A non-technical guide to technical frameworks

Part One

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An exploration of the technologies underpinning the e-Learning framework (ELF) for the non-technical among us – this first part looks at the IT world and new technologies.

I have set myself the task, as a learning technologist of many years experience, of trying to get to grips with what the e-learning framework (ELF) is all about, but this is a very technical subject and the question is, does it really matter if I don't understand what goes on 'under the bonnet'? Some big decisions have been made by educational institutions over the last few years about the platforms for e-learning they are going to provide, particularly VLEs (Virtual Learning Environments), and whilst they have enabled many people to get involved in e-learning, others have also begun to realise that some of the present versions have also placed many constraints on how e-learning can and can't take place. [2]

At the same time some major new developments are taking place in the IT world which may enable us to have more options and control over what we are able to do and could offer greater opportunities for exploiting technology for effective e-learning.

I decided to try and find out more about this and to work out how much of this was 'hype' and how much I needed to know. I then related this to the ELF and began to understand the significance of this strand for the whole e-Learning Programme. Part One of this article looks at the IT and business world, and Part Two will explore its relevance for technical platforms for e-learning. There are many papers, and other resources which are very helpful in explaining the concepts and this article can be seen a sort of reading guide to these for anyone who wants to know more.

The IT world

There is a very big change happening in the world of IT, a paradigm shift is taking place in the way applications are being put together – we are moving from large monolithic systems that play specific roles to an approach which involves putting smaller 'building blocks' together in a more flexible way. The new business environment is often highly distributed and competitive with very tight profit margins and time scales, so the development or purchase of very large systems is increasingly problematic because of their great cost, (both in terms of systems and implementation), their inflexibility, and their inability to share data with other systems.

Education has not traditionally paid a great deal of attention to the IT and Business worlds, however now that technology is assuming such a central role in the way education is managed and provided, this position is no longer sustainable. I thought I would briefly explore what is happening with some key technologies and relate this to what is happening in an educational context.

The role of the web

It is difficult sometimes to remember how recently the web became generally available to the non-computer scientist, and how rapidly its functionality has developed.

Whilst the internet had been under development since the early 1980's, the first web server was created in the early 1990's, and only when commercial graphical user interfaces like Mosaic became available was it possible for the non-technical person to use it. At first the main use was to share pages and files linked through 'hypertext' across networked computers, but now a multiplicity of tools are available, with new ones appearing all the time, which can enable users to do a huge range of activities, in both work and leisure – including general surfing and searching; interacting with others through messaging, email, chat, weblogs; collaborating through groupware and wikis; shopping and selling online; booking travel and holidays, playing games and simulations, sharing digital images and so on [3]. It is now even possible to share the spare computing power of computers which are connected to the internet for 'super computing' to do the hugely complex processing demanded by weather modelling etc

This evolution is evident in the increasing sophistication of websites run by online news services, businesses, travel companies, public service information providers (eg health, government etc) which are regularly evolving to include these new tools. It also means a serious challenge for organisations both small and large who wish to use the web, and means an increasing reliance on people with specialist web skills.

'enterprises will have to manage large-scale and small-scale Web presence consisting of e-commerce sites, portals, collaboration-oriented sites, classic brochureware sites and sites driven by content management' [4]

The internet now plays a central role in education for external communication and recruitment, but also for the delivery of e-learning which is often now mediated through VLEs (Virtual Learing Environments) which rely on the web to provide their technical infrastructure. This will be discussed further in Part Two of this article.

The 'Silo' approach

Most large organisations have several 'Enterprise' applications covering specific areas (eg finance, Human Resources, stock control etc), however whilst they may be located in the same organisation and sometimes have information on the same items, they will tend to operate independently and are most unlikely to be able to share data with each other. These applications and the data that they contain are often described as being in 'silos'

'After many years of ballooning applications within an enterprise, enabling cross-silo communications was the emerging business challenge of the 1990's and it continues today' [5]

Whilst this comment applies to the business world, the problem of integrating large systems (SRS, VLE, Library etc) is every bit as important for education as well, and lies behind the Holy Grail of the single sign-on. This has been the focus of the work that took place in the JISC MLE programme.[6]

New technologies

Some of the new approaches I have mentioned which are helping to address these problems involve the following key concepts and I have attempted to briefly define them below. There are several key documents which provide more detailed explanations from the business and the educational worlds and these can be found in the footnotes and as attached links

Web Services

A new model has emerged which combines the functionality of enterprise applications with the availability of the web. This is a very challenging thing to try and explain in a non-technical way as it is a fundamentally technical subject - but the implications are far reaching. I decided to quote a number of different explanations of web services below -

'A web service is basically a system that lets websites talk to each other, sharing information between each other without the intervention of pesky humans'[7]

'web services does for computer-to-computer interactions what the internet and browsers did for computer-to-person interactions' [8]

'A web service is an application which describes itself to the outside world – telling what functions they perform, how they can be accessed, and what kinds of data they require' [9]

'their containable, reusable objects are designed to interact seamlessly with various applications, regardless of the department, division or unit'[10]

'In a service-oriented world, we divide software into two types; applications and services. Applications are things that people interact with, and have some sort of visual interface. Services are things that Applications (and other services) interact with, and have an interface that is all about exchanging data'.[11]

'Ironically, it is the very nature of Web services as plumbing that makes them an important evolution in Internet computing. Imagine a neighborhood where each house connected to the city water supply using a different kind of pipe. Some are square, some are triangular; some require elbow joints, some don't. It's a plumber's nightmare, and, generally speaking, this was Internet computing before Web services. If the promise of Web services pays off, we'll have provided a universal bracket for all of these pipes, making it a lot easier to get a drink' [12].

'In a recent entry in his ultra-popular Weblog, Dave Winer explained that Web services are boring because "unless you're a programmer who likes to play in different environments, or likes to work with other programmers who work in different environments, or thinks the Internet is cool, even if he or she can't totally explain why. Web services are plumbing, and therefore to most non-programmers, off-topic." [13]

So what this means is that any set of functions can be analysed into discrete services, then combined in a variety of ways, either with each other, or with larger applications that are already in place. An application may 'expose' one of its functions as a service that other applications can 'consume' over the web. The identification of a service, and which ones are needed, may not be a technical matter, but the way these services are connected together is. This is why it is of interest to programmers, but should also be of interest to users.

Standards

In order for a range of web services from a variety of sources to be able to work together, they must conform with a set of technical standards to enable them to 'talk to each other'. At a simplistic level this is analogous to having a standard type of electric plug across the UK.

For more information on technical standards see CETIS [14]

Service Oriented Approach

As already discussed, the question of joining up systems in an organisation is a major issue. When web services are joined up with each other and/or with other applications to meet the needs of a particular user (a business, an academic department etc) this is done through a service oriented approach (SOA). This approach produces a 'composite application' and means that (a) individual services can be replaced by others without having to get rid of the whole system, (b) that existing systems can interact with new applications, and (c) that applications can be developed that better fit the needs of the users. Again, this is a technical subject. [15]

Frameworks

A framework provides a collection of possible services that will be relevant for a particular domain (eg education, research etc). It is therefore possible for a wide range of possible infrastructures to be created based on different combinations of these, as long as they all conform to an agreed set of standards.

'As an analogy, the framework provides a vocabulary and grammar and it is left up to the individual organisations to write the stories' [16]

The following illustration relates to a university:

'In a service oriented approach the application logic (behaviours) contained in the various systems across the organisation – such as student record systems, library management systems, Learning Management Systems (LMS)/Virtual learning Environments (VLE) directories and so on – are exposed as services, which can then be utilised (consumed) by other applications. For example, a student record system may expose services defining enrolment and registration processes and related information, which can then be used by a LMS/VLE or library system'. [17]

For those familiar with Technical Lego [18] the idea is not dissimilar to the possibility of making separate functioning components and connecting these together to form a larger functioning whole (a 'composite') which is greater than the sum of its parts, and this is possible because there is a standard way of connecting them (the lego brick).

(There are some useful diagrams in 'A Technical Framework to Support e-Learning [19] which illustrate how things work now in a university and how they might work in a service oriented architecture.)

What are the benefits of this approach?

These are explored in more depth in several of the papers attached to this article, but in summary they include -

Integration

Web services enable applications to communicate with each other and be connected in a variety of combinations

Reusability

Web Services can be reused in a range of contexts

Adaptation and flexibility

Applications can be adapted by building small projects then expanding to larger systems over time, or by integrating web services into existing enterprise applications

Lower overall costs

This flexibility and the possibility of reuse reduces overall costs of development and maintenance as whole legacy systems do not have to be replaced or built

Business processes

This approach enables business processes to drive the design of the technology infrastructure

'The beauty of this is that the functions, or services, can be used and reused to support different business activities. For example, the finance, sales and marketing departments can all use the "check customer credit" function. This means that organizations don't have to constantly build new applications for various departments, saving time and money, and eliminating redundancies'. [20]

'With SOA and WS the components are building blocks that can be used to construct and recombine functions and processes in a seemingly endless array of combinations' [21]

Whilst these advantages clearly apply to a business context, their relevance for the educational context will be explored in Part Two of this article.

How serious is this?

The Web Services approach has widespread 'buy-in' from all the major players, which means that it will influence how applications are designed in the future and therefore will impact on education whether we like it or not.

'Every major business technology platform provider has adopted Web Services, including Microsoft, IBM, Sun, Oracle, BEA, SAP etc. They all promote web services and support the standards that ensure interoperability across all platforms.... This is a first in the Industry and it will ensure the long term success of Web Services and SOA. [22]

Is there a catch?

Whilst this approach seems to provide solutions to many of the problems I've mentioned, it does mean that organisations have to consider carefully what it is they actually want to do with technology! One of the advantages of purchasing a large commercial system is that it defines how many of the business processes take place, whether these are concerned with stock control, or how invoices are handled and so on. This means that a business doesn't need to engage with how it would ideally like to do these things, it just has to work with the system as it is, and it may find 'work-arounds' for the aspects that don't fit.

If a business decides it would like to use a web services approach, it will need to think carefully about all its business processes, and consider which web services would best support these, and in what combination. This can be a time consuming and non-trivial task, but the business will be at an advantage if it leads to a system which suits the way it does things, that can be adapted easily and relatively cheaply, and enables it to respond quickly, effectively and economically.

In business there will be an advantage in terms of profit which means it will be worth investing in the development necessary to move in this direction, but education is not concerned with making a profit, and does not have high levels of funding to invest, and often, educational institutions may not have dedicated teams who can undertake this work. The purchase of a ready-made system may seem the only option, even if it doesn't offer the flexibility required for teaching and learning.

The e-learning Framework

Part two of this article will explore how the above technologies and approaches offer the possibility of designing technical platforms which will support a wide range of contexts and types of educational institution, and help realise the vision of 'coherent diversity' in the ways we can teach and learn.

Examples

The model of exposing some of your business functions for others to use is a very interesting development.

Some examples of this in action:

Amazon [23] and Google offer some services, and the CapeScience Web Services Development Community [24] also host a range of web services which it makes available

References

[1] Holyfield, S, 11th April 2005 A reading guide to some of the key ELF papers
cetis.ac.uk:8080/elearningprogram/resources/readingguide/view

[2] Britain, S, Liber, O, A Framework for Pedagogical Evaluation of Virtual Learning Environments, Oct 1999
www.jisc.ac.uk/index.cfm?name=project_pedagogical_vle

[3] History of the internet: Origins of the web, Computing
www.computing.co.uk/features/1155696

[4] Gartner, Web Services
www4.gartner.com/research/spotlight/asset_53411_895.jsp

[5] Web Services: The Executive's Guide v3.0, Infravio, July 2004
www.infravio.com/pdf/web_services_execguide.pdf

[6] www.jisc.ac.uk/index.cfm?name=mle_home

[7] E. Benson allconsuming.net...from
www.bath.ac.uk/dacs/cdntl/pMachine/morriblog_more.php?id=315_0_4_0_M

E-Learning Flexible Frameworks and Tools: Is it too late ? – the Director's Cut Derek Morrison, Director, Centre for the Development of New Technologies in Learning, University of Bath 9 September 2004

[8] www.infravio.com/pdf/web_services_execguide.pdf p.3

[9] www.infravio.com/pdf/web_services_execguide.pdfp.3

[10] www.bitpipe.com/detail/RES/1098809759_792.html?src=TRM_TOPN

Service-Oriented Architecture and Web Services: Creating Flexible Enterprises for a Changing World
by Ziff Davis Custom Publishing provided by IBM, October 1st 2004

[11] Wilson, Scott 'Can web service technology really help enable 'coherent diversity' in e-learning?' Feb 2005
http://www.elearning.ac.uk/features/pedagandws

[12] Web Services Primer, Darren Barefoot, Technology Evangelist @ CapeScience, September 9, 2002 CapeSciences Web Services Developer Community www.capescience.com/education/primer/index3.shtml

[13] www.capescience.com/education/primer/index3.shtml

[14] Centre for Educational Technology Interoperability Standards (CETIS)
http://www.cetis.ac.uk/

[15] and for more explanation see Wilson, S, Olivier, B, Jeyes, S, Powell, A, Franklin, T 'A Technical Framework to Support e-Learning.'p.7
www.jisc.ac.uk/uploaded_documents/Technical%20Framework%20feb04.doc

[16] Wilson. S, Blinco, K. Rehak, D Service-Oriented Frameworks: Modelling the infrastructure for the next generation of e-learning systems:
www.jisc.ac.uk/uploaded_documents/AltilabServiceOrientedFrameworks.pdf

[17] op cit

[18] www.lego.com/eng/Default.aspx

[19] Wilson, S, Olivier, B, Jeyes, S, Powell, A, Franklin, T 'A Technical Framework to Support e-Learning.'
www.jisc.ac.uk/uploaded_documents/Technical%20Framework%20feb04.doc

[20] Service-Oriented Architecture and Web Services: Creating Flexible Enterprises for a Changing World
by Ziff Davis Custom Publishing provided by IBM, October 1st 2004
www.bitpipe.com/detail/RES/1098809759_792.html?src=TRM_TOPN

[21] www.infravio.com/pdf/web_services_execguide.pdf p.4

[22] www.infravio.com/pdf/web_services_execguide.pdf p.4

[23] www.amazon.com/gp/browse.html/104-0228234-2451943?node=3435361£