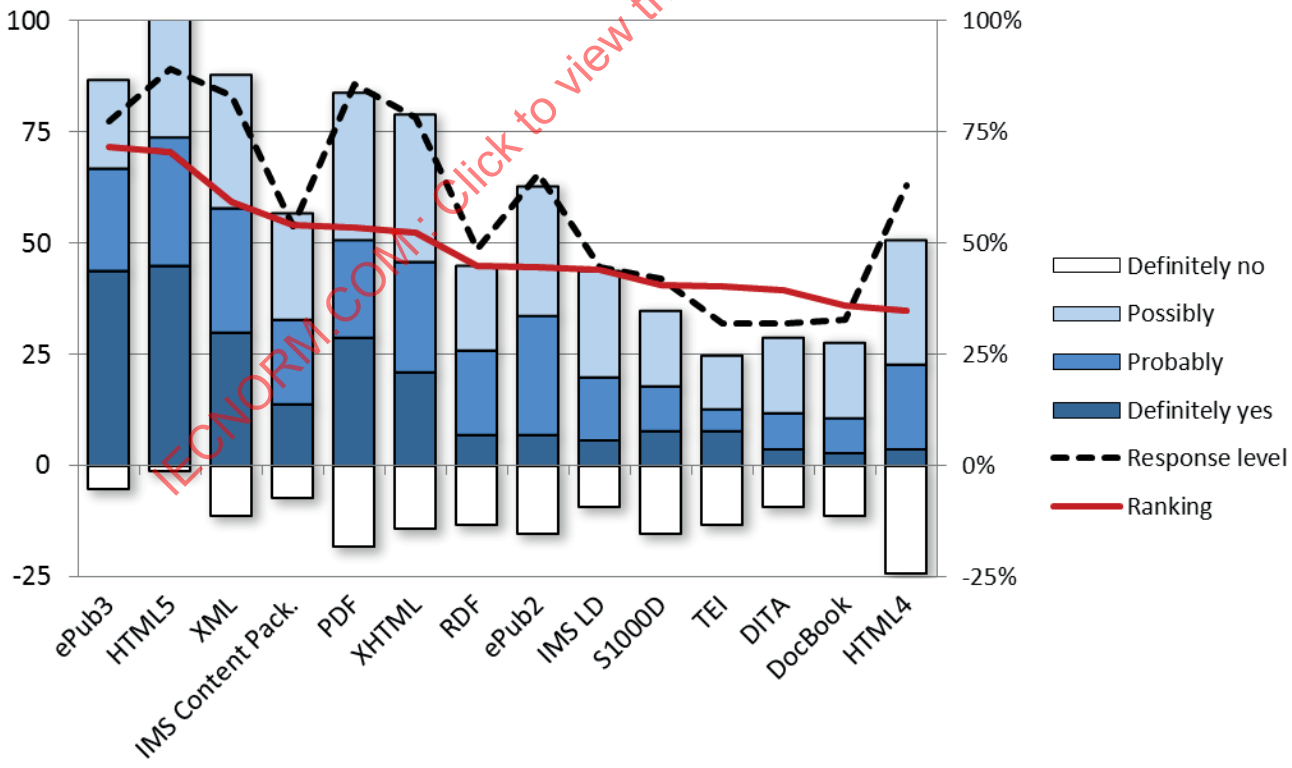

Figure C.7 — Standards for basic content

Table C.2 — Standards for basic content

	EPUB 3	HTML5	XML	IMS Content Pack.	Adobe Acrobat Portable Document Format (PDF)	XHTML	RDF	EPUB 2	IMS LD	S1000D	TEI	DITA	Doc-Book	HTML4
Definitely yes	44	45	30	14	29	21	7	7	6	8	8	4	3	4
Probably	23	29	28	19	22	25	19	27	14	10	5	8	8	19
Possibly	20	31	30	24	33	33	19	29	24	17	12	17	17	28
Definitely no	5	1	11	7	18	14	13	15	9	15	13	9	11	24
Response level	77 %	89 %	83 %	54 %	86 %	78 %	49 %	66 %	45 %	42 %	32 %	32 %	33 %	63 %
Ranking	72 %	70 %	59 %	54 %	54 %	52 %	45 %	44 %	44 %	41 %	40 %	39 %	36 %	35 %

The response level represents the level of recognition of the different standards and the ranking represents the level of approval given by those who were familiar enough with the standard to make a substantive response. These two metrics can be plotted on a two-dimensional graph, as represented below.

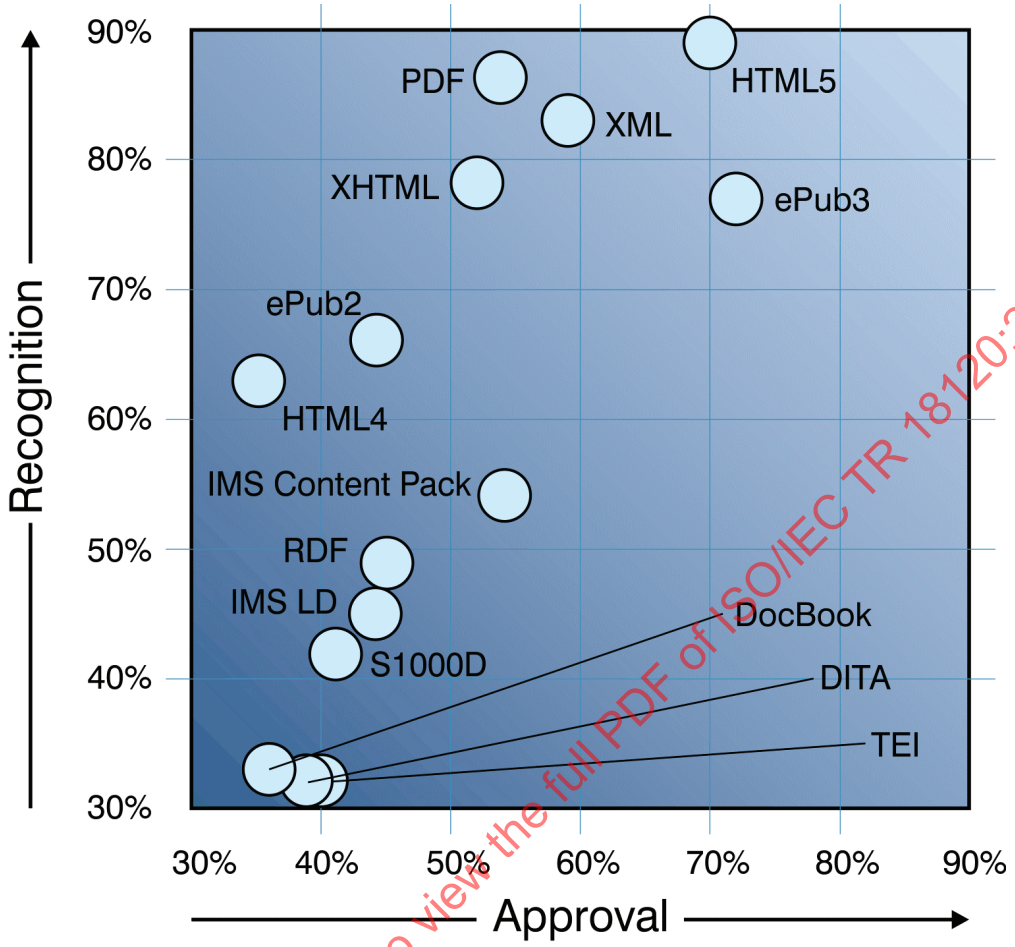

Figure C.8 — Recognition and approval of standards

As expected, EPUB 3 was seen by respondents as the strongest candidate, with a rating of 72 %. HTML5 and, to a lesser extent, XML were also regarded favourably, though it must be stressed that these are not alternatives to EPUB 3, but constituents.

The most popular alternative to EPUB 3 as a "book" format was IMS Content Packaging and PDF at 54 %, although, while PDF received a predictably high recognition at 86 %, IMS Content Packaging's ranking was based on relatively low response levels of 54 %. Respondents completing Chinese, Japanese and Korean questionnaires were more familiar and more supportive of IMS Content Packaging than were respondents to the English questionnaires.

Other "book" standards to receive lower ratings were PDF, EPUB 2, DocBook, DITA and S1000D.

This question confirms the editors' presumption that a future e-textbook standard should be based on EPUB 3 as its base standard, but allow for extensions to handle alternative formats where these are supported by particular communities of practice.

C.3.2 Other standards proposed

Respondents were asked whether there were any other fundamental content standards that had been omitted. The editors were aware that the concept of a "fundamental standard" was difficult to define exactly and many of the standards that were proposed probably fell outside of this definition.

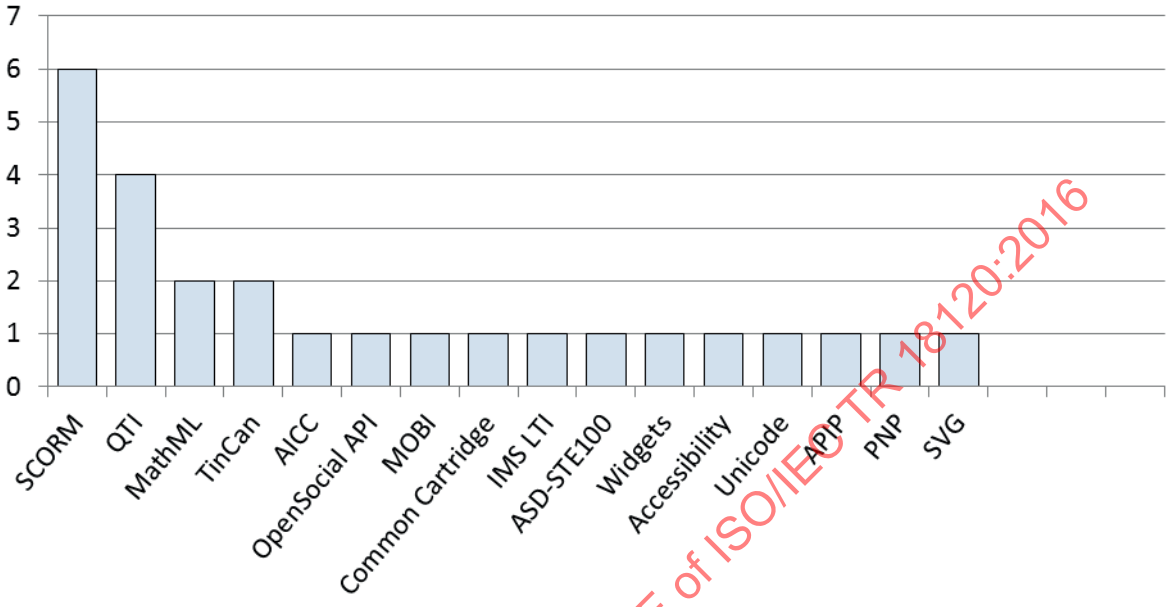

Figure C.9 — Other standards proposed

The most popular group of standards were those that were considered under the heading of "interactivity": SCORM and Tin Can API with regard to runtime reporting; and IMS QTI in multiple choice quizzes. MathML, a standard for rendering mathematical formulae, was mentioned twice, but is already referenced by EPUB 3 and is not an education-specific requirement.

All other standards received only a single mention and could be grouped as follows:

— OpenSocialAPI and the category of Learning Analytics standards could be seen as different sorts of standard for the exchange of runtime data;

— MOBI is a highly compressible e-book format for mobile devices (of which the Amazon Kindle uses a derivative);

— Common Cartridge and Accessible Portable Item Protocol (APIP) are reference models that include different profiles of IMS Content Packaging and IMS QTI, while APIP also includes IMS' accessibility standard Personal Needs and Preferences (PNP);

— IMS, LTI and Google widgets are ways of embedding or mashing-up external tools within an HTML page;

— ASD-STE100 is a standard for plain English and therefore belongs to the general category of quality standards;

— Unicode is a standard character set and Scalable Vector Graphics (SVG) is a standard for Scaled Vector Graphics, both of which (like MathML) are already referenced by EPUB 3.

Laying aside those standards that are already encompassed by EPUB 3, this list of standards can be reduced to the following categories, all of which are dealt with in this document's main recommendations:

— runtime data standards (SCORM, Tin Can API, AIC);

— embedded data formats;

— embedded widgets;

— accessibility standards;

— metadata standards;

— content and content packaging standards;

— syndication standards.

The relative popularity of these standards categories is shown in Figure C.10.

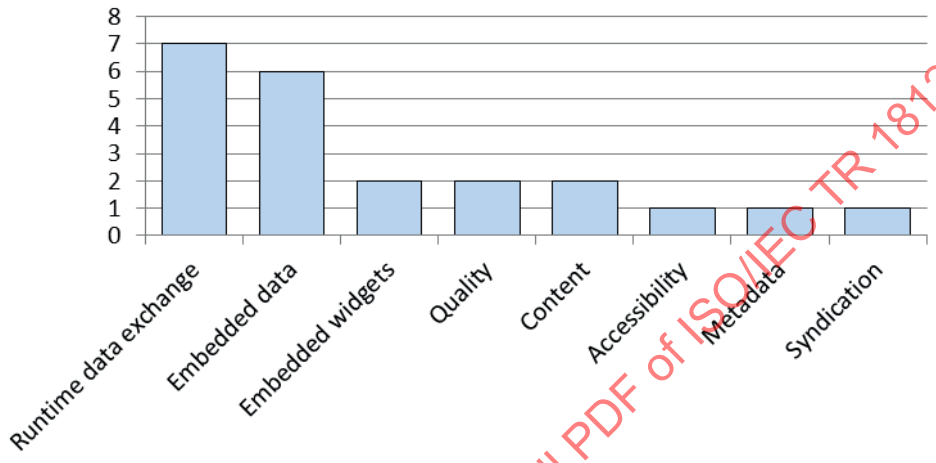

Figure C.10 — Other Standards by Category

C.3.3 Key requirements

Editors identified four key requirements that they believed might be required in an education-specific layer that might sit on top of a basic e-book standard:

— education-specific metadata;

— management of annotations;

— management of interactivity and learning support;

— ability to reorganize and re-sequence content.

Respondents were asked for their views on these high-level requirements, and whether they thought that there were any others that had been missed.

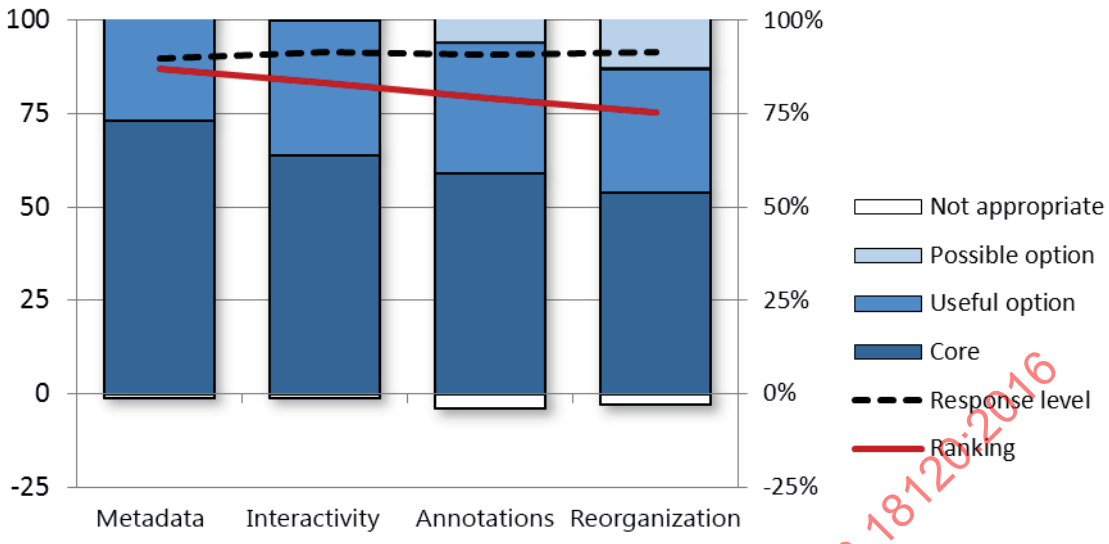

Figure C.11 — Importance of key requirements

Table C.3 — Importance of key requirements

	Metadata	Interactivity	Annotations	Reorganization
Core	73	64	59	54
Useful option	28	36	35	33
Possible option	5	8	10	19
Not appropriate	1	1	4	3
Response level	90 %	92 %	91 %	92 %
Ranking	87 %	83 %	79 %	76 %

All four of the proposed top-level requirements were generally well-received, with reorganization and re-sequencing as the only categories to attract any significant reservations.

C.3.4 Other key requirements

No respondents proposed any other top-level requirements, other than those suggested.

C.4 Metadata

C.4.1 Metadata functions

The creation of education-specific metadata was rated as the most important top-level requirement in 3.4. Respondents were asked to rank the importance of various metadata functions.

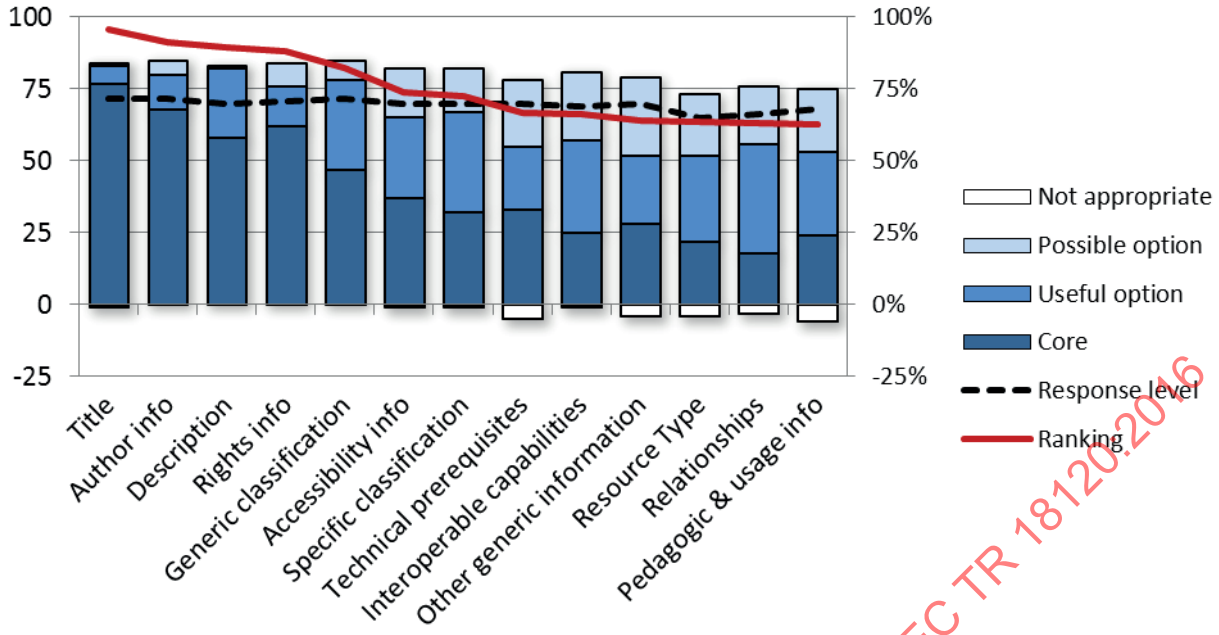

Figure C.12 — Metadata functions

Table C.4 — Metadata functions

	Title	Author info	Description	Rights info	Generic classification	Accessibility info	Specific classification	Technical prerequisites	Interoperable capabilities	Other generic information	Resource Type	Relationships	Pedagogic and usage info
Core	77	68	58	62	47	37	32	33	25	28	22	18	24
Useful option	6	12	24	14	31	28	35	22	32	24	30	38	29
Possible option	1	5	1	8	7	17	15	23	24	27	21	20	22
Not appropriate	–1	0	0	0	0	–1	–1	–5	–1	–4	–4	–3	–6
Response level	71 %	71 %	70 %	71 %	71 %	70 %	70 %	70 %	69 %	70 %	65 %	66 %	68 %
Ranking	96 %	91 %	90 %	88 %	82 %	74 %	73 %	67 %	66 %	64 %	64 %	63 %	63 %

All categories of metadata received rankings of more than 60 %.

A group of three categories (*Title*, *Author information* and *Description*) received rankings of over 90 % or more. A second group (*Rights information, Generic classification* and *Keywords)* received 71 % to 80 %, and *Accessibility information* and *Education-specific classification* were ranked at from 71 % to 80 %. Other categories all received rankings between 60 % and 70 %.

C.4.2 Other metadata functions

Respondents were asked to cite any metadata functions that had been missed.

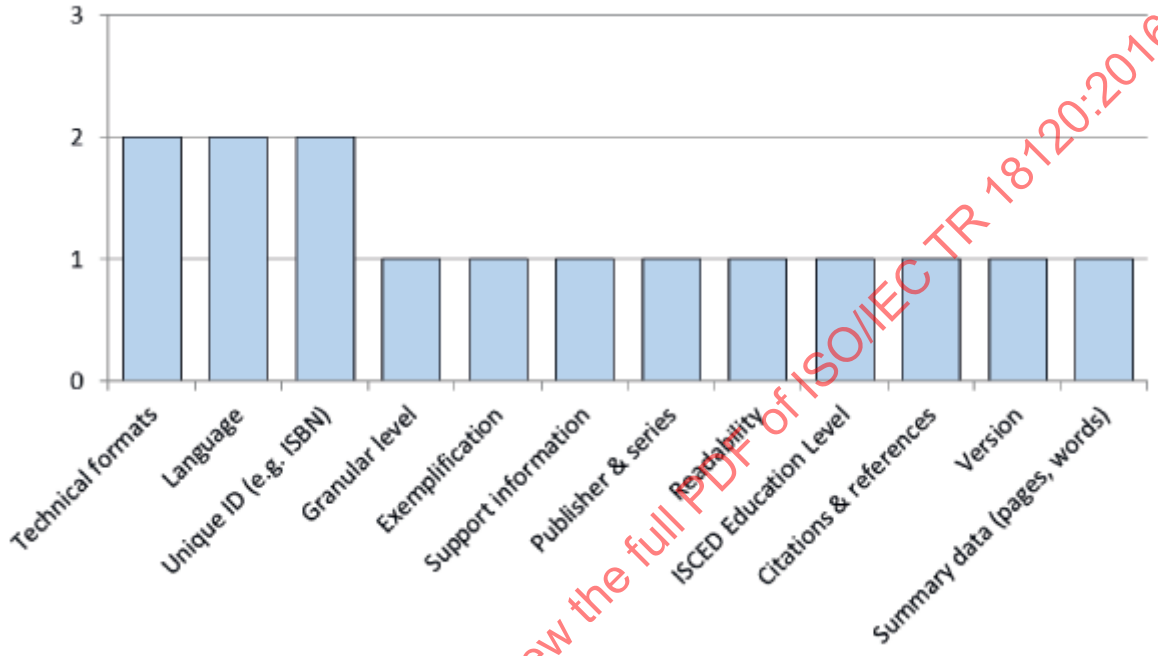

Figure C.13 — Other metadata functions

The only categories of missed metadata to be mentioned by more than one respondent were

— technical formats contained within the e-textbook,

— language, and

— unique identifiers such as ISBN numbers.

Of these three, and in the absence of quantitative survey evidence, we take the unique identifier to be of critical importance and the mark-up of language to be of moderate importance, given that this might not be necessary in the context of a local community of practice. The category *Technical formats* is broadly equivalent to the category *Technical prerequisites*, which was given in the question.

One respondent suggested that metadata should be attached at granular level. This is an issue that will be considered under the "chunking" of content reorganization and re-sequencing.

The categories *Citations and references*, *Exemplification*, and *Versions* are taken to be included under the more general category *Relationships*, which was provided in the question.

The inclusion of *Readability* (or *Reading level*) information has been tried in LOM specification under the label "semantic density". Although technically correct, this label has been poorly understood by users.

One respondent suggested the International Standard Classification of Education (ISCED) to be included in the *Education* level. This is a field that could be classified under the generic category of *Education-*

specific classification. There are a number of proposed measures for education level, none of which is widely recognized in practical use.

C.4.3 Metadata specifications

Respondents were asked what metadata specifications they thought should be used by e-textbooks.

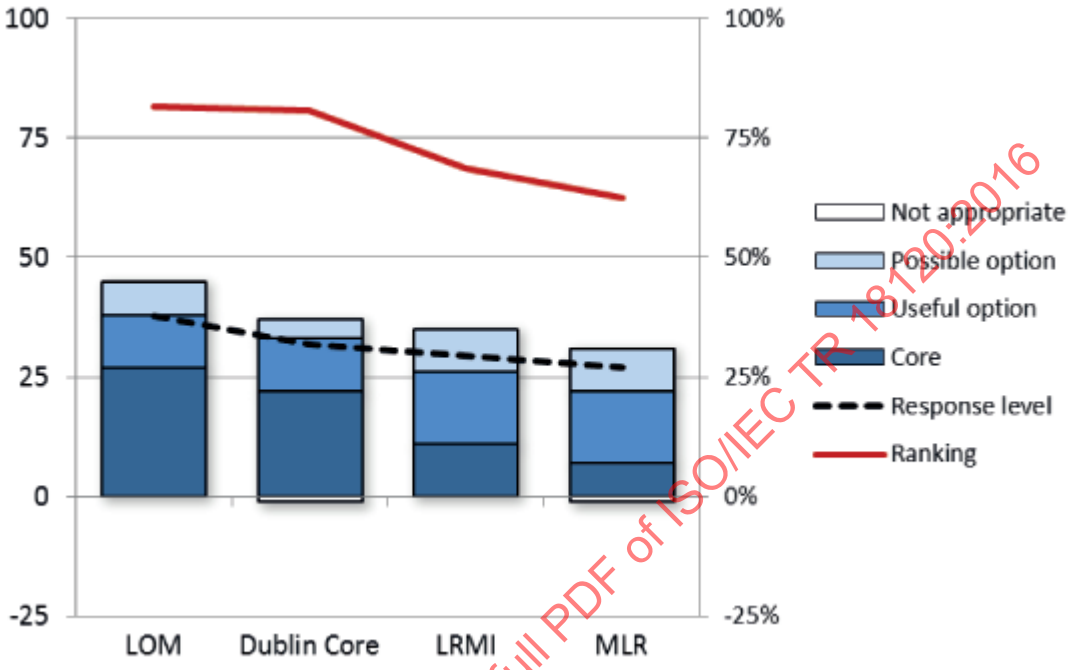

Figure C.14 — Metadata specifications

Table C.5 — Metadata specifications

	LOM	Dublin Core	LRMI	MLR
Core	27	22	11	7
Useful option	11	11	15	15
Possible option	7	4	9	9
Not appropriate	0	1	0	1
Response level	38 %	32 %	29 %	27 %
Ranking	81 %	81 %	69 %	63 %

At about 27 % to 38 %, the response level was relatively low, as might be expected for technical questions.

The two specifications that received the most support, with ratings of 81 % each were LOM and Dublin Core, with LOM receiving the higher response level (38 % as opposed to 32 %). The newer specifications, LRMI and MLR both received slightly lower rankings and response ratings.

Overall, LOM received the highest ratings but none of the metadata specifications commanded general recognition or approval.

C.4.4 Summary

The metadata space could be seen in three dimensions:

— the popularity of the categories (from the narrow set of metadata fields that are used consistently, to the very broad set of metadata fields that might conceivably be of interest);

— the specificity of the metadata (from generic to education-specific categories);

— the degree of formality required, depending on whether a category depends on the use of agreed vocabularies and whether consensus has yet been established in respect of such vocabularies.

In Table C.6, the first two of these dimensions are mapped by the two axes. The third dimension is shown by the typeface:

— **bold text** indicates a category that requires minimum formal specification (generally the naming of fields and the specification of length constraints);

— normal text indicates that some formality might be desirable but that this is either not essential or the degree of consensus required has already been substantially achieved;

— *italic text* indicates that formal vocabularies or other specifications are required.

The popularity of some categories (shown in parenthesis) has not confirmed by quantitative evidence, on account of their having been suggested by respondents.

Table C.6 — Popularity of categories

	Core	**Useful**	**Possible**
Generic	**Title** **Description** Author info (Identifier) *Rights info*	**Keywords** (Language) *Accessibility info*	**(Publisher and series)** Generic Classifications Relationships Technical prerequisites Usage information (Support information) (Readability)
Educational		*Educational classification*	*Resource Type* *(Educational level)*

This analysis suggests the need to

— work with the stewards of EPUB 3 to confirm the availability within the base standard of appropriate core metadata,

— pay particular attention within that process to the formatting of rights information,

— work with the stewards of EPUB 3 on a common recommended approach to accessibility-related metadata,

— agree within the education community on the formatting of educational classification information, and

— provide means for other communities of practice to develop their own metadata profiles, which are also likely to specify appropriate data formats, and to highlight the need for innovative approaches to mapping different local profiles.

The requirement to develop consensus around metadata for educational classifications could be further sub-divided into two:

— generic metadata, such as educational level or reading age;

— curriculum-specific metadata, that will almost invariably depend on local profiles.

C.5 Interactivity and learning support

C.5.1 Interactivity and learning support functions

Respondents were asked to rate the relative importance of different aspects of interactivity and learning support.

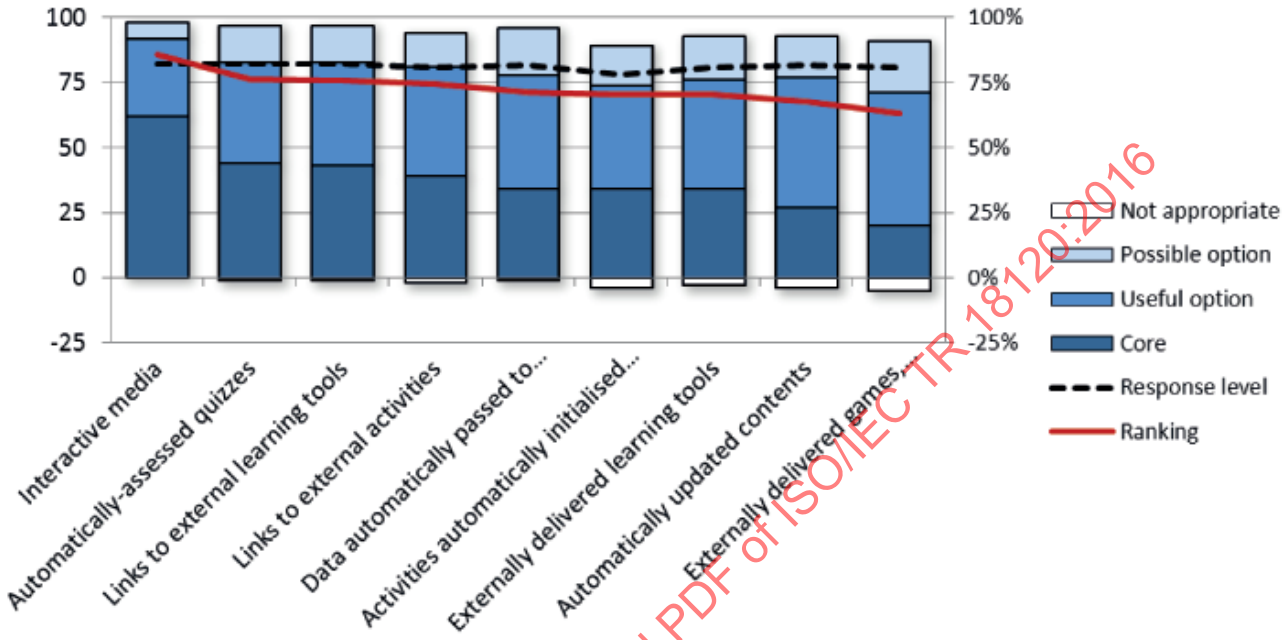

Figure C.15 — Interactivity functions

Table C.7 — Interactivity functions

	Interactive media	Automatically ssessed quizzes	Links to external learning tools	Links to external activities	Data automatically passed to external servers	Activities automatically initialized by automatically download	Externally delivered learning tools	Automatically updated contents	Externally delivered games, simulations
Core	62	44	43	39	34	34	34	27	20
Useful option	30	39	40	42	44	40	42	50	51
Possible option	6	14	14	13	18	15	17	16	20
Not appropriate	0	1	1	2	1	4	3	4	5
Response level	82 %	82 %	82 %	81 %	82 %	78 %	81 %	82 %	81 %
Ranking	86 %	76 %	76 %	74 %	71 %	71 %	70 %	68 %	63 %

The response to this question was higher than any other of those dealing with top-level requirements and the ranking given to the different functions listed was generally more than 70 %. This suggests that interactivity was seen by respondents as an important feature of e-textbooks.

The most popular category was *Interactive media*, which might also be seen as the most general category. Other categories ranked at 70 % or above were

— automatically assessed quizzes,

— links to external tools,

— links to external activities, and

— data reported externally.

It is clear from this list that respondents expected that e-textbooks should do more than provide interactivity natively in their own pages. They should also link to interactive software provided externally to the e-textbook itself, and should be able to report the results of activities to remote management systems.

The survey question did not raise the distinction between external services might be

— installed locally on the user's device, and

— provided remotely over the Internet.

C.5.2 Other interactivity and learning support functions

Respondents were asked whether there were any other functions for interactivity and learning support that needed to be covered.

The most common response was to discuss the tension between the need for interactivity that involved remote services and need to be able to use an e-book off-line. This affected both reporting behaviour and decisions about how much of a richly interactive e-textbook should be preloaded onto a local device.

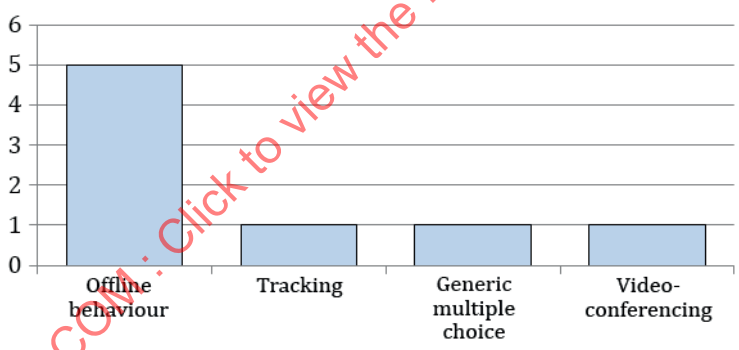

Figure C.16 — Other interactivity and learning support functions

Apart from reiterating the need for tracking and multiple-choice quizzes, the only new functionality suggested was for the option of accessing remote tutoring through video conferencing, a suggestion that implicitly raises the same issue around off-line behaviour.

C.5.3 Specifications for interactivity and learning support

Respondents were asked about the suitability of a range of specifications that aimed to deliver interactivity and learning support.

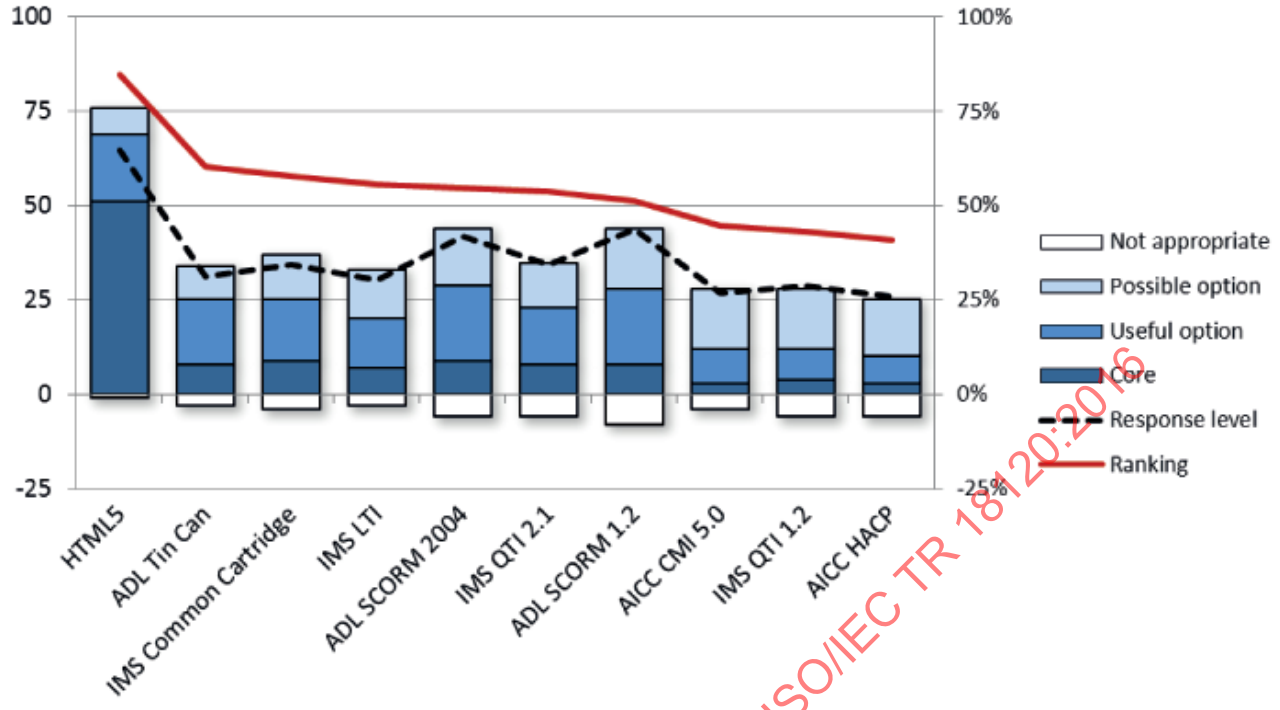

Figure C.17 — Interactivity specifications

Table C.8 — Interactivity specifications

	HTML5	ADL Tin Can	IMS Common Cartridge	IMS LTI	ADL SCORM 2004	IMS QTI 2.1	ADL SCORM 1.2	AICC CMI 5.0	IMS QTI 1.2	AICC HACP
Core	51	8	9	7	9	8	8	3	4	3
Useful option	18	17	16	13	20	15	20	9	8	7
Possible option	7	9	12	13	15	12	16	16	16	15
Not appropriate	1	3	4	3	6	6	8	4	6	6
Response level	65 %	31 %	34 %	30 %	42 %	34 %	44 %	27 %	29 %	26 %
Ranking	85 %	60 %	58 %	56 %	55 %	54 %	51 %	45 %	43 %	41 %

The response level was relatively low for this question. Apart from HTML5 which attracted a 65 % response and SCORM 2004 and 1.2 which attracted response levels of 42 % and 44 %, respectively, no other standard achieved a higher response than IMS Common Cartridge at 34 %. This indicates that many respondents are not particularly familiar with current education-specific specifications in this field.

In terms of ranking, HTML5 received the highest ranking by a significant margin (85 %). ADL's Tin Can led the rest of the field at 60 %.

C.5.4 Other specifications for interactivity and learning support

There were a few suggestions for other standards, including three comments that all warned, explicitly or implicitly, against creating education-specific solutions for generic requirements. These suggested variously that

— EPUB 3 already had all the functionality required,

— recommended generic standards for cloud computing being developed by IEEE, and

— activity streams used to report social networking activity and on which the new ADL Tin Can specification is modelled.

C.5.5 Summary

The questions on interactivity and learning support covered a number of different issues.

First is the delivery of interactive content, where there is a strong consensus that EPUB 3's native HTML5 should be the primary and most straightforward solution. However, there was also interest in the ability to embed external widgets, interpret education-specific data (such as standardized quizzes), and link to external content.

A separate issue is that of communications, principally driven by the need to report outcomes of interaction, but also to communicate with fellow students or remote tutors, or to embed content that depended on remotely hosted services.

Both the inclusion of what might be non-native, interactive content, and the need to communicate with remote servers and other users, raise fundamental questions about the ability to reconcile an interactive e-textbook with the ability to function in an off-line environment.

C.6 Annotations

C.6.1 Annotation functions

Annotations received a rating of 81 % when assessed as a top-level requirement. Although this placed it in third position out of four options, it nevertheless confirms its importance in an educational context.

Respondents were asked which annotation functions they thought were most important. Options included adding notes, bookmarks and hyperlinks, highlighting text, marking annotations with the identity of the author, and creating an index of hyperlinks.

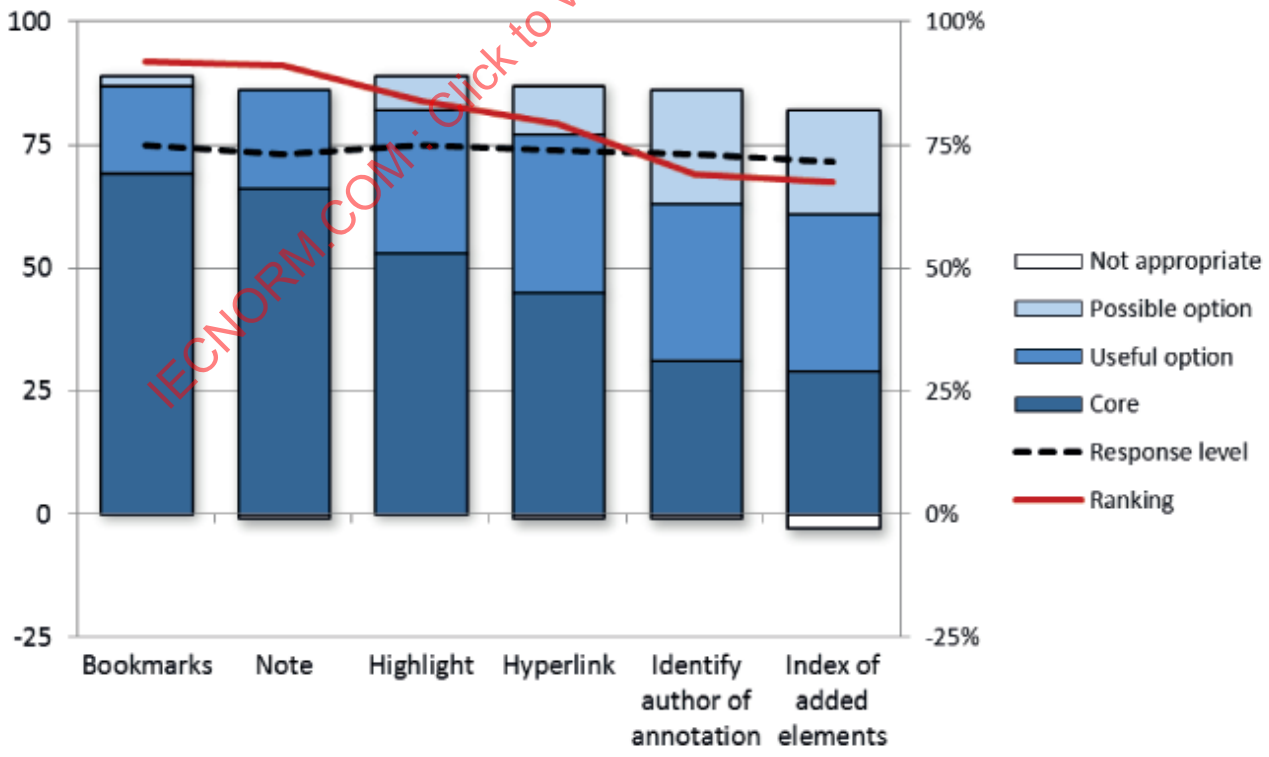

Figure C.18 — Annotation functions

Table C.9 — Annotation functions

	Bookmarks	Note	Highlight	Hyperlink	Identify author of annotation	Index of added elements
Core	69	66	53	45	31	29
Useful option	18	20	29	32	32	32
Possible option	2	0	7	10	23	21
Not appropriate	0	1	0	1	1	3
Response level	75 %	73 %	75 %	74 %	73 %	71 %
Ranking	92 %	91 %	84 %	79 %	69 %	67 %

The annotation functions fell into three groups:

— the ability to add bookmarks (92 %) and notes (91 %) was given strong support;

— highlighting text (84 %) and adding hyperlinks (79 %) were also supported, though more respondents saw these as optional extras;

— the ability to identify the author of an annotation (69 %) and the organization of annotations in an index (67 %) tended to be seen as options rather than core functions.

C.6.2 Other annotation functions

Respondents were asked whether they could suggest any other functions for annotations.

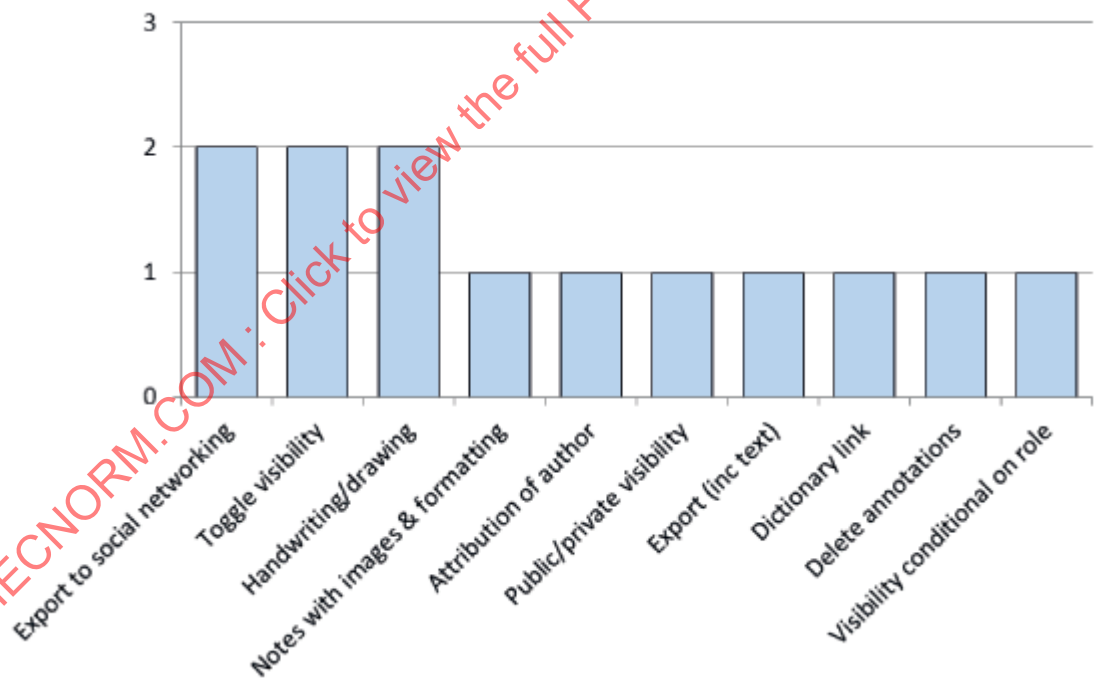

Figure C.19 — Other annotation functions

Two respondents suggested the potential for integrating annotations with social networking functions, perhaps by exporting annotations or otherwise allowing for threaded discussions. One respondent noted that the export of annotations would suppose the need to export an excerpt from the original text, which might have copyright implications.

Two respondents from China wanted support for handwritten or drawn annotations, a feature that may be particularly significant with Asian typefaces.

A second group of responses focused on the need to toggle visibility, either of annotations or of text. This might be accomplished manually, or by permanent deletion of an annotation or by some automatically mediated role-based logic, a minimal implementation of which might depend on annotations being marked as public or private.

When applied to the original text, one respondent suggested that such control over visibility represented a more appropriate mechanism for the selection of relevant passages than highlighting, which was tied too closely to a book metaphor. When revising, the student should be able to collapse irrelevant clauses, rather than highlight what was important.

In its more advanced forms, applying this kind of selectivity to the text could be classed under *Reorganization and re-sequencing* rather than under *Annotations*, highlighting a grey area between the two.

One respondent suggested the ability to link to a dictionary definition. This could be classed as a type of hyperlink, which was a category provided in the question, perhaps suggesting a possibility of providing a visual classification of hyperlinks (e.g. as dictionary definitions, examples, rebuttals, further information).

One respondent suggested the need in an Open Educational Resources (OER) environment to include attributions of original authors. This might better be classed as a metadata issue. Again, the point indicates a grey area between annotations, metadata and reorganization, where e-textbooks become reorganizable collections of diverse content elements, where more informal elements might be classed either as annotations or as original content.

One respondent suggested the need for notes to include images and formatted text in annotations, a suggestion that again begs the question of whether there is a qualitative difference between adding a note and adding new, substantive content.

One respondent suggested that none of the functions being suggested were specific to e-textbook but were features of e-book more generally. This may indeed be true and it is an objective of the current document to isolate education-specific requirements from generic requirements. Even functions that are generic from the point of view of the technical standards may still be relevant to a standard which recommends a minimum set of functionality to readers designed for use in educational settings.

C.6.3 Current support for annotations in base standards

Respondents were asked what they felt about the level of support for annotations in whatever base standard they had already chosen.

Only 11 % of respondents (4 out of 35) thought that annotations were already fully supported, though there was the potential for confusion between the support for annotations provided in the standards, and the support for annotations supported by current e-book readers.