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## Conceptualising item banks

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# CONCEPTUALISING ITEM BANKS

**Niall Sclater**

# Conceptualising Item Banks

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## Abstract

Sclater and MacDonald (2004) provide a simple definition of an item bank:

*a collection of items for a particular assessment, subject or educational sector, classified by metadata which facilitates searching and automated test creation.*

There is a need to define more closely the various elements and attributes of the item bank itself and to show how an item bank might fit into the larger picture of a distributed national (or even international) item bank infrastructure. This paper examines these issues. The Item Bank Infrastructure Study (IBIS) expands on this vision more fully and is available from www.toia.ac.uk/ibis.

## What is an item?

Before discussing item banks it is important to establish the nature of items themselves. The terms *item* and *question* are often used interchangeably. However the assessment community generally prefers to use the word *item* which, while it has little value in itself, has taken on a specific meaning in the context of assessment.

The most basic component of an item is the question stem. This presents the key information to the candidate that is used when selecting or entering a response.
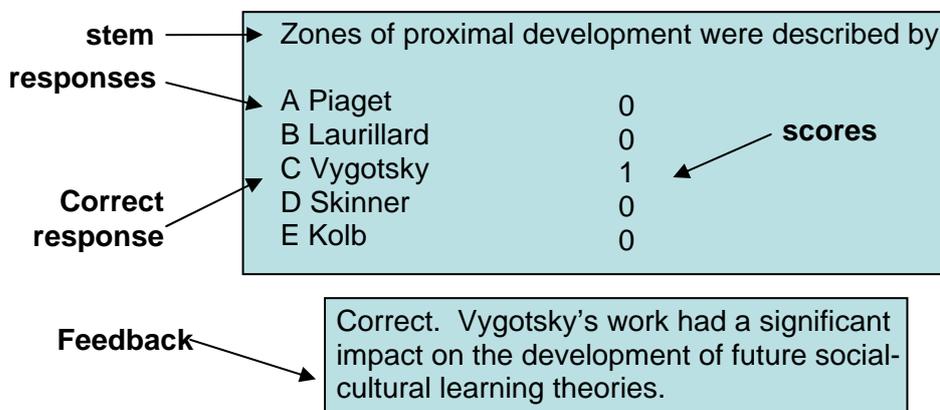


**Figure 1. Anatomy of an item: the basic item**

The most commonly used item type - multiple choice - contains other elements such as the responses available to the candidate. While the candidate is not normally initially shown which answer is correct, this information will be contained in the item, as can be the scores for individual responses. For formative assessment, each response may provide its own feedback. There may be other information such as instructions to the candidate, details on whether random ordering should be used for the responses, and whether candidates should only be given a certain amount of time to respond.

Most item banks contain multiple choice items such as this one but there is nothing to stop an item bank containing any type of item (or any type of digitised material to be used in an assessment).

An item must have a globally unique identifier (GUID) so that it can be tracked through the various item banks and delivery systems it may end up in (and correlated with responses and results after delivery). GUIDs are a type of metadata - or data about data.
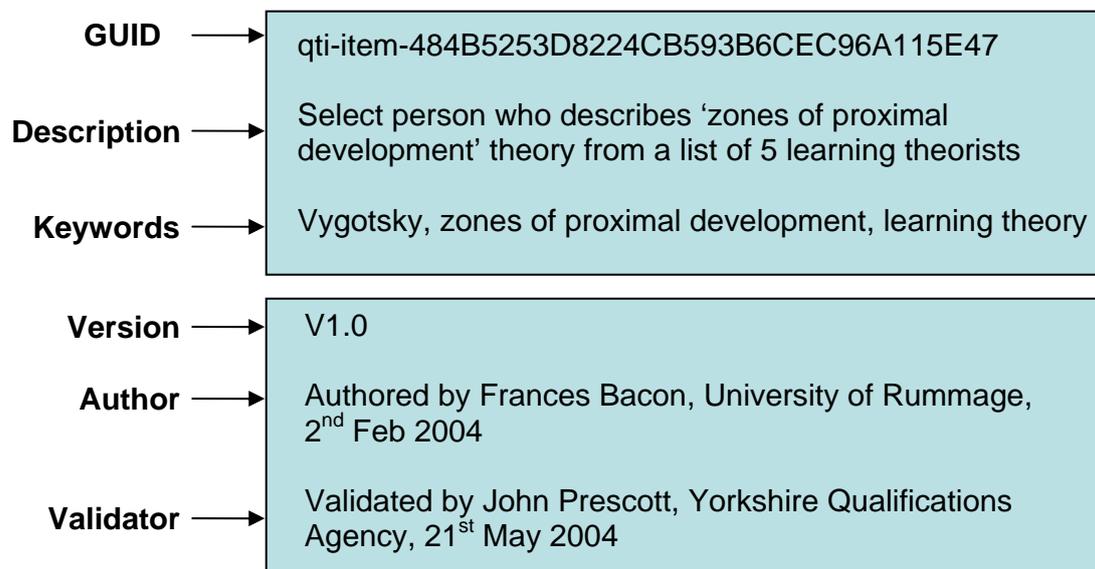
**GUID** ⟶ qti-item-484B5253D8224CB593B6CEC96A115E47

**Description** ⟶ Select person who describes 'zones of proximal development' theory from a list of 5 learning theorists

**Keywords** ⟶ Vygotsky, zones of proximal development, learning theory

**Version** ⟶ V1.0

**Author** ⟶ Authored by Frances Bacon, University of Rummage, 2$^{nd}$ Feb 2004

**Validator** ⟶ Validated by John Prescott, Yorkshire Qualifications Agency, 21$^{st}$ May 2004

**Figure 2. Anatomy of an item: metadata**

There are many different metadata elements which can relate to an item such as *description, keywords, version number, author* or *validator*. Metadata is an essential component of an item and should be included with it. IBIS also expects metadata to be extractable from an item so that it can be held independently within a central metadata repository.

## Grouping items into item pools

Individual items have limited value; normally they are delivered with other items as assessments (tests). Some item banks such as COLEG OnLine Assessment (COLA) group items into assessments which map neatly onto parts of a curriculum. Instead of assessments IBIS uses the more flexible

concept of item *pools* ie collections of related items from which a subset can be drawn to create a test. Thus an item pool may consist of 100 items of similar difficulty with 20 items drawn randomly from the pool for one test. The pool might also consist of only 20 items, all of which are required to be delivered to a candidate during the test. This type of pool would be identical to the COLA concept of an assessment.
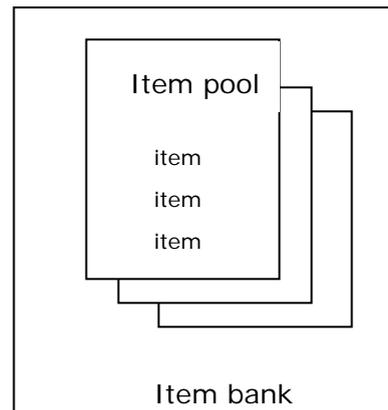


**Figure 3. Items, pools and banks**

Items can belong to more than one pool. This gives them maximum reusability across different subject areas, curricula and institutions. It also means that tracking usage properly in order to ensure they do not become over-exposed becomes even more critical.


## Developing a distributed item bank system

The current situation is one where in general every organisation (and project) maintains its own item bank. The market for items is as yet almost completely undeveloped. This may be for the following reasons:

- Potential customers are unaware that the item banks exist
- Organisations do not have the structures in place to market the content
- Organisations may not wish to lose control of their content
- The content is usually held in proprietary formats and cannot easily be exported to other systems

One solution would be to hold all items centrally and manage them under a national service. There would be considerable economies of scale and it would be easier to ensure high levels of security, quality assurance, adherence to standards etc. A one stop shop could be provided for anyone interested in obtaining assessment content with purchases handled by a central agency. This approach is problematic however because many organisations and projects will prefer to retain local control over their items. It might also have implications for resilience in that if the central system went down no-one would have access to any content at all.

The best solution may be somewhere between these two extremes. Organisations which wish to can retain control over their item banks. A brokerage system is developed which handles certain processes such as searching for and obtaining items. This requires all item banks to be able to export content in a standard format and also to use the same system of protocols for permissions and the releasing of that content.

The critical issue is to decide which processes should be maintained by the local organisation and which ones should be carried out centrally. It is likely that this will have to remain flexible – some organisations may only wish to use the brokerage system for marketing and purchasing while others may wish to outsource the entire item bank service to a third party.

It is helpful to start by defining the various components of a stand-alone computer assisted assessment system.

Sclater and Howie (2003) outline the data structures in an online assessment system and twenty-one user roles (see Figure 4 below). In this model items are authored and combined into assessments. Learners (candidates) belong to groups which are scheduled to take assessments at particular times. This produces candidate responses and results.

With a distributed item bank service as proposed by IBIS, items may be authored and held by one organisation but delivered by another. Organisations can use their preferred software for authoring items and can hold the items in their own item banks. However the item banks must be able to respond to requests for item pools and send them out in a standard format.

IBIS envisages the creation of a 'market' for items, held in item pools. Item pools are contained in item banks. Item banks are held by different organisations for different purposes in a variety of proprietary formats with different types of metadata. In order to facilitate the exchange of items these item banks must have the facility to export items and item pools in a commonly understood format. IMS QTI v1.2 (and probably the new v2.0 specification) is the only suitable format for the time being. Items should be packaged together using the IMS Content Packaging specification and contain metadata conforming to the appropriate application profiles of the IEEE Learning Object Metadata standard.
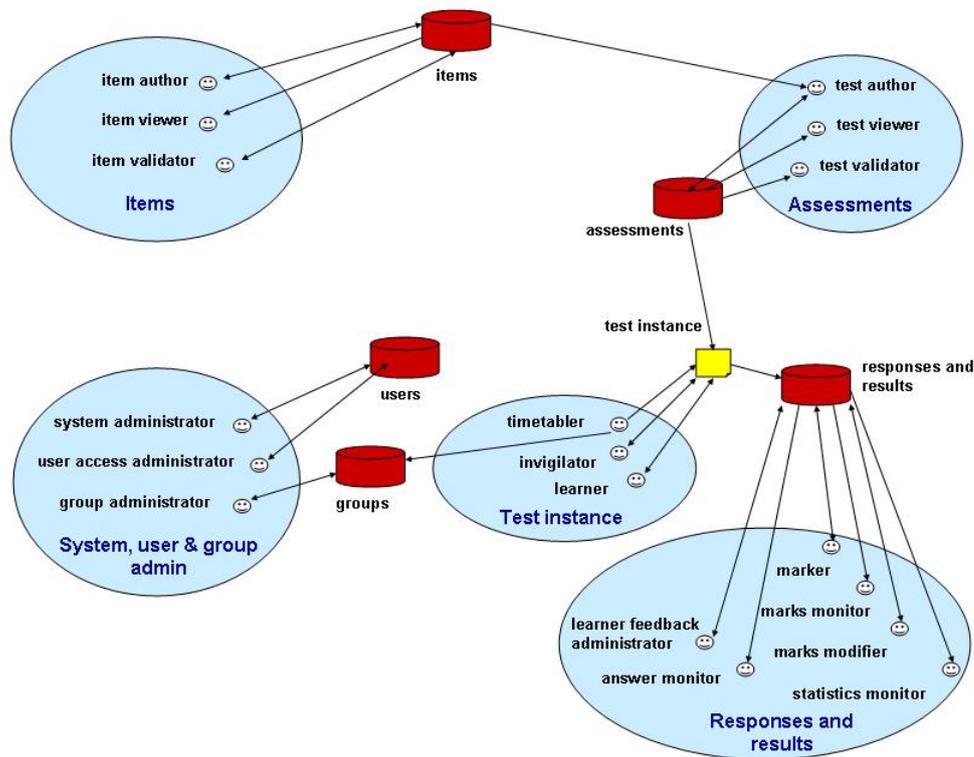
**Figure 4. Anatomy of an online assessment system**

The item bank is merely a collection of item pools and does not contain any functionality. Theoretically an entire item bank could be zipped up in a single file and transferred to another organisation.
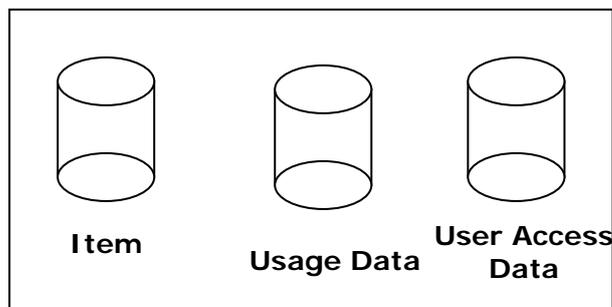


**Figure 5. Data in an item bank system**

Item banks become more useful when data is collected on how they are being used. This is known as *usage data* and is held alongside the item bank.

The item bank system (IBS) is the system which controls access to the item bank and the usage data. It contains three separate databases: the item bank(s), usage data and user access data (ie detailed records of who has been accessing the item bank and what they have done with it.

Figure 6 shows the data flows between the organisation hosting an item bank, a central brokerage service and an organisation delivering tests.

The brokerage system is run by a central organisation for the benefit of all and has the purpose of acting as an intermediary between owners of item banks

and those who might wish to purchase or obtain freely available items (referred to in this report as *customers*).  The brokerage system allows item banks and customers to register with it.  A customer can then search and browse item and item pool metadata (which is supplied by the item banks when the items within them are initially uploaded or change) and ultimately obtain the content.
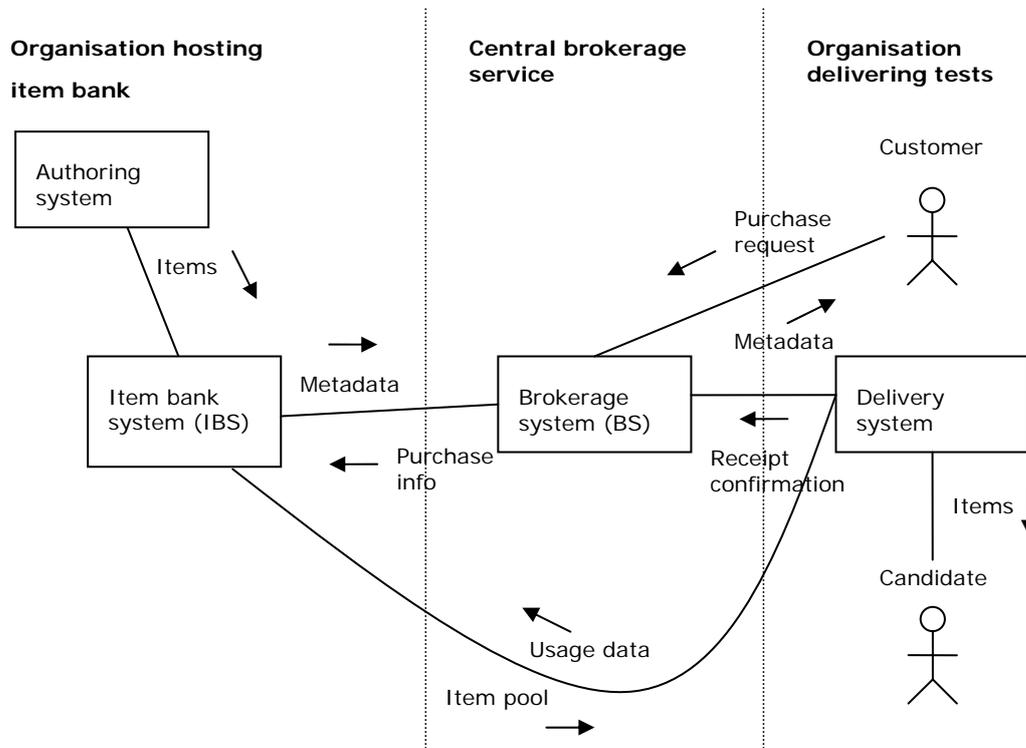


**Figure 6. The IBIS vision**

The brokerage system informs the IBS that a customer has permission to obtain a particular item pool.  The IBS then sends that pool to the customer's delivery system – and a message confirming receipt is sent from the delivery system to the brokerage system.  After the delivery system has delivered items to a candidate, usage data is returned to the IBS.


## Conclusion

A nationally-funded item bank service could hold, manage and distribute items centrally.  It is envisaged that this service would host a brokerage system and the item banks of those organisations wishing to outsource their management to a central service.  IBIS would be appropriate for items developed by Joint Information Systems Committee (JISC) projects and other centrally funded content such as that produced by Higher Education Academy subject centres. It need not be restricted to higher and further education in the UK however; other private organisations and overseas institutions may find it appropriate to collaborate within such a distributed system or at least take the technologies developed and replicate them in their own environments.

As well as offering download of items to the community, the item bank could accept items uploaded by institutions for sharing nationally. The item banks held centrally would sit amongst a distributed network of item banks. Organisations that wished to provide their own item banks could of course continue to do so. Such institutions might wish to view the brokerage system as offering them the opportunity to publish content externally or they could employ their own methods of selling or sharing content. For small institutions that could not afford to provide item banks for their own staff the central item bank would offer access to items and management of those items on their behalf.

It is envisaged that the brokerage system would be developed and held centrally to handle certain processes such as searching for items, control over who has access to the content, and purchasing. This would require all item banks to be able to export content in a standard format and also to use the same system of protocols for permissions and the releasing of that content.

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