ITEC - WP 8

D8.3 - WIDGET STORE TECHNOLOGY EVALUATION REPORT WITH DEMONSTRATOR MAINTENANCE AND SUPPORT PROCEDURES

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<td>ABSTRACT</td>
<td>This deliverable documents the evaluation work undertaken with users on the system. It draws together data from the underlying system, feedback evaluation data from other work packages and evaluation data from usability testing. The deliverable also documents the technical work done on the iTEC Widget Store and the procedures which have been developed to handle user involvement, inter-application integration and update protocols.</td>
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1 PU = Public
PP = Restricted to other programme participants (including the EC services);
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Executive summary

iTEC is a large-scale validation project which investigates the way in which existing and new ICT can be usefully deployed in schools. In order to support this large-scale investigation and validation exercise, a number of new technological interventions were planned. One of these was the adoption and deployment of the W3C widget specification as means of integrating technologies into existing platforms. To support this use of widgets WP8 developed the iTEC Widget Store. This supports the use of the W3C widget specification through social meta-data, searching, widget creation and widget management. In this context the present report has three main purposes:

- to describe the development work carried out
- to show that the work is of good quality and fit for purpose
- to assess the opportunities for use and innovative aspects of the system

The first part of this report places the Widget Store in the context of innovation within the iTEC project as a whole, and sets out the role of WP8 in creating a service capable of distributing services across multiple platforms and education systems.

The new features of the Store are then described. These were delivered in two feature updates and several minor bug-fix updates. The architecture of the most recent release, 1.4, is documented, with details of the API, and technical information on the protocols. Appendices are provided covering documented elements such as the data models, API and data transport formats. Pre-standardisation work carried out with IMS is described. The prospects for sustainability and exploitation are analysed in terms of potential adopters and recommended policy.

The report then moves on to describe of the evaluation work carried out, and to analyse the results. The first release of the store technology has been available throughout this year, and evaluation information has been gathered in the following ways.

- Server Logs
- Evaluation Data from WP5
- Feedback from National Coordinators
- Pilot Usability Testing
- User Feedback sessions

The results of usability testing and other feedback demonstrate that:

a) The system is robust and effective at carrying out the tasks for which it was designed
b) the design and procedures of the app store did not present difficulties for the users
c) specific interface issues were identified which were addressed in subsequent releases of the Store.

It is clear that there has been varied uptake of the store. In some cases there has been great enthusiasm and in others a lack of understanding of what the widgets might be able to contribute. The data and feedback has been analysed in order to gain an understanding of the affordances and barriers experienced in using the store. Some barriers relate to the implementation of the Store, and these can be addressed. Others barriers relate to the role intended for the Store, and the assumptions which this made about educational processes. There are many unknown factors relating to ICT use and the practices, policies and needs of the classrooms across the broad spectrum of schools in Europe. Indicators of observable patterns of behaviour in use of the Widget Store have begun to shed light on these uncertainties. This not only provides valuable information for the finalisation and exploitation of the Widget Store, it also offers the opportunity to learn more about the use of technology in the classroom and its promotion, and provides evidence which feeds into future decisions on which interventions are more likely to be successful.
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Introduction

The title of the report is, as stated in the Description of Work, *Widget Store Technology Evaluation Report with Demonstrator Maintenance and Support Procedures*. These topics do indeed form a substantial part of the report. Thus largest part of the report deals with evaluation (Section 7 & 8), pulling together evaluation information about the iTEC Widget Store from a number of sources. A section is also dedicated to maintenance and support procedures (Section 4), and bindings to relevant technologies (Section 5).

In addition the report provides information on all the tasks which have been active in this year. This includes detail of the development work carried out to enhance the feature set, performance and usability of the iTEC Widget Store (Section 3). To make this comprehensible, this description is set in the context of the overall architecture of the Store, with a description of the whole service, as it stands at the end of the third year of the project. Inevitably this means that some brief description is included of work that was carried out in early reporting periods, but a section is provided which indicates the major new features developed over the year (section 3.4) and also the new features in release 1.4, published at the end of the reporting period (section 3.6).

Sections are also included which discuss the work carried out in pre-standardisation (Section 6), particularly in coordination with IMS, and which analyse the prospects for sustainability and exploitation (Section 9).

In addition a section on innovation has been included in response to the concern of the reviewers that this should be clarified. This is placed at the beginning of the report (Section 2) to provide a context for the work that follows.

This is a lengthy deliverable, but the reader will be heartened to discover that almost a quarter of the document consists of appendices. The Appendices provide detailed technical information about the current release of the iTEC Widget Store which will be of interest primarily to those who are deploying or adapting the Store, or who are thinking of doing so. Most readers will have no need to read these, as they are intended solely as additional documentation to be consulted as necessary by those with a particular interest in the topic which they address.
1. Innovation in the use widgets to support learning

1.1. Constraints on innovation in the use of ICT in schools

The iTEC project is investigating the ways in which the use of Information and Communications Technology (ICT) can be facilitated and promoted in schools across Europe in a way that supports innovation in learning and teaching. The scale of this challenge was recently emphasised in a report from the Institute for Prospective Technological Studies, *ICT-enabled innovation for learning in Europe and Asia: Exploring conditions for sustainability, scalability and impact at system level.*  

This examines 7 projects which used technology as a means of transforming the classroom, and analysed 7 aspects which can be grouped as follows. On the one hand, three aspects of the project intervention:

- **innovation** (incremental, radical, or disruptive)
- **target:** (single actors, multiple actors, wide range of actors)
- **implementation phase** (pilot, scale, mainstream)

and on the other hand, two aspects of project impact:

- **impact area** (process, service, organisation)
- **access level** (local, regional/national, cross-border)

![Figure 1: Aspects of Innovation Projects (Institute for Prospective Studies)](image)

The results reveal inter-dependencies which are relevant to iTEC in three ways.

1. There is a trade-off between the impact area and the degree of cross-border impact which was achievable. As cross-border impact is a key goal of iTEC, it therefore makes sense that the project focuses on localisable learning activities which can be adapted to the organisational context.

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2. There is a trade-off between the degree of innovation and the breadth of a project intervention. This implies that a project such as iTEC, which aims at mainstreaming with a wide range of actors, will be constrained in the degree of innovation which it can introduce.

3. There is a trade-off between the degree of innovation introduced by a project and the degree of success which it can hope to achieve in the two impact aspects. iTEC therefore has to balance its desire to deploy radical or disruptive innovation against its need to deliver cross-border impact.

In the course of the project, iTEC has been continually faced by the need to make judgements about the trade-offs identified above, and to judge the degree of innovation which can be introduced without compromising other project goals. However, the ways in which the different aspects impact on each other are unknown, and each design decision implies a hypothesis about the mechanisms which are involved.

1.2. The response of iTEC to constraints on innovation in the use of ICT in schools

The iTEC project has not simply accepted these constraints on the degree of innovation which can be introduced into the education system. It has been innovative in its own interventions in the ways in which it seeks to extend the degree of TEL innovation which it is possible to combine with mainstreaming to a wide range of actors.

a) iTEC has been innovative in its methodology. The landscape of education across Europe is culturally complex: practices, environments, expectations and curricula are diverse. Educational activities are not easily coordinated or compared across these different contexts, because like cannot be compared with like. The innovative contribution of ITEC is to provide a method for the specification and design of educational scenarios for comparable IT innovation across different educational systems.

b) iTEC has developed innovative technologies for the delivery, support and facilitation of learning activities across a wide range of geographical and institutional contexts. These can be deployed on a wide range of platforms, so that activities can be carried out across educational contexts with differing technical infrastructure. This makes it possible to deploy the designs for innovative IT use across the wide range of systems used in the different education systems in Europe, and to coordinate the tools and resources which are used. It also provides a context within which stakeholders can define, describe and select the resources and tools used in learning activities. A principal component of this infrastructure is the ITEC Widget Store, and it is this aspect of iTEC innovation which is relevant to the present deliverable.

c) iTEC makes use innovative use of emerging technologies. The infrastructure described in (b) which the iTEC project provides for coordination of ICT based learning activities across contexts is neutral as to the nature of those resources. As described in the next section, 2.3, the Widget Store enables and explores the potential of emerging technologies, including the 'real-time web' and innovative integrations of Widget Store technology with Interactive Whiteboards and other current classroom technology. Similarly the innovative work of the project in ontologies and in the Person and Event Directory is integrated into and delivered through the Widget Store.
1.3. The contribution of the Widget Store to innovation in iTEC

Within this context, innovation in WP8 is centred on how our work addresses the need for technological coordination, see (b) above. Most schools still depend on Virtual Learning Environments for the support of learning. These are ‘document-oriented’ coordination mechanisms, in that they offer static resources which are only available in one location. This constrains the kinds of activities which teachers can conduct.

Widgets (small web-based applications) provide functionality which can create much more flexible, activity-based solutions. For example, widgets make it possible for service and content providers to embed their products in any web platform, rather than to expect users to navigate to their own web site. Similarly users can capture web content, tools and services from around the web and include them in their own sites. However, there is little evidence that this has been used to any extent in educational practice. The iTEC Widget Store seeks to lower the barriers which teachers face in making use of dynamic web resources and activities. It makes it easy for them to be configured in multiple contexts, and to be easily instantiated across the project. This enables teachers to coordinate their own classroom use of tools which are to-hand in the store environment, and to represent their use by rating them and sharing their experiences. The principal innovative features of the iTEC Widget Store are as follows:

- A curation service for teachers and learners for the management of interoperable tools and web resources in education. Search facilities are available whereby new widgets, popular widgets, curriculum-specific widgets may all be searched for.
- Management of a personalised collection of widgets which can be instantiated across a wide range of platforms.
- Facilities for the addition of new tools, by adding embeddable components from other web resources, by uploading HTML documents, or transformatting Flash games (of which they are many) into Widget format
- Social tagging and rating of Widgets within an educational App Store paradigm.

The new features developed in the present release 1.4 have been designed to increase the effectiveness of these innovations, and are documented in section 3.4 of this deliverable.

The widgets in the store can be used for a wide range of purposes. They include:

- educational games which can be used as ‘ice-breakers’ in class;
- curriculum-specific tools for helping with mathematics, languages, geography, etc.;
- image search tools providing ways of accessing images from the web;
- musical instruments implemented as widgets;
- video resources on a number of topics;
- resources produced by students which may be interest to other ITEC teachers and other students

The iTEC Widget Store enables teachers to create and/or curate widgets that make use of services drawn from many sources. It also enables the widgets to be described, accessed, and embedded in many different platforms, enabling teachers to share important aspects of their practice with technology. No existing platform provides this functionality.

In this way the Store provides opportunities for exchange and development of practices, within a single institution or across different education systems. The widgets can be embedded into virtual learning environments and interactive whiteboards using ‘embed codes’ from the Widget Store. More sophisticated integrations support the identity management and multi-user functionality of widgets, and these are now available in Moodle, .LRN, in the SMART notebook, and in Open-Sankoré an Open Source electronic whiteboard application. In recent work the Store has been integrated with the Moodle Open Mashup
Description Language\(^3\) (OMDL) viewer, which allows for many widget tools and activities to be presented to a learner on one page. Widgets may simply be instantiated in other online platforms, or they can be sequenced through the use of video tools, or other facilities such as Mozilla Popcorn, to create rich learning experiences. The Widget Store is integrated with the iTEC Composer, which enables widgets to be integrated with pedagogical designs.

The Store is not only a part of a system enabling a service provider to deliver widget services across platforms (for example, within iTEC, the delivery of TeamUp). It is also, and perhaps more importantly, a way in which teachers can ‘mash up’ parts of the Web which were inevitably isolated, bringing them together in one page. Once teachers have become familiar with this activity, it can be suggested that they can move on to creating their own widgets by encapsulating web functionality, by uploading web sites to the store, or by creating widgets from scratch.

1.3.1 The store as a means of exploring emerging technologies

The Store has been used as a means of exploring the use of emerging technologies in education. Technologies that enable real-time collaboration are becoming established, and can be managed by widgets in interesting ways. For example, when working with a Virtual Learning Environment, the teacher creates pages, and has to request that the learner navigate to the correct place. But the teacher cannot check that the learners are really looking at the material. Using widgets the teacher can have much finer control over this process, and make changes in real time. For example, the Presenter widget can be used to update the material shown on the learners screen without any intervention from the learner. Similarly, making use of the video captioning capabilities of HTML5, a video widget can sequence the other widgets shown to the learners. Widgets can also be configured to enable learners to update the state of the widgets seen by other class members. These technological developments provide the opportunity to establish a different organisation in the classroom. This enables teachers to provide new activities for learners as the situation requires, making use of the curated resources and tools in the Store, and to support interactions that go beyond the constraints of synchronous and asynchronous messaging.

The use of real-time environments by Smart Technologies is a good example of how the pedagogies of the ITEC scenarios can be realised through technologies directly explored through the project.

The ability to embed widgets in existing platforms, and to manipulate them in real time, enables technology to be integrated with existing collaborative pedagogies, and encourage group work, open-questioning, collaborative inquiry. This means that the pedagogical argument for the use of the technologies can be situated in the context of things teachers already do, which is a valuable capability when seeking to introduce technology into teachers practice.

Similar techniques can create sequenced widgets, using HTML5. For example, a resource was needed which could be engaging within a classroom setting, provide direct experience of the widgets for children, illustrate that “new things are possible”, and explain the tools in their native language. The video (Figure 2) made it possible for a teacher (remote, or face to face) to coordinate a set of learning activities for learners, who were presented with new tools and activities as the video progressed. These developments are also relevant to distance education. A remote presentation by an outside expert can be made more involving for participants through video-based sequencing of widgets and other activities produced using real-time web and JavaScript technologies.

\(^3\) http://omdl.org/
1.3.2 Relationship to other innovative initiatives

In the domain of emerging technologies, ITEC work is aligned to a number of developments outside the project, some of which have been deployed directly by project partners in pedagogical delivery. The fact that related initiatives and frameworks are emerging which address the same goals using similar technologies is evidence that the technical work carried out by ITEC is both innovative and pragmatic.

For example, the use of Web-Socket driven real-time communication is the essential ingredient in Smart Technology’s “Extreme Collaborate” real-time interaction environment, which easily facilitates group engagement through mobile devices in the classroom.

Such innovations have parallels which are also being used in education more broadly. For example the approach to creating enriched video content with HTML5 which has been developed by the research project Chroma+ was presented at the First Worldwide Web Workshop on Linked Media in the summer of 2013. This takes a similar approach to linked video widgets as that described above, although it uses a different coordination mechanism. Within an industrial context the Popcorn.js is part of a Mozilla program which seeks to support Web video creation. As with Chroma+, Popcorn.js uses a different mechanism to coordinate video and widgets. Because the ITEC Widget Store is built using interoperable technologies, it is possible for ITEC to profit from this development. Authoring of linked media videos is not a straightforward task for teachers. However, Popcorn.js provides an easy to use authoring environment for the development of interactive videos and widgets which can be used by teachers or content developers. The product can then be encapsulated within the ITEC Widget Store, described, shared between teachers, and embedded. The alignment between ITEC and these technological developments creates new potential for teacher-led technological innovation. WP8 has created the infrastructure enabling this to happen, and carried out the experiments to demonstrate its capabilities.

4 http://chroomaplus.eu/
4http://vsr.informatik.tu-chemnitz.de/demo/chrooma/icwe13/
6 http://popcornjs.org/
2. Widget Store Architecture

This section briefly outlines the main components of the suite of services and interfaces which make up the iTEC Widget Store. It is described here, as is, as a whole service, at the end of the third year of the project. Information regarding parts of this service has been included in previous deliverables, but it was felt that the entire store system should be documented, at least in outline, to give a full picture of the technical architecture behind the store at this stage in the project.

Section 4.1 outlines the various components that make up the store service.

Section 4.2 describes the store interface, which is itself a Wookie widget.

Section 4.3 covers the various elements in the REST API which was documented last year but has been enhanced and extended to cover the features described in 5.4 and 5.6.

Section 4.4 gives an outline of specific developments that have occurred during this reporting period.

Section 4.6 gives an overview of the final release of the store that is being finalized and deployed at the time of writing this document. This section briefly outlines the main components of the suite of services and interfaces which make up the iTEC Widget Store. It describes the interrelations between those services and how they are accessed via external clients.

2.1. The System as a Whole

The store is built from several pre-existing software systems as well as some newly created ones.

The pre-existing software systems are:

- Wookie 7– which houses, parses, manages and delivers W3C widgets.
- Solr 8– which is used for search indexing and query language.
- Shindig 9– which is used to house, parse and manage OpenSocial gadgets.

The store service itself is based upon Edukapp 10. This software has been extended to include a dedicated pure REST API and also to include some model requirements particularly to describe functionalities. There is more on the REST API in section 4.3.

The user interface for the store is implemented as a separate software package. In this case a pure html/javascript client has been written and packaged as a W3C Widget. Figure 20 gives an overview of the various services that make up the store.

The diagram shows that the Store REST API built upon Edukapp is central to communication between the store and the clients. In this case two clients are shown. One is the Widget Store Client which, as mentioned above, has been packaged as a W3C Widget. The other is a Moodle block, which allows widgets to be included in a Moodle course. The lines indicate the flow of control and information between the services. Edukapp is central the service architecture as it makes use of the functionalities in the other services to support two different formats of widgets and searching.

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7 http://wookie.apache.org/
8 http://lucene.apache.org/solr/
9 http://shindig.apache.org/
10 http://widgets.open.ac.uk:8080/
2.2. The Store Widget

The primary user interface to the store has been developed as a widget, as has already been said. The rationale for this was simple. The project already supported the inclusion of W3C widgets in a number of shells so this was an easy way for the store to be integrated.
The store interface was written as html with javascript. All functionality is accessed via the REST API using Ajax. Security on the REST API is handled via http authc basic. This is the most flexible way of securing a REST API as typically such interfaces don’t make use of session management and the authentication is passed with each function call. This allows clients to the API to be written in any language which supports network calls, so not tied to web browser technologies.

2.3. The REST API

This is where the core functionality of the store is exposed to clients and it contains a number of different modules, which supply discrete functionality. It has been designed to encapsulate the types of functionalities associated with store including things like reviews and ratings. A full listing of the REST API can be found in Appendix 1 of this document.

Our definition of the store goes a little further than this encompassing the publishing side of the store and extended categorizations through functionalities. The following diagram shows these modules.

**Figure 5: The REST API**

**Creator:** This handles uploading of widget packages to the store and has calls allowing widgets to be created either from flash, java applets, embed codes or web folder packages. Web folder packages are zip files with self contained web sites in. The web site can have any kind of functionality. This zipped folder is converted to a W3C widget by the system.

**Discovery:** This API exposes the store’s search and filtering mechanism. The calling system can also get extended profile information for particular widgets.

**Tags:** These functions allow widgets to be tagged and those tags to be managed. Tags can also be used to get a list of widget profiles associated with a tag.

**Reviews and Ratings:** These modules handle reviews and ratings for widgets. Reviews are many to one as are ratings. For the purposes of this store each user can only have one rating per widget. The ratings can be changed. They are also averaged.
**Functionalities:** This is an iTEC specific requirement. It is a type of weighted tag associated with the widget profile that is based purely on an agreed taxonomy. In this way these functionalities are directly usable by the recommender and composer.

**Users:** User management is included to allow the store to be used independently of the iTEC environment, however as has already been stated this aspect is handled by UMAC for iTEC.

**Stats:** Calls made to the store are recorded in the database automatically. Other calls can be made to update the stats from external services. This is particularly useful to allow the client to track external actions outside of the REST services such as users downloading the widget, embedding it or merely viewing it. These stats are included within the widget profile structure. The full REST API and data types are attached to the end of this document as appendices.

### 2.4. New features of the iTEC Widget Store

At the beginning of the year the store was in its infancy. A first version was tentatively release in September and used in the teacher-training event. There was quite a lot of interest from the National Coordinators on the potential of the store at that stage but required further development to allow people to use it. Requirements for developing new features arose from feedback from general feedback from the community. The community included all the schools, NCs and partners who were using the store. Feedback was received through the community portal, via email and at the end of training and research sessions.

The initial version of the store was an html/javascript site which called the REST API. The interface design for this version had been taken from the early prototype created the year before. This meant that effectively the Widget Store was a place on the web. However the widgets would not actually be used in the store or installed directly from the store. Most of the widgets in the store would actually be used either in Moodle or LRN. This meant that widgets could be created, reviewed and rated in one place but used in a different one. It would, however, be much better to have the store in the same place as the widget container or shell.

**The Store as a Widget**

Because of this we re-developed the store as a W3C widget – albeit quite a large one. All the functionality and more that was in the original site were transferred to the widget. This could then be embedded in the shell in the same way that any other widget could. Also, another login wasn’t required as widgets are routinely passed user information through the shell. Login has already happened so the user is known.

**Upload and Widget Creation**

At the beginning of the year the widget creation was limited to uploading either a widget file or attaching an Open-Social gadget, the user was expected to know how to create these packages already before installation. As part of the work package we wanted to address widget creation in some way. Plans for creating tools allowing users to create widgets directly in the store were put in place in the previous year. During this year these tools were deployed in the store.

The first tool was a form allowing users to create a widget using an existing Flash or Java Applet. These could be uploaded and there were form fields asking the user for the extra metadata required for making a widget package. Sending this form triggered a widget package creation section in the store which, using templates embedded the applet in an html page, created the widget configuration file and packaged the whole thing together as a widget package, which was then posted to Wookie, indexed and made searchable. The user
could attach a flash file, fill in the fields in the form, click send and then the widget would be available in the store. This first tool was made available in the first part of September.

It became clear however that more was needed, in particular being able to handle embed codes as a way of sharing existing widget tools, movies, content etc. Initially a special widget was developed that allowed the user to input an embed code, this then generated a widget package and installed it on the server. This functionality was moved into the store itself. Later on the facility to upload a zipped up mini web site was added. This was converted into a widget package on the server. The following screen shot is of the Web Folder form.

Figure 6: Widget Upload and Creation

The intention is to support users who already know how to create a web site in converting those web sites into widgets. Many tools already exist to create web sites, ranging from something like Adobe Dreamweaver to a simple text editor. Widget packages for the most part are small self-contained web sites. The only extra meta-data required for generating a widget package are a title, description, width and height. So the server generate the package in a similar way as described for the flash and java files except that the main html page within the uploaded site is used as the index rather than one being generated.

**Widget Icons**

To help identify different types of user created widgets in the store a set of icons have been created and included in the widget creation tools. There are three sets of the same icons with different mini icons in the corner indicating whether they are flash files, web embeds or no mini corner icons indicating web folders. When uploading standard W3C widgets the creator does not get the option to add icons as they contain their own configurations and icons.

The icons have the following intended meanings:
Figure 7: Widget Icons

The version of the icons with the flash mini icon in the corner have been used here

My Widgets

After creating widgets the users needed some way of managing them. In this first iteration of the 'my widgets' section a simple list of widgets was presented. Selecting one of them allowed the user to delete that widget, but little more. The following screenshot shows this.
As can be seen in the above screenshot the functionality of this section implemented last year that required to allow users to delete widgets that they had created.

**Administrative Tools**

The original incarnation of the store supplied the ability to search or browse the full collection of widgets, or to order them by date and popularity. An additional list of “Featured” widgets was added. To enable an administrator to set a widget as featured an admin section was added to the store (see figure 26).
This was presented as a list which allowed an administrator to set widgets as featured. It also allowed for widgets to be deleted and viewed. The ordering of the widgets listed could be selected by any of the tabs at the top of the list.

2.5. Apache Wookie

During the last year Wookie has graduated from an Apache incubator project to a full project. Work was done increasing its robustness and updating features that were required by iTEC. As Apache Wookie is a separate project which has a life of its own under the umbrella of Apache projects the input from iTEC in contribution to graduation was relatively small. The two main areas where work was done in Wookie specific to iTEC’s requirements were:

- Changes were required to the OpenID management to support widgets which needed to sign into the UMAC authentication system - especially with the addition of roles.
- Updates to the connector to allow our Moodle connection to work more efficiently.

2.6. Release 1.4 of the iTEC Widget Store

Release 1.4 of the store went live this Autumn, and contains a number of additional changes and features, developed in response to the feedback from evaluation, the usability testing session, suggestions and recommendations from key people within the iTEC team and our own internal testing of the usability of the store and how it is accessed.

The features release 1.4 are listed below.

- New search interface
- New tabbed navigation
- Can select favourites
- Shows my favourites after login
- Two sets of sticky, optional, categories – 21st century skills list and age range.
- Facetted search based upon Tags and Categories
- List of users, which show their favourites.
- Can import other’s favourites to your own or add singly
- New “My Widgets” area which includes the following.
  - You are able to edit widgets , which you have created.
  - Publish levels for created widgets. New widgets are not automatically live, but are pending publication. Only the creator can see them and edit them. They can also set them as published when happy with them. That generates a request to an administrator to review the widget and accept or reject it.

An important feature has been added in release 1.4, with the inclusion of a new mashup creator format in Moodle which integrates the store in the widget choosing process. Previously widgets were created, tagged, reviewed etc. in the store widget which is in a particular course in Moodle - as well as standalone. The process of including a widget in a course was by adding a special block in Moodle where a widget could be selected. This is non-intuitive to the user. To address this in Moodle we have adopted a new widget based page format from the Omelette project. This has been integrated with the store. When a user chooses a widget to go into their mashup page the store is shown with all its features, so they can create, edit, tag, review widgets at this point if they wish. There is also the option to install the widget in the mashup page directly from the store. A prototype of this integration has been installed on iTEC Moodle which will be updated with the release.
3. Procedures and protocols for the effective support and management of the Widget server community.

Procedures and protocols have been established for describing:
  a) The processes the users need to follow in their use of the store. This takes into consideration the different places that they can access the store, including Moodle, LRN and Open-Sankoré.
  b) The protocols for how the Widget Store fits with other iTEC technologies. This includes the communication methods, the taxonomies adopted, and the communication streams that are employed.
  c) The processes for upgrades, patch notes, protocol for informing users when the servers will be maintained and other functional aspects.

3.1. User Protocol

The User Protocol Diagram below gives an overview of the procedure that a user goes through in using the Widget Store.

![User Protocol Diagram]

Figure 10: User Protocol Diagram

Login
For three of the four shells in the diagram login is required. The process for this is to either click on the login link and use already registered credentials to access the shells, or to register if this hasn’t been done before and then use the newly registered credentials to login. The specifics of this process are in the domain of Work Package 7 but have an impact on access to any of the iTEC services. Login is via username and password. Alternatively existing Google, Yahoo, EUN or Facebook accounts can be used. Registration requires a valid Email address, a login name, first name, last name, password and a request for a particular role. Registration is validated via email and the role request is considered by an iTEC administrator.

**Widget Store Access**

The way in which the Widget Store is accessed depends upon the particular shell being used. In the case of the “Store Thin Shell” access to the store is direct. In fact the store is available for searching only even without login. In the case of Moodle the store is contained in a specific course that is available via popup link at the top of the home page. .LRN uses the store slightly differently as they have incorporated it into their Learning Activity building tools allowing widgets to be search and installed as part of the process.

**Widget Store Actions**

The Widget Store actions can be divided into four subgroups: searching, creating or managing your own widgets, submitting widget paradata and installing.

- Searching: Tools that exist to find widgets are currently in two forms, a search box and list of widgets showing featured widgets, all widgets and the latest widgets. Filtered listing by Tags will be available in the next release coming out in October 2013.
- Creating Widgets: fully formed widget packages can be uploaded to the server. New widgets can be created either from flash files, an embed code or a zipped up folder containing a small web site. The tools to do this all exist within the upload section of the store which can be accessed only if logged in. The “My Widgets” section currently allows you to access your widgets and delete them. Edit tools for “Store Created” widgets will be available in the next release.
- Paradata: This is data about the use made of resources, as distinct from access tracking. It is currently supported by tagging, reviewing and rating tools exist on the widget view page. Clicking on a particular widget in the search results area will take the user to this page where they can undertake these activities.
- Installation: In the Moodle and thin shells only the embed code is directly available in the store - this can be accessed from the widget view page. In the .LRN shell an additional install button is available in the widget view page. This install button allows widgets to be put directly into a learning activity as it is being created.

**Widget Installation**

In the case of Moodle and Open-Sankoré, widgets can be installed to be available in courses or on worksheets. This is done by choosing from a list of widgets that are available from the store. This action creates an instance of the widget, which is then automatically embedded into the shell (course or workbook). Widget instances are “live” versions of the widget, which can access instance specific communication and data services. This allows states to be saved, widget specific and context specific data to be saved and communication to happen.
3.2. Underlying Service Structure - Protocols between Services.

The following diagram gives an overview of how the store services interact with other iTEC components from the point of view of the Widget Store architecture.

![Store Integration Diagram](image)

**Figure 11: Store Integration Diagram**

It should be noted that this diagram shows the protocols from the store service architecture point of view and does not attempt to interrelate the whole iTEC system. For instance the relationship between the SDE and the Composer and the SDE and P&E (People and Events) directory are not exposed here.

The Store Service and Wookie are the two outward facing services of the Store Service Architecture. The Store Service is comprised of four components.

- A modified version of Edukapp
- The Solr search engine
- Shindig for Open Social Gadgets
- MySQL Database

For the purposes of this section it is not necessary to describe the protocols between these components as only Edukapp contains the interface which is supplied to other iTEC services.

**Wookie API**

Apache Wookie operations and parameters are accessed via its REST API. All data is transmitted as XML. A set of calls can be made via this API to instantiate widgets, associate participants with widgets and set properties and preferences for the widget instance. A full description of the API is available here: [http://wookie.apache.org/docs/api.html](http://wookie.apache.org/docs/api.html)
In addition to there being a direct API which can be called there are several packages for developing connectors to Wookie which encapsulate the API in frameworks in various languages. These include Java, PHP, flash/flex, CSharp, JavaScript, Python and Ruby.

For the purposes of this project the Java and PHP frameworks are used. The Java connector is utilized by the Store Service to save widgets for delivery by Wookie and the PHP connector is utilized in the Moodle block which allows widgets to be installed in Moodle courses.

**Store Service**
The full API and data structures are attached to this document as appendices. The other services consume particular aspects of the API, the only object which consumes for the full API is the Widget Store interface.

- SDE: the SDE is primarily interested in widget profile data - see appendix two for a full description. The extended widget profile contains the stats and the functionality selections which allow recommendations to be made.
- Composer: the Composer consumes and installs widgets. It also generates Learning Activity Widgets which are then posted to the store. The composer also embeds the Widget Store Interface to allow users the full functionality of the store.
- Shells: these embed the Widget Store interface (which is developed as a widget itself). They also have plugins which consume widgets directly from Wookie via the plugin frameworks.
- UMAC: there is no direct link between the store and UMAC. There is a link between Wookie and UMAC which allows specific widgets to be developed which consume UMAC services and also supply their own iTEC login when the widget is being used standalone. This has been created (by WP7) as an extension to Wookie which supplies OpenID services to widgets if they require it.
- People and Events: an interface to this has been written as a widget which is housed within Wookie. It also makes use of UMAC via the Wookie extension.

**Dependencies**
The following dependencies exist for the store service.

- Apache Wookie - required
- MySQL - required
- Solr - required
- Edukapp - required
- Shindig - required

The following iTEC services depend upon the store service.

- The Composer - strongly
- The SDE - partially - for data
- People and Events - loosely - only for the P&E Widget

**3.3. Update Protocol**
Because the Store is a live service which is currently being consumed by the schools involved in the pilot, care needs to be taken to manage updates, patches and bug fixes. To this end a simple update process has been created to allow the store to be updated effectively without too much interruption to the service. The following diagram chart’s this protocol.
Figure 12: Update Protocol Diagram
This flow was developed during the last patch primarily because the patch was undertaken during pre-pilots.

Pre-installation
The first stage of the protocol is creating the patch notes. These need to contain enough information about any new features for the users to make sense of them without being overwhelming with redundant information about existing services.

It also needs to report upon any bug fixes there have been especially where the fixes are responses from issues reported by the community of users.

Underlying fixes for issues only the developer is aware of should be reported only if they might impact upon the user’s experience of using the store.
**Communication**
The primary purpose of creating the patch notes and agreeing downtime for the server whilst the patch is installed is to communicate effectively with the community information which they need to know.

So an effective channel of communication between the developer and the community of users needs to be employed. In the case of iTEC pilots the list of those who need to know area as follows.

- The project management.
- Project partners who rely on the services for their own services.
- National Coordinators who can pass the information onto the participating schools.

**Negotiation**
Because of the nature of the use of the store, it would be impossible for the developers to “decide” when the patch should happen and simply pass this information out through the correct channels. Schools may have planned sessions using the store, coordinator maybe running training sessions and the project management may have sessions planned.

A period of negotiation is required to ascertain when the best time to perform the upgrade might be.

**Production Testing**
It is important that once the patch or package has been applied then thorough testing of the production system should happen before the server goes live again. If anything about the patch fails or is unsatisfactory at this stage then the server should be rolled back.

If the server is rolled back then this information needs to be communicated to the community through the proper channels.
4. Model and Bindings to Relevant Technologies

4.1. Implementation of the Data Model

The data model for the store revolves primarily around two important entities: the widget profile and the user account.

Figure 13: ITEC Widget Store Data Model

For the purposes of ITEC the user account only consists of an id, the other information representing a user in the system is held by UMAC and accessed from there. However, the functionality of the store required an id to be held as an entity to allow the internal logic of the store to connect an identity with the activities that the store provides such as reviews, ratings and widget management. The ER diagram provided in Figure 30, above, gives an overview
of the data model underlying the store. As can be seen there are many tables with many relationships between them but it is clear that the central entity is the Widget Profile. This contains the meta-data used to describe and manage a widget. It corresponds to the tools model developed by the iTEC team taking into account that we are only dealing with widgets.

The approach adopted for the store was to create joining tables between related objects which had a many to many relationship, but that these joining tables also contained extra information relating to the strength of that relationship. In this way the relationship between functionality and widget instance with a weighting factor was achieved.

4.2. Implementation of analytics capabilities

Google Analytics has been included within the pages of the store in the present release of the store. This will enable the project to track the pathways taken by users through the store, and the tools that they use. Typically the limitation of this approach is that this type of analytics looks only at users navigation between pages, and does not report on access to REST services via AJAX, which is how much of the data in the store is retrieved.

To resolve this problem, a usage tracking entity has been implemented within the Widget Store database which records when widgets are created, updated and deleted. An additional widget statistics entity has been implemented which records the number of times a widget has been reviewed, downloaded or embedded.

4.3. Creation of configuration parameters and inclusion of PMRPC

Because the store is now used as a widget in a number of different contexts it became necessary to allow shells to configure the store for their own needs. An example of this is the Composer (WP7) uses the store not only to access widgets, but also to install them directly into the shell. Callback parameters were required within a configuration block that is passed to the store from the shell. This configuration block allows inter-widget callbacks to be made for the installation of new widgets.

4.4. Authentication and Authorization (Authz)

The unified authorisation within the iTEC services is being managed by UMAC and is being directly accessed by the shells (WP7). In this reporting period the Widget Store has been implemented as a widget, and thus it can take its authorisation parameters from the shell. In addition it was desirable to have direct access the store without having to navigate through a learning environment, which is valuable to whiteboard users, among others. To achieve this a thin shell was implemented and deployed on the iTEC servers.

Although Edukapp does have its own authz implementation, for the purposes of the iTEC environment this was not sufficient. The iTEC environment comprises of a number of different service packages - description of these is beyond the scope of this document, but in brief it includes a Learning Activity Composer, a People and Events Directory and a Recommendations Engine. In addition to this there are Shells. These are environments which host the learning activities, tools and content. An installation of Moodle is one or the Shells used by the project as is .LRN and the interactive whiteboard environments or Smart, and Promethean.

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11 https://github.com/izuzak/pmrpc
12 http://smarttech.com/Solutions/Education+Solutions/Products+for+education/Software/
These services all needed to use a centralized user management system. This was developed within the project and is called UMAC, which stands for User Management and Access Control.

Figure 14: Authentication Authorization

For the purposes of iTEC the most obvious way of supporting centralized authz was through the shells. In this way identity is propagated through the WidgetStore widget and then on through the REST APIs of both the store services (Edukapp) and Wookie.
5. Pre-standardisation

5.1. Open Mashup Description Language (OMDL)

At the project meeting in Bolton WP8 gave a demonstration of the Open Mashup Description Language specification (OMDL), developed within the context of the European Project Omelette. In the light of this iTEC has decided to adopt OMDL, which will be incorporated into future releases of the Widget Store and, optionally, in shells. This is a pre-standardisation specification, and the project will feed into its further development.

The IMS App Store

iTEC was represented at IMS Learning Impact, San Diego, May 2013, in order to coordinate iTEC’s App Store development work with the IMS App Store initiative which had recently been announced by Rob Able, CEO of IMS. This participation was prepared by direct conversations between University of Bolton and Rob Able. The main points emerging from the event were:

a) The IMS App Store is, as we suspected, in its infancy. What IMS has done so far is to commission a scoping document and ideas from a group called Learning Objects. Learning Objects are IMS members, and their Website is available at http://www.learningobjects.com/leadership.jsp Learning Objects have created some wireframes, which have similarities to what we have done, with functionality such as ratings and reviews. Three or four screenshots were presented, with an hour-long discussion of how the store might develop. There was a great deal of interest in the idea, and iTEC is not alone in wanting to be involved.

b) It is not clear if the term ‘App Store’ is the right one for what IMS are proposing. It seems that this name was used because it is one that the public recognises. The IMS App Store will work with IMS LTI, which is achieving substantial levels of adoption. Adoption by Blackboard and other VLEs has meant that all the publishing houses use LTI as a means of delivering electronic content. LTI is a conduit through to a tool, or more often to content. If you want to buy a book through LTI, you go to the vendor, you choose the ones you want, then they give you the information with the link and authorisation to the content. At present there is no way to create the equivalent of an Amazon marketplace. Now the publishers and VLEs want a standardised discovery service to support such a marketplace, and this is what IMS refer to as an App Store. This indicates that IMS will be defining a standard API for interrogating a store to know what is available on it. We could propose the iTEC way of doing it as a starting point for doing that. However, we do not have a commercial use case for doing this, while they do, so the functionality will be different. IMS are not going to host an App Store themselves, or provide a service. At most they are interested in having a reference implementation.

Work is being undertaken in WP7 to explore and compare the W3C widget approach and the LTI approach to connectivity between services and service providers. The store itself is not exclusively tied to the W3C approach either, and it can itself be an LTI Basic provider. What is at question here is not whether to adopt LTI or W3C widgets as the main way of delivering or embedding stuff, but how best to design and arbitrate search, paradata, collections and perhaps purchases between consumers and providers in a standardized way.
c) Although the IMS use cases and business model are different from the iTEC App Store, though there are substantial overlaps in functionality and technology, notably:

- discovery service
- ratings and reviews (in our case shared by Spaws).

IMS do not seem to be interested in the widget creation, because their focus is the publishers, who are already producing many things.

**Opportunities to align iTEC with the IMS App Store**

The creation of the IMS App Store may involve the definition of an API specification for a standard discovery service. If that were the case, the nature of that specification is yet completely open. It would involve creating a group to work on this. Bolton, as IMS members would be able to work on this and propose an API informed by our work. Learning Objects were very interested in our work and asked for a demonstration. It was agreed that they would carry on working on their documents for the IMS App Store, and pass them to us for comment.

It is possible that they would like to pick up and run with the code which we have produced. It is also a possibility (at present a theoretical one because it has not been discussed) that they might want to make use of our expertise through some kind of consultancy.

In addition to considering how we can input to IMS in relation to the App Store, we should also consider the opportunities which may be opened up by the IMS initiative. We have a different kind of block or connector for each environment (e.g. Moodle, LRN). If we adopted LTI as the way of doing things, then anything that has LTI capability would immediately be able to use our system. It goes straight into Blackboard, straight into Moodle Rooms, Sakai, Canvas. The IMS App Store makes this a more convincing approach.

**The practicalities of aligning iTEC with the IMS App Store**

There is an initial implementation in the store as it stands which enables you to deliver widgets or the Widget Store itself through LTI, but this is not functional in the current release. It requires revision and bug fixing before it can be released. Because Bolton are at present members of IMS certification for conformance tests could be obtained. The next steps would be

- to enable the App Store to receive LTI content, as well as open social and W3C.
- to make it easy to set up an LTI provider definition on the App Store. This involves creating a definition with a shared secret and a consumer key and a launch URL. The App Store currently generates a key automatically, and there would need to be more administrative control over that.

**5.2. Relationships with other standards and specifications making bodies**

**Coordination with W3C**

In relation to W3C, our main role is to provide feedback. The principal aspect here is the difficulties we have faced in knowing where a particular widget can run in terms of the technology which it uses. This is particularly true of Flash content, java applets and html 5, all of which have varying degrees of support in different environments. This might be alleviated if the widget gave some indication of the type of objects it includes and the platforms which should support it. Perhaps a type attribute in the config document which makes use of a known vocabulary would help here.

**Coordination with CEN/ISSS.**
The iTEC Widget Store was presented to the CEN ISSS Workshop on Learning Technologies, and on the basis of this it was proposed to work towards a Workshop Agreement on the use of widgets in education. This was well received by the Workshop on Learning Technologies, who agreed to move this forward within CEN ISSS. However, this process is currently on hold, as the status of the Workshop on Learning Technologies is itself under question within CEN.
6. Evaluation and Testing

6.1. Overview of evaluation of the Widget Store

There has been a continuous process of socio-technical evaluation of the widget store which has run in parallel with Work Package 5. The focus of our evaluation has been to understand what our technical intervention might tell us about the technology and the intervention situation, complementing the broader project evaluation in WP5. This effort has ranged from the utilisation of the store by project partners, usability testing with groups of teachers to ensure that the Store is fit for purpose, monitoring engagement with other technical developments, identifying key issues resulting from events to promote the use of the store and running a pilot ‘widget competition’ with children. There are simple questions that can be asked: is this any good? How might it be improved? But on inspection, these are not simple questions: whose problem are we trying to solve? What would improvement mean (and to whom)?

Section 6.1 provides an overview of the efforts that have gone into understanding these different questions. We begin with data collected following use of the Widget Store in pilots (Section 6.2), and comments from National Coordinators involved in supporting these activities (Section 6.3). We then turn to a formal usability testing trial and associated qualitative feedback (Section 6.4). This is followed by description of post-hoc evaluation with teachers and learners who had already used the store. The next three sections analyse statistics on use of the store and its contents (Sections 6.5, 6.6, and 6.7).

In Section 7 we consider the results of this evaluation work, and look at the deeper questions arising from use of the Store. In summary, the technical performance of the Widget Store, the positive results from usability testing, and generally positive remarks about the store itself indicate that a good job has been done in developing the system which was specified in the DOW. Looking to the exploitation stage, however, take up of the Store has not yet been significant. To plan for the future we need to understand how our evaluation results relate to classroom practice. This leads us to a consideration of the value of the store as an artefact through considering utilisation data) and considering the store as the focus of processes relating to the overall project goals.

The evaluation methodology used overall is loosely based on Pawson and Tilley’s Realistic Evaluation. The method focuses on establishing as rich a picture as possible of the different dimensions of what actually happens: store utilisation, usability results, discursive impact within different communities, etc. The aim of the evaluation is to posit mechanisms (Section 7.1) that might explain the production of the phenomena that are observed. In the next phase of the project, these mechanisms can be tested, rejected, refined or verified. In this way, ITEC’s widget store intervention can be both an instrument for knowledge discovery about the classroom, as well as (we may hope) a useful tool that improves the educational experiences of children and teachers.

6.2. Evaluation of the Widget Store in pilots

Evaluation of the Widget Store by WP5 produced some very positive results. For the convenience of the reader these most important are summarised here:

Use of the Widget Store

Of those teachers responding to the survey question, ‘Did you use the widget store?’ (n=330), 38% (126) said they had done so. Out of those who had used the widget store, 27% (34) said that they created their own widgets. The widget store was used by the greatest numbers of teachers in the following countries: Turkey (22), Italy (21), Portugal (15), Lithuania (14) and France (10) (See Appendix ?? for a full breakdown by country).

The feedback from those teachers who had used the widget store was largely positive:

- 83% agreed it had the potential to enable teachers to discover new digital tools and services
- 81% agreed it had the potential to enable teachers to select and use digital tools and services:
  - 79% agreed the widgets store was a useful tool
  - 79% said they would use it again
  - 79% said they would recommend to others
  - 76% agreed it had the potential to lead to technical innovation.

**Benefits of the Widget Store**

The potential benefits of the Widget Store for learning and teaching which were most frequently mentioned among survey respondents (n=125) were: accessibility of resources (21); the provision of a structured approach which makes it easy to discover and organise widgets (18); access to a wide variety of widgets (13); ease of use (11); greater efficiency and time-saving for teachers (11); and motivational for both students and teachers (11).

**Accessibility of resources**

- All meaningful and "useful" tools together in "a place"; you can choose what you want to use. (Austria)
- Provide effective access to educational content anywhere. (Turkey)

**A structured approach**

- "You could easily find new widgets which are suitable for school." (Finland)
- Provide students with an organized environment for learning. Teachers can easily organize an environment that contains several elements that are "ready to use" by students (videos, applications, text, etc..) (Portugal)

**Access to a variety of widgets**

- Easy access to many different programs that can help to support teaching and learning methods in different subjects. (Norway)
- Provide teachers with a variety of applications in different areas. (Spain-SMART)

**Ease of use**

- Ready-made and free tools which are easy to use. (Finland)
- Makes innovative technical tools available and simple (France)

**Efficiency and time-saving**

- Saves time because it provides the possibility of finding the required resources in the same place, which you can easily reach. (Turkey)
- all tools listed in one place, so less time spent (Lithuania)

**Motivational**
- Carry out the business of teaching and learning in a more entertaining and profitable and unusual way for both the students and the teacher (Italy).
- Innovative and engaging tools (UK-SMART)

Other potential benefits mentioned by smaller numbers of teachers included: supporting innovation and new pedagogies (10); can be in learning and linked to existing resources and tools (9); adaptability for different subjects, activities and learning platforms (7); and potential for encouraging sharing amongst teachers (5).

Four teachers in the Portugal widget store case study identified the fact that the widgets could be used in various platforms as an advantage. The NTC interviewed for this case study also felt that the lack of advertising was an advantage the widget store had over some commercial alternatives.

In discussing the continued use of the Widget Store there were positive indications from Italy, Israel and Spain.

**Problems encountered using the widget store**

The system used in pilots has a number of layers, the Widget Store, the shell (e.g. Moodle or .LRN), and the widgets themselves, delivered through Apache Wookie. To this should be added the contextualisation of the use of the Store in Learning Activities, which can give meaning (and perceived usefulness) to the activity with the Store. In analysing the WP5 evaluation, it may be seen that many of the potential challenges of the Widget Store for learning and teaching related to factors other then the Store itself:

“…the most frequently mentioned potential challenges of the Widget Store for learning and teaching (n=114) were a lack of support for teachers wishing to use the Widget Store (18) … and an insufficient range of widgets currently available (14).

“… Other problems related to the context were difficulty accessing the Widget Store (7); a lack of widgets which match the needs of teachers and students (e.g. different age groups) (7); a lack of infrastructure in schools to support the use of the Widget Store (6); language barriers (5); and unreliability of widgets in the Widget Store (5).”

These are, of course, important considerations, but not directly relevant to the Widget Store and its evaluation. It should be remembered, however, that problems in associated technologies may have a negative impact on perception of the Store itself.

Among the problems specifically relating to the Store were:

“difficulties selecting the ‘right’ widget (16); time required to learn how to use widgets and the Widget Store effectively (15);”

“… difficulty integrating widgets into school learning environments (6) … language barriers (5);”

None of the problems identified in the WP5 evaluation concerned the underlying functionality of the store, with the exception from one comment from Estonia that the system was not sufficiently stable. The problems which were identified have since largely been addressed by release 4.1 of the Store. Thus, a translation mechanism has been provided, and changes to the interface made to improve discovery of widgets, and the reliability of the service is now high (in part due to improved deployment). The implementation of the Store itself as a widget will enhance integration of the Store into shells. It is hoped that this will assist with “time required to learn how to use widgets and the Widget Store effectively”. The effectiveness of these responses to problems identified in WP5 will of course need to be confirmed.

**Reflections on the WP5 evaluation of the Widget Store**
The findings of WP5 indicate that the Widget Store is robust, well designed and effective. Some problems were identified, and have since been addressed.

The evaluation shows that the users were clearly enthusiastic about the potential of the widget store. The interviews and case studies in the report also indicate that there was willingness to continue using the Store, particularly in Portugal, Spain, Turkey and the UK.

The problems identified appear to be highly contextual, and their solution may be more to do with teacher development and improved infrastructure than the changes to the Store itself. Indeed the benefits are also contextual. For example a benefit identified in the UK is clearly specific to that education regime: “Given the interest in coding in the UK, iTEC widgets and the way they can be discovered and integrated into personalised learning environments has much promise. (UK National Case Study)”. The context-dependent nature of feedback on the Widget Store is also relevant in the following section, relating to National Coordinators.

6.3. Feedback from National Coordinators

Qualitative feedback has been provided by WP6 out of their work with national coordinators. This contains a mix of views, but there are some encouraging words about the Store's potential. Interpretation of the feedback needs to be treated with caution, as the context in which the National Coordinators are operating is not fully known, and is certainly not consistent across the project.

For example, there are widely differing levels of technological capability among teachers. In France this was clearly very high “Teachers demonstrated a great deal of creativity in the use of IT tools and learning stories. One teacher had her students create a digital version of Monopoly game (Create a game) which was mainly developed outside school hours. Another teacher built on student’s own devices (smartphones) to create video tutorials of chemical reactions for a target public of younger students...”. On the other hand, other respondents argued that teachers experienced difficulty using the Store because Moodle (through which the Store is accessed) was too difficult for teachers to use: “Majority of the involved teachers never used a VLE before iTEC. Neither did their pupils. In many cases introducing Moodle proved to be too difficult task in the frame of iTEC. (Hungary)”. Similarly, in Portugal the National Coordinator described problems related to “Instability in Internet access and in some cases even no access at all. No existing equipment in quantity and quality in order to support the tools and technologies used by iTEC, like Web 2.0 tools.”

Some respondents argue that the store is not useful because ‘the internet is full of tools (Estonia)’, with the implication that teachers are sophisticated users of the Web who do not need the additional functionality which the iTEC Widget Store can offer. However, it was interesting to note that in Finland, which is not a technically impoverished country, the response was the opposite “ITEC widget store and technology provided by Promethean and Smart are promising and useful”.

It is clear that many factors come into play here, which make it hard to achieve a unitary statement on the value of the Store using this data. It is also clear from the comments of coordinators that they do not distinguish in their feedback between the different layers of the infrastructure which they are working with, and the role which this plays in the project activities. This is entirely reasonable, as they, like any user, deal with the system as a whole in trying to carry out their tasks. However, for the purposes of WP8 it is necessary to distinguish between the widgets, the store and the shell in which the store is deployed. For example the feedback from Slovakia focuses on the shell and the widgets, without mentioning the Store as such. Naturally, the more effective our integration, the harder it becomes to discuss these distinctions with users. Similarly the achievement of integration
and interoperability, which is a key goal for WP8, is visible to the user only as ‘the system just works’, and feedback will not draw attention to this.

One coordinator commented on a lack of connection between the tools in the store, the pedagogic purposes which the tools are intended to solve, and the pedagogic activities in the project. Similar points were made in the Case Study in Portugal carried out by WP5. This suggests that a better response to the Widget Store could be achieved if its use was more tightly linked into project activities. This was the case for TeamUp, which was delivered through the store and achieved good levels of use (as we discuss below).

The importance of training in achieving take up is mentioned by a number National Coordinators. For example “In Slovakia, there was a special training on iTEC Moodle shell and some popular widgets, as a special, all day in-person activity. Based on feedbacks, this was a good step which helped to overcome inappropriate respect of teachers to this shell. After the training, some teachers started to work with Moodle actively together with their students”. Similarly in Turkey “We observed that rewarding face-to-face training activities draw more teachers’ participation.” This is clearly an important factor which will greatly impact on perceptions of the Widget Store.

Thus the feedback from National Coordinators indicates that responses to the Widget Store varied from enthusiasm to lack of interest, and that this was highly context dependent. Moreover, many of the problems identified did not relate directly to the store, but to other factors. Within this context the barriers to use identified by National Coordinators were concentrated in two areas:

1. Four reported that the schools involved had major difficulties with teachers’ confidence with technology, or available infrastructure, or both (Turkey, Slovakia, Hungary and Portugal).
2. Two countries reported that the lack of good widgets was a barrier to adoption (Estonia, France), while two others (Portugal and Spain) said that the connection between widgets and pedagogic activities was insufficient.

The implications of this are also twofold.

Firstly, training and capacity development will clearly be necessary if any Web technology is to be effectively integrated in these contexts, including the Widget Store. The work of iTEC can contribute to this in targeted schools.

Secondly, enhanced usefulness of the widgets served by the Store is likely to enhance its use. It is not possible to create an entire ecosystem of widget apps, and so this is best managed by providing widgets which have a relation to particular Learning Stories and Learning Activities (as the Portuguese and Spanish coordinators suggested). The success of TeamUp is evidence for the effectiveness of this strategy. Indeed the value of a widget depends on its pedagogic use, and a simple video content widget may be very effective in a particular curricular situation. Therefore a community of teachers, or pedagogic coordinators, who wish to share such resources could also have a strong impact in increasing the perceived value of using the Store.

6.4. Usability and Qualitative Testing

To identify any possible technical deficiencies in the store technology, usability and qualitative testing was conducted by WP8 with a user-group of teachers. Given that the underlying activities supported by the store are searching for widgets, the collection of paradata for widgets (review, rates tags) and the creation of widgets, the usability testing method sought to find out how effective the interface tools were in supporting these activities. This usability testing was used to guide the redesign of the interface between the first and
second deployments of the store. Its primary purpose was to expose barriers in its use. It was focused on the store interface embedded in Moodle. This was done because sign-in and navigation via Moodle is a significant part of how the store was presented to users. A session was run with ten users all of whom had an educational background: six were teachers from local secondary schools, three were educational students and one a retired teacher. The age range was not recorded. Seven were female and three male. All were new to the store but three had used Moodle before. All of the users were English. The session ran for one hour. The users were given a sheet on which were seven tasks; they were all given access to a computer. The users were expected to try to complete the tasks after which they were to give the activity a score of one to five. Each task was given approximately seven minutes apart from task six which was given ten. The scale was form them to indicate how difficult they found the task to complete, one being simple and five being very difficult or impossible. They were asked to write comments about each task as they completed them describing any difficulties or issues they had or any ideas they might have for improvements. Time was given at the end for general comments to be written which could be added at the bottom of the sheet or on the reverse side. The sheet is attached as an appendix to this document.

Here is a list of the tasks they were asked to complete.

- Login to Moodle and navigate to the Widget Store (this was done as one task because the navigation to the store was at the top level of Moodle, was very simple to find and in no way warranted a task of it’s own)
- Find the widget called PlanetWerks and view it.
- Review, rate and tag this widget.
- Explore the widgets for a few minutes.
- Find the widget upload area.
- Create an embed widget.
- Navigate to the My Widgets area and delete the widget you have just created.

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- Find the widget called PlanetWerks and view it.
- Review, rate and tag this widget.

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15 Since this trial deployment of the Store has shifted focus a little, and it is now also offered as a stand alone resource. This is how it will be presented in Edukata.
• Explore the widgets for a few minutes.
• Find the widget upload area.
• Create an embed widget.
• Navigate to the My Widgets area and delete the widget you have just created.

**Score Results**

The users largely worked separately, but one or two asked for help with the “create an embed widget” task, as shown below in the qualitative data. At the end of the session the sheets were collected and users’ scores collated. This was done by placing all the scores in a table then calculating the average. The following graph shows all the scores from the individual users giving an indication of the scattering of scores over the tasks.

![Figure 15: User scores per task](image)

**Difficult Tasks – High Mode Results**

As can be seen the majority of scores were low with some specific spikes where users found a particular task difficult or impossible. If we extract from this the tasks that scored a five for some users and add the frequency of those scores we can construct this table (Figure 4).
Four different users considered three tasks ‘very difficult’ or ‘impossible’. “Create an embed widget” caused the most people difficulty, as borne out by the average data shown in the table below which gave this task an average of over three. In total there were six scores of five in seven tasks undertaken by ten people. This gives an indication of problem areas when using the store. Four out of ten users found these tasks difficult to complete. However, the qualitative data in the next section of this document gives some indications as to why the tasks were difficult.

**Easy Tasks – Low Mode Results**

Users considered a number of the tasks to be easy (see Figure 5 below)

All tasks were considered easy by some users, including “Create and embed widget” though only by one. “Find the widget upload area” was by far the easiest task though this preceded the create task which might suggest that upload to create is not an intuitive leap.
**Overall Picture**

The following box chart gives an overview of the scores given by the users.

![Box Chart Overview of Results](image)

**Figure 18: Box Chart Overview of Results**

The results here show strongly on the low quartile. In fact the low quartile for three of the tasks is the one which is the lowest (in our case the most desirable) result. For three of the tasks the mean average was between one and two. The two tasks which showed high quartile results of above three were the login task and the create widget task.

The results here give a clear indication of difficult areas, but also of areas where the store was easy to use and therefore probably easy to understand. So from a purely interface point of view the results show where change may be needed but that the store is usable once barriers are overcome.

**Qualitative Data**

In usability session methodology - Hallway Testing in particular - the goal is to provide a controlled environment under which users can be observed trying to use the software. For this to happen there should only be a handful of participants at one time, but with several sessions where users are asked to come up with issues until no more exist. However, because we wished to have a slightly larger group to allow the statistical information to be collected, we had to handle this aspect slightly differently. To address this the users were asked to provide comments about each of the tasks they had undertaken. This we felt would give us a far greater insight into usability issues than just scores.

The users wrote the comments on the results sheet. In most cases the comments were associated with particular tasks but in some cases general comments were made either at the bottom of the sheet or on the other side. Nine out of the ten participants in the session left comments of some kind or other.

The comments are reasonably short so they are included here in the following table.
<table>
<thead>
<tr>
<th>Task</th>
<th>Comment</th>
</tr>
</thead>
</table>
| Login to Moodle and navigate to the Widget Store                     | • Login was a problem. Finding link to widget store.  
• I could not log in. Had to click onto login to go to cloud to login  
• Two login messages on screen. Not clear needed to connect to cloud. |
| Find the widget called PlanetWerks and view it.                      | • Had to search (Note: the user meant they had to scroll through the full list to find the widget manually)  
• Search not clear. Started by looking at all widgets.  
• Had to search (Note: as above)  
• Not obvious where search is. |
| Review, rate and tag this widget.                                    | • Didn’t notice review panel  
• When I typed in « Solar System » it said It’d already got the tag, but didn’t show in tag box  
• Left review but showing ID instead of name.  
• Tags did not appear until I had tagged. So some of the tags I tried to use had already been taken.  
• Rating easy. Review - Scroll not working initially. Tag said my tag already there but I could not find it.  
• Controls are not intuitive. A lot of features, not sure how much I would use them.  
• Not sure why I would want to use this. |
| Explore the store widgets for a few minutes.                         | • Organize under curriculum, headings or alphabet  
• Clicked StoreFront above - why is it called different? Left hand nav... I didn’t know which category I was in - selected state?  
• Store Front is not clear label, needs to be different colour called Widget Store not Store Front.  
• Why not in alphabetic order?  
• Not obvious how to launch some widgets - « Store Front » not obvious. Alphabetic order.  
• Is there a back button to go back after exploring widgets? Now I see it is « store » but not obvious. |
| Find the widget upload area                                           | • Expected an upload button in the grey box |
| Create an Embed widget*                                               | • How do you edit a widget once it is created?  
• I could embed but had difficulty creating a widget. Needed help with html. If I hadn’t had a tech savvy person next to me would have been unable to do this.  
• With help from Chris  
• I didn’t know html, so embed instructions didn’t make sense.  
• Adding underscore for spaces in the name given.  
• Info and Height/width need help instructions?  
• I cannot write html. Managed to get code from colleague though.  
• Can steal code already written, can’t write html though  
• I didn’t know that it was « Done » kept clicking « save » but that was review submit. |
| Navigate the My Widgets area and delete the widget                    | • Did not know how to delete until clicked on.  
• Didn’t realise you had to go to « My Widgets » I searched and couldn’t edit from there. Frustrating. |
you have just created

- Not obvious - Just guessed and got there!

<table>
<thead>
<tr>
<th>General Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>- I would like to be able to search for an app by age group, subject, classroom management etc.</td>
</tr>
<tr>
<td>- I didn't know I had to drag the functionalities box to change the %</td>
</tr>
<tr>
<td>- Tell me how to use the embed code, so I can use it in PowerPoint etc.</td>
</tr>
<tr>
<td>- GeoGebra returned message « JAVA™ out of date »</td>
</tr>
<tr>
<td>- Triangle how do you rotate protractor</td>
</tr>
<tr>
<td>- Had to use back arrow to get back to my search results after looking at a widget. Why is back and forward part of store?</td>
</tr>
<tr>
<td>- Searching by tag name is important.</td>
</tr>
</tbody>
</table>

Overview of results

It is interesting to note the number of comments that were left on particular tasks. As expected there were many comments on the “embed widget” task, but not exactly the type we were expecting based upon the scores given – more about that below. There were however only a few comments on the login task and many comments on the review and explore tasks.

Login Task

It’s clear from the comments left that logging in was a very specific problem for some people. The interface to login at the front of Moodle contains both the iTEC Cloud login and Moodle’s own login. As can be seen from this screenshot the login section is cluttered and hard to understand.

Figure 19: ITEC Cloud Login
This is not specifically about the store but it does affect how the store is accessed in this context so will need to be addressed.

The nature of the difficulty for some users explains why the scores were so high. For some this was a “Brick Wall” problem without help they could not login and left to their own devices would have given up at that point.

For others they simply clicked on the top link and logged-in with the accounts we had set up for them so did not perceive it as a problem at all.

**Find a Widget Task**
The comments here mainly seem to suggest that searching is not as intuitive as it could be for some. The search interface currently looks like this.

![Search Interface](image)

**Figure 20: Search**
It is located at the top right of the store. However when you are on the front page you already have a list of widgets – either featured, latest or all so perhaps some people scroll through the list rather then type in a search string. Also perhaps the words “Search term here” aren’t clear enough.

**Review Rate Tag Task**
The comments here are varied, some of which are clearly bugs – for instance the reviews showing ids instead of names and the tagging issues. All of which are addressed in the latest release. However, the “not sure what it’s for”-type comments are of concern. Even though the overall score of this task was not high suggesting that the task was not very hard there is a lack of clarity of purpose suggested here and perhaps the interface is a rather cluttered as can be seen in this screen shot.
So a rethink on the purpose of this and maybe placing these activities in other areas where they appear more appropriate would make sense.

**Explore Task**

It is clear from the comments under this heading that navigation is not a major issue except perhaps for the use of the word “Store Front” to get back to the main page. The remaining comments are suggestions for organizing the widgets in a way that would make them more searchable or relevant to the user. The overall score for this task was under two suggesting that users didn’t find it hard to explore the widgets in the store even though there are over six hundred of them. So these comments are more about meta-data associations, maybe the concept of category beyond user generated tags needs to be re-implemented.

![Figure 21: Widget View](image)

**Find the Widget Upload Area Task**

There was only one comment in this area but it is not clear from the data what the user’s concern was. A think aloud protocol may be valuable in analysing this further in future, if feedback from use suggest that this task is problematic. However, the score for this was very low, so it appears to be a short and simple task.

**Create Task**

Possibly the most difficulties were encountered with this task. Certainly that is what the high score indicates. However, the comments left by the users indicate a different difficulty in the nature of the task itself. User’s need to paste and copy embed codes from the Web, in much the same way as one can copy a URL and paste it into a browser window. However, many of the users appear to have been disturbed by the need to deal with HTML in any form, and to feel that their unfamiliarity with HTML was a barrier to completing the task effectively. In effect the task itself was not sufficiently self-contained to allow the users to judge the effectiveness of the interface. Looking at the interface itself it is a matter of filling out some fields in a form as shown in this screen shot. The difficulty encountered by the users was not how to do this but what to put into the top box. For future sessions the task itself needs to be
addressed with a clear process given for acquiring the embed code – perhaps from widget box or YouTube – to be pasted into the box.

One important comment was made concerning the size boxes. The types of values that should go into width and height need to be clearly stated or documented (these are pixel sizes in the widget spec).

![Figure 22: Widget Creator](image)

**My Widgets and Delete**

The comments here are most useful, in particular the need to be able to edit created widgets. Typically by creating the widget again this overwrites the current widget if the same id is used. This works for uploading w3c widgets but not for created ones as the store manages the creation of widget packages in these cases based upon the name given for the widget – rejecting a submission if a user tries to use a widget name that already exists. This functionality along with a redesign of the My Widgets section is in the next update of the store. There is still the issue of it not being obvious how to delete widgets even in the “my widget” section which will need to be addressed.

**General Comments**

The comments suggesting ideas for navigation and categorization are most useful here and reflect some of the comments left under particular tasks. Those that are about the GeoGebra widget are not about the store itself but one of the widgets which in fact references material from elsewhere on the web, so it is not possible for us to address them directly except perhaps by pointing people to appropriate documentation.

**Results of WP5 evaluation and the Widget Store**

The wider project evaluation documented in iTech deliverable 5.4 contains some conclusions concerning the Widget Store. Specifically, on page 70 it makes the following recommendations for the Widget Store and its use:
22. Improve the moderation procedure for the Widget Store to ensure that all widgets are of an acceptable quality.
23. Improve resource discovery methods associated with the site (e.g. search, tagging, categorisation).
24. Work with WP3 to link widgets with each Learning Activity (LA) (possibly based on the process conducted in Portugal).
25. Provide more support for teachers (including training, written guidance and possible online video demonstrations) to help them to find, use and create widgets. (The work undertaken in Portugal may provide a model for some aspects of this).
26. Work with teachers to develop the range of widgets available (including widgets in national languages).

Points 22 and 23 point to some important design issues with the Store, and echo the results of WP8 usability evaluation. Both point 22 and point 23 have been addressed by new features and substantial revisions to the functionality and interface of the Widget Store in the current release 1.4, whose features are detailed in section 5.4 of this deliverable. There may well be additional features that would be desirable to add to the store, and there are no doubt further interface adjustments to be made. However, deliverable 5.4 does not indicate that there are any major underlying problems with the design and implementation of the Store.

Points 24, 25 and 26, in contrast, point to opportunities to enhance the level of use of the Store in project activities. As such these recommendations are valuable, and will inform the final phase of iTEC activities with the Store. These recommendations also have the merit of going beyond consideration of the design of the Store, and addressing the way in which it is used in context. However, they do not help us to understand if the iTEC Widget Store is a coherent initiative in the context of European schools, or the ways in which it may be useful to teachers and learners. In order to reach a deeper conception of what has been achieved it is necessary to understand why teachers and learners have responded as they have, and in what ways the Store can be useful to them.

Conclusions from Usability Testing

Usability testing can tell us if there is there anything wrong with the technology. Clearly some issues like avoiding confusion in the login process, or increasing the ease of uploading widgets can be improved by relatively minor changes to the interface, and this has been done in release 1.4. Similarly the need for moderation processes and improved resource discovery (raised by D5.4) have been addressed with new features. But there does not seem to be sufficient negative feedback to attribute major deficiencies to the technology. Many of the more general comments about the widget store were encouraging and enthusiastic: there was a feeling that this was a ‘good idea’. Moreover, the successful use of the Store to deliver TeamUp across pilots has demonstrated that the technology successfully performs the tasks for which it was designed. We can therefore safely conclude that the Widget Store delivers the functionality for which it was designed, and does so in a usable manner. Nevertheless, the levels of use of the store outside beyond project training activities have been disappointing. In order to prepare for exploitation we need to understand this better, and so that appropriate action can be taken in the remainder of the project to maximise the impact of the work carried out to date.

The qualitative data from both the WP8 evaluation and the NTCs' feedback contains some clues as to where a disconnect between experience with the technology as ‘technology’ and its utilisation in the classroom might lie. Each comment is ‘bounded’ by tasks set during usability testing. Owing to the nature of usability testing itself, these comments are directed towards ‘technical’ issues (for example, ‘knowing’ HTML, editing widgets, being able to login, etc.). None of these comments relate to pedagogy or to the classroom ‘utilisation situation’.
Obviously, in ‘usability testing’ we would not reasonably expect them to. Yet it is indicative of a problem that within a technical context of testing a different kind of feedback is gained from users (even when these users are teachers) that only indirectly relates to the actual situation within which the technologies are intended to be used.

This is symptomatic of the fact that there are relatively ‘easy’ questions to ask about educational technology (What does the technology do? Is it reliable?), and there are hard questions (Whose problem is the deployment of this system solving? What is the reality we are dealing with? What changes in human activities and relationships would be involved if we were successful?). The answers to these questions are important in achieving coherent research outcomes, and also in planning for sustainability and exploitation.

Data can be collected to address both the easy questions and the hard questions, and perhaps we should not be surprised if we find inconsistencies in the data. Yet the inconsistencies are an invitation for new explanations – and it is to this that we now turn our attention.

6.5. Post-hoc evaluation

The widget usability testing done under closed conditions (i.e. where teachers have simply sat in front of the computer and worked through new tasks relatively unaided) has been compared with running the same usability questions with teachers in the project under post-hoc conditions where teachers had already engaged in a variety of activities with the store. This was done with larger numbers of teachers in one go (up to 70 in Turkey), and the responses were collected through a show of hands by teachers at the end of the session. The data that results from this application of the same usability questionnaire, though approximate, provides some interesting indicators of how the experiences of usability related to the types of activity that the teachers had been engaged with the store.

Turkey

Turkish national coordinators organised a number of events oriented around ITEC, and the face-to-face meeting in Turkey had been preceded with a webinar with 9 iTEC teachers where the basic concepts of the widget store had been introduced. Whilst the webinar medium is not the most effective way of engaging people in interactive technologies, this event served to whet the appetite for the face-to-face meeting. It took users through the stages of uploading and embedding widgets. When asked “do you think this is easy?” all responded positively.

This webinar was followed up by the participation on the iTEC Store development team in a two-day event which considered the broadest questions of the ‘problems of education’. The post-hoc evaluation event took place at the end of this event.

The language barriers involved in presentation (few of the Turkish teachers had good English), meant that a very direct and activity-oriented approach had to be used to do this: the situation of this ‘project meeting’ of ITEC needed itself to be highly pedagogically thought-through, with carefully chosen activities that would adapt themselves to whatever (somewhat unreliable) internet and other technology provision was available. It provided an opportunity for

- Turkish teachers to talk to each other about their pedagogic challenges
- Some Turkish teachers to ‘show off’ their particular innovations
- All teachers present to engage at some level with something new to them (Many made video through PowerPoint, Open-Sankoré, etc.; some uploaded these to the widget store)
The result was that the ITEC technologies could be showcased as a way of directing a deeper conversation about educational practice, and as a framework for stimulating new engagements with technology among the technologically uninitiated. In contrast to previous work with teachers the store was not presented as a ‘solution to a problem’; it acted as a framework to stimulate discussion, where teachers could discuss what was meaningful to them and situate the technologies they saw within this context.

The usability questions were asked after teachers had completed the 2-day activity, and the responses to the questions are indicated in the graph below:

![Graph showing responses to the Widget Store in Turkey]

**Figure 23: Responses to the Widget Store in Turkey**

Most teachers had already been taken through the tasks that the questions asked about. The results therefore indicate the success of the activity that they had undertaken, as well as the affordances of the store. Feedback about the store was very positive and many teachers at this session had managed to upload something into the store (many had created their own videos to upload).

This event produced considerable enthusiasm, which was in contrast to the reception in some other countries. This may have been because of way in which the Turkish event was organised (it was more activity-focused); it may be because Turkish teachers are keener to engage in EU-related activities than more long-standing EU members; it may be because there was a particularly well-selected group of teachers (about 70). We have not been able to find any evidence that it is the result of any fundamental difference between the educational system in Turkey and the rest of Europe.

**Austria**

By contrast, an activity was conducted with teachers in Austria where they too attempted to use the store guided by an activity aimed at introducing the ITEC competition. Teachers here tended to be more negative about the store (although precise levels of their satisfaction were not recorded on this occasion). Unlike the Turkish teachers, this selection of Austrian teachers (16) were particularly concerned with the interoperability of widgets across different platforms (some had tried to use Flash-based Widgets on iPads, for example). Failure in the reliability of a particular widget tended to colour overall judgements about ease of use of the store and the utility of widgets. The occasion was not helped by difficulties in maintaining effective WiFi connections: factors outside the control of the Widget store, but which in the minds of users appear inseparable from assessments of the technology in general.
Spain
A similar exercise was carried out with 30 Spanish school children aged between 11 and 14 in Madrid. At the end of an exercise to demonstrate the Widget Store to the children, and to encourage the children to design their own widgets, the children were asked what they thought of the technology. Like the Austrian event, this event too had been plagued by poor WiFi performance which affected their children’s experiences of the store. However, the event itself was received with much enthusiasm. The judgements of the children about the ‘ease of use’ of the store, and the value of widgets was also positive: most (about 65%) considered the tasks of logging-in and browsing widgets trivial (even though a slow WiFi had made things difficult). The children’s response was one of general excitement about what might be possible with the store rather than what its current capabilities were.

A small-scale ‘widget competition’ involving children in a Spanish school was piloted, with the aim of holding a broader competition later on. With the participation of an observer from the Store development team, children were introduced to the concepts of widgets and the store through an interactive video that could either be delivered face-to-face or at distance. They were then asked to design their own widgets (on paper). The experience of the observer was that enthusiasm was relatively easy to establish among children, but that enthusiasm was more difficult to establish among teachers. The competition was introduced in three countries during the year. In two of those countries, a presentation about the competition and the possibilities of the store was made to teachers alone. In the country where successful engagement with the competition occurred, an intervention was made directly to children in the class situation.

The need to introduce the widget store remotely demanded a way of engaging teachers with the widgets directly and in a consistent way. The Widget technologies were used to do this by exploiting the tools of the real-time web, and enabling the synchronisation of user activities on computing devices (laptops, tablets, phones) with the activities demonstrated by the video (see section 1.3.1). This provided another example of where the pedagogic needs of running a competition across many countries demanded technical innovations to specifically address pedagogical problems.

The widget designs produced by children (aged 11-14) in Spain demonstrated considerable enthusiasm for the concept of widgets - noticeably greater enthusiasm from the children than was evidenced by most teachers who were shown the technology!

Norway
A similar activity with the store was conducted at a distance via webinar with a group of teachers in Norway (again 16 in number). The activity was coordinated through the technologies documented in section 1.3.1, whereby teachers could participate through their own devices whose display of widgets was synchronised with the presentation to them. Once
again, WiFi problems affected the experience, although feedback from the national coordinator suggested that although teachers felt that they wouldn’t use widgets immediately in their teaching, they appreciated the potential of the technology. In Norway too, interoperability of particular widgets on particular devices was raised as an issue.

Conclusions
The challenge of any usability testing is making the distinction between those user experiences which are caused by the interactions with the software, and those experiences which are caused by the context of the activity of engaging with the software. With educational software, the context is always education, and it is the education which (in the final analysis) is the reason why any intervention with software is made in the first place. Poor technologies can be mitigated with good educational activities; indeed, technological failings (like the failure of WiFi in Spain) can be of benefit to the overall experience of learners because they inspire greater creativity in teachers.

The usability testing suggests that there is little inherently wrong with the design and usability of the ITEC Widget Store. What matters is how it is presented to users. There were differences of approach taken with users in Austria and Norway from those with the children in Spain or the teachers in Turkey. The engagement with children is particularly interesting, because the purpose of this was not to introduce “the project”; it was to introduce an activity of widget design (which was much more fun!). When faced with teachers, there was a perceived need to introduce “the project”. In Turkey, however, this was not done so explicitly – the Turkish event was more focused on “experiences of education”.

Some perceived problems with the technology may be problems of positioning between “the project” and teachers. By introducing the technology in the context of “the project”, it is easy to give the message that “we are the experts”, to which teachers may react with some disdain. If the technology is introduced as an experiment (which was the case in Spain and Turkey), the message is more collaborative “we’re not quite sure about this… what do you think?” In terms of generating engagement and enthusiasm, this has been shown to be a better approach.

6.6. Statistics on use of the Widget Store
The store technology has been available to teachers throughout the current project year, but the data indicates that patterns of usage have been sporadic, with the majority of the usage statistics pertaining to interventions made to train teachers (i.e. part of the process, rather than a measure of the value of the artefact itself). Consequently there is a need to get beyond opinion and dig beneath the data to uncover tendencies of behaviour within the education system knowledge of which may be important for the future engagement with the system.

The visitors graph tells a story from May to October, 2013.
Figure 25: Store ‘hits’ from May to October 2013

The statistics of visits (as reported by hits to the webserver) to the ITEC Widget store show a general trend of activity which averages around 200 visits per day (much caution should be exercised about this actual figure, for reasons mentioned below). There are peaks on particular days, and by triangulating data from widget uploads with peaks indicated by log files, some peaks can be attributed to training days for the project teachers. This is hardly surprising, although the hope might be that engagements with the store continue after the training days.

The figures should be treated with caution because they feature visits from the US, Japan and China, which indicate that such visiting figures are not entirely accurate (tending to account for about 70% of the daily traffic). The visitor bounce rate (the rate at which visits are one-off and short) is generally high, which could be indicative of crawling the site automatically, although in many cases will be genuinely a measure of time spent with individual widgets. To put this in perspective, a reasonably well-referenced blog from the e-learning sector may receive in the order of 50 visits per day, with “hits” (including web bots) in the region of 100-200 per day.

Given this statistical picture, it is not difficult to project likely access figures for the store once the project has finished. It would be optimistic to suggest that the ITEC widget store as it is currently deployed will thrive. This does not undermine the success achieved in developing the store, nor does it indicate that its presence in the project has been without significance. But this does suggest that a sustainability strategy for the widget store cannot be based on a “build it and they will come” approach, in which the store is simply made available to teachers. The users who can benefit from it need to be clearly identified, the way in which they can benefit clearly proposed, and targeted dissemination carried out. This is a task for the remaining activity of WP8, which is focused on demonstration, and also needs to be considered within a more holistic sustainability for the project as a whole.

6.7. The Content of the Widget Store

The widget store contains content gleaned from pre-existing web tools, videos and presentations relating to the project made by teachers and students, and other aggregations of resources that individual teachers find useful. The number of individuals contributing content is relatively low (at time of writing there are 600 widgets in store, with 73 contributors), although spread over a range countries. Much content within the store is effectively “test” content whose purpose appears to either test the functionality of the store, or the capability of users in uploading new content. Much of the teacher-generated content has been uploaded during ‘training days’ and accounts for the peaks in usage shown in Figure 1.
One of the interesting features about the widget store engagement is what it might reveal about practices. ITEC as a whole has generated enthusiasm for educational innovations. Some of the teacher-generated widgets reflect levels of innovation and enthusiasm amongst this group of teachers. Putting resources into the widget store is a way of sharing what teachers have done within a group setting: within the context of a training day, for example, it is a way of sharing information about particular practice.

As an example of this, the following widget was added describing how a widget might be added to the widget store. Like many teacher-generated widgets, this widget is a video that has been embedded within the store. Its audience is clearly the ITEC community of teachers, not necessarily students. The act of submitting this kind of content is one of attempting to communicate with other participants in the project and to disseminate particular technical practice.

![User video on creating a W3C Widget from Scratch](image)

As with YouTube widgets, there are a number of other widgets produced in other Web2.0 services which are embedded within the widget format. For example the widget below is a presentation of ITEC made using the Prezi tool. Like the “widget making” widget, this is also a resource that attempts to disseminate practice. For the teacher that made this tool, we can speculate on the meaningfulness for them both of the presentation, and in the embedding of the presentation in the widget store. For example, part of the motivation may be drawing attention to their innovative use of Prezi; part of it may be drawing attention to the project more generally.
Some widgets (also videos) have been created in collaboration with children. The dominance of video in this is interesting because it is the easiest way to get content that might conceivably be useful into the widget store. The making of video is something that children can see is a useful output of the project, and the uploading it into the ITEC store makes the point about ITEC being the frame for the activities that are captured in the video.

Other tools, not videos, have been aggregated by some teachers who have found an excuse to embed things from the web. One example of this is the ‘Stick man’ game where children can create a ‘stick man’ animation and solve problems. Other teachers have found video resources which they’ve wanted to bring to the ITEC audience, so for example the “Cavalleri’s Principle” video resource has a surprising number of hits within the store. The widget store has provided a frame for sharing practices and resources – at least within specific confines of the project, and for sharing practices in different contexts.
A lot of this activity appears positive, and many aspects of engaging with the store have benefited teachers who are provided with a way of disseminating things that they have found interesting. However, on analysing data within the widget store itself, and how many times each widget is accessed, the apparent impact of widget uploads is small. Apart from TeamUp (whose interface uses the Wookie engine), and which has been largely promoted throughout the project through the learning stories, most widgets have fewer than 100 hits over the period May to October 2013 (see Table 1 below).

It is useful to situate the store statistics in context. The “Principio de Cavalieri” video in the store has 146 hits. On YouTube, it has 5985 hits since it was uploaded in April 2012. This is not a deficiency in the store, but rather places in context its role as means of pointing at and describing valuable Web resources. The Butterfly widget is often used to demonstrate the widget store’s capabilities in training, and so this can account for the relatively high figure, as is the Six Thinking Hats widget and the Geogebra widget. But what is not here in this list are the widgets that teachers have uploaded where they talk about the project, or talk about classroom practice, or share presentations they have made. These widgets have low utilisation and therefore do not appear in the statistics. As few teacher-generated widgets are currently used by others, there not at present a social reward for posting to the Store.

The numbers behind ‘hits’ on the site are a measure of specific technical actions (“clicks”) taken in response to conversations, situations and reflections amongst and within teachers, few of which can be inspected. For example, regarding the ‘perception of utility of widgets’ it may be noted that TeamUp apparently demonstrates “perceived utility” for teachers - and yet unlike any other widget in the store, TeamUp was fully integrated into the learning stories of the project, and so utilisation was effectively ‘hard-wired’ into the discussions around the project and the learning activities in general.
<table>
<thead>
<tr>
<th>Widget Name</th>
<th>Number of Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teamup</td>
<td>3260.0</td>
</tr>
<tr>
<td>Principio_de_Cavalieri</td>
<td>146.0</td>
</tr>
<tr>
<td>Butterfly</td>
<td>133.0</td>
</tr>
<tr>
<td>Bubbles</td>
<td>106.0</td>
</tr>
<tr>
<td>SixHatsLarge</td>
<td>87.0</td>
</tr>
<tr>
<td>Popplet</td>
<td>79.0</td>
</tr>
<tr>
<td>GeoGebra_BoxFolding</td>
<td>67.0</td>
</tr>
<tr>
<td>PlanetWerks</td>
<td>66.0</td>
</tr>
<tr>
<td>Food_Chain_Animation</td>
<td>60.0</td>
</tr>
<tr>
<td>Bubbl.us</td>
<td>59.0</td>
</tr>
<tr>
<td>Activity_Timer_Rocket</td>
<td>52.0</td>
</tr>
<tr>
<td>Meiosis_Animation</td>
<td>49.0</td>
</tr>
<tr>
<td>teamup/index.htm</td>
<td>45.0</td>
</tr>
<tr>
<td>BBC_li_01</td>
<td>42.0</td>
</tr>
<tr>
<td>Folha_excell2</td>
<td>39.0</td>
</tr>
<tr>
<td>distance_over_the_World_-_Wolfram_Alpha</td>
<td>36.0</td>
</tr>
<tr>
<td>Web_2.0_tools_for_Education</td>
<td>32.0</td>
</tr>
<tr>
<td>Triangle</td>
<td>29.0</td>
</tr>
<tr>
<td>Construir_um_guiao</td>
<td>29.0</td>
</tr>
<tr>
<td>TeamUp_Presentation</td>
<td>28.0</td>
</tr>
<tr>
<td>eXploring_Alberti</td>
<td>28.0</td>
</tr>
<tr>
<td>stopwatch</td>
<td>27.0</td>
</tr>
<tr>
<td>Cor_da_luz_para_um_comprimento_de_onda</td>
<td>27.0</td>
</tr>
<tr>
<td>ITEC_OGUZCAN</td>
<td>27.0</td>
</tr>
<tr>
<td>irewidptTW/widget.htm</td>
<td>26.0</td>
</tr>
<tr>
<td>Stretch_ty_story!</td>
<td>25.0</td>
</tr>
<tr>
<td>4_instrumental_remix</td>
<td>24.0</td>
</tr>
<tr>
<td>video8</td>
<td>23.0</td>
</tr>
<tr>
<td>Sudoku</td>
<td>23.0</td>
</tr>
<tr>
<td>widget_view</td>
<td>22.0</td>
</tr>
<tr>
<td>camera</td>
<td>22.0</td>
</tr>
<tr>
<td>IdeaCards</td>
<td>22.0</td>
</tr>
<tr>
<td>Geogebra</td>
<td>22.0</td>
</tr>
<tr>
<td>Doc</td>
<td>21.0</td>
</tr>
<tr>
<td>Natter</td>
<td>20.0</td>
</tr>
<tr>
<td>itec-composer.eun.org</td>
<td>20.0</td>
</tr>
</tbody>
</table>
Apart from the figures for TeamUp, it is likely that these statistics reflect widgets in use in iTEC training rather than classroom teaching. Since the widget store was conceived as a technology for integration with classroom delivery platforms, this looks like a sign that the technology still has some way to go in its wider ambition to be a “hub” for the delivery of tools within the classroom. The reasons for this are complex, and go beyond the design of the Widget Store itself. The include:

- Existing capability of embedding widgets means that users do not need to use the store, and so may never come across its benefits.
- The perceived utility of particular widgets
- The buy-in of teachers in uploading their widgets to the store
- The perceived value of uploading widgets to the store over other means of online dissemination (e.g. YouTube, Prezi, etc.)
- Inertia in changing habits and/or typical workflows
- Cultural and organisational factors which contextualise the Store in different ways

6.8. Thematic analysis of Widget Store contents

One test whereby engagement with the store can be measured is the variety of submission amongst individual users. The store is a facility where both information and activities can be deposited as well as accessed. Even if things are not accessed, it may be that the act of depositing tools in the store has some value for stakeholders.

Table 3: Range of widget uploads per user

<table>
<thead>
<tr>
<th>User</th>
<th>Number of widgets</th>
<th>Technical Type</th>
<th>Content</th>
<th>Technically functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>User 1</td>
<td>19</td>
<td>Embedded, video, flash</td>
<td>Science, maths, education, music (5)</td>
<td>16</td>
</tr>
<tr>
<td>User 2</td>
<td>5</td>
<td>Embedded, video, flash</td>
<td>Education, science</td>
<td>3</td>
</tr>
<tr>
<td>User 3</td>
<td>5</td>
<td>Embedded, video</td>
<td>Science (most not working), games</td>
<td>2</td>
</tr>
<tr>
<td>User 4</td>
<td>12</td>
<td>Video, embedded</td>
<td>Science, language</td>
<td>7</td>
</tr>
<tr>
<td>User 5</td>
<td>79</td>
<td>Embedded, video</td>
<td>Language, science, games, collaborative tools</td>
<td>68</td>
</tr>
</tbody>
</table>

This is only a straw poll, but it indicates is that a few users have submitted a very diverse range of content. Under what circumstances might this happen? In the case of a person who is using a tool to solve a particular problem, we might expect identifiable patterns in their usage of the tool (for example, a teacher wanting to use the Widget Store to teach science may upload a series of related widgets). In the case of user 1, there is some interest in music amongst the widgets uploaded, although even these music widgets are media players, with each widget representing a different song. In the case of user 1 and user 5, there is no thematic pattern: widgets are spread across all subject areas and all kinds of technologies. The lack of ‘themed’ uploads is consistent with exploration and demonstration of the
capabilities of the widget store. This would indicate that the store has focused key stakeholders in the project on a technical activity which embraces a range of other technologies and approaches with the aim of maintaining a discussion around the ITEC project. In terms of understanding the impact of the store, we might ask how this discussion would have taken place were the store not to exist? Whilst there a lack of extensive evidence of the store being an artefact of direct utility to teachers in the classroom, there does appear to be support for the idea of the store as an artefact for focusing a conversation within the project on a broad range of technical practices across Europe. This is an important factor, and suggests that there is a viable future for the Widget Store, although the context for this is not yet entirely clear. It should be remembered that many technologies do not find their niche immediately. The example of IMS QTI comes to mind, which was initiated in 1999, in 2009 appeared moribund and was removed from the IMS Web site because it ‘did not achieve sufficient implementation and feedback’¹⁶, but which has now achieved substantial adoption. Similarly tools which are not generally embedded in educational technology may nevertheless have strong impact by supporting research and demonstrating functionality, as has been the case, for example, with the Reload¹⁷ tool for packaging educational content, which has gradually built a strong base of research users and remains popular ten years after its first release. The lesson from this is simply that the adoption of standards based solutions in education is a long-term process, and high levels of adoption should not be expected from the first releases of a specification or system.

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¹⁷ http://www.reload.ac.uk/
7. Making sense of the evaluation of the Widget Store

Surveying the evaluation activities described in Section 7 above, we see a range of different responses to the Widget Store. The results of evaluation of the Store in pilots, and usability testing, demonstrate that the Store is an effective and usable implementation of the system proposed in the DOW. There is also evidence from the pilots, national coordinator feedback and WP8 user feedback sessions that there has been some enthusiasm for the functionality offered by the store from teachers, mixed with other ambivalent or negative responses. We have seen that this range of responses is highly context dependent, and also related to the way in which the contents of the store are integrated into project activities. Finally we have seen that, with an eye on exploitation, independent use of the Store by teachers outside project activities has not yet taken off. This raises the question of why, if the response to the store has been on the whole positive, the Store has not yet gained traction as an open platform. The creation of a successful open platform was not an objective of the work plan, but this remains a relevant question for understanding how the Widget Store can best be positioned for exploitation.

Making sense of this is not an easy task. We do not know enough about the reality of the classroom to know the causal factors that bear upon how decisions to use technologies are made. This is what philosophers and sociologists would call ‘social ontology’ (see the work of Searle\(^\text{18}\), Lawson\(^\text{19}\) and Bhaskar\(^\text{20}\)). However, evidence from the externally observable patterns of engagement with tools like the ITEC widget store can provide some indicators. If these merely show a disconnect between the rationale for the creation of the widget store (for example, rationalising the provision of tools) and teachers’ actual practice such knowledge ought to have significance in the planning and design of future interventions. The deeper ontological questions concern the meaningfulness of teaching activity: what matters to teachers? Is it the provisioning and organising of their technical infrastructure and the sharing of practice? Is it the organisational feat of getting through a lesson and conducting meaningful coordinations with students? Is it classroom management? Is it student success? Is it appeasing management? Is it simply ‘survival’? It is likely that many of these factors feature in teacher psychology but at different levels (for example, in a difficult classroom management situation, priorities may be different from a good classroom management situation). Widget store usage, both in what patterns of usage are present and what is absent, preserves a trace of these patterns and may give an indication of what matters to teachers. The following section considers the patterns of practice with the widget store and considers them in the light of possible causal mechanisms which can explain these patterns of behaviour.

The widget store is a new artefact within the teaching situation, as are the widgets it contains. This effectively is an addition to the environment of the classroom, although as with all online environments, it is only visible to those who choose to see it (an online intervention is not like a piece of hardware!). The tools the store contains may each have their own utility in particular circumstances, whilst the store itself provides utility in the packaging and making them available. The perception of utility of the store artefact is fundamental to its success; however, the perception of utility is something which depends on processes of “training” with stakeholders. Therefore, considering widget store, there are two perspectives to examine:


\(^{19}\) Lawson, T (1997) *Economics and Reality*, Routledge

\(^{20}\) Bhaskar, R (1979) *The Possibility of Naturalism*
The artefact: what is the value of the technologies that have been made to users? To what extent will the artefact live beyond the project?

The process: what is the value of the process of creating the artefacts within the project? To what extent does new knowledge arises from this process?

In answering these questions as educational technologists we may argue that ‘things are changing in education’, but this needs to be situated within the context of teachers’ professional identity and job security. To step outside the frame of established expectations in one’s professional environment and do something different carries professional risks. Compliance with rules and expectations remains a significant force in the maintenance of professional identity, but different communities exhibit different rules and regulations. In many cases this regulatory context works against experimentation with technology, but in some cases teachers may be required to show that they have made an effort to introduce new practices, perhaps in the context of a project such as iTEC. It is a reasonable hypothesis to propose that the willingness of teachers to participate within the ITEC training sessions, and the difficulty experienced in sustaining Widget Store practices outside the training environment can both be explained in the context of these regulatory factors, and teachers’ response to them. Teachers’ intuitive and emotional acceptance or rejection of new technologies will inevitably be linked to practice, and the context which informs it, at a level of detail has too much variety to be manageable by the developers of technology. Nevertheless, the wider challenge is to excite teachers with the potential of technology, for without this they will see no reason to expose their learners to it.

### 7.1. Towards a mechanism to explain the data

There are three domains of intervention where we have considered both the product and the process of intervention. These are:

1. The domain of the classroom
2. The domain of the ITEC project steering and delivery
3. The domain of the technical discourse

These three domains overlap (see Figure 19) and between them are flows of information concerning practices, problems, technologies and skills. In a successful post exploitation scenario, with the Widget Store widely adopted, these flows of information (from pedagogical discussion to classroom, from technologists to pedagogy, from classroom to technologist) would translate technical innovation to classroom practice and pedagogic design.

**Figure 30: Interconnected Domains in iTEC**

In some cases, these information flows appear to already be occurring. In the case of TeamUp, for example, the close coupling between pedagogic vision, project scenario and tool implementation has led to strong adoption by teachers involved in pilots. Similarly use of the Composer to support Learning Activity design has the potential to achieve similar results. In other uses of the Store, communications within each domain are less well connected.
Each domain comprises a social structure (children, teachers and curriculum in the class; technologists and their tools; project stakeholders and their relation to the project contract) and individual agents. Information transfer occurs because many agents move from one domain to another (so participants in an iTEC pedagogical meeting may be technologists; teachers move from the pedagogical meeting to the classroom, etc.) The ITEC widget store is an artefact that has different presences between the three domains: it is a technical artefact for technologists; a technology of the project in iTEC steering and delivery; something to be tried in the classroom by interested parties. Because of its multifaceted nature, the ITEC widget store can stimulate the discursive connections between the domains: technologists have something to talk to pedagogical partners about (and those partners can respond); pedagogic partners can talk to teachers about the store. The store is effectively an attenuator of the complexity of the project and allows the project ideals to be expressed through the means of a simple tool.

In each domain the actors seek to fulfil their role successfully by carrying out their tasks to the best of their ability. ITEC stakeholders seek to make the project a success; technologists creating the best technologies, they can envisage; and teachers focus on educating children and complying with school regulations. In carrying out these activities, the agency of these actors leads to the identification of ‘absences’ or ‘gaps’ within their specific domain which their action might be able to address. For example, amongst technologists, what tends to be identified as missing is the capabilities of current technology and awareness of pedagogical issues. In the classroom, what tends to be seen as missing is the students’ knowledge of the curriculum targets they have been set. The project steering and delivery provides a way of joining these concerns together. However, typically it also has its own dynamic concerned with addressing the absences in the fulfilment of the project plan, to which stakeholders are invited to contribute. As far as technology utilisation in the classroom is concerned, new technologies may well be missing, but this may not be perceived within the social structure of the classroom, where learning needs dominate.

Other areas of discourse which directly relate to classroom practice are absent from the discourse. Individual school leadership can be transformative of classroom practice, as we have seen at ESSA Academy in Bolton, which both received a visit from a wide range of project partners, and also presented to the iTEC mainstreaming conference. School management can, for example, intervene in the provisioning of tools and the coordination of effective delivery. However, it is only represented in iTEC at the Ministry of Education level, and usually not at the individual school level.

The challenge to establish effective flows of information is to establish common absences between domains to which a particular technical practice is the solution. TeamUp’s success can be attributed to this mechanism: The challenge of student grouping and reflection was identified among the learning scenarios (pedagogic) which were themselves developed in collaboration with teachers (classroom); this was a shared absence determined between teachers and pedagogic designers. This led to the identification of a specific technical need that could be addressed within the technical framework of the project, and delivery of TeamUp through the widget store has confirmed the quality of the Widget Store infrastructure. Similarly, comparison of the post-hoc evaluations interventions following introduction of the Store (see section 5.5) suggests that there are issues of teacher identity which can be challenged by the technology. Unless invited into educational settings (as in the Spain), project interventions are not always welcomed: a lack of alignment of absences can give the impression that technologists are telling teachers how to do their jobs.

This analysis suggests that the strategy for the exploitation of the Store as a whole should also seek to achieve a ‘coordination of absences’ between classroom teachers, technologists
developing the store and the pedagogical elements in the project. The model presented in this analysis predicts that were this to be found, then corresponding adoption could be expected in the exploitation phase.

7.2. Validation of the mechanism

The widget store is (at the very least) a powerful stimulus to the attempt to understand the nature of the classroom of the present so as to prepare ourselves for the future. Projects on the scale of ITEC are rare opportunities to get underneath the skin of education on a massive scale, and a technological intervention presents much information about teaching and learning – both in how the technology is used and in how it is not used.

Like most technologies, the widget store has been designed to solve a problem, but this problem manifests itself differently to different stakeholder groups. In the light of the proposed mechanism of ‘absences’ suggested above, the questions are: ‘What absences are associated with this problem?’; ‘Who recognises the absences?’, and ‘How can the absences be aligned’.

In furthering this analysis we will need to look at agents moving through different domains of practice, and we should consider what data would support or deny the thesis. We suggest that the motivation for changes in agency of teachers and other stakeholders is the identification of shared absences in practice, and the satisfaction of some of those absences with new technologies and practices. But how can we identify what might be missing?

One approach, suggested by Leydesdorff and Ivanova21 in recent work on the relations between education, industry and government, is to examine the patterns of repetition of practice across different domains rather than individual instances of innovation. In information-theoretical terms, this is to focus on ‘redundancy’ of practice. If shared redundancies are a useful conduit of information and practice, then examining the repetitive patterns of technologists, teachers and within the project itself will:

a) Provide an alternative focus from concentrating on innovations in different domains
b) Shed light on shared absences across domains where effective intervention may be possible.

c) Invite deeper analysis of ‘missing factors’ like (for example) the professional security of teachers in different countries, the different governance arrangements in schools, or the expectations of teachers, learners and technologists.

This approach to further work is aligned with the increasing importance of Learning Analytics. As data analytic techniques become increasingly sophisticated in the identification of deep patterns in data, further evaluation should consider a much broader dataset: not only the results of questionnaires, or usage data, but the collation of data on class activities, lesson plans, timetables, teacher workloads, and so on. The Widget Store is a well-designed and effective service, but like any new technology it faces barriers to adoption. Rich data of this type, combined with the analytical approach we have proposed, would make it possible to gain insight into these barriers, and to identify appropriate strategies.

The validation of any suggested mechanism also requires that it be possible to demonstrate the explanatory power of that mechanism, not just through explaining the data, but also in predicting the likely consequences of action. An effective mechanism ought to be modelable through Agent-based techniques (see for example, Axelrod, 1984; Gilbert, 2008) which would be able to simulate the dynamics of an intervention.

8. Sustainability and exploitation of iTEC outcomes

8.1. The role of the Widget Store in training and dissemination

iTEC articulates a technical vision of education where innovations in technologies play a central role in creating the ‘classroom of the future’. This raises complex issues, and in this context the Widget Store and other iTEC technical interventions have a role in providing a concrete focus for discussion. Discussions relating to the Store most visibly occur within meetings of project stakeholders: between teachers and national coordinators; between technical partners; at general assemblies, etc.

It is likely that some teachers have seen things demonstrated through engagement with the widget store, and then gone on and done new things themselves. For various reasons they may have chosen to explore these practices away from the store. For example, if a teacher is introduced to Google Drive, or to Etherpad through its integration in a widget, they may then go on to investigate the service and use it directly rather than making use of the store. The same may go for some videos that have been uploaded onto the store through YouTube, or some of the widgets embedded from other services like WidgetBox.

In making decisions about whether or not to use the store, teachers have to think about the complexity they are trying to manage. Part of the balancing act of teachers is on the one hand having a “bright idea” for practical use of a particular technology (perhaps Google Drive, having seen it in the store), a resource or a practice (e.g. video), and on the other hand managing the complexity of many resources and tools as they are presented in the widget store. The organisational priorities of teaching make it unsurprising if the simplest possible solutions may be sought, which may mean by-passing the store when teachers already know what Web resources they want to use.

The situation of the project meeting is radically different from the situation of the classroom. Instead of worrying about classroom management, curriculum delivery, student performance, in the project meeting the focus is on experimentation with the tools, and how to keep track of the various innovations and activities taking place in the project. Patterns of widget store usage described in 7.6, 7.7 and 7.8 suggest that most users have been principally focused on these aspects, rather than the problems of the classroom.

However this is not to say that there is not a connection between the issues addressed by the project and those which arise in the classroom. The ITEC project is richly structured and provides scope for a technical discussion about tools and a pedagogical discussion about classroom practice. The benefits of any project in education are that teachers, who otherwise are consumed by the operational priorities of the classroom, are given space to think more holistically about their practice and their engagements with technology. The process of thinking and reflecting must also be coordinated in some way. It may be in this process of coordination of reflection and experimentation away from the classroom that the widget store technologies have been valuable.

The heterogeneous nature of the widget store provides a focus for discussion whilst permitting a rich exploration of the technological universe. When used in this way, its effectiveness is not necessarily measured through levels of engagement with the store itself, but through the broader experiences of those teachers present in project meetings where the store is used as a way of presenting the project goals. The practice of users (for example, User 1 and User 5 in Table 29) of the widget store in uploading many different types of widget in many different formats suggests that a discussion along the lines of “these are the kinds of things that can be embedded in the widget store” is taking place. This is also a discussion about “these are the kind of things that are available in current technology that you might want to consider using”. The example of the widget store and its use in training
activities legitimises a broader discussion and an engagement with technology. Teachers have been exposed to new things that they can do in the classroom which they might otherwise not have realised, whether or not they use the Store platform in their subsequent practice. The Widget Store is particularly suited to this purpose. Alternative approaches might instead focus on individual services or tools on the web (for example, YouTube or Prezi), but these tools do not embrace the range of different practices that are possible in the Widget Store.

Table 4: Comparison of available services with Widget Store

<table>
<thead>
<tr>
<th>Approach</th>
<th>Range of activities</th>
<th>Diversity of resources</th>
<th>Hosting of new tools</th>
<th>Widgets</th>
<th>Presentations</th>
<th>Commercial web-2.0 tools</th>
<th>Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedding individual artefacts (from widget box, for example)</td>
<td>Large range of activities available in WidgetBox, easily embedded</td>
<td>Widget box aggregates a variety of tools and categorises them.</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Embedding of video from YouTube</td>
<td>Large amount of video based content</td>
<td>Videos only</td>
<td>Yes</td>
<td>No</td>
<td>No (apart from video presentation)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Prezi</td>
<td>storage of presentations (no audio)</td>
<td>Presentations</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Widget Store</td>
<td>Anything which is embeddable</td>
<td>Single point of access and coordination in the store</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 17, above, illustrates the heterogeneity of the store and how it compares with the capabilities of other technological platforms.

ITEC is focused on the community of teachers, but the community of technologists is also an important group of people, amongst whom technical developments may be carried forwards and recombined with new technologies building to an emergent and sustainable impact in education beyond the project.

Here, ITEC’s widget store integration into other projects and its engagement with other core technologies may yet have an impact. In particular the integration of the widget store with new standards for aggregating widgets (OMDL), and the embedding of this within a course format in Moodle (work funded through the OMELETTE project) can all contribute to an emergent environment from where new kinds of powerful interventions might emerge. Similarly, the integration of the ITEC widget store into the Open-Sankoré open-source electronic whiteboard software presents a way in which practices with the Widget Store can be situated alongside an attractive open-source solution to classroom presentation. The engagement with the Apache community through the underlying Wookie technology further contributes to a technical discussion where new recombinations of tools, some of which emerging from ITEC can lead to new kinds of interventions and sustainability.

The Widget store integration of real-time technologies – primarily developed for the widget competition resources also provided a point of contact with other technical partners. Partners at SMART had also been developing real-time tools which similarly used Web-Sockets for integration, and this coherence between technical approaches led to richer discussions about
what might now be possible in the interactive classroom. It also meant that technical problems with WiFi when using both technologies afforded a coordinated response.

Whilst technical discussions are not pedagogical discussions, the value of ITEC as a project is to throw a pedagogical light on technical innovations, presenting new use-cases for emerging technologies. Because ITEC has a strong technical strand in creating the Widget Store, it has legitimacy in engaging in new communities of technologists and integrating with new tools. If ITEC did not have this technical strand, it is unlikely that this opportunity would exist. In this way there is value in the widget store’s support for conversational processes situated within technical communities, as well as in its role in the classroom.

8.2. Exploitation of the Widget Store

Sustainable outcomes of WP8

The sustainable outcomes of ITEC technical work may be placed into the following principle categories. The strategy for exploitation adopted by the project will need to be adapted to the differing requirements of the different cases.

Firstly ITEC has produced end user services and applications. The Widget Store is both a prime example of this aspect of work, and also the shop window for other services offered by ITEC.

Secondly, a body of reusable code has been created. Edukapp, which underlies the store itself, builds on earlier projects.

Thirdly, in building the Widget Store existing open source server applications have been extended. A key component of the Widget Store is Apache Wookie, which provides the underlying widget services for the store.

Fourthly, widgets have been produced or enhanced.

Exploitable capabilities of the Widget Store

With regard to the Widget Store as a service, as opposed to the software which supports it, this has a number of capabilities which can be leveraged to support sustainability, including:

- Providing a platform for the curation of cross platform resources and tools for use individually or bundled in activities, both in teacher training and in the delivery of education.
- Offering a quick and easy way of integrating services into a wide range of platforms, including mobile platforms.
- Enabling teacher trainers and pedagogic coordinators to draw attention to innovative technologies by storing them as widgets and making them discoverable within a pedagogic context.
- Providing an opportunity for the collection of learning analytics data across multiple platforms.
- Offering an easy and safe route into creation publication of web resources on the web, ranging from simple wrapping of resources, through creation of Websites, to the creation of sophisticated JavaScript code.
**Constraints on exploitation of the iTEC Widget Store**

The following factors constrain the exploitation of the Widget Store, and create barriers to its adoption:

**Table 5: Constraints on exploitation of the Widget Store, and their implications**

<table>
<thead>
<tr>
<th>Constraint on exploitation</th>
<th>Implication for strategy</th>
</tr>
</thead>
</table>
| The W3C Widget Specification has not been as widely adopted as had been anticipated. Opera have dropped the standard, and others who we hoped would adopt the standard have not done so. | a) This constraint has reduced public awareness of the specification. It should, however, be noted that iTEC widgets run on all platforms, and there is no reason to suppose that the specification is no longer an appropriate technology for the purposes of iTEC. Moreover, users do not need to know anything of the specification in order to use the store.  
  b) The anticipated large number of high quality sophisticated widgets from a wider W3C Widget ecosystem has not materialised. |
| Some teachers have experienced difficulty in accessing or using the Widget Store.           | Although is simple to use, not all teachers are ready or able to make use of it. This is due to  
  a) some teachers’ lack of familiarity with Web tools in general.  
  b) In some cases Internet infrastructure may be too unreliable, or access to remote sites limited to a white list.  
  c) log-in problems in accessing the shell                                                                                                         |
| Momentum has not yet been achieved in teachers’ use of the Widget Store as an open access system | Simply making the Widget Store available as an open service will not be an effective strategy.                                                                                                                         |
| The Store has not yet built momentum as a hub for the sharing of educational resources.    | The lack a large body of shared resources reduces the motivation for teachers to use the system.                                                                                                                                 |
| The benefits of interoperability are not necessarily convincing to teachers who work within the confines of a single learning platform, and with a restricted set of tools. | The message about the benefits of interoperability should be targeted at those who have a problem which interoperability can resolve.                                                                                 |
| The benefits of curating a collection of Web resources in the Widget Store are not necessarily obvious to teachers. | If they are to make use of the Store, teachers and pedagogic coordinators will need to be exposed to examples of practice, and collections of resources whose value they can easily understand. |
| Teachers do not have the ability to set up a Virtual Learning Environment with Widget Store integration. | The message about the benefits of the Widget Store should not only be targeted at teachers, but also at decision makers who can influence institutional systems. |
Many potentially interested parties do not know about the Widget Store  
Effective demonstration and dissemination are high priority activities in the final year.

**Towards a strategy for exploitation of the Widget Store**

In considering the analysis of factors and their implications in Table 5, above, the following principal conclusions may be drawn.

1. Effective demonstration and dissemination of the Widget Store is the highest priority for WP8 work in the remainder of the project. Plans to this end are already in place for the final year of the project. These demonstrators also have a key role in maintaining the discourse around the Widget Store beyond the lifetime of the project, with continued interactions between teachers and educational managers, researchers and technologists.

2. Demonstration and dissemination work needs to be carefully targeted. The project as a whole, and WP8 in particular, should reconsider the positioning of the Widget Store product within the educational landscape. The assumption has been that the target is primarily individual teachers. Within the context of project activities this makes sense, but in the wider context this may not always be the case. As noted in Table 5, teachers do not generally have a strategic interest in interoperability between systems. Nor do they usually have the authority to make decisions about the systems which are deployed in their schools. Appropriate targets are therefore education ministries and local authorities, the providers of educational services and platforms, and transnational agencies and organisations, who have the necessary influence, resources and freedom of decision to deploy the Widget Store. Where dissemination work is successful, champions should be sought in these groups.

3. The claims made in dissemination should be realistic, and take into consideration that the effectiveness of the Widget Store depends significantly on the context in which it is used. As the results of evaluation have shown, even a perfect product of this nature will be faced by the reality that in some educational contexts the functionality which it offers is not perceived as useful, and that some users will be confronted by technical difficulties which are beyond the control of the developers of the Store. Dissemination should be aware of this, and focus, where possible, on targets which can readily make use of its capabilities.

4. While it is expected that most use of the Widget Store will be through Web platforms, recent completion of a plug in for Open-Sankoré, enabling it to act as an iTEC shell, has potential for use with teachers. This is because teachers are able to install and run this application on their own laptops, which they control, and to make use of the Widget Store within that context. This solution has some limitations, because it does not make use of the identity management systems within the Widget Store and iTEC Cloud. Nevertheless, it provides an opportunity to explore the potential of the Widget Store to provide relevant functionality to teachers.

5. Innovative functionality should be highlighted in demonstration, in particular

- The recent inclusion of OMDL functionality to deliver collections of widgets to users in the Moodle shell fits well with the strategy of appealing to pedagogic and technical coordinators, who can use this to deliver ready-made pages of resources and tools.
- Collections of OMDL widgets which demonstrate inter-widget communication should be demonstrated
- Real time activity coordination widgets should be included
• Linked media widgets making use of HTML5 video tags should be included, and also have potential as a means of demonstrating the Store.

6. As argued in Section 7, the best opportunities for exploitation will come from identifying actors for whom the Widget Store satisfies an absence which they currently identify in their work environment. If absences in common can be identified among actors, with the Widget Store being able to occupy that absence, then we may expect adoption to follow.

7. The Widget Store is built using open source code. An important part of this is Wookie widget server, which in the course of the project, and in part thanks to the efforts of iTEC, has graduated as Apache Wookie. However, the code for the store itself is built on Edukapp, the open source output of an earlier project, although it has radically transformed it from its starting point. If Edukapp, or an iTEC fork of this, is to be built on by other developers, it will need to be made available as a fully-fledged open source resource, not simply as a code dump. This task will need to be addressed in the final year of the project.

8. As with many other Web2.0 services, the collection and analysis of data from the Widget Store may be of equal importance to the functionality which the Store offers. There is scope for further innovation in the way that ITEC exploits its data about what teachers are doing, and for aligning the Widget Store with the strong trend towards the use of Learning Analytics in education.

The analysis presented in this section constitutes a starting point for a deeper consideration and detailed planning in the final year of the project.
Appendix 1 – Widget Store API

The Widget Store API is a pure REST service which is divided into eight sections. Each section deals with a particular aspect of the store.

Base url: [http://[host]:[port]/edukapp/api/rest](http://[host]:[port]/edukapp/api/rest)
The base url given here is the common part of all of the REST calls. In the case of iTEC the host is wookie.eun.org and the port is 80 so can be omitted.

**Widget Creator**

These calls allow widgets to be created in a number of ways. Widgets files can be uploaded, links to open social gadgets can be created, flash files, java applets and zip files of a web folder can be uploaded and widgets can be created out of html pasted into a form (embed codes for instance).

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td></td>
<td>Returns a list of icon urls that can be used in widget creation.</td>
<td>none</td>
</tr>
<tr>
<td>POST</td>
<td>widgetFile</td>
<td>Post a widget file (.wgt). This is added to the store and a widget profile is returned.</td>
<td>http basic</td>
</tr>
<tr>
<td>POST</td>
<td>uploadurl</td>
<td>Post a gadget url to the store. A widget profile is returned</td>
<td>http basic</td>
</tr>
<tr>
<td>POST</td>
<td>widgetdescription</td>
<td>Builds a widget from a file. A media file must be either a flash file or a java applet. Alternatively a site file must be a zipped up folder with html pages in it. This returns a widget profile.</td>
<td>http basic</td>
</tr>
<tr>
<td>POST</td>
<td>title</td>
<td>This builds a widget out of embed code (actually any html is fine). A widget profile is returned.</td>
<td>http basic</td>
</tr>
</tbody>
</table>
Functionalities
This group of calls allows the pre-defined functionality list to be retrieved and functionalities to be associated with/removed from a widget. The relevance parameter when associating functionality is a number between 0 and 100.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>{baseurl}/functionalities</td>
<td>Returns a list of functionalities.</td>
<td>none</td>
</tr>
<tr>
<td>GET</td>
<td>{baseurl}/functionalities/{level}</td>
<td>Returns a list of functionalities</td>
<td>none</td>
</tr>
<tr>
<td>POST</td>
<td>{baseurl}/edit</td>
<td>Associates a functionality with a widget. This returns a functionality structure</td>
<td>http basic</td>
</tr>
<tr>
<td>DELETE</td>
<td>{baseurl}/edit</td>
<td>Removes the association between a widget and a functionality</td>
<td>http basic</td>
</tr>
</tbody>
</table>

Ratings
Ratings are associated with a particular widget and particular user. If a user repost a rating for a particular widget, the old value is overwritten, as it is assumed that they are re-rating the widget not averaging.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>{baseurl}/ratings/average/{widgetId}</td>
<td>Returns the average rating for a widget</td>
<td>none</td>
</tr>
<tr>
<td>GET</td>
<td>{baseurl}/ratings/{widgetId}</td>
<td>Returns the signed in user’s rating for a widget</td>
<td>http basic</td>
</tr>
<tr>
<td>POST</td>
<td>{baseurl}/edit/{widgetId}/(rating)</td>
<td>Posts a user’s rating for a widget which is then returned</td>
<td>http basic</td>
</tr>
</tbody>
</table>

Reviews
Reviews are associated with a particular widget and a particular user. Each user can have any number of reviews and each widget can have any number of reviews. At the minute there is no way to edit or delete a review. This will be added in the upcoming patch.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>{baseurl}/reviews/{widgetId}</td>
<td>Returns a list of reviews for the widget</td>
<td>none</td>
</tr>
<tr>
<td>POST</td>
<td>{baseurl}/reviews/edit/{widgetId}</td>
<td>Creates a new review from comment and returns the review structure</td>
<td>http basic</td>
</tr>
</tbody>
</table>
Stats
Posting increments the statistic for either number of views, embeds and downloads. These functions are supplied so clients can influence the statistical information stored on the server. The stats information is returned as part of the extended widget profile. See the widgets section below.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>POST {baseurl}/stats/views/{widgetid}</td>
<td></td>
<td>Increments the number of times a widget has been viewed</td>
<td>none</td>
</tr>
<tr>
<td>POST {baseurl}/stats/embeds/{widgetid}</td>
<td></td>
<td>Increments the number of times a widget has been embedded</td>
<td>none</td>
</tr>
<tr>
<td>POST {baseurl}/stats/downloads/{widgetid}</td>
<td></td>
<td>Increments the number of times a widget has been downloaded.</td>
<td>none</td>
</tr>
</tbody>
</table>

Tags
Tags are intended to be user generated short (single word) annotations of a widget. Once they are created other people can reuse them. The intention is for a tag cloud to develop.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET {baseurl}/tags</td>
<td></td>
<td>Gets a list of tags</td>
<td>none</td>
</tr>
<tr>
<td>GET {baseurl}/tags/popular</td>
<td></td>
<td>Gets a list of the most popular tags</td>
<td>none</td>
</tr>
<tr>
<td>GET {baseurl}/tags/widgets/{tagid}</td>
<td></td>
<td>Gets a list of widgets associated with a tag</td>
<td>none</td>
</tr>
<tr>
<td>POST {baseurl}/tags/edit/{widgetid}</td>
<td>tag</td>
<td>Associates a tag with a widget. The tag is created if it doesn’t already exist</td>
<td>http basic</td>
</tr>
<tr>
<td>DELETE {baseurl}/tags/edit/{widgetid}/ {tagid}</td>
<td></td>
<td>Removes the association between a tag and a widget</td>
<td>http basic</td>
</tr>
</tbody>
</table>
**Users**

The following section deals with the user. Here users can be created, retrieved, updated and deleted. A user’s favourite widgets can also be retrieved here.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET {baseurl}/users</td>
<td></td>
<td>Returns a list of useraccount structures</td>
<td>none</td>
</tr>
<tr>
<td>POST {baseurl}/users/edit</td>
<td>username email password realname</td>
<td>Creates a new user and returns a useraccount structure</td>
<td>http basic admin</td>
</tr>
<tr>
<td>PUT {baseurl}/users/edit</td>
<td>userId username email password realname</td>
<td>Updates a user and returns a useraccount structure</td>
<td>http basic admin</td>
</tr>
<tr>
<td>POST {baseurl/users/login</td>
<td>username password</td>
<td>Logs a user in and returns their useraccount structure</td>
<td>http basic admin</td>
</tr>
<tr>
<td>GET {baseurl/users/widgets</td>
<td></td>
<td>Gets a list of widgetprofile structures for widgets owned by the user identified by authentication</td>
<td>http basic</td>
</tr>
<tr>
<td>GET {baseurl/users/favourites/userId}</td>
<td></td>
<td>Returns a list of widgets which the user has selected as favourites</td>
<td></td>
</tr>
<tr>
<td>POST {baseurl/users/favourites</td>
<td>widgetId level</td>
<td>Adds a favourite for the user with a level indicating how much and returns a WidgetFavourite structure</td>
<td>http basic</td>
</tr>
</tbody>
</table>
**Widgets**

The widgets section is central to the API. It supplies the api for searching for widgets, getting widget information, toggleing "featured" for a particular widget and deleting widgets.

<table>
<thead>
<tr>
<th>Request</th>
<th>Parameters</th>
<th>Description</th>
<th>Authentication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GET</strong></td>
<td>{baseurl}/widgets/{widgetId}</td>
<td>returns an extended widget profile structure for widgetId</td>
<td>none</td>
</tr>
<tr>
<td><strong>GET</strong></td>
<td>{baseurl}/widgets/search/{query}/{start}/{rows}</td>
<td>returns a list of widget profiles structures</td>
<td>none</td>
</tr>
<tr>
<td><strong>GET</strong></td>
<td>{baseurl}/widgets/search/{query}/{start}/{rows}</td>
<td>Returns a list of widget profiles structures ordered by date, popularity or</td>
<td>none</td>
</tr>
<tr>
<td><strong>GET</strong></td>
<td>{baseurl}/widgets/featured</td>
<td>returns a list of widget profile structures for the featured widgets</td>
<td>none</td>
</tr>
<tr>
<td><strong>PUT</strong></td>
<td>{baseurl}/widgets/featured/toggle/{widgetId}</td>
<td>Toggles featured on and off for a particular widgets</td>
<td>http basic admin</td>
</tr>
<tr>
<td><strong>DELETE</strong></td>
<td>{baseurl}/delete/{widgetId}</td>
<td>Deletes a widgets – currently this completely removes the widget</td>
<td>http basic for owned widgets http basic admin for all widgets</td>
</tr>
</tbody>
</table>
# Appendix 2: Widget Store Data Model

## Account Info

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Null</th>
<th>Default</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>int(11)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>realname</td>
<td>varchar(35)</td>
<td>Yes</td>
<td>NULL</td>
<td></td>
</tr>
<tr>
<td>website</td>
<td>varchar(256)</td>
<td>Yes</td>
<td>NULL</td>
<td></td>
</tr>
<tr>
<td>joined</td>
<td>timestamp</td>
<td>Yes</td>
<td>NULL</td>
<td></td>
</tr>
<tr>
<td>lastseen</td>
<td>timestamp</td>
<td>Yes</td>
<td>0000-00-00 00:00:00</td>
<td></td>
</tr>
<tr>
<td>shortbio</td>
<td>varchar(2056)</td>
<td>Yes</td>
<td>NULL</td>
<td></td>
</tr>
</tbody>
</table>

## Activities

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Null</th>
<th>Default</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>int(11)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>activitytext</td>
<td>varchar(64)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Categories

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Null</th>
<th>Default</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>int(11)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>title</td>
<td>varchar(255)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>group</td>
<td>int(11)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Comments

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Null</th>
<th>Default</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>int(11)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>commenttext</td>
<td>varchar(1024)</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Favourites

<table>
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### Widget Profile Activities

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## Widget Profile Tag Joins

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## Widget Statistics

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## Widget Descriptions

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## Widget Profile Functionality Joins

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Appendix 3: Widget Store Data Structures

All data is returned as JSON objects. The objects are shown below as JSON string objects.

**Search Results**
This is a simple wrapper around a list of widget profiles returned from the search routines. For convenience the number of results is included as a property of the SearchResults object. There is a member variable called “SearchResults” which contains the list of the WidgetProfiles.

```json
SearchResults
{
    "number_of_results": n,
    "SearchResults": [ WidgetProfile, ... ]
}
```
Widget Profile
Here the main metadata for a widget is presented back to the caller. This structure is often returned in an array of widget profiles. Both tags and functionalities are presented as a list or functionality and tag objects as below.

```json
WidgetProfile
{
  "id" : n,
  "name" : "Widget Name",
  "icon" : "http:/../path/to/icon",
  "publish_level" : n,
  "deleted" : 0 or 1,
  "featured" : 0, or 1
  "created" : "Date String",
  "updated" : "Date String",
  "tags" : [
    tag,
    ...
  ],
  "activities" : [not used in iTEC],
  "description" : "Description String",
  "functionalities" : [],
  "type" : "W3C Widget",
  "downloadUrl" : "http://.../widgetfile",
  "uri" : "http://wookie.apache.org/widgetid"
}
```
Extended Widget Profile

This has an embedded widget profile at the top. It also contains store specific information including the url required to embed or render the widget, who uploaded it and some stats.

```json
Extended Widget Profile
{
  "widgetProfile" : WidgetProfile,
  "uploadedBy" : UserAccount,
  "renderInfo" : "iFrame HTML code here",
  "renderUrl" : "http://.../path/to/widget/instance",
  "downloads" : n,
  "embeds" : n,
  "views" : n,
  "averageRating" : n,
  "totalRatings" : n
}
```

Functionality

The primary purpose for this structure is to provide the functionality distinction link between the widget store and other services which use the same taxonomy in the name field.

```json
Functionality
{
  "id" : n,
  "name" : "functionality name",
  "uri" : "http://itec.det.uvigo.es/itec/vocabularies/Functionality#stringid",
  "level" : 1 to 6
}
```
User Ratings

This is singular for each widget and user. It is returned by the ratings service

```
UserRating
{
    "id": n,
    "rating": 1 to 5,
    "time": "Date String",
    "userAccount": UserAccount
}
```

User Review

A list of these is returned by the review api.

```
UserReview
{
    "id": n,
    "time": "Date Time String",
    "user": "userid",
    "text": "The review text"
}
```

Tag

These are returned as a list of available tags by the tag service or embedded as a list within the widget profile structure where they indicate which tags have been associated with the widget.
UserAccount
This structure contains user information, the accountInfo is the data returned from UMAC for

```json
UserAccount
{
    "username" : "userid string",
    "accountInfo" : {
        "id" : n,
        "joined" : timestamp,
        "realname" : "Jo Bloggs"
    }
}
```

this username – which is the UMAC userid.

**Message**
A system defined message returned by many of the api service calls which don’t actually return data. Usually the message « OK » indicates that everything worked correctly.
Message
{
    "id": n,
    "message": "The message set to OK if operation successful"
}