



IMS Question & Test Interoperability: ASI Information Model Specification

Final Specification Version 1.1

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About This Document

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Summary	This document describes the IMS Question & Test Interoperability Information Model that is used to support question and test interoperability between different authors, publishers and other corresponding content developers.
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List of Contributors

The following individuals contributed to the development of this document:

Russell Almond	ETS	John Kleeman	Question Mark Computing Ltd
Andy Heath	CETIS/JISC	Paul Roberts	Question Mark Computing Ltd
Steven Lay	University of Cambridge Local Examinations Syndicate, UK	Eric Shepherd	Question Mark Corporation
Richard Johnson	Goal Design Inc	Colin Smythe	Dunelm Services Ltd

Revision History

Version No.	Release Date	Comments
Final 1.0	5 th June, 2000	The version 1.0 of the IMS Question & Test Interoperability Information Model Final Specification.
Final 1.01	22 nd August, 2000	An update of the version 1.0 specification. The core amendments are denoted by a shading of the corresponding lines in the document.
Final 1.1	9 th March, 2001	<p>The released version of the 1.1 specification. The key amendments are:</p> <ul style="list-style-type: none"> • The <i>entityref</i> attribute has been added to the tabular description and the object-oriented definitions. This is used as an alternative to the <i>uri</i> attribute; • The addition of the <i>xml:space</i> and the <i>xml:lang</i> attributes to the <i>mattext</i> and <i>matemtext</i> elements; • The concept of flows to provide partial control over material to be presented has been added. A complete description is given in Sub-section 4.3; • The <i>flow</i>, <i>flow_label</i> and <i>flow_mat</i> elements have been added to the tabular description and the object-oriented definitions. The <i>class</i> attribute has also been added; • The <i>matbreak</i> element has been added as one of the possible elements used with <i>material</i>. <i>matbreak</i> is used to force a line break into the layout of the associated text; • The <i>matemtext</i> element has been added to enable the identification of emphasised text. This can be used wherever the <i>mattext</i> element is permitted; • Redefinition of the content of the <i>duration</i> element to conform to durations as per ISO8601; • Vocabulary-based meta-data has been added. This allows new meta-data to be associated with Assessments, Section and Items. All QTI-specific meta-data is defined as optional; • The Overview sub-section (1.1) has been re-written. This is now common to all of the IMS QTI documents; • The tabular tables in Section 5 have been given a portrait orientation instead of the previous landscape-orientation; • The Conformance Statement in Section 7 has been reworked. This now contains a summary statement plus a detailed technical definition of the capabilities of a particular usage of the IMS QTI specification. <p>The core changes are shown within this document by the shading of the appropriate lines.</p>

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1. Introduction

1.1 Question & Test Interoperability Overview

The Question & Test Interoperability (QTI) specification describes a basic structure for the representation of question (item) and test (assessment) data. Therefore, the specification enables the exchange of this test and assessment data between Learning Management Systems, as well as content authors and, content libraries and collections. The QTI specification is defined in XML to promote the widest possible adoption. XML is a powerful, flexible, industry standard markup language used to encode data models for Internet-enabled and distributed applications. The QTI specification is extensible and customizable to permit immediate adoption, even in specialized or proprietary systems. Leading suppliers and consumers of learning products, services and content contributed time and expertise to produce this final specification.

The QTI specification, like all IMS specifications, does not limit product designs by specifying user interfaces, pedagogical paradigms, or establishing technology or policies that constrain innovation, interoperability, or reuse.

1.1.1 Historical Perspective

An initial V0.5 specification was released for discussion in March, 1999 and the corresponding Base Document was agreed in November, 1999. The Public Draft Specification was released in February, 2000 and the IMS Question & Test Interoperability (Q&TI) v1.0 specifications were released in their final form in May 2000. A version 1.01 update was released in August, 2000. Version 1.1 was released in March 2001 and contained the introduction of the QTILite specification. During the development of these specifications and their subsequent adoption by the community, several areas of further work were identified and the '1.x' versions of the IMS Q&TI Specifications were scoped to address these issues¹. To-date, in excess of 3000 copies of the QTI V1.1/V1.01 have been downloaded from the IMS web-site. The release of V1.2 is timetabled for August 2001 and V1.3 for February 2002; V1.2 will introduce 'Results Interoperability'.

1.1.2 The Requirements

The IMS QTI Working Group's work specifically relates to content providers (that is, question and test creators), virtual learning environment and tool vendors, and question/test users (that is, learners and teachers or trainers needing assessment tools). The targeted markets include primary and secondary education, community, junior and vocational colleges, higher education, and commercial and military training. The QTI specifications are intended to meet international needs as well. Therefore the QTI Working Group was focussed on enabling the following functionality:

- The ability to provide question items/banks to users regardless of virtual learning environment (VLE) deployed by the user;
- The ability to use question items/banks from various sources within a single VLE;
- Support for tools to develop new question items/banks in a consistent manner;
- The ability to report test results in a consistent manner.

Consequently, the following requirements have been suggested and are presented in order of priority:

- Definition of standardised attributes (question meta-data) for questions, choices, feedback/branch, scoring, meta-data along with identification of required and optional elements;
- Interoperability of question items/banks – definition for packaging and distribution;
- Extended schema for results reporting;
- Extended schema for assessment, tracking and presentation;
- APIs for dynamic interface into question retrieval and scoring/assessment engines.

¹ The version '1.x' nomenclature is used as a generic reference to all future releases that are derivative of the version 1.0 specification i.e. v1.1, v1.3, v1.3, etc.

It is also considered essential that the specification allows for extensibility and flexibility based on yet unidentified future needs and necessitated by specific customised implementations.

1.1.3 Key Terminology

Despite its name, the QTI specification details more than how to tag questions and tests. The standard Question types e.g. multiple choice, fill in the blank, or true/false choice, etc. can be constructed using a core set of presentation and response structures, and results of questions can be collected and scored by using a variety of methods. To represent these options, the QTI specification defines the ‘Item’. Items contain all the necessary data elements required to compose, render, score and provide feedback from questions. Therefore, the key difference between a ‘Question’ and ‘Item’ is that an ‘Item’ contains the ‘Question’, layout rendering information, the associated response processing information, and the corresponding hints, solutions and feedback.

Similarly, the ‘test’ is an instance of an Assessment. Assessments are assembled from Items that are contained within a ‘Section’ to resemble a traditional test. Additionally, Assessments might be assembled from blocks of Items that are logically related. These groups are also defined as ‘Sections’ and so Assessments are composed of one or more Sections which themselves are composed of Items, or more Sections. Collectively, these three data objects are referred to as the ASI (Assessment, Section, Item) structures.

To avoid limitations associated with words like user, student, or learner the QTI working group adopted the term ‘participant’ to refer to the person interacting with an assessment.

- **Item** – A combination of interrogatory, rendering, and scoring information;
- **Section** – A collection of zero or more items and/or other Sections;
- **Assessment** – A collection of one or more Sections;
- **Participant** – The user interacting with an assessment.

1.1.4 The Documents

The QTI specification comprises four separate documents²:

The ASI Information Model

The QTI Information Model document is comprised of several sections. The first section contains use cases in which the underlying usage, processing control, and core data structures of the QTI specification are described. It also details the taxonomy of responses, as well as their relationship to questions type and the larger group of ‘items’. The basic information model itself is outlined in conceptual terms by using a tabular layout of the Assessment, Section, and Item objects in terms of their elements, sub-elements and attributes. The Item, Section, and Assessment meta-data, which are used to catalogue these objects, are also described. In addition, the document contains a conformance statement to be used by vendors who plan to implement the specification; we have adopted a descriptive approach to conformance thereby enabling vendors to implement subsets of the full specification. A detailed class and object model for the Assessment, Item and Section objects is also included in an appendix to the document.

The ASI XML Binding Document

The XML Binding document describes the implementation of the QTI information model in XML. XML is introduced by outlining XML basics, including a conceptual discussion of the XML schema. The XML schema description of the QTI specification (IMS_QTIv1p1.dtd) defines the Assessment, Section, and Item as XML elements. An example schema for Assessments, Sections, and Items is included, along with details of the meta-data used to catalogue Assessment, Sections, and Items. The XML Binding document also includes, as appendices, a copy of the uncommented XSD, as well as the uncommented DTD and XDR (XDR document is a Microsoft Corporation XML schema implementation)³.

² The ASI notation is used to differentiate between the documents that refer to the ‘Assessment, Section and Item’ interoperability as opposed to the ‘Results Reporting’ documents that will be introduced as part of the Version 1.2 specifications.

³ For Versions 1.0 and 1.01 the specification bindings were based upon DTDs and XDRs. For version 1.1 and later the specification bindings are based upon XML Schema (XSD) and DTDs.

The ASI Best Practices & Implementation Guide

This document is intended to provide vendors with an overall understanding of the QTI specification, the relationship of the QTI specification with other IMS specifications, and a best practices guide derived from experiences of those using the specification.⁴ Example Item types supported by the specification, examples of composite Item types, and a complete XML example for presenting an Assessment, Section, and Item is included. The Best Practices & Implementation Guide also includes a significant number of actual examples that describe how vendors can make the best use of the QTI specification. These examples, approximately eighty, are also useful as a starting template for each of the different forms of Assessment, Section and Item. Appendices provide the range of available DTDs, XDRs and XSDs (as appropriate), as well as a glossary of key terms and elements used throughout the specification.

The QTILite Specification

This document describes the components that are required to construct the simplest form of a QTI-compliant system. QTILite supports multiple-choice questions (this includes the true/false questions) only and limits the rendering form to the classical one response from a set of choices. Multiple Items can be exchanged in a single QTI-XML instance but Assessments and Sections are not supported. The QTILite specification is a standalone document in that none of the others are required to understand and construct QTILite-compliant systems. All QTILite compliant Items are compliant with the full IMS QTI V1.1 specification but they are not backwards compatible with V1.0 or 1.01 of the specification.

1.1.5 The ASI Structures

The core data structures that can be exchanged using QTI are shown schematically in Figure 1.1.

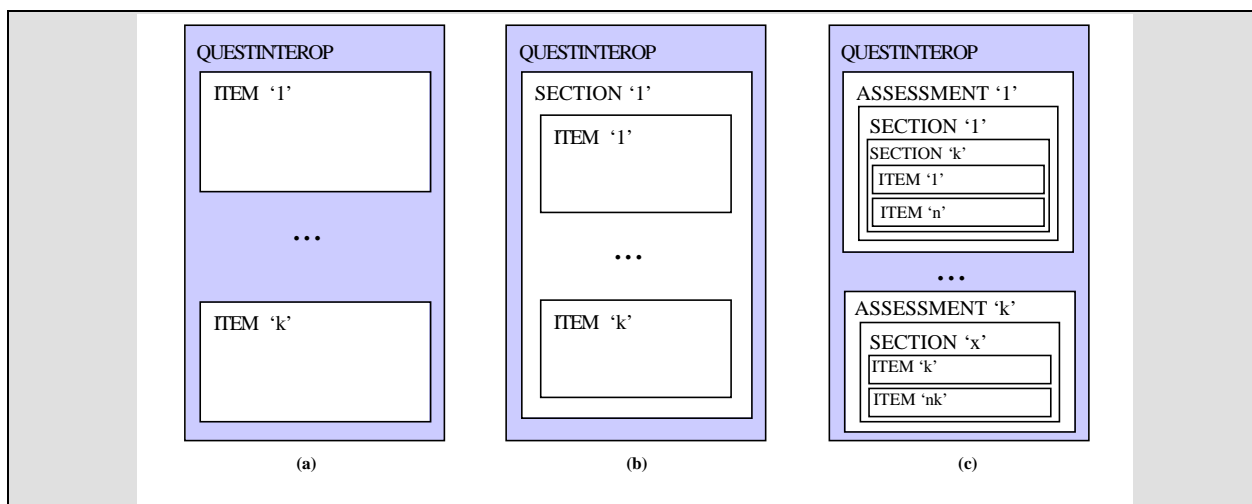


Figure 1.1 The core data structures that can be exchanged using QTI.

The three structures are:

- Item(s) – one or more Items can be contained within a QTI-XML instance. The Item is the smallest independent unit that can be exchanged using QTI. An Item cannot be composed of other Items;
- Section(s) – one or more Sections can be contained within a QTI-XML instance. A Section can contain any mixture of Sections and/or Items;

⁴ We recommend that new users of the QTI specification start with the Best Practices & Implementation Guide. The examples in this document show how we intend the specification to be used whereas the other two documents (the Information Model and XML binding) contain the formal description of the structures, their syntax and semantics.

- Assessment(s) – one or more Assessments can be contained within a QTI-XML instance. It is not possible to define relationships between the Assessments. Each Assessment *must* contain at least one Section, thus it is not possible to have Items housed directly within an Assessment.

While the definition of an Item and Assessment is well established it must be stressed that the ‘Section’ is merely a grouping construct. This allows any level of grouping of the Items and/or Sections. What these Sections actually mean in an assessment environment is dependent on the ways in which the contents are to be used.

1.1.6 Using the IMS QTI Specification

Users wishing to adopt the IMS QTI specifications are advised to start with either the QTILite specification or the Best Practice & Implementation Guide documents. Both of these documents contain extensive examples. All of these examples are available as part of the QTI toolkit and as such they make excellent templates. Several versions of the XML Schema, DTDs and XDRs exist in terms of file structure (IBM, Unix, MacOS) and functional complexity (QTILite; Item-only; Items and Sections; core elements i.e. excluding the extension and V1.x/V2.0 features, the full uncommented; the full commented version). Beginners should focus on the QTILite and Item-only versions. The full commented version should be avoided unless a documented version of the schema is required. The QTI specification includes its own QTI-specific meta-data features but the IMS Meta-data can also be used. The IMS Content packaging specification incorporates the QTI specification as a native structure i.e. the Assessment, Section and Item XML can be contained within the a Content packages XML. It is recommended that the IMS Content Packaging specification approach is used for the physical exchange of the QTI-XML instances.

1.2 Scope & Context

This document is the second revision of the IMS Question & Test Interoperability (Q&TI): ASI Information Model Specification. As such it will be used as the basis for the production of the following documents:

- IMS Question & Test Interoperability: ASI XML Binding Specification v1.1;
- IMS Question & Test Interoperability: ASI Best Practice & Implementation Guide v1.1;
- IMS Question & Test Interoperability: QTILite Specification v1.1.

This requirement has been derived from the agreed IMS Q&TI V1.1 Scoping document [QTI, 00].

Within the next 6 months Version 1.2 of the Information Model will be developed. That version will extend the functions and capabilities of version 1.1 but will be backwards compatible except for those areas identified as extensions and/or for further study.

1.3 Structure of this Document

The structure of the rest of this document is:

- | | |
|--|---|
| 2. SPECIFICATION USE CASES: | The underlying usage, processing control and data structures comprising the question and test interoperability system; |
| 3. QUESTIONS, ITEMS AND RESPONSES: | The taxonomy of responses and their relationship to question/items; |
| 4. BASIC INFORMATION MODEL: | The underlying question and test interoperability information model; |
| 5. CONCEPTUAL DESCRIPTION OF THE DATA OBJECTS: | The detailed description of the Assessment, Section and Item objects in terms of their elements, sub-elements and attributes; |
| 6. METADATA DESCRIPTIONS: | The item, section and assessment metadata descriptions; |
| 7. CONFORMANCE STATEMENT | The definition of Conformance to be used by vendors; |
| APPENDIX A – DETAILED OBJECT MODEL | The detailed class and object model for the Assessment, Section and Item objects. |

1.4 List of Abbreviations

ASI	Assessment, Section and Item
FIB	Fill In Blank
IHS	Image Hot Spot
LDS	Logical Data Structure
LMS	Learning Management System
QTI	Question & Test Interoperability
UML	Unified Modelling Language
XML	Extensible Markup Language

1.5 References

- [ETS, 99] *A Sample Assessment Using the Four Process Framework*, R.Almond, L.Steinberg and R.Mislevy, ETS Working Paper, October 1998.
- [QTI, 99a] *IMS Question & Test Interoperability Requirement Specification*, C.Smythe, Version 1.0, Draft 0.3, IMS, November 1999.
- [QTI, 00] *IMS Question & Test Interoperability Version 1.x Scoping Statement*, C.Smythe and E.Shepherd, Version 1.0, IMS, November 2000.
- [QTI, 01a] *IMS Question & Test Interoperability: ASI XML Binding Specification*, C.Smythe and E.Shepherd, Version 1.1, IMS, March 20001
- [QTI, 01b] *IMS Question & Test Interoperability: ASI Best Practice & Implementation Guide Document*, C.Smythe and Eric Shepherd, Version 1.1, IMS, March 2001.
- [QTI, 01b] *IMS Question & Test Interoperability: QTILite Specification*, C.Smythe and E.Shepherd, Version 1.1, IMS, March 2001.
- [RFC1521] *MIME (Multipurpose Internet Mail Extensions) Part One: Mechanisms for Specifying and Describing the Format of Internet Message Bodies*, N.Borenstein and N.Freed, IETF, IETF Request for Comment, September 1993.
- [RFC1630] *Universal Resource Identifiers in WWW: A Unifying Syntax for the Expression of Names and Addresses of Objects on the Network as used in the World-Wide Web*, T. Berners-Lee, IETF, IETF Request for Comment, June 1994.

2. Specification Use Cases

The Requirement Specification [QTI, 99a] introduced the base QTI system architecture and the v1.x scoping document [QTI, 00] was responsible for extending this requirement. The underlying process components (circles) and data structures (thin rectangles) and the participants (stick-people) are shown in Figure 2.1.

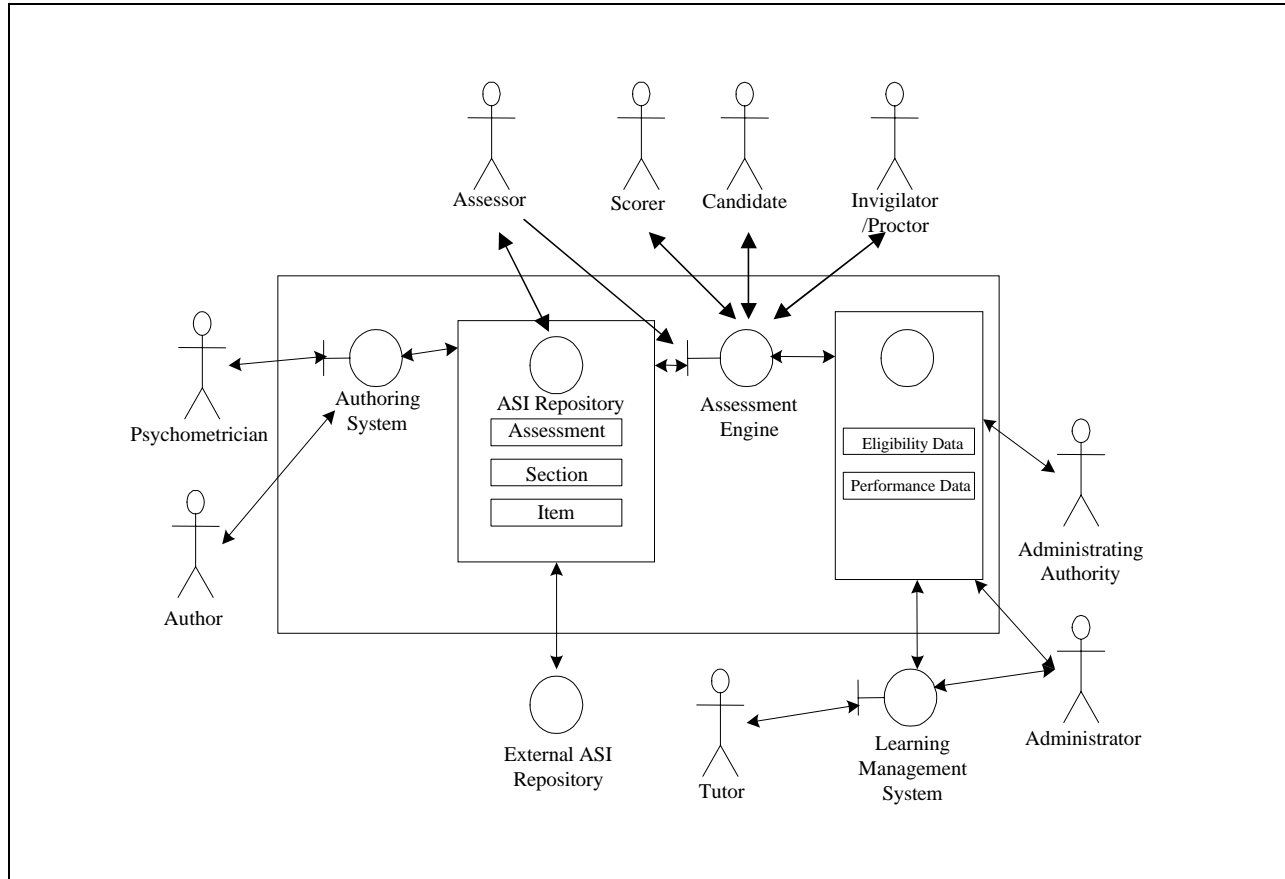


Figure 2.1 Assessment system component representation.

The key components of the assessment system are:

- Authoring system – the process that supports the creation and editing of the Assessments, Sections and Items (ASIs);
- Assessment engine – the process that supports the evaluation of the responses in terms of producing ASI related scores, evaluation and feedback;
- Learning management system – the process/system which is responsible for the management of the entire learning architecture;
- Candidate data repository – the database of the candidate specific information. The eligibility content is outside of the scope of the Q&TI specifications whereas the Examinee record information will be addressed by later versions of this specification;
- ASI repository – the database of the local ASIs;
- External ASI repository – the databases of the external ASI that will be imported through the use of the QTI specifications.

The Version 1.1 IMS QTI Information Model is concerned with the specification of the *ASI* data structures. Throughout the detailed information model description the term ‘view’ will be used to describe the perspective of the system as perceived by a *Participant*. As such different participants will have access to similar functions but the content will reflect the nature of the actor.

A range of Use-cases are possible but only three are presented as examples of this current version of the specification:

- Authoring – creation and editing of the ASIs;
- High-stakes Assessment – candidate examination;
- Low-stakes Assessment – tutor support using the ASIs.

2.1 Authoring Use-case

The sequence of processing, with respect to the ASI data structures is:

The Author launches the Authoring System;

- The *Author* then creates, or modifies, *Items*, *Sections* and/or *Assessments*. These are then exported using this QTI specification and stored in some external database. The ASI data structures can consist of complex groups based upon multiple *Assessments* and/or multiple recursive *Sections* and/or multiple *Items*;
- The Author may import ASIs that will be used to create the new ASIs. These imported ASIs will also conform to the QTI specifications;
- One of the key responsibilities of the author is to determine the response-type and to map this to the appropriate rendering type. This mapping will depend upon the educational objective of the Item. Similarly, the Section and/or Item groupings, selection and sequencing will be dependent upon the educational objectives of the ASI unit. The author is also responsible for supplying the actor view specific information – this is important as it will help the users appreciate how the material is to be used;
- The Psychometrician sets Item weights and parameters in the Assessment and may reference Assessment records (pre-test data);

2.2 Assessment Use-cases

2.2.1 High-stakes Assessment Use-case

The *Assessment Engine* process is responsible for realising this activity (the basic processing scheme is derived from the ETS framework [ETS, 99]). It is important to note that the internal operation of the *Assessment Engine* is beyond the scope of this specification. This use-case is included because it justifies some of the structural components that must be defined within the ASIs. The Assessment Engine’s assessment processing sequence is:

- The *Assessor* constructs/selects the ASIs to be used throughout the assessment procedure. These ASIs will be stored in some internal database and as such the dynamic sequencing information must be self contained;
- The assessment is activated by the *Candidate* and this activity is monitored by the *Invigilator/Proctor*. The *Candidate* responds to the ASIs and produces a set of *Responses*, again stored internally. The *Responses* are the set of Item identifiers plus associated information that accurately characterise the response;
- Either synchronously or asynchronously each *Response* will be evaluated by the *Response Processing* to construct the initial score (the scoring information is a part of the *Item* data structure). This scoring requires the usage of a set of *Evidence Rules* that are used to define the key parameters through which the responses are to be evaluated. The resulting Item evaluation is stored in the *Outcomes* data structure. If an Item is to be reused in two different assessments (e.g. high-stakes selection or low-stakes tutoring), then the same content with different response processing and accumulation can be used. In this case, Authoring Systems would be responsible for changing the associated outcome description and response processing, as well as accumulation data and parameters;
- *Accumulation Processing* now takes place in which the *Outcomes* are analysed and collated in terms of the weighting, etc. defined as part of the *Section* data structures. This information is stored as part of the *Assessment Record* (this data structure will be formally defined in Version 1.2 of this specification);

- The final stage of assessment processing is the *Assessment Accumulated Process* in which the *Assessment Record* is further processed with respect to the *Assessment* data structure level instructions;
- The final stage of processing is feedback of the *Assessment Record* to the *Activity Selection* that may in turn result in a modification of the ASIs presented to the *Candidate*.

2.2.2 Low-stakes Assessment Use-case

The Tutor use-case is similar to the Assessment use-case. The differences are that the Candidate will receive a range of feedback information including hints and one or more possible solutions. The Assessment Engine's tutor processing sequence is:

- The *Tutor* constructs/selects the ASIs to be used throughout the tutoring procedure. These ASIs will be stored in some internal database and as such the dynamic sequencing information must be self contained. Candidates may be able to act as their own tutor with some control over their activity selection;
- The tutor session is activated by the *Candidate*. The *Candidate* responds to the ASIs and produces a set of *Responses*, again stored internally. The *Responses* are the set of item identifiers including response-type identifiers plus associated information that accurately characterise the response;
- Each *Response* is evaluated by the *Response Processing* to construct the *Item* store. This scoring requires the usage of a set of *Evidence Rules* that are used to define the key parameters through which the responses are to be evaluated. The resulting Item evaluation is stored in the *Outcomes* data structure. This information is then used to generate Feedback e.g. *Hints* or to reveal a partial or complete *Solution*.

The rest of the processing is as per the Assessment use-case.

3. Questions, Items and Responses

The terminology adopted for the QTI is that an *Item* is defined as the fundamental block that contains one or more questions and responses. As such the concept of an *Item-type*, or for that matter question-type, is inappropriate and so the fundamental reference identity will be based upon *Response-type*. The *Response-type* is the unique identifier for the type of response required from the user e.g. a selection for a multiple-choice question or a string for a fill-in-blank question.

3.1 A Response-type Taxonomy

The adopted response-type taxonomy is shown in Figure 3.1. An IMS Response-type can be *Basic* or *Composite* (the third category is the Proprietary group):

- Basic – one that contains only a single type of response;
- Composite – a composite response-type refers to a response that acts as a *container* for (sub-) response, normally different combinations of the basic response-types. The series of the sub-response-types are usually related to each other thereby constructing a thematic item.

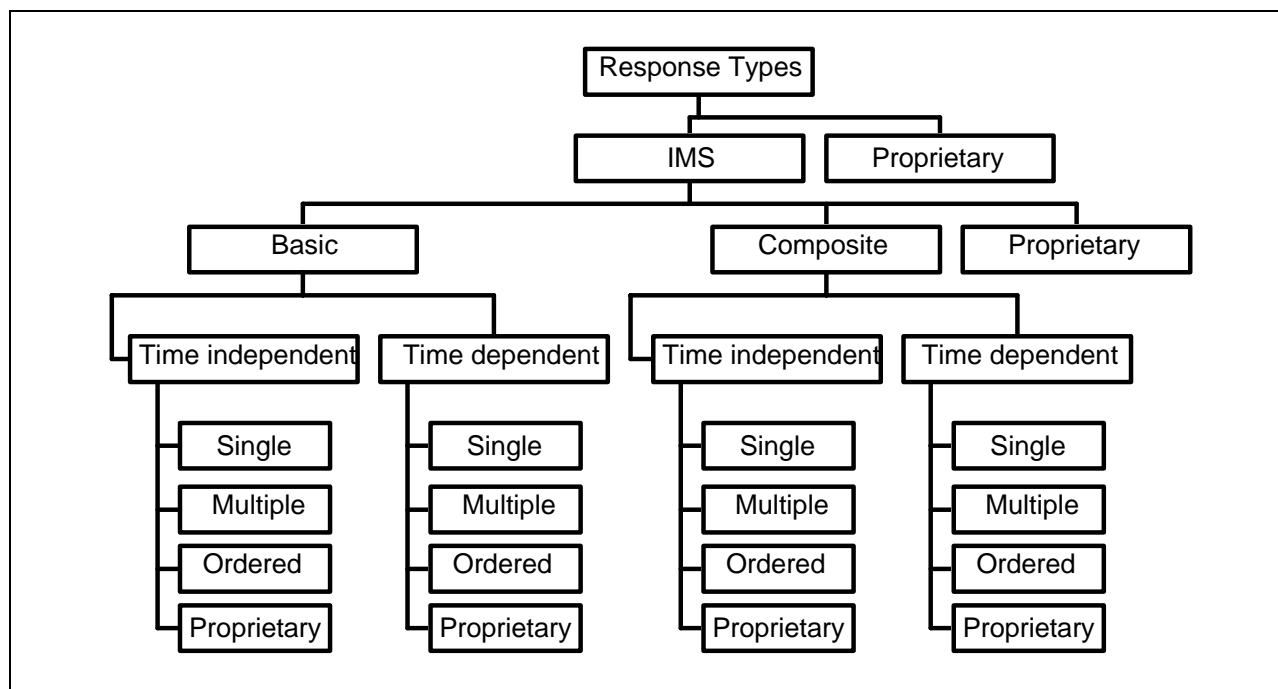


Figure 3.1 A response-type taxonomy.

The taxonomies below the Basic and Composite categories are identical. The next sub-division is based upon:

- Time Dependent – the time taken to respond is important and must be recorded. This could be used by response-types which set a sequence of events to be completed in a predefined period or where the sequence of response-types is determined by the time taken to complete certain responses;
- Time Independent – the time taken to respond is not significant;
- The final level of categorisation in Figure 3.1 is based upon the number of actions required from the user. This categorisation gives rise to Table 3.1.

Table 3.1 User action classification.

Response-type	Basic	Composite
Single	A single user response with each item consisting of a single response-type.	A single user response with each item consisting of more than one response-type. Some of the responses will therefore be 'null'.
Multiple	One or more user responses with each item consisting of a single response-type.	One or more user responses with each item consisting of more than one response-type. Some of the responses may be 'null'.
Ordered	One or more user responses with each item consisting of a single response-type, and the order of selection being significant.	One or more user responses with each item consisting of more than one response-type, and the order of the selection being significant. Some of the responses may be 'null'.

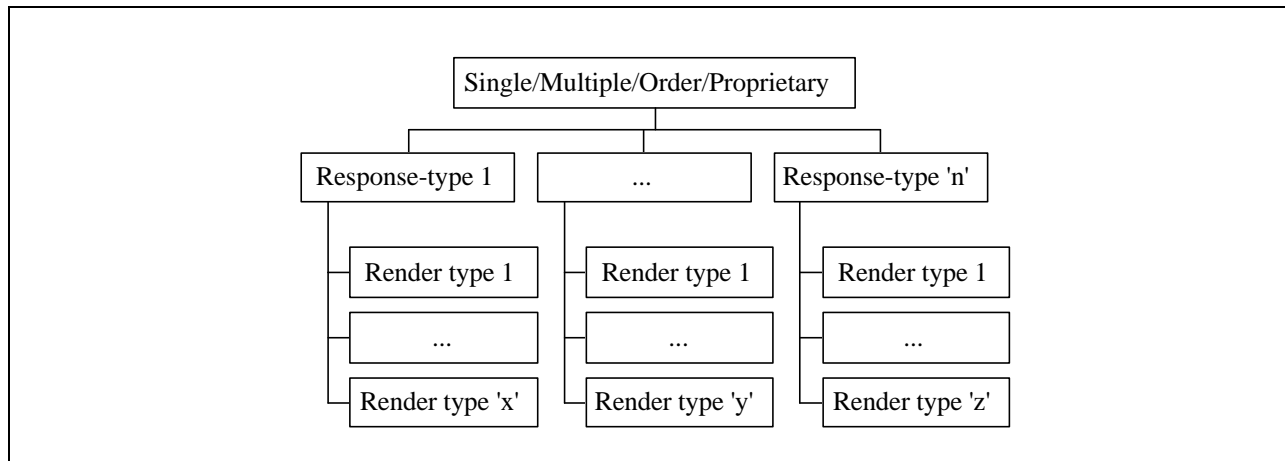


Figure 3.2 The relationship between response-type and rendering.

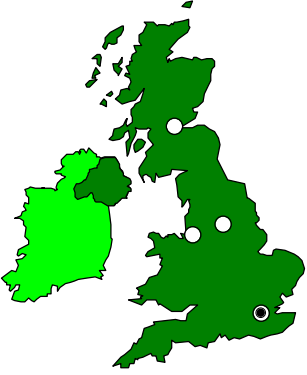
<p>Which <i>city</i> is the capital of <i>England</i> ?</p> <ul style="list-style-type: none"> <input type="radio"/> Sheffield <input checked="" type="radio"/> London <input type="radio"/> Manchester <input type="radio"/> Edinburgh 	 <p>Which <i>city</i> is the capital of <i>England</i> ?</p>
---	--

Figure 3.3a Standard text-based rendering of a multiple choice question.

Figure 3.3b Hot-spot rendering of a multiple choice question.

The next level of taxonomy of the Response-type is shown in Figure 3.2. In Figure 3.2 the relationship between the response type and the different presentation formatting, or rendering, is shown. For each of the classifications there are a number of Response-types and for each Response-type there are one or more ways of rendering that response selection. An example of this multiple rendering is shown in Figures 3.3a and 3.3b. In these two examples the same question is asked ('Which city is the capital of England?') but it is presented/rendered in two different formats⁵:

- Figure 3.3a – using a standard list of text responses with radio buttons;
- Figure 3.3b – using a graphic with marked hot-spots.

The feature of these two renderings is that the same generic action is required of the user – the identification of one correct piece of information from several possible options. The classification scheme is independent of the possible rendering formats because this is a reflection of the rendering engine and the educational objectives. The reason for adopting this form of categorisation is that it is independent of the actual response-types and focuses on the actions required of the user. This means that:

- New response-types can be readily added without altering the classification scheme;
- Rendering is independent of the classification schemes;
- User actions are accurately represented thereby reflecting the required data flow.

3.2 Response-types

The primary objectives of defining the response-types are to establish a common vocabulary and naming conventions and to establish the underlying data structure requirements.

3.2.1 Basic Response-types

The basic response-types explicitly supported by this specification are listed in Table 3.2. Table 3.2 shows the relationship between the Response-types, the more colloquially identified question types and the Single/Multiple/Ordered classification schemes adopted by this specification. This representation uses the colloquial-types as the rendering forms for the Response-types.

The five Response-types become the core information model response-type objects. The three single/multiple/ordered categories become attributes of the basic response-type class, the five instances of which become the response-types. A range of rendering types can then be applied to these response types i.e. the rendering type is the presentation format of the response-type to the user.

The colloquial question types supported by this specification are⁶:

- True/false – multiple choice question with either a 'true or false', 'agree or disagree', etc. response identified by the response identity;
- Multiple choice – multiple choice question with one of the available choices identified by the response identity;
- Multiple response – multiple choice question with one or more of the choices identified by the response identities;
- Image hot spot (IHS) – the response-type is the location on a graphic identified by the 'x-y' co-ordinates of the point of selection;
- Fill-in-blank (FIB) – formatted entry place for text or integer/decimal/scientific number identified by the entered information. The response-type is either a string or integer/decimal/scientific number respectively for each response identity;
- Select text – identification of text from a presented paragraph or list. The response is the identified string or a mapping to a logical identifier;

⁵ The two examples in Figure 3.3 are based upon different educational objectives but this not a consideration of the specification. The example clearly demonstrates that a multiple-choice question can be rendered in more than one way.

⁶ Examples of all of these colloquial question types and their usage in rendering the response-types is given in the IMS QTI Best Practice & Implementation Guide [QTI, 01b].

- Slider – selection of an integer or real number from a predefined minimum and maximum with a set increment. The response-type is a real or integer number, or a mapping to a logical identifier;
- Drag object – these objects are moved into predefined object locations. The response type is identified by the pairing of the source object with the target object identities;

Table 3.2 Basic response-types⁷.

Response-type	Data Structure	Rendering Formats		
		Single	Multiple	Ordered
Logical Identifier (LID)	The response-type identity or list of identities. The order of the list is first choice, second choice, etc.	Multiple choice True/false Slider	Multiple response	Order objects Connect-the-points Match item Drag object Drag target
X-Y Co-ordinates (XY)	The 'x-y' co-ordinates of the centre of the object for each response identity or a list of 'x-y' co-ords. The order of the list is first choice, second choice, etc.	Image hot spot	Order objects	Connect-the-points
String (STR)	The typed string for each response identity.	Fill-in-blank Select text Short answer Essay		
Numerical (NUM)	The entered number for each response identity.	Fill-in-blank Slider		
Logical Groups (GRP)	The response identity and group identity tuples for each matched set of objects.		Match item Drag object Drag target	

- Drag target – objects are dropped into the target object. The response-type is identified by the pairing of the target object with the moved object identities;
- Ordered Objects – the re-ordering of scrambled text or text lines or a set of objects have to be moved to predefined locations on a page. The response is identified by either the set of 'x-y' co-ordinates of the response identities or their logical group;
- Match item – object from each list has to be grouped together. The response-type is an n-tuple of the set of matched items such that for each object its response identity and group number are recorded;
- Connect the points – the ordered connection of a set of points. The response-type is a set of 'x-y' co-ordinates or LIDs.

All of these colloquial question types can be supported by the five response-types listed in Table 3.2. In many cases the response-types can be rendered using different colloquial question types and so the rendering engine must be

⁷ Examples of all of these Response-types is given in the IMS Q&TI Best Practice & Implementation Guide [QTI, 01b].

supplied with sufficient information to map back to the response-type. It is the response type that is used to drive the scoring and feedback mechanism.

3.2.2 Composite Response-types

Composite Response-types are responses in which the user will have to answer two or more basic response-types (these basic types may be the same)⁸. Examples of two composite Response-types are shown in Figure 3.4 (based upon several response-types of the same type) and 3.5 (based upon two different response-types – multiple choice and FIB).

<p style="text-align: center;">Identify the odd one out from each list ?</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Sunday</td> <td style="text-align: center;">Monday</td> <td style="text-align: center;">Tuesday</td> <td style="text-align: center;">Wednesday</td> </tr> <tr> <td style="text-align: center;"><input checked="" type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td style="text-align: center;">Litre</td> <td style="text-align: center;">Pint</td> <td style="text-align: center;">Mile</td> <td style="text-align: center;">Gallon</td> </tr> <tr> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input checked="" type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> <tr> <td style="text-align: center;">Inch</td> <td style="text-align: center;">Yard</td> <td style="text-align: center;">Furlong</td> <td style="text-align: center;">Pound</td> </tr> <tr> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input checked="" type="radio"/></td> </tr> <tr> <td style="text-align: center;">Year</td> <td style="text-align: center;">Decade</td> <td style="text-align: center;">Score</td> <td style="text-align: center;">Century</td> </tr> <tr> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> <td style="text-align: center;"><input checked="" type="radio"/></td> <td style="text-align: center;"><input type="radio"/></td> </tr> </table>	Sunday	Monday	Tuesday	Wednesday	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Litre	Pint	Mile	Gallon	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	Inch	Yard	Furlong	Pound	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	Year	Decade	Score	Century	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<p style="text-align: center;">Which <i>city</i> is the capital of <i>England</i> and name another city in England ?</p> <p style="text-align: center;"> <input type="radio"/> Sheffield <input checked="" type="radio"/> London <input type="radio"/> Manchester <input type="radio"/> Edinburgh </p> <p style="text-align: center;">Another city: <input style="width: 100px;" type="text"/></p>
Sunday	Monday	Tuesday	Wednesday																														
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>																														
Litre	Pint	Mile	Gallon																														
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>																														
Inch	Yard	Furlong	Pound																														
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>																														
Year	Decade	Score	Century																														
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>																														

Figure 3.4 Composite response-type based upon the same basic response-types.

Figure 3.5 Composite response-type based upon the different basic response-types.

The range of possible composite types is considerable and as such no attempt is made to identify all of them.

3.3 Proprietary Extensions

A key requirement for the specification is its support for proprietary response-types and rendering formats. The points at which the proprietary extensions fit within the response-type taxonomy are clearly denoted in Figure 3.1:

- As an alternative to the set of IMS types;
- As an alternative to the *Basic* and *Composite* classifications;
- As an alternative to the Single/Multiple/Ordered classifications.

Further extensions are possible in the range of rendering types as shown in Figure 3.2. The final issue is whether or not the range of basic response-types, listed in Table 3.2, need to be extended. The XML binding will describe a mechanism by which proprietary extensions are available should new response-types be required by vendors.

The process by which proprietary extensions can be supported is further defined in the IMS Q&TI XML Best Practice & Implementation Guide [QTI, 01b].

⁸ The difference between a basic response-type that requires multiple responses e.g. multiple response, or a composite response-type based upon several of the same response-types is an artifact of the adopted definitions. If the response-type does NOT exist as a basic type then multiple entries are only possible through the construction of a composite response-type. At some later point IMS may decide to adopt this as a basic multiple response-type.

4. Basic Information Model

The underlying logical data structures for the QTI are shown in Figure 4.1. This representation shows the relationship between the ASI elements. This relationship is summarised as:

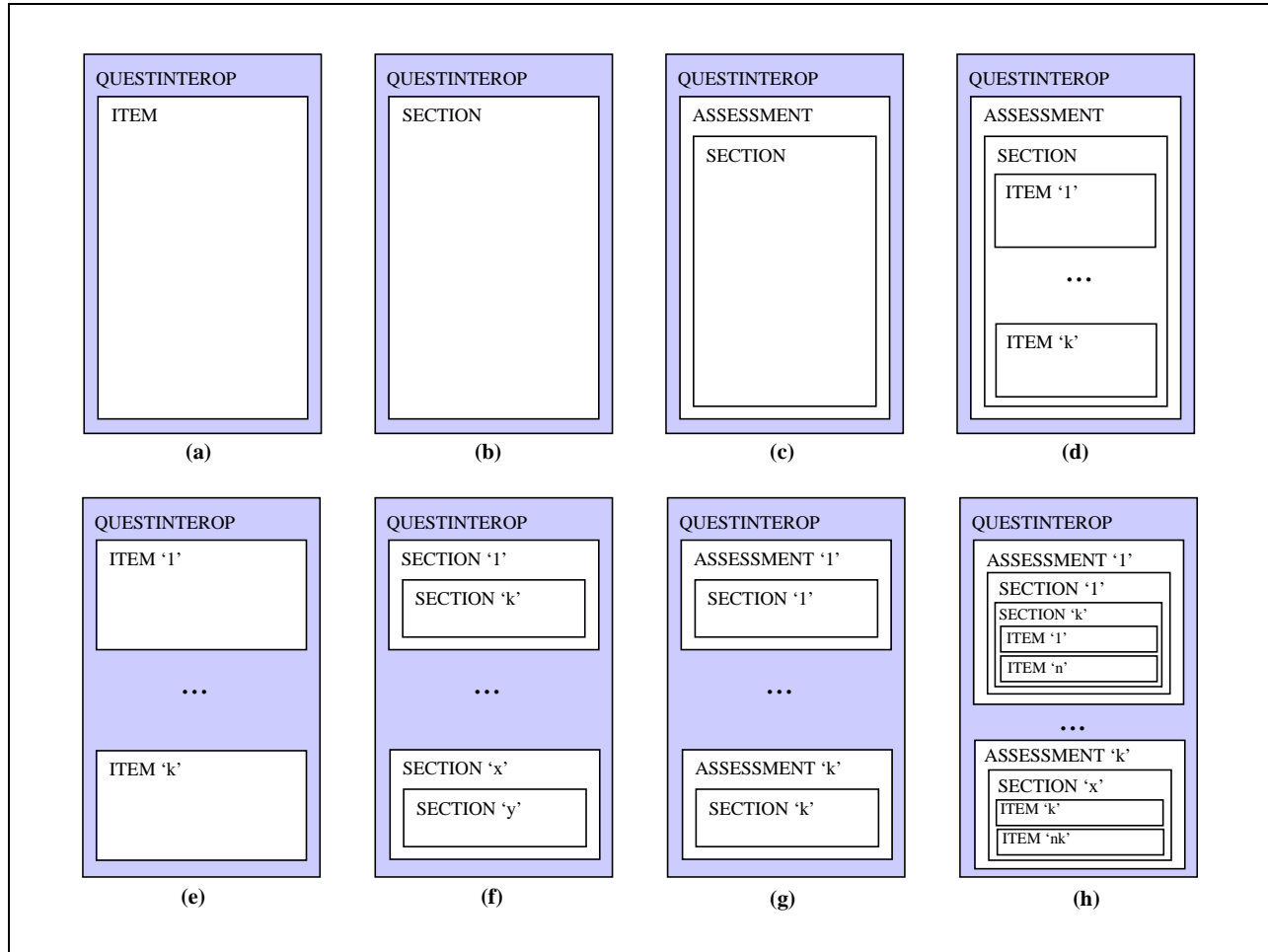


Figure 4.1 The principle Q&TI data structures.

- An *Assessment* consists of at least one *Section* (c);
- A *Section* may contain other *Sections* (b) and (f);
- A *Section* may contain one or more *Items* (d) and (h) – this permits the null *Section* definition.

While the basic data structure definition at the root level is simple it is extremely flexible. As such the data structure can be used to import/export data structures that consist of:

- One or more assessments only (c) and (g);
- One or more sections only (b) and (f);
- One or more items only (a) and (e);
- Any number and combination of assessments, sections and items (d) and (h);
- An assessment may or may not contain more than one section (c) and (g);
- A section may or may not contain items (b), (c), (d), (f), (g) and (h).

4.1 Underlying Object Model

The conceptual object model for the Q&TI is shown in Figure 4.2.

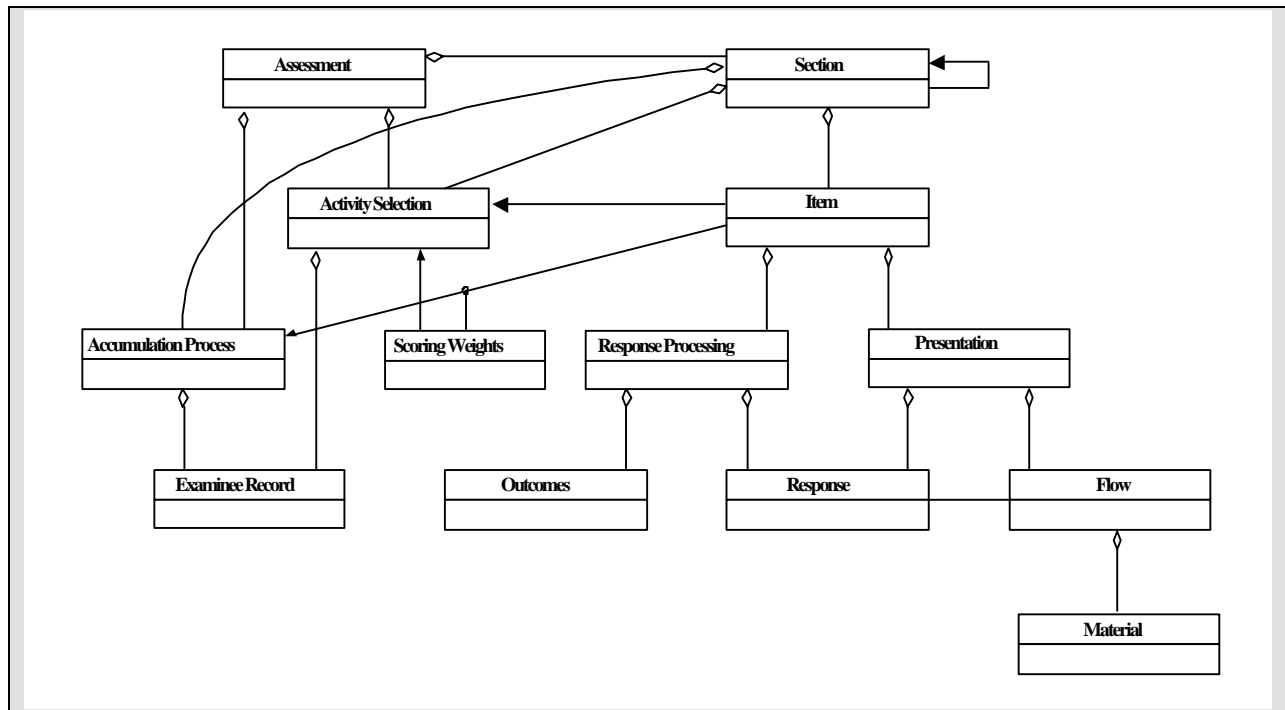


Figure 4.2 The underlying object-based information model.

The objects in this model and their key behaviours are:

- Assessment – the object that represents the *Assessment* data structure;
- Section – the object that represents the *Section* data structure;
- Item – the object that represents the *Item* data structure;
- Activity Selection – selection of the next activity determined by the progress and results obtained upto the moment of activity selection;
- Accumulation Process – the reconciliation of all the evaluation outputs to produce an overall Assessment/Section evaluation;
- Scoring Weights – the scoring weights that are to be assigned to the results output from the response processing;
- Response Processing – the processing and evaluation of the user responses;
- Presentation – the rendering of the content and the possible responses;
- Examinee Record – the set of collated results that are output from the complete process. This is a ‘life-long’ record in that it contains the historical progress of the individual;
- Outcomes – the set of outcomes that are to be evaluated by the response processing object. These determine the scoring metrics to be applied to the response evaluations;
- Response – the responses that are supplied by the user of the Items i.e. the input user selections;
- Flow – the underlying presentation structure that defines the block relationship between the different material components;
- Material – the content that is to be displayed.

The full object model is described in Appendix A. The current scope of Version 1.1 is defined by the Assessment, Section, Item, Presentation, Response Processing, Outcomes, Response, Flow and Material objects shown in Figure 4.2

4.2 Response-types

Within an Item there is a complex set of data structures based upon the Response-type. The information returned by the basic Response-types can be defined in terms of lists of objects, namely⁹:

- Logical identifier (LID)
 - Single = {identifier}, {duration}
 - Multiple = {identifier, identifier, ..., identifier, duration}, {duration}
 - Ordered = {event_1_identifier, event_2_identifier, ..., event_k_identifier}, {duration}
- X-Y co-ordinates (XY)
 - Single = {{identifier, xcoord, ycoord}}, {duration}
 - Multiple = {{identifier, xcoord, ycoord}, ..., {identifier, xcoord, ycoord}}, {duration}
 - Ordered = {{event_1_identifier, xcoord, ycoord}, {event_2_identifier, xcoord, ycoord}, ..., {event_k_identifier, xcoord, ycoord}}, {duration}
- String (STR)
 - Single = {{identifier, string}}, {duration}
 - Multiple = {{identifier, string}, {identifier, string}, ..., {identifier, string}}, {duration}
 - Ordered = {{event_1_identifier, string}, {event_2_identifier, string}, ..., {event_k_identifier, string}}, {duration}
- Numerical (NUM)
 - Single = {{identifier, number}}, {duration}
 - Multiple = {{identifier, number}, {identifier, number}, ..., {identifier, number}}, {duration}
 - Ordered = {{event_1_identifier, number}, {event_2_identifier, number}, ..., {event_k_identifier, number}}, {duration}
- Logical group (GRP)
 - Single = {{{identifier, groupid}, {identifier, groupid}}}, {duration}
 - Multiple = {{{identifier, groupid}, {identifier, groupid}, ..., {identifier, groupid}}, {{identifier, groupid}, {identifier, groupid}, ..., {identifier, groupid}}, ..., {{identifier, groupid}, {identifier, groupid}}, ..., {identifier, groupid}}, {duration}
 - Ordered = {{{event_1_identifier, groupid}, {event_1_identifier, groupid}, ..., {event_1_identifier, groupid}}, {{event_2_identifier, groupid}, {event_2_identifier, groupid}, ..., {event_2_identifier, groupid}}, ..., {{event_k_identifier, groupid}, {event_k_identifier, groupid}, ..., {event_k_identifier, groupid}}}, {duration}

In each case the Response-type clause identifier is used to tag the data-set thereby ensuring that the scoring attributes can be correlated to the generating response.

The {duration} element is the period between the item being triggered and the response(s) being supplied. The period is defined as complete when the next Item is invoked or when some other pre-defined termination sequence is entered by the user (the generation of this value is a vendor specific feature).

4.3 Content

4.3.1 Flows

During adoption of the QTI v1.0 specification it was noted that there was an issue arising from the display of multiple <material> blocks. This issue is demonstrated in Figure 4.3 (this example is taken from the QTI best Practice & Implementation Guide [QTI, 01b]). In this example there are three FIB questions posed in a single Item. This continuous text and the introductory question text are contained in several <material> elements. The problem

⁹ The 'kth' identifier in the lists denotes the last case.

is that there is no clear blocking semantics defined for the <material> element and so it is unclear how the first sentence should be defined as a separate paragraph. To rectify this issue the concept of ‘flows’ has been introduced.

Fill-in-the blanks in this text from
Richard III:

Now is the _ _ _ _ _ of our
discontent made glorious _ _ _ _ _
by these sons of _ _ _ _ .

Figure 4.3 Unclear semantics for text paragraphs.

A flow is defined as a set of content that is to be handled by the display rendering engine as a logical block, or paragraph. How the block is delimited is undefined and left to the display engine – the only constraint is that the display engine handles blocks consistently, including blocks within blocks, etc¹⁰. A flow can contain other flows and so a complex system of hierarchical flows can be constructed – again it is left to the display engine to decide how these should be consistently displayed. In the case of Figure 4.3, we have two flows or blocks.

In V1.1 flows may or may not be used – this ensures backwards compatibility. When flows are used this will be indicated by the presence of the top-level <flow> element within the <presentation> element. If any flow construct is to be used then the <flow> element must be present within the <presentation> element. Three separate elements have been defined to support flows:

- <flow> – this is used to indicate the top level flow within the <presentation> element;
- <flow_label> – this is used to encapsulate the <response_label> element;
- <flow_mat> – this is used to encapsulate the <material> element e.g. for <objectives>, <rubric>, etc.

In all three cases the element can be recursive i.e. <flow_mat> within <flow_mat>, and the blocking rules must be defined and implemented consistently (the rules can vary for each element but must be consistently applied). The availability of flows under V1.1 gives rise to the display guidelines shown in Figure 4.4:

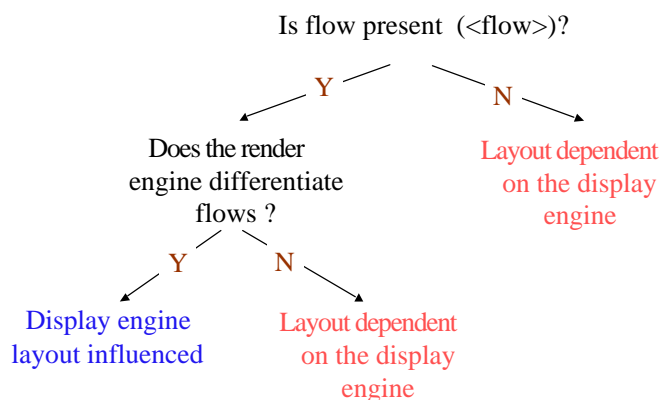


Figure 4.4 V1.0/V1.1 flow implications.

¹⁰ It is strongly advised that the display engine should delimit a block using a new line and carriage return at the very least. It is also strongly recommended that a block within a block should be indented.

As implied in Figure 4.4, the usage of flows does not guarantee that the blocking will be implemented or that blocking in two different display engines will result in the same layout. Further control on the type of blocking is supported using the ‘class’ attribute on the three elements but the number of defined block structures is limited. The usage of flows allows authors to influence layout issues such as:

- Paragraphing for text;
- The interleaving of text with response-type prompts e.g. multiple FIB responses required for a single Item;
- The alignment of lists, including vertical or horizontal alignment of the options available within standard multiple-choice questions.

It is strongly advised that all V1.1 and later Items use the ‘flow’ approach. This enables a more clear set of semantics to be defined for controlling the layout of the Items and more readily supports techniques such as XML Style-sheets. Further refinement of the semantics for flows may be introduced in later versions of this specification once we have established best practice and identified further needs.

At first consideration, the concept of flows could be developed to include a broader range of stylistic capabilities such as font-type, colour, lines-per-inch, etc. We have intentionally stopped short of being this prescriptive or feature-rich thereby ensuring that the specification does not become weighed-down with issues of style as opposed to our main goal of **functional interoperability**. Our intention is to allow the author to influence the layout without creating complications for display engines e.g. different fonts will lead to significant complications that are avoided by allowing the display-engine to use its own set of defaults

4.3.2 Text

A significant amount of content displayed to the participant will be of a textual nature. The QTI specification has extensive features for handling text-based content, namely:

- Mime type – the mime type associated with the text as defined using RFC1521. The default value is set as ‘text/plain’;
- Character set – the default value is set as ‘us-ascii’ but the range of possible values is as defined according to ISO10646. This character set is used to inform the system of the nature of the text contained or within the referenced file. XML supports two encoding formats namely: UTF-8 (default) and UTF-16. UTF-16 should be used with character sets such as Arabic, Chinese, etc;
- Language – this is supported using the ‘xml:lang’ attribute. This allows the text to be made available in a variety of different languages. This mechanism is **not** to be used to provide alternative language content in a single Item e.g. the material for the question supplied in French, German, English, etc. in the same Item. This should be achieved using different Items;
- White-space handling – this is supported using the ‘xml:space’ attribute. The default setting is that white-space is **not** preserved;
- Emphasis – under V1.1 the <matemtext> element has been added. This is used to allow authors to distinguish certain parts of text from others. The manner in which the emphasis is achieved e.g. bold, italic, etc. is left to the display engine;
- Paragraphs – under V1.1 the flow structure has been added (see sub-section 4.3.1). Also added is the <matbreak> element that is used to denote a break in the material e.g. a paragraph break perhaps. The nature of the break is undefined and left to the display engine but it is strongly advised that a line feed and carriage return form is used. The <matbreak> mechanism should only be used when the flows approach is unavailable.

It is important to stress that many stylistic issues pertaining to fonts are outside the scope of the specification. These issues should be handled using XSL style-sheets, externally referenced files such as HTML, etc.

4.3.3 Images

The presentation of images to the user requires the definition of the anchor point. The anchor point is defined by the co-ordinate of the top left-hand corner, in terms X0, Y0. The other two attributes are the ‘height’ and ‘width’ of the image. Definition of both the height and width should cause the image to be presented in that aspect ratio. Omission of either the height or width will be taken to imply that the missing size must be determined automatically

by maintaining the original aspect ratio of the image and using the supplied value as the reference length from which the missing length will be determined. The reference size of the display is assumed to be 800x600 pixels at 72dpi. This means that some scaling may have to be performed when using other types of output device.

An example of a multi-image screen is shown in Figure 4.5. The two images have their size and location defined by X0, Y0 and width and height. The X0 and Y0 points are defined with respect to the top left hand corner of the screen. The two hotspot images are also defined in a similar manner. In the case of overlapping images the order of precedence is defined by the order of the *response_label* elements - the first declared has the highest precedence.

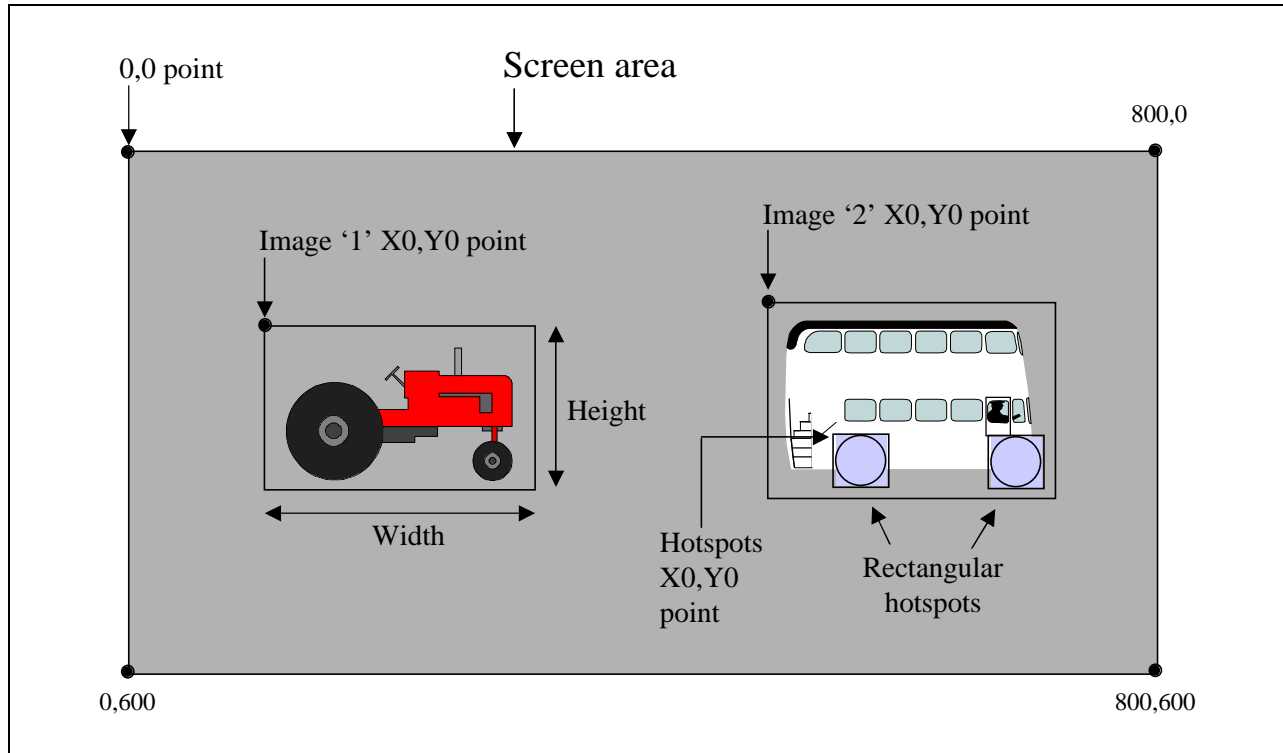


Figure 4.5 Multi-image screen layout reference.

4.3.4 Audio

To be completed in V2.0.

4.3.5 Video

To be completed in V2.0.

5. Conceptual Description of the Data Objects

The tables in this Section provide a conceptual, informative description of the elements in the data objects. The columns in these tables refer to:

No: The number of the data element. An element may be composed of sub-elements. The numbering scheme reflects these relationships.

Name: The descriptive name of the element.

Explanation: A brief functional description of the element.

Required: Indicates if the element is required:

- **M** = Mandatory Element that must be included in the data object, if the element at the higher level is included;
- **C** = Conditional Element. Existence is dependent on values of other Elements;
- **O** = Optional Element.

Multi: Multiplicity of the element:

- Blank = single instance;
- Number = maximum number of times the element is repeatable;
- **n** = multiple occurrences allowed, no limit;
- Repeatability of an element implies that all sub-elements repeat with the same element.

Type: A description of formatting rules for the data element, the set of valid entries for the data and the coding schemes. The set of values as defined in the Domain i.e. making it closed. The list of values cannot be extended to include values not defined in the specification. If there is a need for values not included in the domain set of values then the extension should be done defining a new element under the Extension element that is a part of each data object definition. Type includes the maximum length of the element's content:

- **ID** = element used to uniquely identify an object;
- **Code** = element value from a list of codes;
- **Description** = descriptive element, human language
- **Flag** = binary flag
- **Enumerated** = list of predefined non-numeric options
- The international character set specified by ISO 10646 will be used for all fields.

Note: Additional descriptive information about the element.

The description of the data objects has six sub-sections:

- Assessment – describes the assessment data structure;
- Section – describes the section data structure;
- Item – describes the item data structure;
- Common elements – describes the elements used in more than one of the above data structures;
- Common attributes – describes the attributes used in more than one of the above data structures;
- Meta-data – describes the QTI specific meta-data objects used in the Assessment, Section and Item data objects.

Note on Extensibility

This specification includes several points where proprietary extensions can be defined for each data object. Extensions are to be implemented in structures that are sub-elements. This applies to all extensions, including extensions to valid codes for elements that have a domain set of valid values as defined as part of the specification. Examples of valid extensions are provided in the IMS Question & Test Interoperability Best Practices & Implementation Guide [QTI, 01b].

5.1 ASSESSMENT Data Object

An *Assessment* object contains all of the information to make the use of individual *Items* meaningful i.e. apart from the *Sections* the object includes the relationships between the *Sections*, the group evaluation processing and the corresponding feedback.

Table 5.1 Assessment data object detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
1.1	title	As per structure 6.2				
1.2	ident	As per structure 6.3				
1.3	qticomment	Comments on the Assessment.	O			As per structure 4.6
1.4	duration	The duration of the Assessment.	O			As per structure 4.7
1.5	assessmentmetadata	The Assessment meta-data as listed in Section 6.1.	O			Will include only those entries that are mandatory or which are optional but defined.
1.5.1	qtimetadata		O	n		As per structure 4.13.
1.5.2	qmd_absolutescore	Range of scoring for the Assessment.	O			As per structure 5.1
1.5.3	qmd_assessmenttype	The role of the Assessment.	O			As per structure 5.2
1.5.4	qmd_feedbackpermitted	Whether or not feedback is available.	O			As per structure 5.4
1.5.5	qmd_hintspermitted	Whether or not hints are available.	O			As per structure 5.5
1.5.6	qmd_scoretype	The type of scoring used.	O			As per structure 5.13
1.5.7	qmd_solutionspermitted	Whether or not solutions are available.	O			As per structure 5.15
1.5.8	qmd_sectionselection	Support for Section selection.	O			As per structure 5.16
1.5.9	qmd_sectionsequence	Support for Section sequencing.	O			As per structure 5.17
1.5.10	qmd_itemselection	Support for Item selection.	O			As per structure 5.18
1.5.11	qmd_itemsequence	Support for Item sequencing.	O			As per structure 5.19
1.5.12	qmd_timelimit	The number of minutes or an unlimited duration.	O			As per structure 5.22
1.5.13	qmd_toolvendor	The name of the vendor of the tool creating the Assessment.	O			As per structure 5.23
1.5.14	qmd_material	The type of material used within the Assessment.	O	n		As per structure 5.25
1.6	objectives	The Assessment objectives per view of the system.	O	n		As per structure 4.11
1.7	rubric	Material used to describe the context of the Assessment to users.	O	n		As per structure 4.12
1.8	assessmentcontrol	Control of the capabilities to	O	n	There is no	These switches

No	Name	Explanation	Reqd	Mult	Type	Note
		be permitted to operate within the Assessment.			content for this element.	should be used to control the operation of the Assessment related conditions. Each view can have its own switch definition.
1.8.1	view	As per structure 6.1				
1.8.2	solutionswitch	As per structure 6.4				
1.8.3	hintswitch	As per structure 6.5				
1.8.4	feedbackswitch	As per structure 6.6				
1.8.5	qticomment	Comments on the Assessment control.	O		As per structure 4.6	
1.9	assessprocessing (For further study in V1.2).	Assessment accumulated processing and feedback.	O			This element defines the standard Assessment processing features. Proprietary alternatives are available
1.9.1	scoremodel	As per structure 6.20				
1.9.2	qticomment	Comments on the Assessment processing.	O		As per structure 4.6	
1.9.3	scores	As per structure 4.10				
1.9.4	scorecondition	As per structure 4.9				
1.9.5	condition_extension	Proprietary extension of the evaluation of the scores to determine the responses.	O		ANY	All extensions to the processing for new conditions are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
1.10	assessproc_extension	Proprietary alternative Assessment processing extension.	O		ANY	All proprietary alternatives to Assessment processing are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
1.11	assessfeedback	Feedback of the Assessment scoring.	O	n		A response will be defined for each view.
1.11.1	title	As per structure 6.2				

No	Name	Explanation	Reqd	Mult	Type	Note
1.11.2	ident	As per structure 6.3				
1.11.3	view	As per structure 6.1				
1.11.4	qacomment	Comments on the Assessment feedback to be used.	O		As per structure 4.6	
1.11.5	material	The content to be presented due to the score value.	O	n	As per structure 4.1	
1.11.6	flow_mat	Flow structuring of the material encapsulated.	O	n	As per structure 4.14	
1.12	sectionselection (For further study in V1.2).	To enable the appropriate Sections to be selected from the Section-pool.	O	n	TBD	TBD
1.13	sectionsequence (For further study in V1.2).	To sequence the utilisation of the selection blocks.	O		TBD	TBD
1.14	sectionref	To pull into scope Sections that are not defined within this Assessment block.	O	n		The referenced Section must be available somewhere otherwise execution errors will occur. Binding is outside the scope of this specification.
1.14.1	linkrefid	As per structure 6.14				
1.15	section	The Section data object (see Section 5.2).	M	n		There will be at least one Section per Assessment and Sections can contain Sections.

5.2 SECTION Data Object

A *Section* object contains all of the information to meaningfully group together *Items* i.e. apart from the *Items* the object includes the relationships between the *Items* and the selection criteria of the *Items*.

Table 5.2 Section data object detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
2.1	title	As per structure 6.2				
2.2	ident	As per structure 6.3				
2.3	qticomment	Comments on the Section.	O		As per structure 4.6	
2.4	duration	The duration of the Section.	O		As per structure 4.7	
2.5	sectionmetadata	The Section meta-data as listed in Section 6.2.	O			Will include only those entries that are mandatory or which are optional but defined.
2.5.1	qtimetadata		O	n	As per structure 4.13.	
2.5.2	qmd_numberofitems	The number of Items contained by the object.	O		As per structure 5.9	
2.5.3	qmd_sectionsincluded	Whether or not Sections are included available.	O		As per structure 5.14	
2.5.4	qmd_sectionselection	Support for Section selection.	O		As per structure 5.16	
2.5.5	qmd_sectionsequence	Support for Section sequencing.	O		As per structure 5.17	
2.5.6	qmd_itemselection	Support for Item selection.	O		As per structure 5.18	
2.5.7	qmd_itemsequence	Support for Item sequencing.	O		As per structure 5.19	
2.5.8	qmd_timelimit	The number of minutes or an unlimited duration.	O		As per structure 5.22	
2.5.9	qmd_material	The type of material used within the Item.	O		As per structure 5.25	
2.6	objectives	The Section objectives per view of the system.	O	n	As per structure 4.11	
2.7	rubric	Material used to describe the context of the Section to users.	O	n	As per structure 4.12	
2.8	sectionprecondition (For further study in V1.2).	The preconditions that control whether or not the Section is utilised.	O	n	TBD	TBD
2.9	sectionpostcondition (For further study in V1.2).	The postconditions that control whether or not the Section is utilised.	O	n	TBD	TBD
2.10	sectioncontrol	Control of the capabilities to be permitted to operate within the Section.	O	n		These switches should be used to control the operation of the Section related conditions. A definition can be

No	Name	Explanation	Reqd	Mult	Type	Note
						made for each view.
2.10.1	view	As per structure 6.1				
2.10.2	solutionswitch	As per structure 6.4				
2.10.3	hintswitch	As per structure 6.5				
2.10.4	feedbackswitch	As per structure 6.6				
2.10.5	qtcomment	Comments on the Section control.	O		As per structure 4.6	
2.11	sectionselection (For further study in V1.2).	To enable the appropriate Sections to be selected from the Section-pool.	O	n	As per structure 1.11	
2.12	sectionsequence (For further study in V1.2).	To sequence the utilisation of the selection blocks.	O	n	As per structure 1.12	
2.13	sectionref	To pull into scope Sections that are not defined within this Section block.	O	n	As per structure 1.13	
2.13.1	linkrefid	As per structure 6.14				
2.14	section	Self reference for recursive Sections.	O	n		
2.15	itemselection (For further study in V1.2).	To enable the appropriate Items to be selected from the Item-pool.	O	n	TBD	TBD
2.16	itemsequence (For further study in V1.2).	To sequence the utilisation of the Items.	O	n	TBD	TBD
2.17	itemref	To pull into scope the Items that are not defined within this Section block.	O	n		The referenced Item must be available somewhere otherwise execution errors will occur. Binding is outside the scope of this specification.
2.17.1	linkrefid	As per structure 6.14				
2.18	item	The Item data object (see Section 5.3)	O	n		There may be zero, one or more Items per Section.
2.19	sectionprocessing (For further study in V1.2).	Processing of the Section accumulated responses and scores.	O			This element defines the standard Section processing features. Proprietary alternatives are available
2.19.1	scoremodel	As per structure 6.20				

No	Name	Explanation	Reqd	Mult	Type	Note
2.19.2	qticomment	Comments on the Assessment processing.	O			As per structure 4.6
2.19.3	scores					As per structure 4.10
2.19.4	scorecondition					As per structure 4.9
2.19.5	condition_extension	Proprietary extension of the evaluation of the scores to determine the responses.	O		ANY	All extensions to the processing for new conditions are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
2.20	sectionproc_extension	Proprietary alternative Section processing extension.	O		ANY	All proprietary alternatives to Section processing are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
2.21	sectionfeedback	Feedback of the Section scoring.	M	n		A response will be defined for each view.
2.21.1	title					As per structure 6.2
2.21.2	ident					As per structure 6.3
2.21.3	view					As per structure 6.1
2.21.4	qticomment	Comments on the Section feedback to be used.	O			As per structure 4.6
2.21.5	material	The content to be presented due to the score value.	O	n		As per structure 4.1
2.21.6	flow_mat	Flow structuring of the material encapsulated.	O	n		As per structure 4.14

5.3 ITEM Data Object

An *Item* object contains all of the information for the presentation of a question and its subsequent processing to the user. The structure of the *Item* includes the actual question and its presentation format, the range of possible responses, the ways in which the responses are to be processed, and the possible solutions and hints to the *Item*.

Table 5.3 Item data object detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
3.1	title	As per structure 6.2				
3.2	ident	As per structure 6.3				
3.3	label	As per structure 6.7				
3.4	maxattempts	The number of attempts permitted.	O		Integer 2	
3.5	qticomment	Comments on the Item.	O	As per structure 4.6		
3.6	duration	The duration of the Item.	O	As per structure 4.7		
3.7	itemmetadata	The Item metadata as listed in Section 6.3.	O			Will include only those entries that are mandatory or which are optional but defined.
3.7.1	qtimetadata		O	n	As per structure 4.13.	
3.7.2	qmd_computerscored	Whether or not the Item can be scored by computer.	O		As per structure 5.3	
3.7.3	qmd_feedbackpermitted	Whether or not feedback is available.	O		As per structure 5.4	
3.7.4	qmd_hintspermitted	Whether or not hints are available.	O		As per structure 5.5	
3.7.5	qmd_itemtype	The type of Item used.	O		As per structure 5.6	
3.7.6	qmd_levelofdifficulty	The education level for which the Item is intended.	O		As per structure 5.7	
3.7.7	qmd_maximumscore	The maximum score possible from that Item.	O		As per structure 5.8	
3.7.8	qmd_renderingtype	The type of rendering used within the Item.	O	n	As per structure 5.10	
3.7.9	qmd_responsetype	The class of response expected for the Item.	O	n	As per structure 5.11	
3.7.10	qmd_scoringpermitted	Whether or not scoring is available.	O		As per structure 5.12	
3.7.11	qmd_solutionspermitted	Whether or not solutions are available.	O		As per structure 5.15	
3.7.12	qmd_status	The status of the Item.	O		As per structure 5.20	
3.7.13	qmd_timedependence	Whether or not the response are timed.	O		As per structure 5.21	
3.7.14	qmd_timelimit	The number of minutes or an unlimited duration.	O		As per structure 5.22	

No	Name	Explanation	Reqd	Mult	Type	Note
3.7.15	qmd_toolvendor	The name of the vendor of the tool creating the Assessment.	O			As per structure 5.23
3.7.16	qmd_topic	A brief description of the topic covered by the Item.	O			As per structure 5.24
3.7.17	qmd_material	The type of material used within the Item.	O	n		As per structure 5.25
3.7.18	qmd_typeofsolution	The type of solution available in the Item.	O			As per structure 5.26
3.7.19	qmd_weighting	The weighting to be applied to the Item's score.	O			As per structure 5.27
3.8	objectives	The Item objectives per view of the system.	O	n		As per structure 4.11
3.9	itemprecondition (For further study in V2.0).	The preconditions that control whether or not the Item is utilised.	O	n	TBD	TBD
3.10	itempostcondition (For further study in V2.0).	The postconditions that control whether or not the Item is utilised.	O	n	TBD	TBD
3.11	itemcontrol	Control of the capabilities to be permitted to operate within the Item.	O	n		These switches should be used to control the operation of the Item related conditions. A definition can be made for each view.
3.11.1	view	As per structure 6.1				
3.11.2	solutionswitch	As per structure 6.4				
3.11.3	hintswitch	As per structure 6.5				
3.11.4	feedbackswitch	As per structure 6.6				
3.12	itemrubric	The view specific description of the Item.	O	n		This will normally contain instructions pertaining to the Item. This element is deprecated in preference to 'rubric'.
3.12.1	view	As per structure 6.1				
3.12.2	material	The content of the rubric.	M			As per structure 4.1
3.13	rubric	Material used to describe the context of the Item to users.	O	n		As per structure 4.12.
3.14	presentation	The container for the responses (basic or composite) plus the rendering.	O	3.14		Only one view of the presentation is available.
3.14.1	ident	As per structure 6.3				
3.14.2	label	As per structure 6.7				

No	Name	Explanation	Reqd	Mult	Type	Note
3.14.3	qtcomment	Comments on the Presentation.	O		As per structure 4.6	
The structure that follows is as per the original V1.0 specification and is maintained for backwards compatibility. The alternative approach is to use the flow element as per V1.1 – see structure 3.14.11						
3.14.4	material	The content of the responses.	C	n	As per structure 4.1	This will form part of the question itself.
3.14.5	response_lid	The logical identifier response-type.	C	n		As defined in the Q&TI Information Model.
3.14.5.1	ident	As per structure 6.3				
3.14.5.2	rcardinality	As per structure 6.16				
3.14.5.3	rtiming	As per structure 6.17				
3.14.5.4	material	The content of the response types.	O		As per structure 4.1	This will form part of the question itself.
3.14.5.5	render_choice	Rendering of the classical multiple choice/multiple response and true/false questions.	O			
3.14.5.5.1	shuffle	Whether or not the possible selections should be shuffled for presentation.	O		Enumerated: Yes (default) No	Default value is “No”.
3.14.5.5.2	minnumber	As per structure 6.21				
3.14.5.5.3	maxnumber	As per structure 6.22				
The structure that follows is as per the original V1.0 specification and is maintained for backwards compatibility. The alternative approach is to use the flow_label element as per V1.1.						
3.14.5.5.4	material	The content of the responses.	C	n	As per structure 4.1	This will be a part of the question itself.
3.14.5.5.5	response_label	A possible response that can be selected.			May contain #PCDATA.	
3.14.5.5.5.1	ident	As per structure 5.3				
3.14.5.5.5.2	rshuffle	Determines if the response can be shuffled.	O		Enumerated: Yes No (default)	Default is “No”.
3.14.5.5.5.3	rarea	The type of area used to denote the hot spot.	O		Enumerated: Ellipse Rectangle Bounded	Information describing the key points must be given. The ellipse is 'x,y,r1,r2', the rectangle is 'x0,y0,height,width' and the bounded area is 'x1y1,...,xnyn'.
3.14.5.5.5.4	rrange	The accuracy of the numerical result required.	O		Enumerated: Exact (default)	‘Exact’ means exactly whereas

No	Name	Explanation	Reqd	Mult	Type	Note
					Range	'Range' is followed by the range permitted about the given value.
The next structures are the preferred flow_label elements as per V1.1.						
3.14.5.5.6	response_label	A possible response that can be selected.	C	n	As per structure 3.14.5.5.5	
3.14.5.5.7	flow_label	Establishes the flow block around the possible response-label structures.				
3.14.5.5.7.1	class	Guidance on the type of block structuring.	O		As per structure 6.25	
3.14.5.5.7.1	response_label	A possible response that can be selected.	C	n	As per structure 3.14.5.5.5	
3.14.5.5.7.2	flow_label	Recursive structure to support complex block layouts.			As per structure 3.14.5.5.7	
3.14.5.5.8	response_na	Proprietary extension for not attempted response.	O		ANY	All NA extensions are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
3.14.5.6	render_hotspot	Rendering of the material using an image(s).	O			The images to which the responses are referenced.
3.14.5.6.1	minnumber	As per structure 6.21				
3.14.5.6.2	maxnumber	As per structure 6.22				
3.14.5.6.3	showdraw	Informs the rendering system that the points identified by the user are to be displayed 'as connected' using some marking mechanism.	O		Enumerated: Yes No (default)	
The structure that follows is as per the original V1.0 specification and is maintained for backwards compatibility. The alternative approach is to use the flow_label element as per V1.1.						
3.14.5.6.4	material	The content of the responses.	C	n	As per structure 4.1	This will be a part of the question itself.
3.14.5.6.5	response_label	A possible response that can be selected.			May contain #PCDATA.	
The next structures are the preferred flow_label elements as per V1.1.						
3.14.5.6.5	response_label	A possible response that can be selected.	C	n	As per structure 3.14.5.5.5	
3.14.5.5.6	flow_label	Establishes the flow block around the possible response-label structures.			As per structure 3.14.5.5.7	
3.14.5.6.6	response_na	As per structure 3.14.5.5.8				

No	Name	Explanation	Reqd	Mult	Type	Note
3.14.5.7	render_slider	Rendering of the response as a slider.	O			The form of the slider is host dependent.
3.14.5.7.1	orientation	The orientation of the slider.	O		Enumerated: Horizontal Vertical	The physical style of the slider is vendor dependent.
3.14.5.7.2	lowerbound	The lowest value shown by the slider.	M		Numerical 16	This value must be less than 'upperbound'.
3.14.5.7.3	upperbound	The highest value shown by the slider.	M		Numerical 16	This value must be greater than 'lowerbound'.
3.14.5.7.4	step	The increment value of the slider.	O		Numerical 16	
3.14.5.7.5	startval	The setting at which the slider is set when displayed.	O		Numerical 16	Must be in the range of LowerBound to UpperBound.
3.14.5.7.6	steplabel	Display of the units on the slider.	O		Enumerated: Yes (default) No	Default setting is "Yes".
3.14.5.7.7	minnumber	As per structure 6.21				
3.14.5.7.8	maxnumber	As per structure 6.22				
The structure that follows is as per the original V1.0 specification and is maintained for backwards compatibility. The alternative approach is to use the flow_label element as per V1.1.						
3.14.5.7.9	material	The content of the responses.	C	n	As per structure 4.1	This will be a part of the question itself.
3.14.5.7.10	response_label	A possible response that can be selected.			May contain #PCDATA.	
The next structures are the preferred flow_label elements as per V1.1.						
3.14.5.7.11	response_label	A possible response that can be selected.	C	n	As per structure 3.14.5.5.5	
3.14.5.7.12	flow_label	Establishes the flow block around the possible response-label structures.			As per structure 3.14.5.5.7	
3.14.5.7.13	response_na	As per structure 3.14.5.5.8				
3.14.5.8	render_fib	Rendering of the material using a FIB format.	O			
3.14.5.8.1	charset	The character-set to be used for the entry.	O		As per MIME in RFC1521. CDATA string describing the character set.	Default setting is "us-ascii".
3.14.5.8.2	encoding	The coding to be used for the text.	O		String. CDATA string	Default setting is "UTF-8". Typical entries are given in

No	Name	Explanation	Reqd	Mult	Type	Note
					describing the encoding.	the Best Practice & Implementation Guide.
3.14.5.8.3	fibtype	The type of information expected.	O		Enumerated: String (default) Integer Decimal Scientific Boolean	Default setting is "String".
3.14.5.8.4	rows	The number of rows available for the entry.	O		Integer 3 1-999	
3.14.5.8.5	columns	The number of columns available for the entry.	O		Integer 3 1-999	
3.14.5.8.6	maxchars	The maximum number of characters that can be entered.	O		Integer 8 1-9999999	
3.14.5.8.7	prompt	The style of holder presented to contain the material.	O		Enumerated: Box (default) Dashline Asterisk Underline	Default setting is "Box".
3.14.5.8.8	minnumber	As per structure 6.21				
3.14.5.8.9	maxnumber	As per structure 6.22				
The structure that follows is as per the original V1.0 specification and is maintained for backwards compatibility. The alternative approach is to use the flow_label element as per V1.1.						
3.14.5.8.10	material	The content of the responses.	C	n	As per structure 4.1	This will be a part of the question itself.
3.14.5.8.11	response_label	A possible response that can be selected.			May contain #PCDATA.	
The next structures are the preferred flow_label elements as per V1.1.						
3.14.5.8.12	response_label	A possible response that can be selected.	C	n	As per structure 3.14.5.5.5	
3.14.5.8.13	flow_label	Establishes the flow block around the possible response-label structures.			As per structure 3.14.5.5.7	
3.14.5.9	render_extension	Proprietary extensions facility.	O		ANY	All extensions to the render-type are to be implemented as sub-elements under this element (see the Q&TI best Practice Guide for the naming convention).
3.14.6	response_xy	The X-Y co-ordinate response-type.	C	n		As defined in the O&TI Information

No	Name	Explanation	Reqd	Mult	Type	Note
						Model.
3.14.6.1	ident	As per structure 6.3				
3.14.6.2	rcardinality	As per structure 6.16				
3.14.6.3	rtiming	As per structure 6.17				
3.14.6.4	material	The content of the response types.	O		As per structure 4.1	This will form part of the question itself.
3.14.6.5	render_choice	As per 3.14.5.5				
3.14.6.6	render_hotspot	As per 3.14.5.6				
3.14.6.7	render_slider	As per 3.14.5.7				
3.14.6.8	render_fib	As per 3.14.5.8				
3.14.6.9	render_extension	As per 3.14.5.9				
3.14.7	response_str	The string response-type.	C	n		As defined in the Q&TI Information Model.
3.14.7.1	ident	As per structure 6.3				
3.14.7.2	rcardinality	As per structure 6.16				
3.14.7.3	rtiming	As per structure 6.17				
3.14.7.4	material	The content of the response types.	O		As per structure 4.1	This will form part of the question itself.
3.14.7.5	render_choice	As per 3.14.5.5				
3.14.7.6	render_hotspot	As per 3.14.5.6				
3.14.7.7	render_slider	As per 3.14.5.7				
3.14.7.8	render_fib	As per 3.14.5.8				
3.14.7.9	render_extension	As per 3.14.5.9				
3.14.8	response_num	The numerical response-type.	C	n		As defined in the Q&TI Information Model.
3.14.8.1	ident	As per structure 6.3				
3.14.8.2	rcardinality	As per structure 6.16				
3.14.8.3	rtiming	As per structure 6.17				
3.14.8.4	material	The content of the response types.	O		As per structure 4.1	This will form part of the question itself.
3.14.8.5	render_choice	As per 3.14.5.5				
3.14.8.6	render_hotspot	As per 3.14.5.6				
3.14.8.7	render_slider	As per 3.14.5.7				
3.14.8.8	render_fib	As per 3.14.5.8				
3.14.8.9	render_extension	As per 3.14.5.9				

No	Name	Explanation	Reqd	Mult	Type	Note
3.14.9	response_grp	The logical group response-type.	C	n		As defined in the Q&TI Information Model.
3.14.9.1	ident	As per structure 6.3				
3.14.9.2	rcardinality	As per structure 6.16				
3.14.9.3	rtiming	As per structure 6.17				
3.14.9.4	material	The content of the response types.	O		As per structure 4.1	This will form part of the question itself.
3.14.9.5	render_choice	As per 3.14.5.5				
3.14.9.6	render_hotspot	As per 3.14.5.6				
3.14.9.7	render_slider	As per 3.14.5.7				
3.14.9.8	render_fib	As per 3.14.5.8				
3.14.9.9	render_extension	As per 3.14.5.9				
3.14.10	flow	The primary blocking structure that groups the presentation content.	O			The form of block structure is dependent upon the rendering engine. The semantics must be consistent with the 'flow_label' and 'flow-mat' elements.
3.14.10.1	class	The type blocking.	O		As per structure 6.25	
3.14.10.2	material	The content of the response types.	C	n	As per structure 4.1	This will form part of the question itself.
3.14.10.3	flow	Allows recursive flow structures to be used.			As per structure 3.14.10	
3.14.10.4	The alternative to the flow structure is the set of structures given in 3.14.4 to 3.14.9.				This ensures backwards compatibility with the V1.0 specifications. The usage of the 'flow' element is preferred for V1.1 onwards.	
3.15	resprocessing	The container for the processing of the responses.	O			This element defines the standard Item processing features. Proprietary alternatives are available.
3.15.1	qacomment	Comments on the Response processing.	O		As per structure 4.6	
3.15.2	outcomes	The container for the declaration of the variables returned for response scoring.	M			
3.15.2.1	qacomment	Comments on the Outcomes.	O		As per structure 4.6	

No	Name	Explanation	Reqd	Mult	Type	Note
3.15.2.2	decvar	Declaration of the score variables.	M	n		As per structure 4.3.
3.15.2.3	interpretvar	Interpretation of the variable comments.	O	n		As per structure 4.5.
3.15.3	respcondition	Evaluation of the response with respect to the defined conditions.	M	n		A series of conditions could be applied depending on the number and type of responses.
3.15.3.1	title	As per structure 6.2				
3.15.3.2	continue	As per structure 6.15				
3.15.3.3	qtcomment	Comments on the Response Condition.	O			As per structure 4.6
3.15.3.4	conditionvar	Conditions applied to the scores to determine the feedback.	M	n		As per structure 4.4.
3.15.3.5	setvar	Manipulation of the declared scoring variables.	O	n		As per structure 4.3
3.15.3.6	displayfeedback	Display trigger for the Item feedback.	O	n		As per structure 4.8.
3.15.4	respond_extension	Proprietary extension of the evaluation of the scores to determine the responses.	O		ANY	All extensions to the Item processing for new conditions are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
3.16	itemproc_extension	Proprietary alternative Item processing extension.	O		ANY	All proprietary alternatives to Item processing are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
3.17	itemfeedback	Feedback of the Item scoring and other types of feedback.	M	n		A response will be defined for each view and each type of feedback.
3.17.1	title	As per structure 6.2				
3.17.2	ident	As per structure 6.3				
3.17.3	view	As per structure 6.1				
3.17.4	material	The content to be presented due to the score value.	C	n		As per structure 4.1
3.17.5	flow_mat	The block structured item feedback.		n		As per structure 4.14.1

No	Name	Explanation	Reqd	Mult	Type	Note
3.17.6	solution	The solutions available to the different views.	O			Different solutions can be available for tutors, etc.
3.17.6.1	feedbackstyle	As per structure 6.23				
3.17.6.2	view	As per structure 6.1				
3.17.6.3	qtcomment	Comments on the available solutions.	O		As per structure 4.6	
3.17.6.4	solutionmaterial	Container for the set of contents to be revealed as the solution.	M	n		It is this level which acts as either the incremental or multiple content presented.
3.17.6.4.1	material	The content to be presented due as the solution.	C	n	As per structure 4.1	
3.17.6.4.2	flow_mat	The block structured solution feedback.		n	As per structure 4.14.1	
3.17.7	hint	The hints available to the different views.	O			Different hints can be available for tutors, etc.
3.17.7.1	feedbackstyle	As per structure 6.23				
3.17.7.2	view	As per structure 6.1				
3.17.7.3	qtcomment	Comments on the available hints.	O		As per structure 4.6	
3.17.7.4	hintmaterial	Container for the set of contents to be revealed as the hint.	M	n		It is this level which acts as either the incremental or multilevel content presented.
3.17.7.4.1	material	The content of the actual hints.	C	n	As per structure 4.1	
3.17.7.4.2	flow_mat	The block structured hint feedback.		n	As per structure 4.14.1	

5.4 Common Data Objects (Elements)

Table 5.4 describes the data objects commonly used with the Assessment, Section and Item objects.

Table 5.4 Common object detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
4.1	material	The content container for all of the material to be displayed.	O			This will always require at least one sub-element.
4.1.1	label	As per structure 6.7				
4.1.2	qtcomment	Comments on the Material.	O		As per structure 4.6	
4.1.2	mattext	Text to be presented.	O	n	PCDATA	
4.1.2.1	label	As per structure 6.7				
4.1.2.2	texttype	The type of text to be displayed.	O		CDATA in format 'text/*****' String 32 As per MIME under RFC1521.	Default set as "text/plain". The Best Practice & Implementation Guide describes the typical range of values.
4.1.2.3	charset	The character set to be used.	O		CDATA String 32. As per ISO10646.	Default set as "us-ascii". The Best Practice & Implementation Guide describes the typical range of values.
4.1.2.4	uri	As per structure 6.8				
4.1.2.5	entityref	As per structure 6.26				
4.1.2.6	xml:lang	As per structure 6.27				
4.1.2.7	xml:space	As per structure 6.28				
4.1.3	matemtext	Emphasised text to be presented.	O	n	PCDATA	The style of the emphasis is render engine dependent but must be consistent for all occurrences of 'matemtext'.
4.1.3.1	label	As per structure 6.7				
4.1.3.2	texttype	The type of text to be displayed.	O		CDATA in format 'text/*****' String 32 As per MIME under RFC1521.	Default set as "text/plain". The Best Practice & Implementation Guide describes the typical range of values.
4.1.3.3	charset	The character set to be used.	O		CDATA String 32 As per ISO10646.	Default set as "us-ascii". The Best Practice & Implementation Guide describes the typical range of values.

No	Name	Explanation	Reqd	Mult	Type	Note
4.1.3.4	uri	As per structure 6.8				
4.1.3.5	entityref	As per structure 6.26				
4.1.3.6	xml:lang	As per structure 6.27				
4.1.3.7	xml:space	As per structure 6.28				
4.1.4	matimage	An image to be presented.	O	n	PCDATA	The image could be an embedded within the file itself.
4.1.4.1	label	As per structure 6.7				
4.1.4.2	imagetype	The type of image file to be displayed.	O		CDATA string in the form 'image/****'.As per MIME definitions RFC1521 and Q&TI extensions.	Default set as "image/jpeg". The Best Practice & Implementation Guide describes the typical range of values.
4.1.4.3	uri	As per structure 6.8				
4.1.4.4	x0	As per structure 6.9				
4.1.4.5	y0	As per structure 6.10				
4.1.4.6	height	As per structure 6.11				
4.1.4.7	width	As per structure 6.12				
4.1.4.8	embedded	As per structure 6.13				
4.1.4.9	entityref	As per structure 6.26				
4.1.5	mataudio (For further study in V2.0).	Audio to be played.	O	n		The embedded audio will be the sampled waveform.
4.1.5.1	label	As per structure 6.7				
4.1.5.2	audiotype	The type of audio file to be played.			CDATA string in the form 'audio/****'.As per MIME under RFC1521 and Q&TI extensions.	Default setting is "audio/base". The Best Practice & Implementation Guide describes the typical range of values.
4.1.5.3	uri	As per structure 6.8				
4.1.5.4	embedded	As per structure 6.13				
4.1.5.5	entityref	As per structure 6.26				
4.1.5	matvideo (For further study in V2.0).	Video to be played.	O	n		
4.1.6.1	label	As per structure 6.7				
4.1.6.2	videotype	The type of video file to be played.			CDATA string in the form 'video/****'.As	The Best Practice & Implementation Guide describes the

No	Name	Explanation	Reqd	Mult	Type	Note
					per the MIME definitions under RFC1521 and with Q&TI extensions.	typical range of values.
4.1.6.3	x0	As per structure 6.9				
4.1.6.4	y0	As per structure 6.10				
4.1.6.5	height	As per structure 6.11				
4.1.6.6	width	As per structure 6.12				
4.1.6.7	uri	As per structure 6.8				
4.1.6.8	embedded	As per structure 6.13				
4.1.6.9	entityref	As per structure 6.26				
4.1.7	matapplet (For further study in V2.0).	Java applet to be executed.	O	n	TBD.	TBD.
4.1.7.1	label	As per structure 6.7				
4.1.7.2	x0	As per structure 6.9				
4.1.7.3	y0	As per structure 6.10				
4.1.7.4	height	As per structure 6.5				
4.1.7.5	width	As per structure 6.12				
4.1.7.6	uri	As per structure 6.8				
4.1.7.7	embedded	As per structure 6.13				
4.1.7.8	entityref	As per structure 6.26				
4.1.8	matapplication (For further study in V2.0).	An application to be executed.	O	n	TBD.	TBD.
4.1.8.1	label	As per structure 6.7				
4.1.8.2	apptype	The type of application to be executed.	M		As per the MIME definitions under RFC1521.	The Best Practice & Implementation Guide describes the typical range of values.
4.1.8.3	uri	As per structure 6.8				
4.1.8.4	entityref	As per structure 6.26				
4.1.9	matbreak	This causes the flow of the material to have a break inserted.	O	n		The nature of the 'break' insertion is expected to consist of the appropriate combination of linefeed and carriage return.
4.1.10	matref	To pull into scope material that is defined elsewhere.	O	n		The referenced material must be available elsewhere otherwise

No	Name	Explanation	Reqd	Mult	Type	Note
						execution errors will occur. Binding is outside the scope of this specification.
4.1.10.1	linkrefid	As per structure 6.14				
4.1.11	mat_extension	Proprietary material extension.	O		ANY	All extensions to the response-type are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
4.1.12	altmaterial	Alternative material to be displayed in case the linked material cannot be rendered.	O			This alternative material should not be of the same type as the original otherwise it too will not be rendered.
4.1.12.1	linkrefid	As per structure 6.14				
4.1.12.2	qticomment	Comments of the alternative material.	O			As per structure 4.6
4.1.12.3	mattext	Text to be presented.	O	n		As per structure 4.1.2
4.1.12.4	matemtext	Text to be presented.	O	n		As per structure 4.1.3
4.1.12.5	matimage	An image to be presented.	O	n		As per structure 4.1.4
4.1.12.6	mataudio	Audio to be played.	O	n		As per structure 4.1.5
4.1.12.7	matvideo	Video to be played.	O	n		As per structure 4.1.6
4.1.12.8	matapplet	Java applet to be executed.	O	n		As per structure 4.1.7
4.1.12.9	matapplication	An application to be executed.	O	n		As per structure 4.1.8
4.1.12.10	matbreak	Insertion of a break in the flow.	O	n		As per structure 4.1.9
4.1.12.11	matref	To pull into scope material that is defined elsewhere.	O	n		As per structure 4.1.10
4.1.12.12	mat_extension	Proprietary material extension.	O			As per structure 4.1.11
4.2	decvar	Declaration of a variable to be used for scoring.	M	n		Each type of variable must be declared before it is used.
4.2.1	varname	As per structure 6.18.				
4.2.2	vartype	The type of variable.	M		Enumerated: String Integer (default) Decimal Scientific	Default is set to 'integer'.

No	Name	Explanation	Reqd	Mult	Type	Note
					Boolean Enumerated Set	
4.2.3	defaultval	The default value for the variable.	O		Numerical 32 String 33 True/False	Can be set to any value. Default is set to '0'.
4.2.4	minvalue	The minimum value permitted for a numeric score.	O		Numerical 32	Applies to the value of the score after all of the item processing has been completed.
4.2.5	maxvalue	The maximum score permitted for a numeric score.	O		Numerical 32	Applies to the value of the score after all of the item processing has been completed.
4.2.6	members	The set of enumerated values.	O		String 1024	Each member within the set must be delimited using the ' ' character.
4.3	setvar	The type of processing to be applied to the variable.	O		#PCDATA The value to be allocated according to the 'Action'.	One must be defined for each variable to be altered due to the condition.
4.3.1	action	The action to be applied.	M		Enumerated: Set (default) Add Subtract Multiply Divide	The default setting is "Set".
4.3.2	varname	As per structure 6.18				
4.4	conditionvar	The criteria to be applied as part of the actual evaluation of the response.	M			Each of the condition provides a boolean test. Consecutive conditions are linked as an 'and' condition.
4.4.1	varequal	Equivalence test on the variable.	O	n	#PCDATA The comparison value itself.	'True' is returned if equivalent.
4.4.1.1	respidnt	As per structure 6.19				
4.4.1.2	case	As per structure 6.24				
4.4.2	varlt	Less than test of the variable.	O	n	#PCDATA The comparison value itself.	'True' is returned if equivalent.

No	Name	Explanation	Reqd	Mult	Type	Note
4.4.2.1	respident	As per structure 6.19				
4.4.3	varlte	Less than or equal test on the variable.	O	n	#PCDATA The comparison value itself.	'True' is returned if the value is less than or equal to the comparator.
4.4.3.1	respident	As per structure 6.19				
4.4.4	vargt	Greater than test of the variable.	O	n	#PCDATA The comparison value itself.	'True' is returned if the value is greater than to the comparator.
4.4.4.1	respident	As per structure 6.19				
4.4.5	vargte	Greater than or equal test on the variable.	O	n	#PCDATA The comparison value itself.	'True' is returned if the value is greater than or equal to the comparator.
4.4.5.1	respident	As per structure 6.19				
4.4.6	varsubset	Test for containment in a list, set, string, etc.	O	n	#PCDATA The comparison set itself.	'True' is returned if the value is contained within the comparator.
4.4.6.1	respident	As per structure 6.19				
4.4.6.2	case	As per structure 6.24				
4.4.6.3	setmatch	Defines the nature of the set comparison.	O		Enumerated: Exact (default) Partial	The comparison set must be enclosed in {} parentheses and elements are separated by commas.
4.4.7	varinside	The XY co-ordinate is inside an area.	O	n	Numeric 4 CDATA of the co-ordinates of the areas: Ellipse x,y,height,width Rectangle x0,y0,height,width Bounded x1,y1,x2,y2,...,xk,yk.	The set of XY co-ordinates defining the area. 'True' is returned if the XY co-ordinate is within the area.
4.4.7.1	respident	As per structure 5.19				
4.4.7.2	areatype	The type of area against which the co-ordinate is to be tested.	M		Enumerated: Ellipse Rectangle Bounded	The ellipse is defined by the values x,y,height,width. The rectangle is defined by the values x0,y0,height,width. The bounded area is defined by the ordered set of pairs of co-ordinates

No	Name	Explanation	Reqd	Mult	Type	Note
						'x1,y1, x2, y2,...,xk,yk'.
4.4.8	var_extension	A proprietary extension facility.	O		ANY	All extensions to the response-type are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
4.4.9	durequal (For further study in V2.0).	Equivalence test on the response duration.	O		TBD.	TBD.
4.4.10	durlt (For further study in V2.0).	Less than test of the response duration.	O		TBD.	TBD.
4.4.11	durlte (For further study in V2.0).	Less than or equal test on the response duration.	O		TBD.	TBD.
4.4.12	durgt (For further study in V2.0).	Greater than test of the response duration.	O		TBD.	TBD.
4.4.13	durgte (For further study in V2.0).	Greater than or equal test on the response duration.	O		TBD.	TBD.
4.4.14	not	The logical 'NOT' operator.	O			This inverts the logic of the enclosed elements e.g. not (varequal) becomes the 'not equal to' element.
4.4.14.x	Contains one of the following elements: varequal, varlt, varlte, vargt, vargte, varsubset, varinside, var_extension, durequal, durlt, durlte, durgt, durgte, and, or, not.					
4.4.15	and	The logical 'AND' operator.	O			This provides the AND condition across all of the contained element operators.
4.4.15.x	Contains two or more of the following elements: varequal, varlt, varlte, vargt, vargte, varsubset, varinside, var_extension, durequal, durlt, durlte, durgt, durgte, and, or, not.					
4.4.16	or	The logical 'OR' operator.	O			This provides the OR condition across all of the contained element operators.
4.4.16.x	Contains two or more of the following elements: varequal, varlt, varlte, vargt, vargte, varsubset, varinside, var_extension, durequal, durlt, durlte, durgt, durgte, and, or, not.					
4.4.17	unanswered	Unanswered condition test.	O			This should be used to trap response which are

No	Name	Explanation	Reqd	Mult	Type	Note
						not attempted or for which no response is returned.
4.4.17.1	respidnt	As per structure 6.19				
4.4.18	other	Other condition test.	O			This should be used to trap conditions that are otherwise undefined.
4.5	interpretvar	The interpretation to be applied to the variable in terms relevant to an actor.				At present this element will be a comment string however it will be further developed in version 1.2.
4.5.1	varname	As per structure 6.18				
4.5.2	view	As per structure 6.1				
4.5.3	material	The material used to describe the variables.	O		As per structure 4.1	
4.6	qticomment	The comments used to annotate the XML file.	O			Comments should be used to aid human readability of the XML file itself.
4.7	duration	The duration permitted for the activity.	O		#PCDATA PnYnMnDTnHn MnS	As defined by the ISO8601. 'n' is an integer used to denote the number of the corresponding time components ('Y'-years, 'M'-months/minutes, 'D'-days, 'H'-hours and 'S'-seconds).
4.8	displayfeedback	The trigger for displaying feedback.	O			
4.8.1	feedbacktype	The type of feedback to be displayed.	M		Enumerated: Response (default) Solution Hint	The default value is 'Response'.
4.8.2	linkrefid	As per structure 6.14				
4.9	scorecondition	Evaluation of the scores to determine the responses.	M	n		A series of conditions could be applied depending on the number of scores to be processed.
4.9.1	title	As per structure 6.2				

No	Name	Explanation	Reqd	Mult	Type	Note
4.9.2	continue	As per structure 6.15				
4.9.3	qticomment	Comments on the assessment condition.	O			As per structure 4.6
4.9.4	conditionvar	Conditions applied to the scores to determine the feedback.	M	n		As per structure 4.4
4.9.5	setvar	Manipulation of the declared scoring variables.	O	n		As per structure 4.3
4.9.6	displayfeedback	Display trigger for the Assessment feedback.	O	n		As per structure 4.8.
4.9.7	scorecondition_extension	Proprietary extension for scoring conditions.	O		ANY	All proprietary alternatives to score conditions are to be implemented as sub-elements under this element (see the Q&TI Best Practice Guide for the naming convention).
4.10	scores	To create the variables required for the assessment accumulated scores.	M			The assessment accumulated processing variables group.
4.10.1	qticomment	Comments on the scoring system.	O			As per structure 4.6
4.10.2	decvar	Declaration of the score variables.	M	n		As per structure 4.2
4.10.3	interpretvar	Interpretation of the variable comments.	O	n		As per structure 4.5
4.11	objectives	The objectives of the ASI object.	O	n		These objectives are defined with respect to a view.
4.11.1	view	As per structure 6.1				
4.11.2	qticomment	Comments on the Assessment objectives.	O			As per structure 4.6
4.11.3	material	The content of the Assessment objectives.	C	n		As per structure 4.1
4.11.4	flow_mat	Structured material.	C	n		As per structure 4.14
4.12	rubric	The view specific description of the ASI.	O	n		
4.12.1	view	As per structure 6.1				
4.12.2	qticomment	Comments on the Assessment objectives.	O			As per structure 4.6
4.12.3	material	The rubric content.	C	n		As per structure 4.1
4.12.4	flow_mat	Structured material.	C	n		As per structure 4.14
4.13	qtimetadata	The container for all of the	O	n		Multiple

No	Name	Explanation	Reqd	Mult	Type	Note
		vocabulary-based QTI-specific meta-data.				vocabularies can be used for each set of meta-data fields.
4.13.1	vocabulary	The vocabulary to be applied to the associated meta-data fields.	O		#PCDATA String 2048	If no file is used then the vocab can be contained as a comma delimited string.
4.13.1.1	uri	As per structure 6.8				
4.13.1.2	entityref	As per structure 6.26				
4.13.2	qtimetatafield	The structure responsible for containing each QTI-specific meta-data field.	M	n		
4.13.2.1	xml:lang	As per structure 6.27				
4.13.2.2	fieldlabel	The name of the QTI-specific metadata field.	M		#PCDATA String 256	The label should appear in the vocabulary. If no vocabulary is used then external validation cannot take place.
4.13.2.3	fieldentry	Data to be entered for the field identified by the 'fieldlabel' element.	M		#PCDATA String 256	The contents could be bounded by information contained within the vocabulary.
4.14	flow_mat	Similar to material with the blocking guidelines to be applied by the rendering engine.	O	n		The blocking mechanism is render engine dependent.
4.14.1	class	Guidance on the type of block structuring.	O		As per structure 6.25	
4.14.2	material	The content to be displayed.	C	n	As per structure 4.1	
4.14.3	flow_mat	Structured material. This recursive structure allows complex layouts to be constructed.	C	n	As per structure 4.14	

5.5 Meta-data Objects

Table 5.5 describes the data attributes commonly used with the Assessment, Section and Item objects.

Table 5.5 Meta-data object detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
5.1	qmd_absolutescore	Range of scoring for the Assessment.	O		String. PCDATA	The range of scores that the user may attain i.e. max score and min score.
5.2	qmd_assessmenttype	The role of the Assessment.	O		String. PCDATA	The options are: "Examination", "Survey", "Tutorial", "Self-assessment", "Proprietary".
5.3	qmd_computerscored	Whether or not the Item can be scored by computer.	O		String. PCDATA	Yes/No entry.
5.4	qmd_feedbackpermitted	Whether or not feedback is available.	O		String. PCDATA	Yes/No entry.
5.5	qmd_hintspermitted	Whether or not hints are available.	O		String. PCDATA	Yes/No entry.
5.6	qmd_itemtype	The type of Item used.	O		String. PCDATA	The options are: "Logical Identifier", "XY co-ordinate", "String", "Numerical" and "Logical Group".
5.7	qmd_levelofdifficulty	The education level for which the Item is intended.	O		String. PCDATA	The options are: "Pre-school", "School" or "HE/FE", "Vocational" and "Professional Development".
5.8	qmd_maximumscore	The maximum score possible from that Item.	O		Numeric PCDATA	An integer or real number.
5.9	qmd_numberofitems	The number of Items contained by the object.	O		Integer (4) PCDATA	An integer number.
5.10	qmd_renderingtype	The type of rendering used within the Item.	O	n	String. PCDATA	The options are: "Choice", "Hotspot", "Slider", "String", and "Proprietary".
5.11	qmd_responsetype	The class of response expected for the Item.	O	n	String. PCDATA	The options are: "Single", "Multiple" or "Ordered".
5.12	qmd_scoringpermitted	Whether or not scoring is available.	O		String. PCDATA	Yes/No entry.
5.13	qmd_scoretype	The type of scoring used.	O		String. PCDATA	The options are: "Absolute".

No	Name	Explanation	Reqd	Mult	Type	Note
						"Percentage", "Unscored" and "Multidimensional".
5.14	qmd_sectionsincluded	Whether or not Sections are included available.	O		String. PCDATA	Yes/No entry.
5.15	qmd_solutionspermitted	Whether or not solutions are available.	O		String. PCDATA	Yes/No entry.
5.16	qmd_sectionselection	Support for Section selection.	O		String. PCDATA	Yes/No entry.
5.17	qmd_sectionsequence	Support for Section sequencing.	O		String. PCDATA	Yes/No entry.
5.18	qmd_itemselection	Support for Item selection.	O		String. PCDATA	Yes/No entry.
5.19	qmd_itemsequence	Support for Item sequencing.	O		String. PCDATA	Yes/No entry.
5.20	qmd_status	The status of the Item.	O		String. PCDATA	The options are: "Experimental", "Normal" or "Retired".
5.20	qmd_status	The status of the Item.	O		String. PCDATA	The options are: "Experimental", "Normal" or "Retired".
5.21	qmd_timedependence	Whether or not the response are timed.	O		String. PCDATA	Yes/No entry.
5.22	qmd_timelimit	The number of minutes or an unlimited duration.	O		String. PCDATA	Either an integer number of minutes or the string "Unlimited".
5.23	qmd_toolvendor	The name of the vendor of the tool creating the Assessment.	O		String. PCDATA	
5.24	qmd_topic	A brief description of the topic covered by the Item.	O		String. PCDATA	Text-based description of the Item's topic.
5.25	qmd_material	The type of material used within the Item.	O	n	String. PCDATA	The style of the list is as per the MIME formats. The full range of text, video, audio, etc. formats used.
5.26	qmd_typeofsolution	The type of solution available in the Item.	O		String. PCDATA	The options to be used are: "Complete", "Incremental", "Multilevel" and "Proprietary".

5.6 Common Data Objects (Attributes)

Table 5.6 describes the data attributes commonly used with the Assessment, Section and Item objects.

Table 5.6 Common attribute detailed description.

No	Name	Explanation	Reqd	Mult	Type	Note
6.1	view	The view to which the interpretation is applied.	O	n	Enumerated: All (default) Administrator AdminAuthority Assessor Author Candidate Invigilator Proctor Psychometrician Scorer Tutor	The 'All' view is the default value.
6.2	title	The title of the object.	O		Description String 256	Should be a representative description of the object.
6.3	ident	Unique identity of the object.	M		String 32	A unique identifier. See the QTI Best Practice Guide for naming and scoping rules.
6.4	solutionswitch	To enable/disable the provision of solutions.	O		Enumerated: Yes (default) No	Default setting is "Yes". Over-rides all other settings defined within the scope.
6.5	hintswitch	To enable/disable the provision of hints.	O		Enumerated: Yes (default) No	Default setting is "Yes". Over-rides all other settings defined within the scope.
6.6	feedbackswitch	To enable/disable the selection of Feedback.	O		Enumerated: Yes (default) No	Default setting is "Yes". Over-rides all other settings defined within the scope.
6.7	label	A content label.	O		String 256	This label will be used to allow content sensitive search and editing.
6.8	uri	The location of the object.	O		CDATA String 256 As per RFC1630.	An alternative to this is the 'entityref' attribute cf. 6.26).
6.9	x0	Top left hand side X-coordinate.	O		Integer 4 0-9999	Aspect ratio is maintained.
6.10	y0	Top left hand side Y-coordinate.	O		Integer 4	Aspect ratio is

No	Name	Explanation	Reqd	Mult	Type	Note
		ordinate.			0-9999	maintained.
6.11	height	The length of the y-axis side.	O		Integer 4 0-9999	Aspect ratio is maintained.
6.12	width	The length of the x-axis side.	O		Integer 4 0-9999	Aspect ratio is maintained.
6.13	embedded	The encoding used for embedded images.	O		CDATA string describing the encoding.	Default setting is "Base64".
6.14	linkrefid	The identifier of the material to be referenced.	M		String 32	Consistency checking is beyond the scope of this specification. Usage rules are given in the Q&TI Best Practice Guide.
6.15	continue	Next sequence in the processing.	O		Enumerated: Yes No (default)	Default setting is "No".
6.16	rcardinality	The category of the number of responses expected.	O		Enumerated: Single (default) Multiple Ordered	Default is "Single".
6.17	rtiming	Defines if the duration of the user's response is to be recorded.	O		Enumerated: Yes No (default)	Default is "No".
6.18	varname	The name of the variable to be declared.	M		String 16	Default is set as "SCORE".
6.19	respident	The identity of the Response type.	M		String 32	The <i>respident</i> must have been declared as part of a <i>response_label</i> .
6.20	scoremodel	The type of scoring model being adopted.	M		CDATA string describing the model. String 32	Default string is "SumofScores".
6.21	minnumber	The minimum number of responses expected.	O		Numeric 2	
6.22	maxnumber	The maximum number of responses expected.	O		Numeric 2	
6.23	feedbackstyle	The manner in which the hint is to be revealed.	O		Enumerated: Complete (default) Incremental Multilevel Proprietary	The default setting is "Complete".

No	Name	Explanation	Reqd	Mult	Type	Note
6.24	case	Defines the nature of the comparison.	O		Enumerated: Nocase YesCase (default)	'Nocase' means case insensitive and 'YesCase' means case sensitive.
6.25	class	Guidance to the nature of the flow structure required.	O		CDATA string. String 32.	The default setting is assumed to be 'Block'.
6.26	entityref	The entity reference that is used to bind an external file to the XML instance.	O		CDATA string defining the link. String 256.	This is an alternative to the 'uri' attribute (cf. 6.8)
6.27	xml:lang	The language that is being used for the information.	O		String 32.	The language entries will be defined as per the ISO standard.
6.28	xml:space	Space preservation to be maintained or otherwise.	O		Enumerated: Preserved Default (default)	As per the XML standard.

6. Meta-data Descriptions

The meta-data for use with the QTI takes three distinct forms:

- The standard IMS Meta-data that is included in an external description file that is associated with the ASI instance file. An example of this approach is used within the IMS Content Packaging of QTI resources;
- The explicit inclusion of QTI-specific meta-data fields. These fields are included in the ‘assessmentmetadata’, ‘sectionmetadata’ and ‘itemmetadata’ elements within the ASI data objects;
- The vocabulary based QTI-specific meta-data – this is a new approach introduced as part of the version 1.1 development.

6.1 Meta-data Definitions

There are three sets of meta-data descriptions:

- Assessment – describing the Assessments;
- Section – describing the Sections;
- Item– describing the Items.

In Table 6.1 the entry is defined as either Mandatory (‘M’) or Optional (‘O’). If an entry is defined as ‘Fixed’ then only the defined value is to be used. The contents and meaning of the *General*, *Life-cycle*, *MetaMeta-data*, *Technical*, *Educational*, *Rights*, *Relation*, *Annotation* and *Classification* are given in the IMS Meta-data Specifications.

Table 6.1 Assessment, Section and Item meta-data list comparison.

Field	IMS Class	IMS Class	Assess Class	Section Class	Item Class
General					
Resource Identifier	A string or number that uniquely identifies this resource.	M	M	M	M
Title	The title of the resource.	M	M	M	M
Catalogue	The catalogue name.	M	O	O	O
Catalogue Entry	The entry in the catalogue.	M	O	O	O
Language	The language the resource is presented in, ex. US-en. Default: US-en.	M	M	M	M
Description	A textual description of the contents of the resource.	M	M	M	M
Keywords	On or more exemplifying the contents of the course.	O	O	O	O
Coverage	The coverage of the instructional unit, (use of this field is very experimental).	M	N/A	N/A	N/A
Structure	The structure of the resource. Value: XML.	O	M/Fixed ‘XML’	M/Fixed ‘XML’	M/Fixed ‘XML’
Aggregation Level	The level to which the material is aggregated.	O	O	O	O
Lifecycle					
Version	The version of the resource.	M	O	O	O
Status	The status of the material.	O	O	O	O
Contribute Role	The role of the entity serving as the learning resource:	M	N/A	N/A	N/A

Field	IMS Class	IMS Class	Assess Class	Section Class	Item Class
	<ul style="list-style-type: none"> Curriculum Course Unit Topic Lesson Fragment NA (Not applicable) 				
Contribute Entity	The entity name for the contribution.	M	N/A	N/A	N/A
Contribute Date/time	The date of the entry of the contribution.	M	N/A	N/A	N/A
MetaMeta-data					
Catalogue	The name of the catalogue being used.	O	N/A	N/A	N/A
Catalogue Entry	The entry in the named catalogue.	O	N/A	N/A	N/A
Contribute Role	The role of the entity serving as the learning resource: <ul style="list-style-type: none"> Curriculum Course Unit Topic Lesson Fragment NA (Not applicable) 	O	N/A	N/A	N/A
Contribute Entity	The entity itself.	O	N/A	N/A	N/A
Contribute Date-time	The time of the entity entry.	O	N/A	N/A	N/A
Language	The language the resource is presented in, ex. US-en. Default: US-en.	M	M	M	M
Meta-data Schema	Information about Meta-data	M	N/A	N/A	N/A
Technical					
Format	The format of the resource, ex. Book, html etc. Value: XML	M	M/Fixed 'XML'	M/Fixed 'XML'	M/Fixed 'XML'
Size	The size of the material.	O	O	O	O
Location	The URL showing where the resource can be retrieved	O	N/A	N/A	N/A
Requirements Type	The type of requirements.	O	O	O	O
Requirements Name	The requirements.	O	O	O	O
Minimum Version	The minimum set of requirements to use this material.	O	O	O	O
Maximum version	The perfect set of requirements to use this material.	O	O	O	O
Installation Remarks	Remarks concerning the installation of the material.	O	O	O	O
OtherPlatformReqs	Other platform requirements.	O	O	O	O
Duration	The expected duration of the materials.	O	O	O	O
Educational					
Interactivity Type	The type of interactivity used by the materials.	O	O	O	O
Resource Type	The type of the resource, ex. Tutorial. Value: Assessment.	M	M/Fixed Assessment	M/Fixed Section	M/Fixed Item

Field	IMS Class	IMS Class	Assess Class	Section Class	Item Class
Interactivity Level	The level of interaction between the user and the container <ul style="list-style-type: none"> • Low • Medium • High 	O	N/A	N/A	N/A
Semantic Density	Density of the materials.	O	N/A	N/A	N/A
End-user Role	The intended role of the end-user.	O	O	O	O
Learning Context	The context for the learning materials.	O	O	O	O
Typical Age Range	The age range for whom the materials are relevant.	O	O	O	O
Difficulty	The difficulty of the material.	O	O	O	O
Learning Time	The typical time for completing the materials.	O	O	O	O
Description	A description of the learning materials.	O	O	O	O
Language	The language used for the materials.	O	O	O	O
Rights					
Cost	The price of using a particular offering	Conditional	O	O	O
Use Rights	What a user can do with the offering: <ul style="list-style-type: none"> • Restricted • Use • Aggregatable • Disaggregatable • Distributable • Editable 	M	O	O	O
Description	The description of the rights.	M	O	O	O
Relation					
Kind	The nature of the relationship between the named resource and this resource.	O	O	O	O
Resource	An identifier of a second resource and it's relationship with this resource.	O	N/A	N/A	N/A
Annotation					
Person	The individual making the annotations.	O	O	O	O
Date	The date/time of the annotations.	O	O	O	O
Description	The annotations themselves.	O	O	O	O
Classification					
Purpose	Learning objectives met by the container.	O	O	O	O
Taxon Source	The taxonomy source.	O	O	O	O
Taxon ID	The entry identity under the taxonomy.	O	O	O	O
Taxon Entry	The taxonomy entry itself.	O	O	O	O
Description	A description of the classification.	M	O	O	O
Keywords	One or more words exemplifying the contents of the course.	M	N/A	N/A	N/A
ASI Specific					
amd_absolutescore	The range of scores which the user may attain	N/A	O	N/A	N/A

Field	IMS Class	IMS Class	Assess Class	Section Class	Item Class
	(Min Score, Max Score).				
qmd_assessmenttype	The type of assessment role: <ul style="list-style-type: none"> Examination Survey Tutorial Self-assessment. 	N/A	O	N/A	N/A
qmd_computerscored	Whether or not the item can be computer scored [Yes/No].	N/A	N/A	N/A	O
qmd_feedbackpermitted	Whether or not the feedback is to be made available. Value: [Yes/No] with default=Yes.	N/A	O	N/A	O
qmd_hintspermitted	Whether or not the hints are to be made available [Yes/No].	N/A	O	N/A	O
qmd_itemtype	The type of Item: <ul style="list-style-type: none"> Logical identifier XY co-ordinate String Numeric Logical group Composite 	N/A	N/A	N/A	M
qmd_levelofdifficulty	The level of difficulty of the Item: <ul style="list-style-type: none"> Pre-school School Higher/further education Vocational Professional Development 	N/A	N/A	N/A	O
qmd_maximumscore	The maximum score attainable from the Item.	N/A	N/A	N/A	M
qmd_numberofitems	The number of Items directly referenced within the Section.	N/A	N/A	M	N/A
qmd_renderingtype	The type of rendering employed: <ul style="list-style-type: none"> Choice Hot spot Slider Text entry 	N/A	N/A	N/A	M
qmd_responsetype	The class of responses required by the Item: <ul style="list-style-type: none"> Single Multiple Ordered 	N/A	N/A	N/A	M
qmd_scoringpermitted	Whether or not scoring is enabled. Value: [Yes/No] with default=Yes.	N/A	N/A	N/A	O
qmd_scoretype	The scoring classification: <ul style="list-style-type: none"> Absolute Percentage Unscored Multidimensional 	N/A	M	N/A	N/A
qmd_sectionsincluded	Whether or not other Sections are defined within the Section [Yes/No].	N/A	N/A	M	N/A
qmd_solutionspermitted	Whether or not the solutions are to be made available. Value: [Yes/No] with default=Yes.	N/A	O	N/A	O

Field	IMS Class	IMS Class	Assess Class	Section Class	Item Class
¶md_sectionselection	Whether or not the solutions are to be made available. Value: [Yes/No] with default=Yes.	N/A	O	O	N/A
¶md_sectionsequence	Whether or not Section selection is available. Value: [Yes/No] with default=Yes.	N/A	O	O	N/A
¶md_itemselection	Whether or not Section sequencing is available. Value: [Yes/No] with default=Yes.	N/A	O	O	N/A
¶md_itemsequence	Whether or not Item selection is available. Value: [Yes/No] with default=Yes.	N/A	O	O	N/A
¶md_status	The status of the Item: <ul style="list-style-type: none"> • Experimental • Normal • Retired. 	N/A	N/A	N/A	O
¶md_timedependence	Whether or not the user responses are time dependent. Value: [Yes/No] with default=No.	N/A	N/A	N/A	O
¶md_typeofsolution	The type of solution supplied by the Item: <ul style="list-style-type: none"> • Complete • Incremental • Multilevel • Proprietary 	N/A	N/A	N/A	O
¶md_topic	A brief description of the topic covered by the Item.	N/A	N/A	N/A	O
¶md_weighting	The weighting of the Item to be applied in scoring.	N/A	N/A	N/A	O
¶md_material	Listing of the types of content supplied in the Item: <ul style="list-style-type: none"> • Text/basic • Text/rtf • Text/html • Text/xhtml • Image/gif • Image/jpeg • Audio/aicc • Audio/wav • Video/quicktime 3 • Video/quicktime 4 • Video/avi • Video/mpeg 1 • Video/mpeg2 • Video/mpeg4 • Applet/java • Application 	N/A	O	O	O
¶md_timelimit	The number of minutes or an unlimited duration.	N/A	O	O	O
¶md_toolvendor	Name of the vendor of the tool creating the Assessments.	N/A	O	N/A	O

This information is contained within the 'itemmetadata', 'sectionmetadata' and 'assessmentmetadata' elements.

6.2 QTI-Specific Meta-data Definitions

The QTI-specific meta-data definitions are included using an external vocabulary. Any vocabulary can be included using the *uri* and *entityref* attributes but an IMS vocabulary is to be defined (see Sub-section 6.3).

The external vocabulary approach is used to define the possible meta-data labels i.e. the actual fields available. It can also be used to define the constraints for the entries associated with a particular label e.g. the enumeration of the valid entries.

One or more vocabularies can be associated with each of the ASI data objects i.e. one or more vocabularies can be attached to each of the ‘assessmentmetadata’, ‘sectionmetadata’ and ‘itemmetadata’ elements.

For further study.

6.3 QTI-Specific Meta-data Vocabulary

The QTI-specific meta-data vocabulary has to be defined. This vocabulary will be stored in the file: `imsqtiv1p1_metadata.xml`.

For further study.

7. Conformance

The purpose of this statement is to provide a mechanism for customers to fairly compare vendors of assessment systems, tools and content. It is **not** required for a vendor to support every feature of the QTI specification, however, a vendor must detail their level of support with a “Conformance Statement”. For example vendors may choose to accept or publish QTI data, but not choose to repackage QTI data. Compliance is determined through two documents:

- Conformance summary – this is a summary that shows, in colloquial terms, the capabilities of a particular implementation with respect to the IMS QTI specification;
- Interoperability statement – this is a detailed technical checklist that identifies all of the feature capabilities of the implementation in terms of the QTI specification functions.

7.1 Valid Data Issues

Vendors claiming conformance shall publish, accept, and/or repackage valid QTI data as defined by the DTD including proprietary extensions where applicable. Vendors claiming their tools publish QTI shall export valid QTI data. Vendors claiming their system tools accept QTI data shall be able to parse and recognize valid QTI data. Vendors claiming their system tools repackage QTI data shall be able “pass through” valid QTI data whether the tool recognizes the optional elements or not. Vendors claiming their assessment content conforms to this specification shall provide valid QTI data. Publishers claiming their content conforms to QTI shall provide valid QTI data.

7.2 Conformance Summary

Vendors claiming conformance must provide a “Conformance Summary”, detailing their level of conformance, substantially similar to the information shown below, upon a reasonable request from a member of the IMS, a prospective customer(s). It is expected that this table, a template of which is shown in Table 7.1, is a summary of the information given in the ‘Interoperability statement’. The intention is for the ‘Conformance Summary’ to be informative in nature.

Completion of the three columns is intended to reflect:

- Publish – this implies that the XML instance contains the identified elements. If such an element is not ticked then it will not occur within the exported QTI-XML instance(s);
- Accept – it is assumed that the ability to accept the contents of an element is accompanied by the ability to use, and if appropriate, display that content. If this is not the case but the content of the material can be exported then the ‘Repackage’ column can still be ticked;
- Repackage – this is the ability to import QT_XML instances from one or more sources and to create a new instance that combines the imported information. It is not necessary for the repackaging system to be able to operate on the information supplied.

7.3 Interoperability Statement

An example of the detailed ‘Interoperability Statement’ is shown in Tables 7.2a, 7.2b and 7.2c (one for each of the three core data structures). An explanation of how to complete the ‘Interoperability Statement’ and the relationship between it and the ‘Conformance Summary’ is given in the IMS QTI Best Practice & Implementation Guide.

Note that the ‘Interoperability Statement’ addresses support for the various elements within the binding. The set of attributes are not considered. Inclusion of conformance with respect to attributes will be considered in later versions of the specification.

Table 7.1 Conformance summary.


	Conformance Summary (Version 1.1)		
	Publish (export, data)	Accept (import, display)	Repackage Feature
Assessment level support	Y or N	Y or N	Y or N
Objectives & Rubric	Y or N	Y or N	Y or N
Score processing	Y or N	Y or N	Y or N
Feedback	Y or N	Y or N	Y or N
Section level support	Y or N	Y or N	Y or N
Objectives & Rubric	Y or N	Y or N	Y or N
Score processing	Y or N	Y or N	Y or N
Feedback	Y or N	Y or N	Y or N
Items supported	Y or N	Y or N	Y or N
Question types	Y or N	Y or N	Y or N
Multiple choice	Y or N	Y or N	Y or N
Multiple Response	Y or N	Y or N	Y or N
Drag and Drop	Y or N	Y or N	Y or N
Short answer	Y or N	Y or N	Y or N
Fill in the Blank	Y or N	Y or N	Y or N
Numeric	Y or N	Y or N	Y or N
Image hot-spot	Y or N	Y or N	Y or N
Objectives & Rubric	Y or N	Y or N	Y or N
Flow	Y or N	Y or N	Y or N
Response processing	Y or N	Y or N	Y or N
Feedback	Y or N	Y or N	Y or N
Hints & Solutions	Y or N	Y or N	Y or N
Material Content	Y or N	Y or N	Y or N
Text	Y or N	Y or N	Y or N
Emphasised text	Y or N	Y or N	Y or N
Image	Y or N	Y or N	Y or N
Video	Y or N	Y or N	Y or N
Audio	Y or N	Y or N	Y or N
Other	Y or N	Y or N	Y or N

Table 7.2a Interoperability statement (Assessment).

Assessment		Version 1.1	
Mandatory Fields: <i>All of these fields must be supported.</i>			
<input type="checkbox"/> section			
Optional Fields: <i>Optional fields are informative. Checking an optional field implies that all of the associated mandatory elements are supported.</i>			
	Publish (export, data)	Accept (import, display)	Repackage Feature
duration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
assessmentmetadata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
qtimetadata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
rubric	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
assessmentcontrol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
assessprocessing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
assessfeedback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
sectionselection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
sectionsequence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
sectionref	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extension Fields: <i>These features allow the data model to be extended.</i>			
	Publish (export, data)	Accept (import, display)	Repackage Feature
condition_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
assessproc_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
scorecondition_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table 7.2b Interoperability statement (Section).

Section		Version 1.1		
Optional Fields:		<i>Optional fields are informative. Checking an optional field implies that all of the associated mandatory elements are supported.</i>		
	Publish (export, data)	Accept (import, display)	Repackage Feature	
duration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionmetadata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
qtimetadata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
rubric	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionprecondition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionpostcondition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionselection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionsequence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionref	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectioncontrol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionprocessing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionfeedback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
itemselection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
itemsequence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
itemref	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
item	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Extension Fields:		<i>These features allow the data model to be extended.</i>		
	Publish (export, data)	Accept (import, display)	Repackage Feature	
condition_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
sectionproc_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
scorecondition_extenion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Table 7.2c Interoperability statement (Item).

Item	Version 1.1		
Optional Fields: <i>Optional fields are informative. Checking an optional field implies that all of the associated mandatory elements are supported.</i>			
	Publish (export, data)	Accept (import, display)	Repackage Feature
duration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemmetadata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
qtimedata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
rubric	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemrubric	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemprecondition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itempostcondition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemcontrol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
presentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_label	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_lid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_xy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_str	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_num	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_grp	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
render_choice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
render_hotspot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
render_fib	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
render_slider	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Item	Version 1.1		
reprocessing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
outcomes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
decvar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
interpretvar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
respcondition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
servar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
conditionvar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemfeedback	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
solution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
hint	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
flow_mat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
matemtext	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
mattext	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
matimage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
matvideo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
mataudio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
matapplet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
matapplication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extension Fields: <i>These features allow the data model to be extended.</i>			
	Publish (export, data)	Accept (import, display)	Repackage Feature
response_na	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
response_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
render_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
condition_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
respcond_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
itemproc_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
scorecondition_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
mat_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Item		Version 1.1		
var_extension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Appendix A – Detailed Object Model

A1 Common Class Definitions

The common classes defined are:

- Metadata – the meta-data description class;
- Objectives – the content objectives class;
- Predicates – selection mechanism class;
- Material – the content to be displayed;
- Flowed material – block structured content to be displayed;
- Control – feedback control variables class;
- Variable – scoring variables classes;
- Score condition – scoring condition processing class;
- Score – the scoring mechanism class;
- Duration – the duration of an event class;
- Displayfeedback – display feedback trigger class;
- Rubric – contextual content for display.

A1.1 Meta-data Class Definition

The Meta-data class encapsulates the IMS Assessment meta-data set as listed in Section 6 of this specification. The composition of the Meta-data class is shown in Figure A1.1.

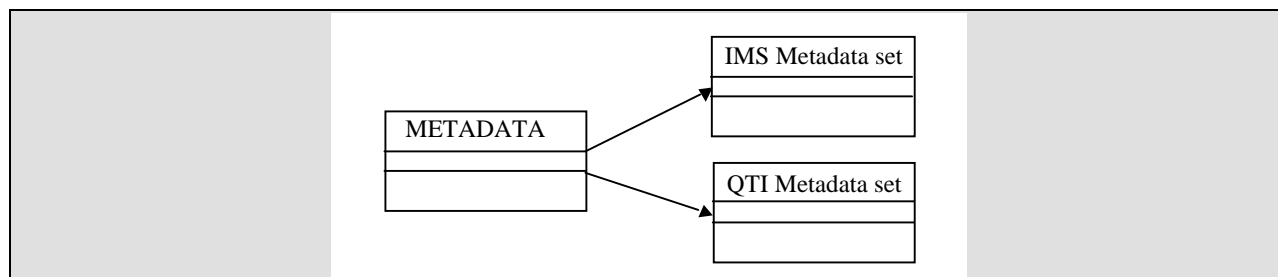


Figure A1.1 Metadata class representation.

The objects that are derived from the Metadata class are listed in Table A1.1. The Meta-data class objects table describes:

- Object name – the name of the object based upon the class;
- Source object – the objects to which the class object is related;
- Description – the usage of the object.

The meta-data enclosed in this class is unique to the QTI data structures only i.e. Assessments, Sections and Items. The standard meta-data items as defined in the IMS Meta-data Specifications are included through the normal mechanisms or can be packaged together with the QTI-XML instances using the IMS Content Packaging approach..

Table A1.1 Description class objects.

Object Name	Source Object	Description
assessmentmetadata	assessment	Assessment meta-data.
sectionmetadata	section	Section meta-data.
itemmetadata	item	Item meta-data.

The QTI Meta-data set is the mechanism used to include the QTI-specific definitions using external vocabularies and/or taxonomies.

A1.2 Objectives Class Definition

The Objectives class contains the objectives for the Assessment, Section and Item structures and maintains the linkage of these objectives with the IMS Content & Management Specifications. Figure A1.2 shows the Objective class and the attributes are listed in Table A1.2. At present the Objectives are expressed as a set of standard Material objects.

The objectives can be defined according to the ‘View’ i.e. the actors (see Figure 2.1) using the system. The view mechanism provides a mechanism by which different types of information can be targeted to the different actors.

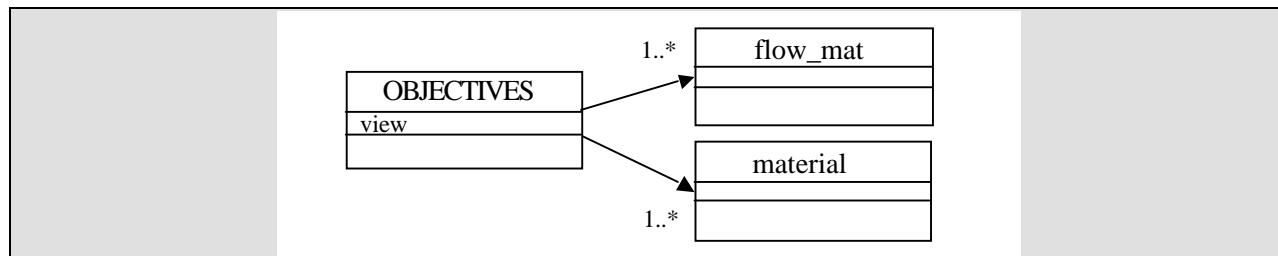


Figure A1.2 Objectives class representation.

The attribute table describes:

- Attribute Name – the name of the attribute;
- Data Type – the data type applied to the attribute;
- Description – a brief description plus the units and range of the data content;
- Req’d – Either mandatory (‘M’) or option (‘O’).

Table A1.2 Objective class attributes.

Attribute Name	Data Type	Description	Req’d
view	Enumerated	<p>These are the different user views that are available. These views match the ‘Actors’ as shown in Figure 2.1. The values are:</p> <ul style="list-style-type: none"> • All • Administrator • AdminAuthority • Assessor • Author • Candidate • InvigilatorProctor • Psychometrician • Scorer • Tutor 	O

A1.3 Predicate Class Definition

The Predicate class contains the information to enable dynamic selection of the possible Sections and Items (a similar selection could be in response to a poor score requiring further assessment. The list of objects derives from the predicate class are listed in Table A1.3. The predicates are defined as either:

- Preconditions – predicates applied before the object is activated i.e. employed to determine if some start conditions are correct;
- Postconditions – predicates applied after the object has completed its activity i.e. employed to determine if some end conditions have been obeyed.

Table A1.3 Predicate class objects.

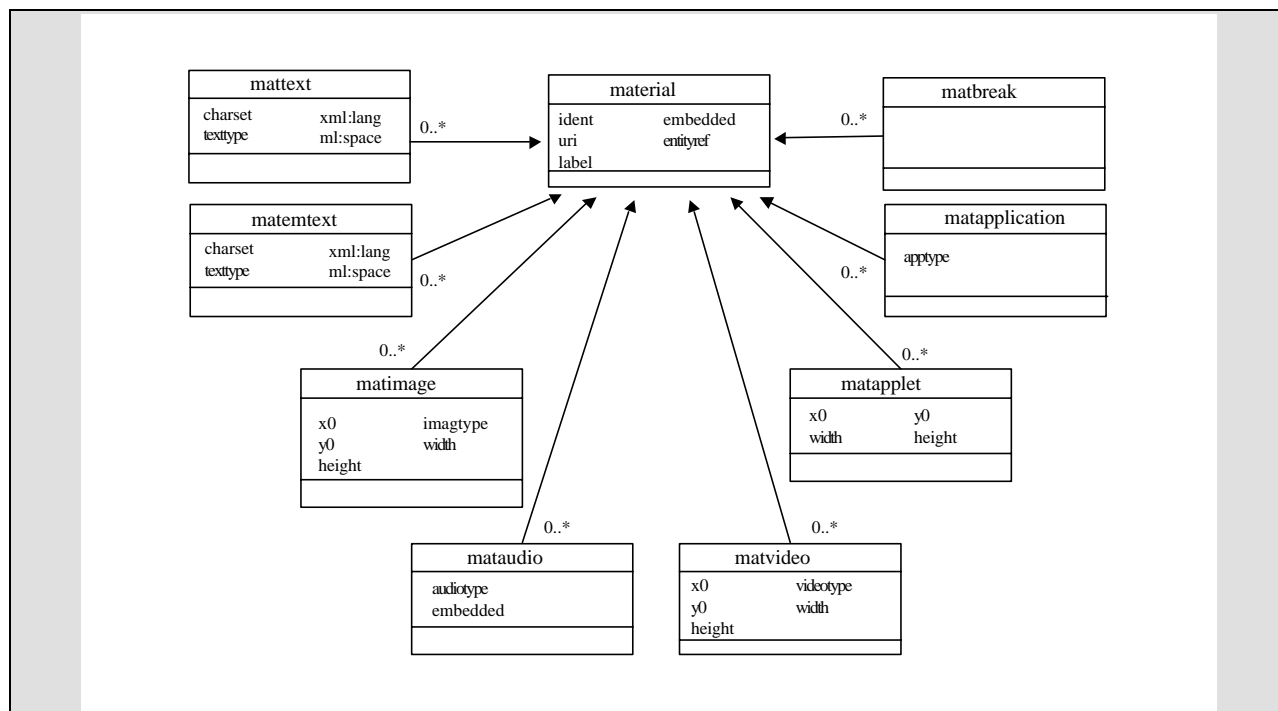
Object Name	Source Object	Description
itemprecondition	item	Precondition predicates for Items.
itempostcondition	item	Postconditions predicates for Items.
sectionprecondition	section	Preconditions predicates for Sections.
sectionpostcondition	section	Postconditions predicates for Sections.

The algorithms for the selection of Sections and Items is outside the scope of this specification. Static selection (selection which is independent of user input) will be based upon the meta-data descriptions (Description). Dynamic selection (fixed, independent of user input, or adaptive, dependent on user activity) will be based upon the pre and post conditions placed upon the Section and Item classes as well as the usage of the Selection and Sequence classes applied to the Item and Section classes.

Item and Section Selection and Sequencing is for further study in V1.2.

A1.4 Material Class Definition

The Material class is the parent for several content specific classes, as shown in Figure A1.3. The Sub-elements for the Material class are defined in Table A1.4 and the corresponding attributes are given in Table A1.5.

**Figure A1.3 Material class representation.**

The sub-elements table describes:

- Sub-element – the name of the sub-element;

- Cardinality – the number of possible associations between the class and the sub-element;
- Description – a brief description of the sub-element plus a reference to its defining source within this specification.

Table A1.4 Material class sub-elements.

Sub-element	Cardinality	Description
mattext	0..*	The presentation of text.
matemtext	0..*	The presentation of emphasised text.
matbreak	0..*	The insertion of a break structure in the content flow.
matimag	0..*	The presentation of images.
mataudio	0..*	The presentation of audio.
matvideo	0..*	The presentation of video.
matapplet	0..*	The running of a Java applet.
matapplication	0..*	The running of an application.

Table A1.5 Material class and sub-element attributes.

Attribute Name	Data Type	Description	Req'd
ident	String	String uniquely identifying the material; Length: 1-32 chars.	M
label	String	A label used to describe the style of the material. Length: 1-256 chars.	O
uri	String	As per RFC1630. Length: 1-256 chars.	O
entityref	String	The reference to the associated XML ENTITY definition. Length: 1-256 chars.	O
embedded	String	Indicator for the embedded inclusion of the material itself. Range: Yes/No.	O
texttype	String	The type of text to be displayed. Length: 1-256 chars.	O
imagetype	String	The type of image to be displayed. Length: 1-256 chars.	O
videotype	String	The type of video to be played. Length: 1-256 chars.	O
audiotype	String	The type of sound file to be played. Length: 1-256 chars.	O
apptype	String	The type of application to be invoked. Length: 1-256 chars.	O
charset	String	The character set to be used, as per RFC1521. Length: 1-256 chars.	O
x0	Integer	The top left-hand X co-ordinate of the image. Range: 0-9999.	O
y0	Integer	The top left-hand Y co-ordinate of the image.	O

Attribute Name	Data Type	Description	Req'd
		Range: 0-9999.	
height	Integer	The height (y-axis length) of the image/video. Range: 0-9999.	O
width	Integer	The width (x-axis length) of the image/video. Range: 0-9999.	O
xml:lang	String	The language of the associated textual material. Length: 1-256 chars.	O
xml:space	String	A switch identifying the processing of white space. Enumerated: Preserved, Default (default).	O

The objects that are derived from the Material class are listed in Table A1.6.

Table A1.6 Material class objects.

Object Name	Source Object	Description
altmaterial	material	Alternative content presentation.
objectives	assessment, section, item	Objectives for the Assessment, Section and Item data structures.
rubric	assessment, section, item	The rubric description for the Assessment, Section and Item data structures.
flow_mat	objectives, rubric, itemrubric, presentation, itemfeedback, sectionfeedback, assessfeedback, solutionmaterial, hintmaterial	This is an alternative structure to 'material', introduced in V1.1. This provides for the blocking structuring of the contained content.
assessfeedback	assessment	Scoring feedback content from the Assessment.
sectionfeedback	section	Scoring feedback content from the Section.
itemrubric	item	The rubric description for the Item. This object is to be deprecated in favour of the 'rubric' object.
presentation	item	Response container for the Item.
response_lid	presentation	LID response type content presentation.
response_xy	presentation	XY response type content presentation.
response_str	presentation	STR response type content presentation.
response_num	presentation	NUM response type content presentation.
response_grp	presentation	GRP response type content presentation.
render_choice	presentation	Choice rendering presentation content.
render_hotspot	presentation	Image rendering presentation content.
render_slider	presentation	Slider rendering presentation content.

Object Name	Source Object	Description
render_fib	presentation	Fill-in-blank rendering presentation content.
response_label	presentation	Available responses content.
solutionmaterial	solution	The available solutions.
hintmaterial	hint	The available hints.

A1.5 Control Class Definition

The Control class is responsible for the setting of the various switches which determine the capabilities to be displayed to the user e.g. the display, or not, of solutions. Figure A1.4 shows the structure of the Control class and the associated attributes are listed in Table A1.7.

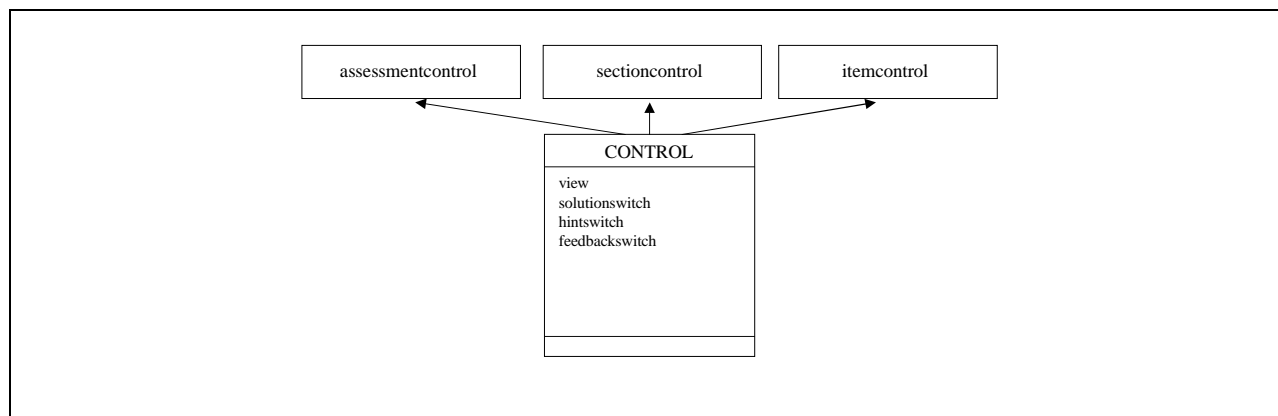


Figure A1.4 Control class representation.

Table A1.7 Control class attributes.

Attribute Name	Data Type	Description	Req'd
feedbackswitch	Enumerated	Determines whether or not the users have access to any feedback information. Range: Yes/No.	O
solutionswitch	Enumerated	Determines whether or not the users have access to any solutions. Range: Yes/No.	O
hintswitch	Enumerated	Determines whether or not the users have access to hints. Range: Yes/No.	O

The objects based upon the Control class are listed in Table A1.8. The order of precedence for these switches is:

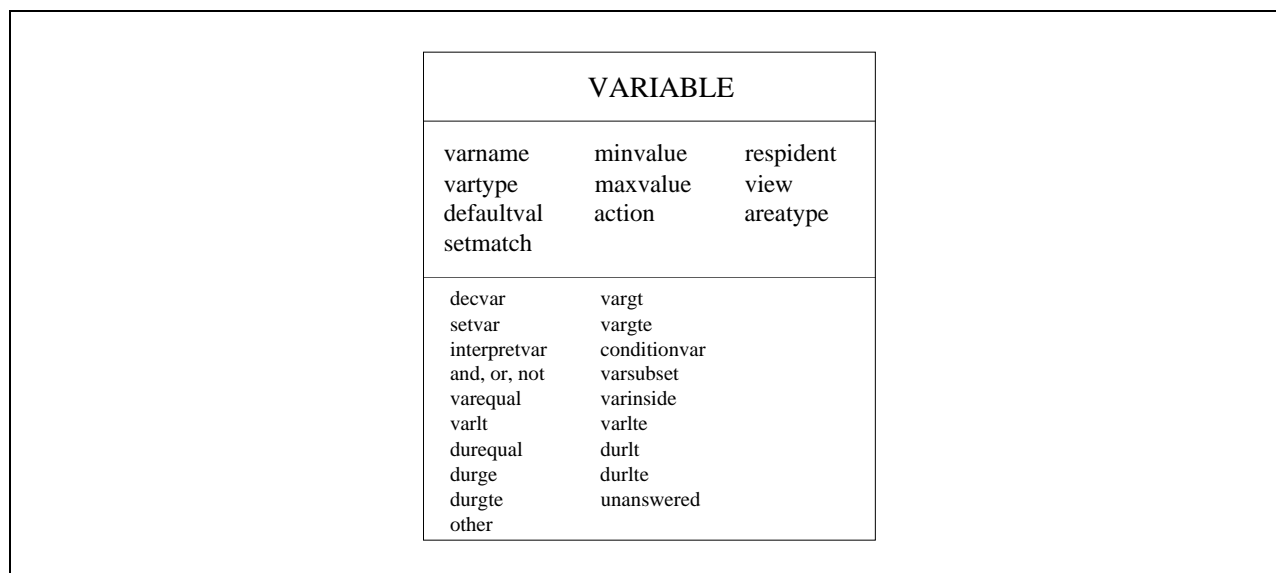
- Item level switches take precedence over everything else;
- Section switches take precedence over Assessment switches;
- Assessment switches define the default state if no switches are defined within either the Section or Item;
- The meta-data elements are used to inform about the availability of control over the switches.

Table A1.8 Control class objects.

Object Name	Source Object	Description
assessmentcontrol	assessment	Switch control for an Assessment.
sectioncontrol	section	Switch control for a Section.
itemcontrol	item	Switch control for an Item.

A1.6 Variable Class Definition

The Variable class is the representation of the data variables and the methods used to support the different response processing operations at the Item, Section and Assessment levels. The Variable class is shown in Figure A1.5 and the corresponding attributes are listed in Table A1.9. The methods for the class are listed in Table A1.10.

**Figure A1.5 Variable class representation.****Table A1.9 Variable class attributes.**

Attribute Name	Data Type	Description	Req'd
varname	String	The name of the variable to be declared or used.	O
vartype	Enumerated	The type of variable to be created: <ul style="list-style-type: none"> • String • Integer • Decimal • Scientific • Boolean • Enumerated • Set 	O
defaultval	String/numeric	The initial value to which the created variable is set.	O
minvalue	Numeric	The minimum value to which the numeric variable can be set.	O
maxvalue	Numeric	The maximum value to which the numeric variable can	O

Attribute Name	Data Type	Description	Req'd
action	Enumerated	be set. The action to be applied to the variable: <ul style="list-style-type: none"> • Set • Add • Subtract • Multiply • Divide 	O
resident	String	The 'Response Identity' to which the processing is to be applied.	O
setmatch	Enumerated	The type of set comparison to be made. The options are: <ul style="list-style-type: none"> • Exact - the default value • Partial 	O
areatype	Enumerated	The type of area to be used for the comparison: <ul style="list-style-type: none"> • Ellipse • Rectangle • Bounded 	O
view	Enumerated	As per Table A1.2.	O

It is the responsibility of the presentation system to support the storage and manipulation of the variables. How this storage and manipulation is supported is outside of the scope of this specification. Support for this capability is part of the conformance requirement and any error handling capabilities are implementation dependent.

Table A1.10 Variable class methods.

Method	Description
devar	Declaration of the variable: string, integer, real, float, scientific, Boolean.
setvar	Setting the value of the variable.
interpretvar	Comments about the variable e.g. mean, standard deviation, etc.
conditionvar	The application of a conditions to variables to determine their value.
varequal	Variable condition comparison of equality.
varlt	Variable condition comparison of less than.
varlte	Variable condition comparison of less than or equal.
vargt	Variable condition comparison of greater than.
vargte	Variable condition comparison of greater than or equal.
varsubset	Determine if the variable is contained within the given set (exact or partial).
varinside	To determine if the XY co-ordinate within the defined area.
durequal	Duration condition comparison of equality.
durlt	Duration condition comparison of less than.
durlte	Duration condition comparison of less than or equal.
durgt	Duration condition comparison of greater than.

Method	Description
durgte	Duration condition comparison of greater than or equal.
not	The logical NOT used to invert the comparison result.
and	The logical AND operator.
or	The logical OR operator.
other	The undefined condition operator.
unanswered	Condition for Item responses that have not been attempted.

The condition processing is based upon the requirements listed in Table A1.11.

Table A1.11 The condition processing to be applied to variables.

Response-type	Single Response	Multiple Responses	Ordered Responses
LID	Equal, Not equal, Subset, Not subset	The set of responses is applied to the set of var*** tests. The order the tests are applied is not significant as each test must be applied to all of the responses.	The order of the tests is applied sequentially. The order of the sequence of responses is applied to the order of the sequence of the var*** elements. Each response is used for only one var*** test per conditionvar element.
XY	Equal, Not equal, Inside, Not inside		
STR	Equal, Not equal, Substring, Not substring		
NUM	Greater than, Less than, Greater than or equal, Less than or equal		
GRP	Equal, Not equal, Subset, Not subset		

A1.7 DecVar Class

The DecVar class supports the evaluation of the responses by enabling different scoring variables to be declared. The list of DecVar attributes are listed in Table A1.12.

Table A1.12 DecVar class attributes.

Attribute Name	Data Type	Description	Req'd
varname	String	Name of the variable declared. Range: 1-32 characters. Default='SCORE'.	M
vartype	Enumerated	The type of variable that is being declared. The options are: <ul style="list-style-type: none"> Integer – an integer variable; Decimal – a real number variable; Scientific - exponential notation number; String – string of characters; Boolean – true/false value; Enumerated – predefined options; Set – a set (this may be empty) Default = 'integer'.	M
defaultval	Number or string	The start value assigned to the variable.	O

Attribute Name	Data Type	Description	Req'd
	or True/False or enumerated type value.		
members	String	String that lists the possible enumerated entries.	O
minvalue	Real Number	The minimum value to be assigned to the variable. Range = -999 to 999.	O
maxvalue	Real Number	The start value to be assigned to the variable. Range = -999 to 999.	O

Each and every scoring variable MUST be declared through its own DecVar statement. 'SCORE' is defined as a default integer variable.

A1.8 SetVar Class

The SetVar class defines the operations permitted on a scoring variable (as defined by DecVar). It is this series of operations that determine the final score made available through the score variables. The attributes for the SetVar class are listed in Table A1.13.

Table A1.13 SetVar class attributes.

Attribute Name	Data Type	Description	Req'd
action	Enumerated	The mathematical actions that can be applied to the variable. The options are: <ul style="list-style-type: none"> Set – set the variable to the defined value; Add – add the value to the named variable; Subtract – subtract the value from the named variable; Multiply – multiply the variable with the defined value; Divide – divide the variable with the defined value. 	M
varname	String	The variable name to which the processing is to be applied. Range: 1-32 characters.	O

A1.9 InterpretVar Class

The InterpretVar class supports description of the declared variables. The attributes for the InterpretVar class are listed in Table A1.14.

Table A1.14 InterpretVar class attributes.

Attribute Name	Data Type	Description	Req'd
varname	String	The variable name to which the processing is to be applied. Range: 1-32 characters.	O
view	Enumerated	As per Table A1.2	O

A1.10 Condition Classes

The Condition class is the collection of condition methods that are applied to variables to determine subsequent actions. The available condition methods and their attributes are listed in Table A1.15. Each condition returns a 'True' if the comparison is 'True' otherwise 'False' is returned.

Table A1.15 Condition methods and attributes.

Method - Attribute	Description
varequal	Variable condition comparison of equality.
respidnt	Refers to the 'Response ident' containing the ResponseId.
case	Defines if the check is case sensitive or not.
varlt	Variable condition comparison of less than.
respidnt	Refers to the 'Response ident' containing the ResponseId.
varlte	Variable condition comparison of less than or equal.
respidnt	Refers to the 'Response ident' containing the ResponseId.
vargt	Variable condition comparison of greater than.
respidnt	Refers to the 'Response ident' containing the ResponseId.
vargte	Variable condition comparison of greater than or equal.
respidnt	Refers to the 'Response ident' containing the ResponseId.
varsubset	Is the variable a member of the defined set.
respidnt	Refers to the 'Response ident' containing the ResponseId.
case	Defines if the check is case sensitive or not.
setmatch	Defines if the set comparison is to be exact or partial.
varinside	Is the XY co-ordinate within the defined area.
respidnt	Refers to the 'Response ident' containing the ResponseId.
areatype	Enumerated choice of area to contain the value: <ul style="list-style-type: none"> • Ellipse • Rectangle • Bounded
durequal	Duration condition comparison of equality. Used for determining if a response has occurred within some period.
respidnt	Refers to the 'Response ident' containing the ResponseId.
durlt	Duration condition comparison of less than. Used for determining if a response has occurred within some period.
respidnt	Refers to the 'Response ident' containing the ResponseId.
durlte	Duration condition comparison of less than or equal. Used for determining if a response has occurred within some period.
respidnt	Refers to the 'Response ident' containing the ResponseId.
durgt	Duration condition comparison of greater than. Used for determining if a response has occurred within some period.
respidnt	Refers to the 'Response ident' containing the ResponseId.
durgte	Duration condition comparison of greater than or equal. Used for determining if a response has occurred within some period.
respidnt	Refers to the 'Response ident' containing the ResponseId.

Method - Attribute	Description
not	Inverts the status code of the enclosed method.
and	Returns the AND condition of the status codes of the enclosed methods.
or	Returns the OR condition of the status codes of the enclosed methods.
other	Explicit undefined condition processing.
unanswered	If the response has not been attempted then this test returns 'True'.
respident	Refers to the 'Response ident' for unanswered processing.

The *not* method can be used to negate the status of any of the methods (except the *unanswered*) listed in Table A1.15. The *and* and *or* methods are used to collect together the methods listed in Table A1.15.

A1.11 Duration Class

The Duration class is the representation of the period for the activity. The Duration is defined as per the ISO8601 standard. The duration class objects are defined in table A1.16. The content of the class is the text string that contains the date/time using the format: PnYnMnDTnHnMnS where 'n' is an integer used to denote the number of the corresponding time components ('Y'-years, 'M'-months/minutes, 'D'-days, 'H'-hours and 'S'-seconds).

Table A1.16 Duration class objects.

Object Name	Source Object	Description
duration	assessment	Duration for Assessments.
	item	Duration for Items.
	section	Duration for Sections.

A1.12 DisplayFeedback Class

The DisplayFeedback class is the representation of the link between processing and the feedback that is to be triggered. The attributes for this class are listed in Table A.17 and the DisplayFeedback objects are listed in Table A1.18.

Table A1.17 DisplayFeedback class attributes.

Attribute Name	Data Type	Description	Req'd
feedbacktype	Enumerated	The type of feedback possible. The possible options are: <ul style="list-style-type: none"> • Response • Solution • Hint 	M
linkrefid	String	The identity of the feedback that is to be triggered. Range: 1-32 chars.	M

Table A1.18 DisplayFeedback class objects.

Object Name	Source Object	Description
displayfeedback	scorecondition	Feedback trigger for Assessments and Sections.
	responcondition	Feedback trigger for Items.

A1.13 Scores Class

The Scores class represents the variables to be used for the processing of the assessment accumulated information. The sub-elements for the Scores class are listed in Table A1.19.

Table A1.19 Scores class sub-elements.

Sub-element	Cardinality	Description
decvar	1..*	Declaration of the variables to be used for the assessment accumulated processing (see Section A1.6 in this document).
interpretvar	0..*	Comments about the variable e.g. mean, standard deviation, etc. (see Section A1.6 in this document).

A1.14 ScoreCondition Class

The ScoreCondition class represents the variables to be used for the processing of the assessment accumulated information. The sub-elements for the ScoreCondition class are listed in Table A1.20.

Table A1.20 Scores class sub-elements.

Sub-element	Cardinality	Description
conditionvar	1..*	The conditions that are to be applied to the variables to determine the feedback (see Section A1.6 in this document).
setvar	0..*	The values to be assigned to the declared variables (see Section A1.6 in this document).
displayfeedback	0..*	The feedback to be displayed as a result of the evaluation processing.

A1.15 Rubric Class

The Rubric class defines the manner in which content is presented that describes the context of the Assessment, Section and Item about to be presented. The content is defined by the view adopted. Figure A1.6 shows the Rubric class, the attributes are listed in Table A1.21 and the associated sub-elements are listed in Table A1.22. Within the Item data object, the rubric class is to be used in preference to the itemrubric class.

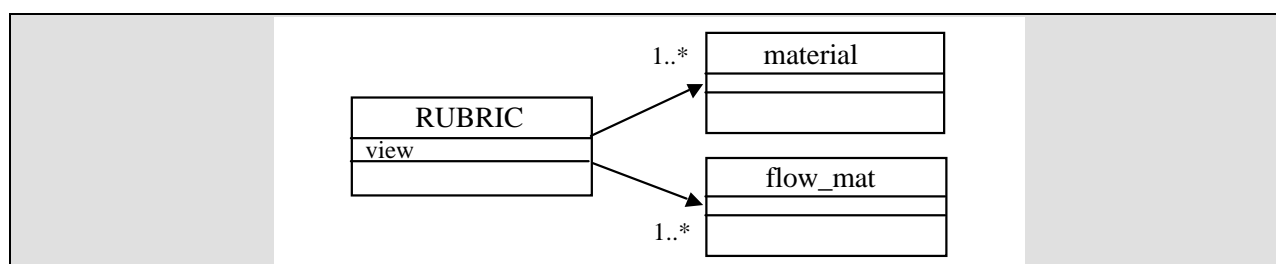
**Figure A1.6 Rubric class representation.**

Table A1.21 Rubric class attributes.

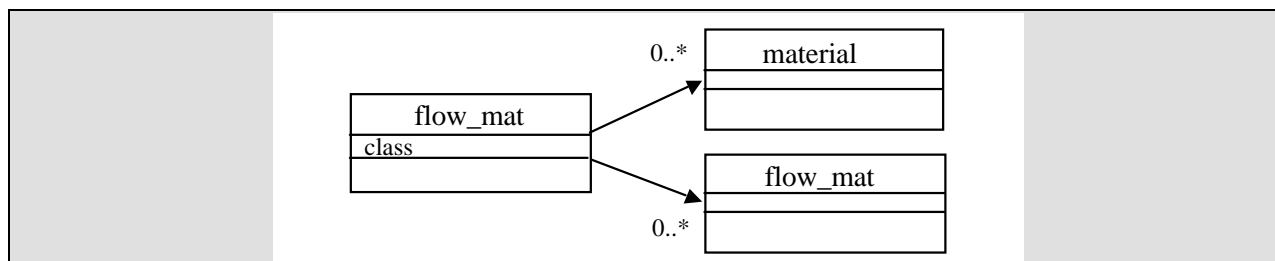
Attribute Name	Data Type	Description	Req'd
view	Enumerated	As per Table 1.2.	O

Table A1.22 Rubric class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as the rubric.
flow_mat	0..*	The block structured content to be presented as rubric.

A1.16 Flow_mat Class

The Flow_mat class contains the guidance for the block structuring of the material content. Figure A1.7 shows the Flow_mat class, the attributes are listed in Table A.23 and the associated sub-elements are listed in Table A1.24. Note that the Flow_mat class was introduced as part of the V1.1 work and as such is not available in V1.0 compliant systems.

**Figure A1.7 The flow_mat class representation.****Table A1.23 Flow_mat class attributes.**

Attribute Name	Data Type	Description	Req'd
class	String	Name of the blocking structure. The default value is 'Block'. Range = 1-32 characters.	O

Table A1.24 Flow_mat class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented.
flow_mat	0..*	The block structured content to be presented.

A1.17 Qtimetadata Class

The Qtimetadata class contains the QTI-specific meta-data based upon external vocabularies/taxonomies. Figure A1.8 shows the Qtimetadata class and the associated sub-elements are listed in Table A1.25. Note that the Qtimetadata class was introduced as part of the V1.1 work and as such is not available in V1.0 compliant systems.

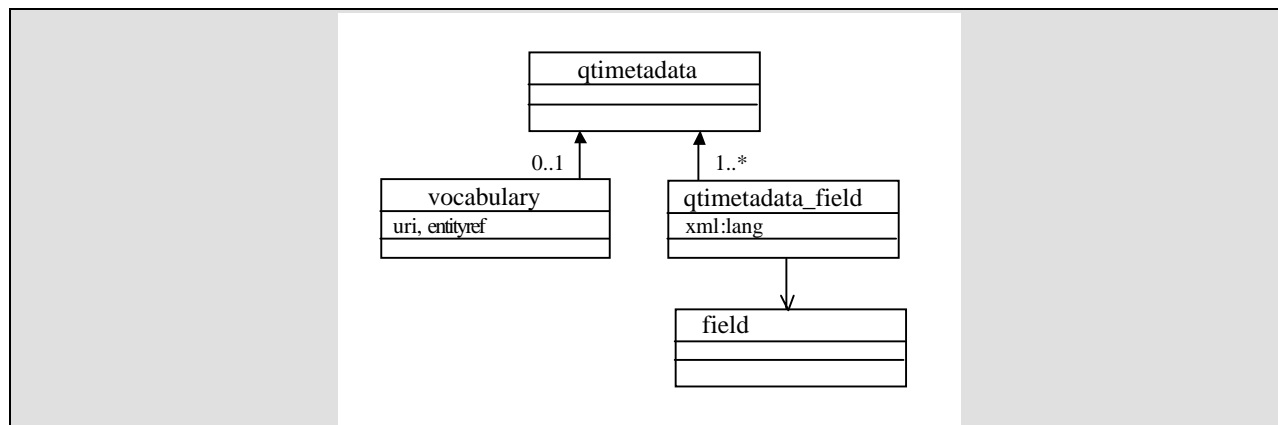


Figure A1.8 The qtimetadata class representation.

Table A1.25 Qtimetadata class sub-elements.

Sub-element	Cardinality	Description
vocabulary	0..*	The vocabulary to be used to define the QTI-specific meta-data.
qtimetadatafield	1..*	The blocs of QTI-specific meta-data.

A1.18 Vocabulary Class

The Vocabulary class defines the external vocabularies that are to be used for the QTI-specific meta-data definitions. If an external reference is not given then the vocabulary is contained in the object itself. The attributes for the Vocabulary class are given in Table A1.26.

Table A1.26 Vocabulary class attributes.

Attribute Name	Data Type	Description	Req'd
uri	String	As per RFC1630. Range = 1-256 characters.	O
entityref	String	The reference too the associated XML ENTITY definition. Length: 1-256 characters.	O

A1.19 Qtimetatafield Class

The Qtimetatafield class contains the set of QTI-specific fields that are grouped by the associated vocabulary. The sub-elements are given in Table A1.27 and the attributes in Table A1.28.

Table A1.27 Qtimetatafield class sub-elements.

Sub-element	Cardinality	Description
fieldlabel	1	The label of the meta-data field (defined within the vocabulary).
fieldentry	1	The actual meta-data field entry.

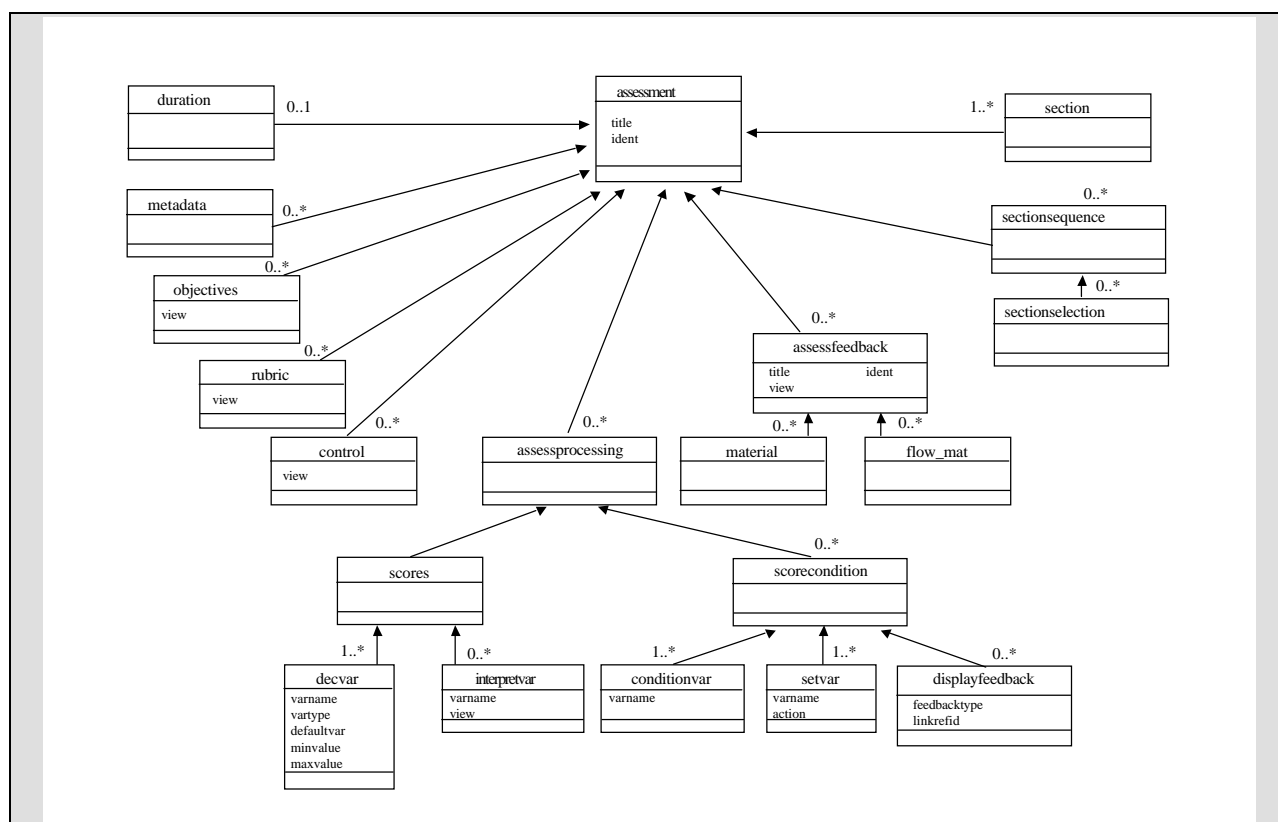
Table A1.28 Qtimetatafield class attributes.

Attribute Name	Data Type	Description	Req'd
xml:lang	String	The language of the associated textual material. Length: 1-256 chars.	O

A2. Assessment Representation

A2.1 Assessment Class

The Assessment class representation is shown in Figure A2.1. Each Assessment must contain at least one Section and may consist of a meta-data description (Metadata), objectives (Objectives), rubric (Rubric), switch control (Control) and assessment processing (assessprocessing) and feedback (assessfeedback). The attributes are listed in Table A2.1.

**Figure A2.1 Assessment class representation.****Table A2.1 Assessment class attributes.**

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the assessment. Range = 1-256 characters.	O
ident	String	The unique identifier of the Assessment. Range: 1-32 characters.	M

The Sub-elements for the Assessment class are listed in Table A2.2.

Table A2.2 Assessment class sub-elements.

Sub-element	Cardinality	Description
metadata	0..1	Meta-data description of the Assessment.
objectives	0..*	Objectives of the Assessment.
rubric	0..*	Rubric describing the Assessment.
control	0..*	Assessment control switches.
assessprocessing	0..1	Assessment accumulated processing. For further study in V1.2.
assessfeedback	0..*	Feedback for the Assessment accumulated processing.
sectionselection	0..*	The selection of Sections to be used. For further study in V1.2.
sectionsequence	0..*	The sequencing of the Sections used. For further study in V1.2.
section	1..*	Primary container for the Items. Each Assessment must contain at least one section.

A2.2 AssessProcessing Class

The AssessProcessing class represents the Assessment Accumulated Processing activity (as defined in the system model in Figure 4.1). The sub-elements are listed in Table A2.3.

Table A2.3 AssessProcessing class sub-elements.

Sub-element	Cardinality	Description
scores	1	Declaration of the variables to be used for the assessment accumulated processing.
scorecondition	0..*	The conditional evaluation to be placed on the assessment accumulated processing variables.

A2.3 AssessFeedback Class

The AssessFeedback class defines the material for feedback, as shown in Figure A2.1. The attributes for the AssessFeedback class are listed in Table A2.4 and the sub-elements are defined in Table A2.5.

Table A2.4 AssessFeedback class attributes.

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the score. Range = 1-256 characters.	M
ident	String	Unique identity of the feedback. Range = 1-32 characters.	O
view	Enumerated	As per Table A1.2.	O

Table A2.5 AssessFeedback class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as a result of the score.
flow_mat	0..*	The block structured format to be presented as a result of the score.

For further study in V1.2.

A2.4 SectionSelection & SectionSequence Classes

For further study in V1.2.

A3. Section Representation

A3.1 Section Class

The Section class representation is shown in Figure A3.1. Each Section may contain other selected sections (Selection) and may consist of a meta-data description (Metadata), the objectives (Objectives), rubric (Rubric), switch control (Control), pre/postconditions (Predicates), Section evaluation (SectionProcessing) and feedback (SectionFeedback) and selected and sequenced Sections (SectionSelection/SectionSequence) and Items (ItemSection/ItemSequence).

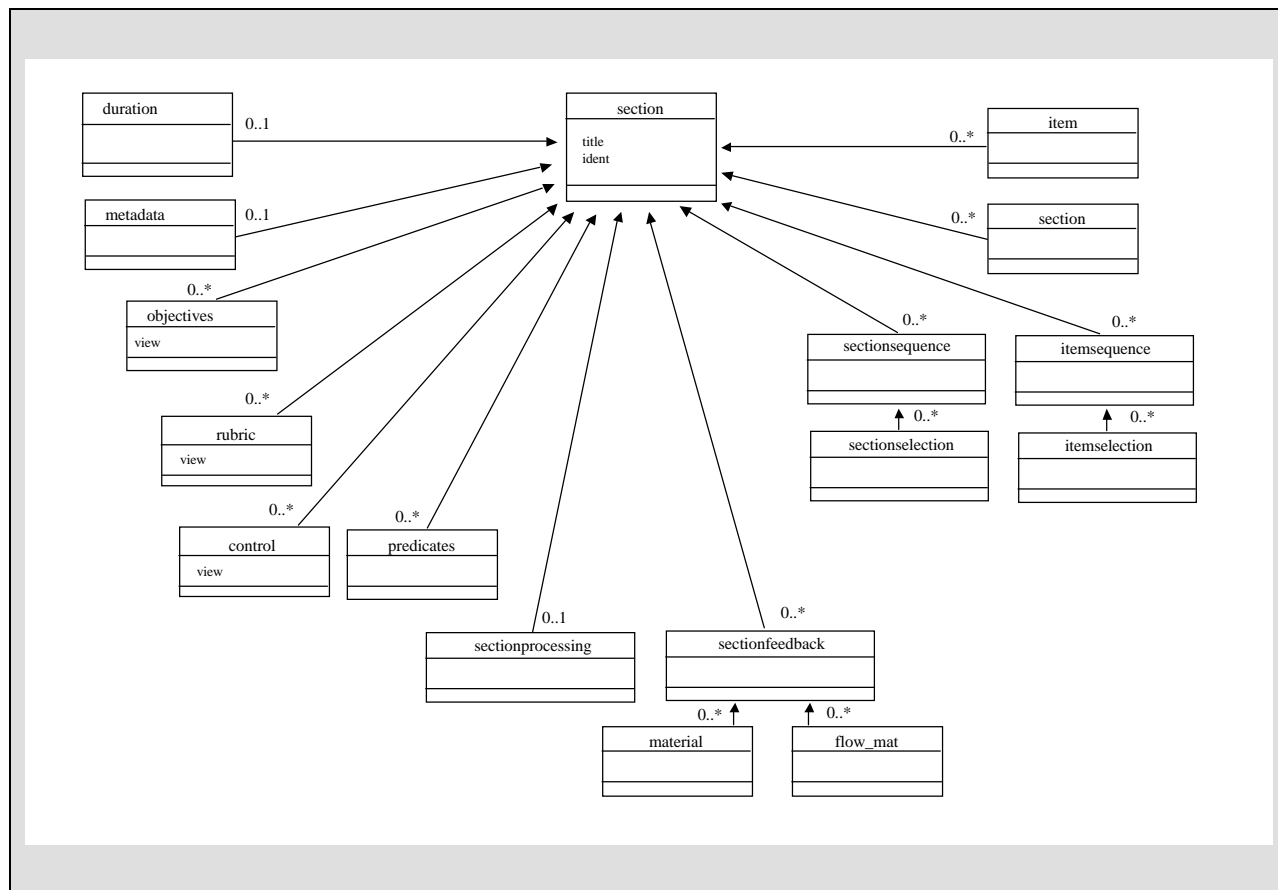


Figure A3.1 Section class model representation.

The attributes for the Section class are listed in Table A3.1:

Table A3.1 Section class attributes.

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the Section. Range = 1-256 characters.	M
ident	String	Name uniquely identifying the Section. Range = 1-32 characters.	M

The Sub-elements for the Section class are listed in Table A3.2:

Table A3.2 Section class sub-elements.

Sub-element	Cardinality	Description
metadata	0..1	Meta-data description of the Section.
objectives	0..*	Objectives of the Section.
rubric	0..*	Rubric describing the Section.
control	0..*	Section control switches.
predicates	0..*	Pre/post condition predicates applied to the Sections to decide which is to be invoked.
sectionprocessing	0..1	Assessment accumulated processing and feedback. For further study in V1.2.
sectionfeedback	0..*	Feedback of the results of the section level processing. For further study in V1.2.
sectionselection	0..*	The selection of Sections to be used. For further study in V1.2.
sectionsequence	0..*	The sequencing of the Sections used. For further study in V1.2.
section	0..*	Primary container for the Items. Each Section may contain other Sections.
itemselection	0..*	The selection of Items to be used. For further study in V1.2.
itemsequence	0..*	The sequencing of the Items used. For further study in V1.2.
item	0..*	The Items to be used.

A3.2 ItemSelection & ItemSequence Classes

For further study in V1.2.

A3.3 SectionProcessing Class

The SectionProcessing class represents part of the Assessment Accumulated Processing activity (as defined in the system model in Figure 4.1). The sub-elements are listed in Table A3.3.

Table A3.3 SectionProcessing class sub-elements.

Sub-element	Cardinality	Description
scores	1	Declaration of the variables to be used for the assessment accumulated processing.
scorecondition	0..*	The conditional evaluation to be placed on the assessment accumulated processing variables.

For further study in V1.2.

A3.4 SectionFeedback Class

For further study in V1.2.

A4. Item Representation

A4.1 Item Class

The Item class representation is shown in Figure A4.1. Each Item may consist of a meta-data description (Description), the view dependent rubric (ItemRubric), the selection predicates (Predicates), the available responses (Presentation), the corresponding response evaluation (RespProcessing), the associated feedback (RespFeedback). The attributes for the Item class are listed in Table A4.1 and the Item class sub-elements in Table A4.2.

Table A4.1 Item class attributes.

Attribute Name	Data Type	Description	Req'd
ident	String	Name uniquely identifying the Item. Range = 1-32 characters.	M
title	String	Title or name of the Item. Range = 1-256 characters.	O
label	String	Label identifying the Item. Range = 1-256 characters.	O
maxattempts	Integer	The maximum number of attempts permitted. Range = 1-99.	O

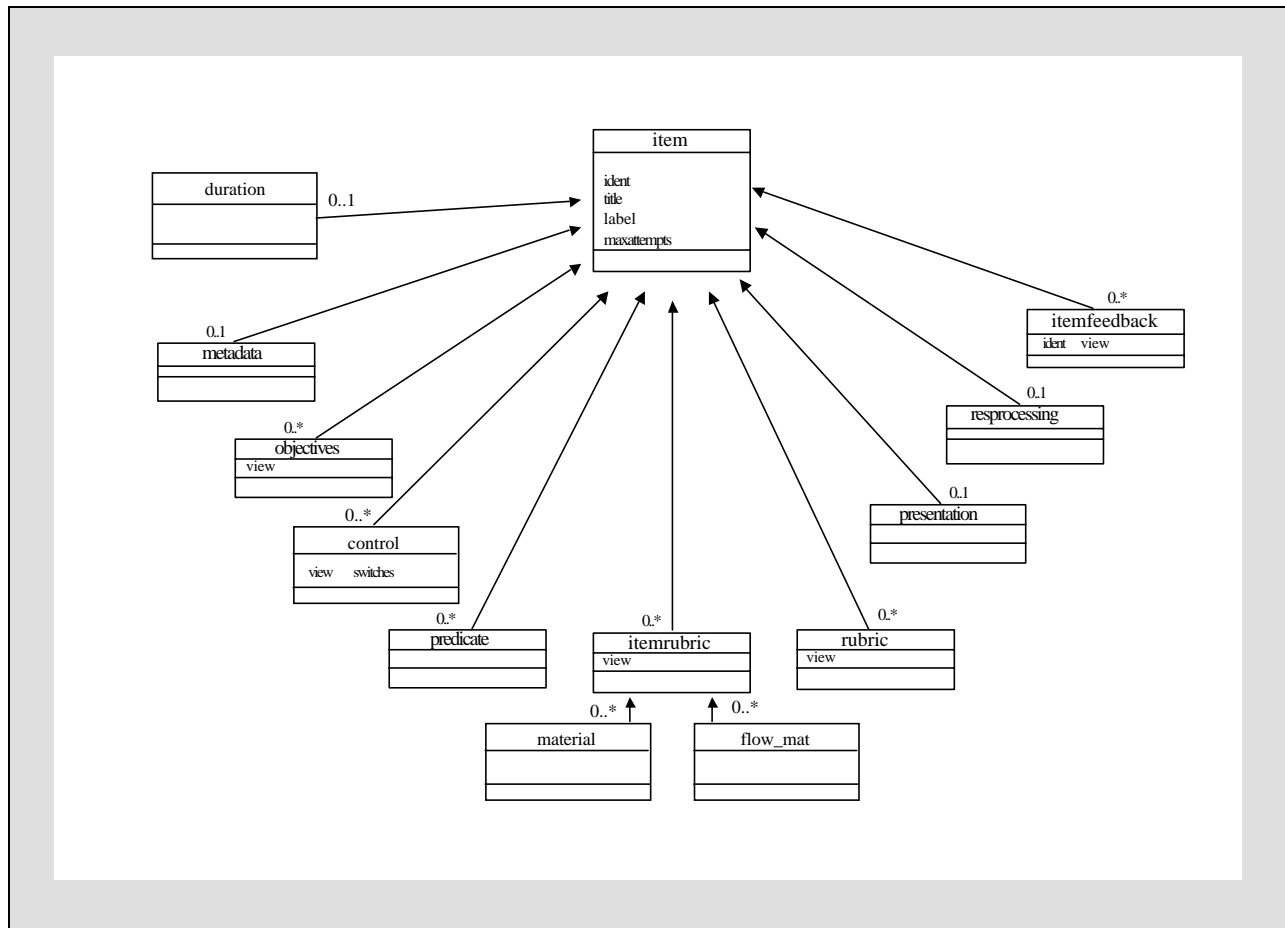


Figure A4.1 Item class representation.

Table A4.2 Item class sub-elements.

Sub-element	Cardinality	Description
metadata	0..1	Meta-data description of the Item.
objectives	0..*	The view specific objectives.
rubric	0..*	Rubric describing the Item.
predicate	0..*	The pre/postcondition predicates applied to the Item selection.
control	0..*	Item control switches.
itemrubric	0..*	The content describing the context of the Item.
presentation	0..1	The range of responses to be offered to the user.
resprocessing	0..1	Processing of the users responses.
itemfeedback	0..*	Feedback in terms of responses, solutions and hints..

A4.2 ItemRubric Class

The ItemRubric class defines the manner in which content is presented that describes the context of the Item about to be presented. The content is defined by the view adopted. The attributes are listed in Table A4.3 and the associated sub-elements are listed in Table A4.4.

Table A4.3 ItemRubric class attributes.

Attribute Name	Data Type	Description	Req'd
view	Enumerated	As per Table A1.2.	O

Table A4.4 ItemRubric class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as the rubric.
flow_mat	0..*	The block structured content to be presented as rubric.

As part of the V1.1 recommendations, the usage of the ItemRubric class is to be deprecated in favour of the Rubric class. Its inclusion herein is to maintain backwards compatibility.

A4.3 Presentation Class

The Presentation class representation is shown in Figure A4.2. Each Response may consist of a response content (Material), block structured response content (flow) the available response types (Response), the corresponding rendering of the response type (Rendering) and the available responses (ResponseLabel). The attributes for the Response class are listed in Table A4.5:

Table A4.5 Presentation class attributes.

Attribute Name	Data Type	Description	Req'd
ident	String	Name uniquely identifying the Item. Range = 1-32 characters.	M

The Sub-elements for the Responses class are listed in Table A4.6.

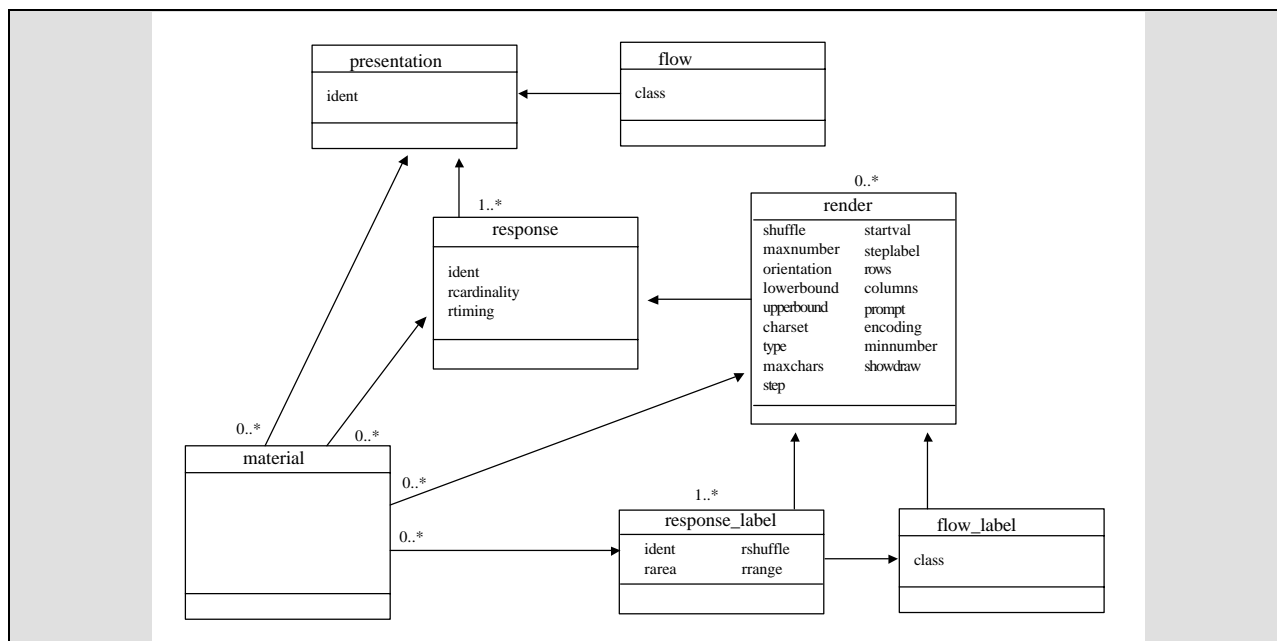


Figure A4.2 Presentation class representation.

Table A4.6 Presentation class sub-elements.

Sub-element	Cardinality	Description
material	0..1	The content to be presented for setting the scene to the response.
flow	0..1	The block structured approach to the presentation of the Item. This is the preferred approach for V1.1 Items onwards.
response	1..*	The response types container. Multiple response types means the response is a composite question.

A4.4 Response Class

The Response class defines the range of different types of response that can be provided. The Response attributes are listed in Table A4.7 and the list of sub-elements is listed in Table A4.8.

Table A4.7 Response class attributes.

Attribute Name	Data Type	Description	Req'd
ident	String	Name uniquely identifying the Item. Range = 1-32 characters.	M
rcardinality	Enumerated	The classification of the number of responses to be expected. The possible values are: <ul style="list-style-type: none"> • Single – one response only; • Multiple – more than one response; • Ordered – multiple responses where the order is significant. 	O
rtiming	Enumerated	Determination that the time taken to make a response is significant and needs to be recorded. The options are: <ul style="list-style-type: none"> • Yes; 	O

Attribute Name	Data Type	Description	Req'd
		• No.	

Table A4.8 Response class sub-elements.

Sub-element	Cardinality	Description
material	0..1	The content to be presented as part of the response itself.
render	1..*	The presentation format to be used to render the response type.

The objects based upon the Response class are listed in Table A4.9.

Table A4.9 RespType class objects.

Object Name	Source Object	Description
response_lid	presentation	The logical identifier response type.
response_xy	presentation	The XY co-ordinate response type.
response_str	presentation	The string response type.
response_num	presentation	The numeric response type.
response_grp	presentation	The logical group response type.

A4.5 Flow Class

The Flow class representation is shown in Figure A4.3. Each Flow may consist of a response content (Material), block structured response content (flow) or the available response types (Response). The attributes for the Response class are listed in Table A4.10:

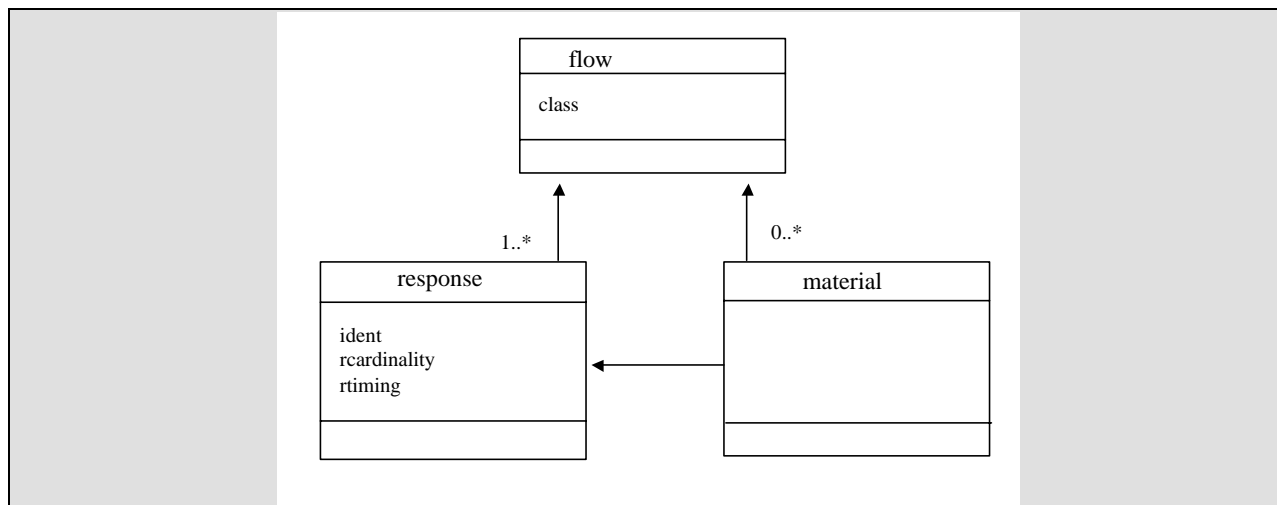


Figure A4.3 Flow class representation.

Table A4.10 Flow class attributes.

Attribute Name	Data Type	Description	Req'd
class	String	Name of the blocking structure. The default value is 'Block'. Range = 1-32 characters.	O

The sub-class elements for the Flow class are listed in table A4.

Table A4.11 Flow class sub-elements.

Sub-element	Cardinality	Description
material	0..1	The content to be presented for setting the scene to the response.
flow	0..1	The block structured approach to the presentation of the Item. This is the preferred approach for V1.1 Items onwards.
response	1..*	The response types container. Multiple response types means the response is a composite question.

A4.6 Render Class

The Render class defines the range of presentation formats that it is possible to apply to the response types. The Render class attributes are listed in Table A4.12 and the associated sub-elements are listed in Table A4.13.

Table A4.12 Render class attributes.

Attribute Name	Data Type	Description	Req'd
shuffle	Enumerated.	Defines if the multiple choice options are to be shuffled each time the item is invoked. Range = Yes/No (default = No).	O
minnumber	Integer	The minimum number of responses to be recorded. Range = 1-99.	O
maxnumber	Integer	The maximum number of responses to be recorded. Range = 1-99.	O
showdraw		Setting the connect-the-points feature of the display. Range = Yes/No (default = No).	
orientation	Enumerated	The orientation of the slider graphic. Range = Horizontal/Vertical.	O
lowerbound	Real number	The lowest value to be permitted by the slider. Range = less than 17 characters wide.	M
upperbound	Real number	The highest value to be permitted by the slider. Range = less than 17 characters wide.	M
step	Real number	The increment steps to be permitted by the slider. Range = less than 17 characters wide.	O
startval	Real number	The initial value to be displayed by the slider. Range = less than 17 characters wide.	O
steplabel	Enumerated	Defines if the unit values on the slider are to be displayed (the value covered by the pointer must always be displayed). Range = Yes/No (default = Yes).	O
charset	Enumerated	The character set to be used for the FIB. Range = as defined by RFC1521.	O
encoding	Enumerated	The encoding set to be used for the FIB. Range = as defined by RFC1521.	
rows	Integer	The number of rows for the FIB field. Range = 1-999	O

Attribute Name	Data Type	Description	Req'd
columns	Integer	The number of columns for the FIB field. Range = 1-999.	O
prompt	Enumerated	The type of visual prompt that will be supplied as part of the FIB rendering. The options are: <ul style="list-style-type: none"> • Box – a bordered area surrounding the text field; • Dashline – a dotted line representing the number of expected characters; • Asterisk – line of asterisks representing the number of expected characters; • Underline – single underline. 	O
type	Enumerated	The type of information to be put in to the FIB field. The options are: <ul style="list-style-type: none"> • String – a string of characters; • Integer – an integer; • Decimal – a real number; • Scientific – exponential notation; • Boolean – Yes/No 	O
maxchars	Integer	The maximum number of characters that can be entered. Range = 1-99999999	O

Table A4.13 Render class sub-elements.

Sub-element	Cardinality	Description
material	0..1	The content to be presented as part of the rendering.
response_label	0..*	Identification of the possible responses.
flow_label	0..*	Block structured layout of the identification of the possible responses.

The objects based upon the Render class are listed in Table A4.14.

Table A4.14 Render class objects.

Object Name	Source Object	Description
render_choice	presentation	The basic multiple choice text presentation.
render_hotspot	presentation	The image hot spot presentation.
render_slider	presentation	The slider representation.
render_fib	presentation	The fill-in-blank presentation.

A4.7 Response_Label Class

The Response_Label is the set of responses that a user may select. Each Response_Label may consist of the presented response content (Content). The attributes for the Response class are listed in Table A4.15:

Table A4.15 ResponseId class attributes.

Attribute Name	Data Type	Description	Req'd
ident	String	Name uniquely identifying the Item. Range = 1-32 characters.	M
rshuffle	Enumerated	Determines if that particular response is subject to shuffling. Options: Yes/No. (default=No)	O
rarea	Enumerated	The type of area that are to be used as hot-spots. The options are: <ul style="list-style-type: none"> • Ellipse • Rectangle • Bounded 	O
rrange	Enumerated	Sets the accuracy of the answer. The options are: <ul style="list-style-type: none"> • Absolute • Relative 	O

The Sub-elements for the Responses class are listed in Table A4.16:

Table A4.16 Response_Label class sub-elements.

Sub-element	Cardinality	Description
material	0..1	The content to be presented for setting the scene to the response.

A4.8 Flow_Label Class

The attributes for the flow_label class are shown in Table A4.17.

Table A4.17 Flow_label class attributes.

Attribute Name	Data Type	Description	Req'd
class	String	Name of the blocking structure. The default value is 'Block'. Range = 1-32 characters.	O

The sub-class elements for the Flow_class class are listed in table A4.18.

Table A4.18 Flow_label class sub-elements.

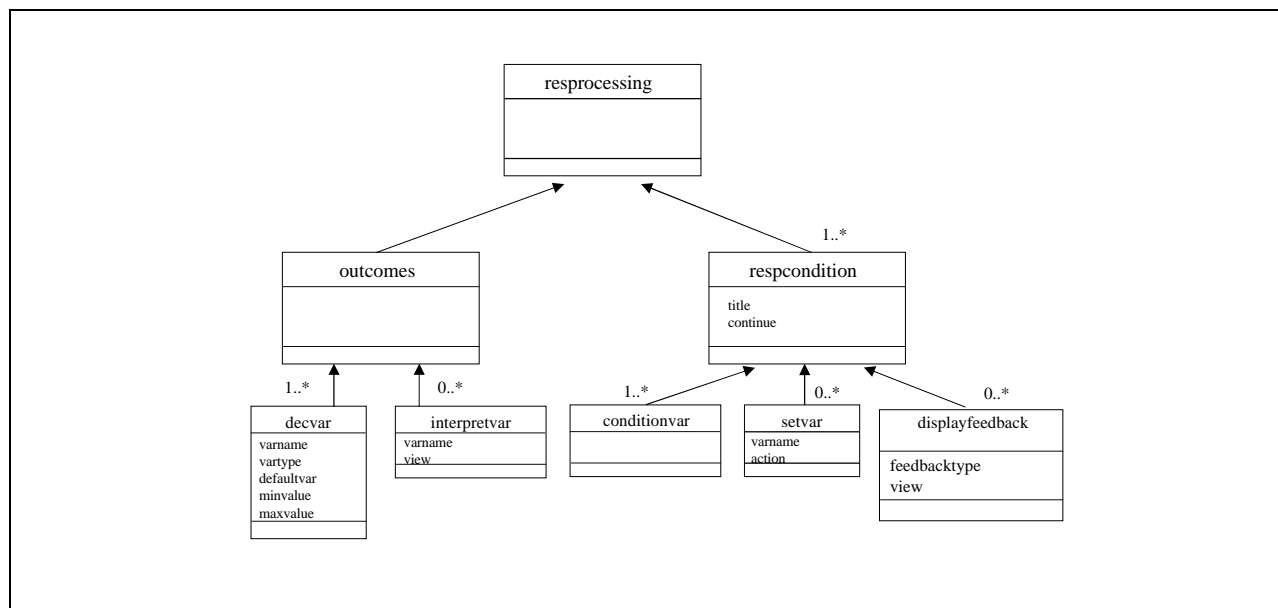
Sub-element	Cardinality	Description
response_label	0..*	Identification of the possible responses.
flow_label	0..*	Block structured layout of the identification of the possible responses.

A4.9 ResProcessing Class

The ResProcessing class describes the evaluation processing that is applied to the responses supplied by the user. The structure of the ResProcessing class is shown in Figure A4.4. The Sub-elements for the ResProcessing class are listed in Table A4.19:

Table A4.19 ResProcessing class sub-elements.

Sub-element	Cardinality	Description
outcomes	1	Declaration of variables to be used to provide scoring.
respcondition	1..*	Evaluation of the responses.

**Figure A4.4 ResProcessing class representation.****A4.10 RespCondition Class**

The RespCondition class defines the manner in which the response evaluation is actually processed. The attributes for the RespCondition class are listed in Table A4.20 and the associated sub-elements are listed in Table A4.21.

Table A4.20 RespCondition class attributes.

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the assessment. Range = 1-256 characters.	M
continue	Enumerated	The condition that defines if further processing should be applied. Options = Yes/No (default = No).	O

Table A4.21 RespCondition class sub-elements.

Sub-element	Cardinality	Description
conditionvar	1..*	Conditions applied to determine the associated Item score.
setvar	0..*	Assignment of a score to a scoring variable.
displayfeedback	0..*	Feedback of the response to the defined view.

A4.11 ItemFeedback Class

The ItemFeedback class, as shown in Figure A4.5 contains the feedback returned to the user (defined through the view) in response to the scoring achieved. The attributes for the ItemFeedback class are listed in Table A4.20 and the sub-elements are defined in Table A4.21.

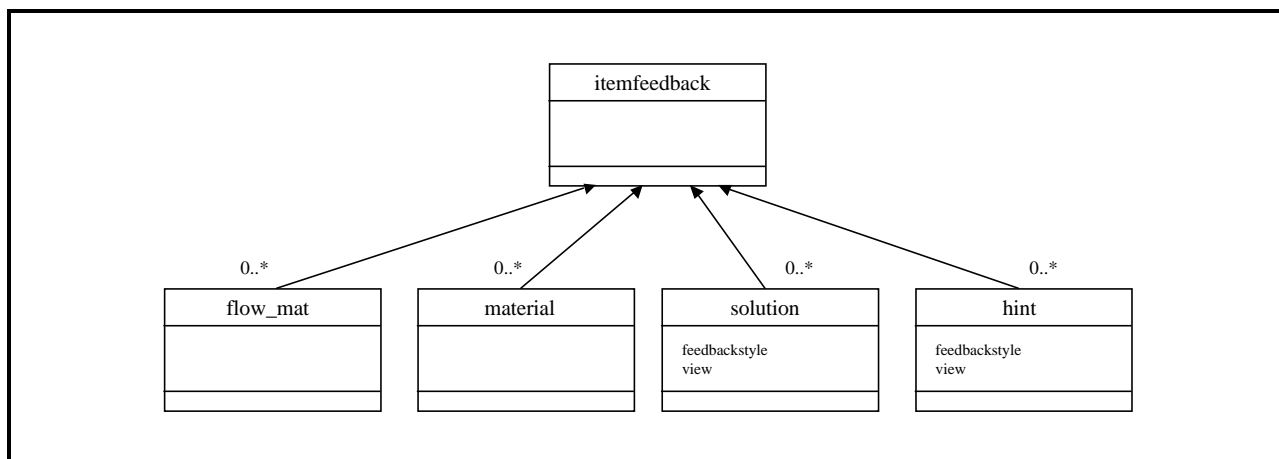


Figure A4.5 ItemFeedback class representation.

Table A4.20 ItemFeedback class attributes.

Attribute Name	Data Type	Description	Req'd
view	Enumerated	As per Table A1.2.	O

Table A4.21 ItemFeedback class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as response feedback.
flow_mat	0..*	Block structured content to be presented as response feedback.
solution	0..*	Control of the revelation of solutions for the Item.
hint	0..*	Control of the revelation of hints for the Item.

A4.12 Solution Class

The Solution class describes the series of steps that produce the resulting answers solicited from the user. The structure of the Solution class is shown in Figure A4.6 and the associated attributes are listed in Table A4.22.

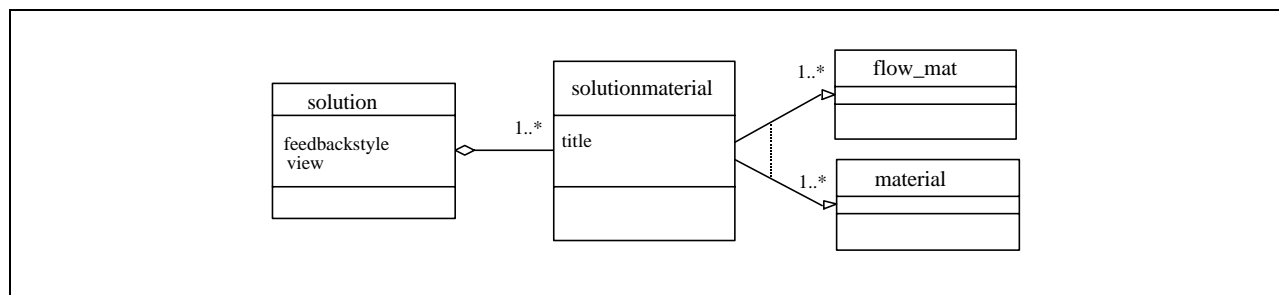


Figure A4.6 Solution class representation.

The attributes for the Solution class are listed in Table A4.22:

Table A4.22 Solution class attributes.

Attribute Name	Data Type	Description	Req'd
feedbackstyle	Enumerated	The type of solution that is available. The options are: <ul style="list-style-type: none"> Complete – a single complete solution; Incremental – a single solution is available that is revealed in portions; Multilevel – several complete solutions; Proprietary – proprietary feedback scheme. The default setting is “Complete”.	O
view	Enumerated	As per Table A1.2.	O

The Sub-elements for the Solution class are listed in Table A4.23:

Table A4.23 Solution sub-elements.

Sub-element	Cardinality	Description
solutionmaterial	1..*	The container for the content for a solution which could be complete, multiple or incremental.

A4.13 SolutionMaterial Class

The SolutionMaterial class represented the flow of information to the user. Its attributes are listed in Table A4.24 and the associated sub-elements are listed in Table A4.25.

Table A4.24 SolutionMaterial class attributes.

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the assessment. Range = 1-256 characters.	O

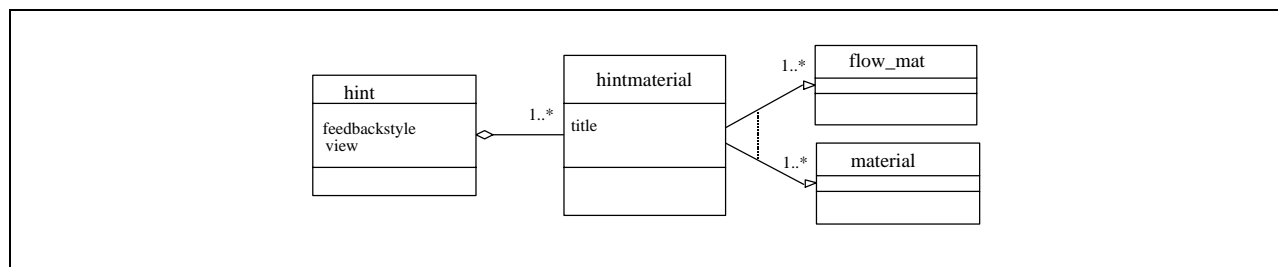
Triggers for the solution are generated by the DisplayFeedback object (Table A1.12).

Table A4.25 SolutionMaterial class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as part of the solution.
flow_mat	0..*	The block structured content to be presented as part of the solution.

A4.14 Hint Class

The Hint class describes the series of hints that can be revealed to the user. The structure of the Hint class is shown in Figure A4.7 and the associated attributes are listed in Table A4.26.

**Figure A4.7 Hint class representation.****Table A4.26 Hint class attributes.**

Attribute Name	Data Type	Description	Req'd
feedbackstyle	Enumerated	The type of Hint that is available. The options are: <ul style="list-style-type: none"> Complete – a single complete hint is available; Incremental – a single hint is available that is revealed in portions; Multilevel – several complete hints are available; Proprietary – proprietary feedback scheme. The default setting is “Complete”.	O
view	Enumerated	As per Table A1.2	O

The Sub-elements for the Hint class are listed in Table A4.27. Triggers for the hints are generated by the DisplayFeedback object (Table A1.12).

Table A4.27 Hint class sub-elements.

Sub-element	Cardinality	Description
hintmaterial	1..*	The container for the content for a Hint which could be complete, multiple or incremental.

A4.15 HintContent Class

The HintContent class represents the flow of hints to the user. Its attributes are listed in Table A4.28 and the associated sub-elements are listed in Table A4.28

Table A4.28 HintContent class attributes.

Attribute Name	Data Type	Description	Req'd
title	String	Title or name of the assessment. Range = 1-256 characters.	O

Table A4.29 HintContent class sub-elements.

Sub-element	Cardinality	Description
material	0..*	The content to be presented as part of the solution.
flow_mat	0..*	The block structured content to be presented as part of the solution.

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