Institution: University of Bolton

Unit of Assessment: UOA 25: Education

Title of case study: The Wookie Widget Server

1. Summary of the impact

The delivery of interchangeable services across a range of educational platforms has been a long-term problem in the field of technology enhanced learning. The Institute for Educational Cybernetics (IEC) identified widgets as having a potential role in resolving this problem, and developed a widget server, Wookie, to provide a research tool to investigate this. The research is summarised in [4] and [6]. The work attracted international attention, and the server has been reused in a number of other projects to provide interoperable services, both in education and beyond, and including a number of European funded initiatives. The impact of the work was recognised and enhanced by its acceptance by the Apache Software Foundation as an incubator project. It has now graduated as Apache Wookie, and is a full Apache project.

2. Underpinning research

An outline of the underpinning research

The research which led to the establishment of Wookie was funded by the European Commission. The initial research was carried out within the TENCompetence project, in which the IST Programme provided £455,00.00 funding for IEC. Further work was carried out in the Omelette (ICT Programme, with £278,000.00 for the IEC) and the iTEC project (7th Framework Programme, £295,000.00 for the IEC).

The research investigated solutions to some of the shortcomings of Virtual Learning Environments (VLEs). The development of VLEs may be seen as a means of facilitating the deployment of online services for learning, and controlling access to these. VLEs have been widely adopted, but restrict teachers and learners to making use of those services supported by the VLE. The IMS Learning Design (LD) interoperability specification provided an abstracted representation of learning activities, so that they could be transferred between VLEs. This generated the research question addressed in the work reported here: by what mechanism can an online service be both abstract (so that it can be specified in an interoperable lesson plan for use on a range of systems) and specific (so that particular services can be provided for particular learners on particular platforms).

The strategy adopted was to generalise the problem and seek a generic solution, rather than one which would only work with IMS LD compliant systems. The emerging W3C widget specification was identified as a promising approach. However, there was no available implementation of the W3C widget specification which could be deployed to support learning activities, and this need was met by Wookie.

The research carried out through Wookie was closely informed by the concept of the Personal Learning Environment (PLE), itself also influenced by work on LD [4]. The concept of a PLE was first proposed by Professor Oleg Liber (retired) of the IEC, and indeed work in this research line was a candidate for a case study to this submission. The Wookie research and development constituted a strong intervention into this discourse, particularly through the three MashUP and Personal Learning Environments conferences, at which IEC was strongly represented. This synergy was an important contributor to the impact reported here.

Research insights or findings which relate to the impact claimed in the case study.

The impact achieved by the Wookie Widget Server was based on the following research outcomes:

a) In the course of the research the emerging W3C widget specification was interpreted and transformed. Conceptual problems in the specification were resolved, and processes were designed which could make feasible the functionality foreseen by the specification. The results of the research are cumulated in [1].

b) A solution was conceived, implemented and demonstrated with which to overcome the technical barriers to the implementation of IMS LD services. See [2]
c) The research identified that the W3C specification was too limited to support a full range of learning activities, and needed to be extended [3]. Two principal areas were investigated, and the research resulted in both specifications and systems which supported:
    - multiple concurrent users needed to be able to use the same widget,
    - data associated with particular users needed to persist until their next visit.
d) Highly innovative functionality was conceived, designed and demonstrated which could deliver the same instance of the same service to multiple learning platforms. For example a learner on Moodle, and a learner on Blackboard could participate in the same conversation on a chat service, see [4, 5].
e) The results of research into the use of Wookie widgets in education led to new understandings of the value of the app store paradigm in education [6]

3. References to the research

[1] Apache Foundation. *Apache Wookie* (2011). Available at: http://wookie.apache.org/ [Accessed November 5th, 2013]
[2] Griffiths, D., Beauvoir, P., Liber, O., Baxendale, MB. (2009) From Reload to ReCourse : learning from IMS Learning Design implementations. *Distance Education*, 30(2) pp. 201-222
[3] Wilson, S., Sharples, P., Griffiths, D., Popat, K. (2011). Augmenting the VLE using widget technologies. *International Journal of Technology Enhanced Learning*, 3(1) pp. 4-20.
[4] Griffiths, D., Johnson, MW., Popat, K., Sharples, P., Wilson, S. (20012) The Wookie Widget Server: a case study of piecemeal integration of tools and services. *Journal of Universal Computer Science*, 18(11) pp. 1432-1453
[5] Griffiths, D. et al., (2010). *TENCompetence deliverable D6.4*, Available at: http://hdl.handle.net/1820/2298.Griffiths, D. et al., 2010. TENCompetence deliverable D6.4, Available at: http://hdl.handle.net/1820/2298.
[6] Griffiths, D., Johnson, MW., Popat, K., Sharples, P., Wilson, S., Goddard, T. The educational affordances of widgets and application stores. *Journal of Universal Computer Science*, 18 (16) p. 2252-2273

4. Details of the impact

Wookie has had an impact in 3 spheres.

1) In the field of IMS Learning Design (LD)

IMS Learning Design was the result of a major European initiative to create an interoperability specification for the exchange of learning activities between Virtual Learning Environments, adopted and published by IMS Global Learning. The development of the Wookie server, and associated ReCourse authoring application, provided a solution to the problem in the implementation of IMS LD of providing services which were both abstracted from the learning activity, and which could also be provided to particular learners and teachers at particular times. The significance of was recognised by the TENCompetence project (a major European Integrated Project) by including Wookie in the software published by the TENCompetence Foundation following the project close (which was not the case for much of the software developed during the lifetime of the project). The availability of Wookie enabled evaluation work to be carried out for the first time with learning activities supported by flexible and configurable services for IMS LD. The impact of Wookie in this area was to demonstrate that the problems experienced in the adoption and use of IMS LD were more deep seated than the lack of appropriate service infrastructure, as discussed in [6].

2) Adoption and certification by the Apache Foundation and specification bodies

The value of Wookie to both educational computing and the wider ICT industry has been recognised. The findings of research into the required extensions to the W3C widget specification

were submitted to W3C, and were accepted as input into the revised specification. The architect of the Wookie system, Scott Wilson of IEC, was accepted as a member W3C on the basis of his research.

Research into the interpretation of the W3C widget specification, which was required in order to create functioning systems which could be used in education and other domains, was reflected in the development of the Wookie server. This work was recognised by W3C, which designated Wookie as a reference implementation of the W3C widget specification [7]. As such Wookie provides a model for interpretation of the specification which can be followed by other developers.

Research into Wookie exemplified the research focus of IEC which acts at the intersection of technology, pedagogy and institutional organisation. This was acknowledged by Charles Severance formerly Chief Architect of the Sakai Project, and currently employed by Blackboard as Sakai Strategist. In a blog post of 2009 he drew the attention of a worldwide audience to the contribution of IEC member Scott Wilson in (submitted to UOA 36). *Once Scott built his pre-alpha version of Wookie support for Basic LTI it was a simple matter to embed a W3C widget into Blackboard, Desire2Learn, WebCT Vista, and Sakai. … the TENCompetence-developed chat widget is served from Wookie and placed in each of the LMS systems. … I am very excited to be starting to feel a slow and gentle shift in IMS Basic Learning Tools Interoperability from focusing nearly exclusively on getting vendors to support the specification to instead starting to think how we teachers will ultimately make use of the specification.* [8]

The significance of the approach to service integration was recognised by the Apache Software Foundation, which accepted Wookie into its incubator in 2009 [9]. When IEC wanted to credit the TENCompetence project and EU funding on the Apache Website, we wrote to Dan Brinkley, co-chair of the W3 Social Web Group and Developer Advocate at Google Inc. He wrote back stating: I'd love to see it included. The structure of academia tends to reward scholarly paper- publishing but doesn't really know what to do with software and data work. European projects also tend towards producing deliverables that are mostly likely to be giant PDFs rather than running re-usable code. So when we do finally get useful outputs from European research funding that enrich the open standards / open source scene, please let's not be shy in celebrating that! Maybe others will follow the great example, and start thinking more seriously about open source life-after-funding for their codebases, rather than taking a "throw the code over the wall and hope for the best" approach. [10]

Wookie was subsequently accepted as a full Apache project [9]. The criteria for this acceptance is the existence of a documented group of committed developers from a number of organisations of sufficient strength to justify the Apache Foundation in believing that the software is sustainable. The acceptance of Apache Wookie as a top-level Apache project is therefore both a significant impact in itself, and evidence of impact among a wider user group. Apache Wookie is integrated with Apache Rave, a system for the development of widget based portals, and this argues strongly for its future viability within the Apache ecosystem of applications. This was recognised in a case study published by OSS Watch [17]

3) Flexible service delivery

Wookie had been designed as a generic solution to a wider problem, that of flexible service delivery across platforms. It therefore attracted attention from a wide range of researchers and companies, both within the field of education and beyond. Projects and applications which had a need to integrate services across platforms adopted the software, for example:

- The Learning Activity Management System (LAMS) Foundation in Australia, see [11].
- The Omelette project, funded by the European Commission to develop a platform for integrated telecoms and internet applications, see [12]
- The Role project, funded by the European Commission to develop a Personal Learning Environment, see [13].
- The EduKapp project, funded by Jisc to develop an application store for education, and the iTEC Widget Store that builds on this, see [14].
- User-tailored Inter-Widget Communication Extending the Shared Data Interface for the Apache Wookie Engine, see [15]

- In work carried out in Estonia into the delivery of interoperable assessment services [16]

Testament to the generic capabilities of Wookie is that the IEC won funding for continued work with Wookie in the following projects: iTEC, Omelette, Trailer, Edukapp, and Spaws, as detailed in the funding section of this submission.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[7] W3C (2011). *Implementation Report for Widget Packaging and XML Configuration*. Available at: http://dev.w3.org/2006/waf/widgets/imp-report/ [retrieved December15, 2011].

[8] Severance, C., (2011). *Apache Wookie and IMS Basic Learning Tools Interoperability*. Dr. Chucks Blog. 2009. Available at: http://www.dr-chuck.com/csev-blog/2009/11/apache-wookie-and-ims-basic-learning-tools-interoperability/ [Accessed December 12, 2011].

[9] *Apache Board minutes relating to Wookie* (2009 – 2013) https://whimsy.apache.org/board/minutes/Wookie.html [Accessed November 5th, 2013].

[10] Kew, C. et al. (2009) *D10.4 - Report with an assessment of the WP results including ID10.12-ID10.17*. Available at http://hdl.handle.net/1820/2297 [Accessed November 5th, 2013]

[11] Ghiglione, E. (2012) *LAMS Wookie*. http://wiki.lamsfoundation.org/display/lams/Wookie [Accessed November 5th, 2013].

[12] Chudnovskyy, O. et al. (2012). *End-User-Oriented Telco Mashups: The OMELETTE Approach*. In: WWW '12 Companion Proceedings of the 21st international conference companion on World Wide Web pp. 235-238. ACM, NY.

[13] Govaerts, S., Verbert, K., Dahrendorf, D., et al. (2011). *Towards Responsive Open Learning Environments : The ROLE Interoperability Framework*. In: C. Delgado-Kloos C et al. (Eds.) EC-TEL, Lecture Notes in Computer Science. Springer-Verlag;:125-138.

[14] Wild, F., Anastasiou, L. (2012) *The Edukapp Widget Store*. Jisc Presentation, available at http://www.jisc.ac.uk/media/documents/events/2012/05/Edukapp_Fridolin%20Wild.pdf. [Accessed November 5th, 2013]

[15] Hoisl B, Drachsler H, Waglechner C. (2010). *User-tailored Inter-Widget Communication Extending the Shared Data Interface for the Apache Wookie Engine*. In: International Conference on Interactive Computer Aided Learning 2010. Hasselt, Belgium; 2010. Available at http://hdl.handle.net/1820/3027

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[17] OSS Watch (2011). *Wookie : a case study in sustainability*. Available at: http://www.oss-watch.ac.uk/resources/cs-wookie.xml [Accessed December 15, 2011].