

Institution: University of Bolton (UoB)		
Unit of Assessment: 23 Education		
Title of case study: Improving the Online Experience for Learners, Tutors, Institutions and Industry: Applying Educational Technology Interoperability Standards		
Period when the underpinning research was undertaken: Jan 2015 - July 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
David Griffiths	Professor of Educational Cybernetics	2010 – Present
Paul Hollins	Professor of cultural Research Development	2003 – Present
Adam Cooper	Reader	2010 – 2016
Wilbert Kraan	Researcher	2010 - 2015
Period when the claimed impact occurred: 2015 -2021		
Is this case study continued from a case study submitted in 2014? No		
1. Summary of the impact (indicative maximum 100 words)		
<p>Paradoxically, the greater the benefit of educational technology standards the greater their invisibility; All Technology Enhanced Learning platforms/systems rely on 'boring' technical standards that allow the 'interesting' to flourish. This Longitudinal research has resulted in improved experiences and outcomes for (1) Learners, more effective & efficient technology for (2) Tutors (3) Institutions and (4) Industry and has contributed to the development of standards deployed in systems across international education networks. Every international Higher and Further Education institution deploying a Virtual Learning Environment uses standards and every admission system in the UK uses a coding system underpinned by the research.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>The work reported here builds on activity described in the 2014 RAE Education submission and continues to support the development of interoperability specifications, and the stakeholder groups highlighted in (1)(2)(3)(4) who directly benefitting from them. Formerly the Centre for Educational Technology & Interoperability Standards (CETIS) activities were absorbed into the School of Education with applied research focussed on the early developmental stage of both formal approaches and informal community Technology Enhanced Learning (TEL) specifications and their practical adoption in commercial /institutional systems worldwide.</p> <p>A significant part of UOB research activity representing the UK national interests through JISC has been in partnership and support of IMS http://www.imsglobal.org/ during the period of the REF work has focussed on two key international initiatives IMS Question and Test Interoperability (QTI) (Paper 3.1) and IMS learning Tools interoperability (LTI) (Paper 3.6). These projects involved UOB undertaking extensive qualitative research in specific areas firstly (a) the establishment of focus groups to provide evidence and data to determine the user requirements to inform the development of these two specifications. Secondly (b) in controlled testing of the specifications in Learning scenarios and integrating with Learning analytics services interoperating with Virtual Learning Environments (VLE's) and finally (c) in undertaking a</p>		

qualitative evaluation of the LTI specification performance with the Moodle VLE. This work served to inform the ongoing development of the two specifications which are both now widely adopted in TEL systems.

In 2015, as part of the HESA data and information improvement programme, UoB provided evidence of user requirements to inform the development of a new HE coding system to replace the obsolescent Joint Academic Coding System (JACS) the system used by HE institutions to classify academic subjects and modules. The work involved qualitative research using focus groups, case studies to provide evidence of the requirements of the sector of a replacement system. The replacement system **Higher Education Classification of Subjects (HECOS)** (<https://www.hesa.ac.uk/innovation/hecos>) (Paper 3.7) was implemented in 2019.

In 2014, as part of the EU FP7 Project **Learning Analytics Community Exchange (LACE)** (Papers 3.2,3.3,3.5) <https://cordis.europa.eu/project/id/619424> UoB led the evaluation of the use of Learning analytics. Qualitative research involved the engagement of focus groups in structured methods, including a policy Delphi to assess the feasibility and desirability of possible future states. Specific detailed work undertaken included a qualitative evaluation of the efficacy of the **experience Application Profile Interface (xAPI)** specification. The specification provides for the collection of digital experiences and the sharing of the data collected across multiple learning systems.

Work also included cross disciplinary collaboration with Business colleagues in to the **Realising an Applied Gaming Ecosystem (RAGE) project** (Papers 3.4 ,3.6) <https://cordis.europa.eu/project/id/644187> in the evaluation and testing of the **LTI** and **xAPI** specifications with learners using applied games. This work forms a substantial part of the UoB Business (UoA17) submission to this REF exercise.

3. References to the research (indicative maximum of six references)

3.1 Bogaerts, J., Hoffmann, T., Howard, R., Kraan, W., McKell, M., Smythe, C. (Eds) (2015) *IMS Question and Test Interoperability (QTI): Overview Version 2.2*. IMS Global Learning Inc. http://www.imsglobal.org/question/quiv2p2/imsqti_v2p2_oview.html

3.2 Griffiths, D., Brasher, A., Clow, D., Ferguson, R., Yuan, L. (2016). *Visions of the Future. Learning Analytics Community Exchange Horizon Report, Public Deliverable –D3.2*. Available at <http://www.laceproject.eu/deliverables/d3-2-visions-of-the-future-2/>

3.3 Ferguson, R., Clow, D., Griffiths, D., & Brasher, A. (2019). Moving Forward with Learning Analytics: Expert Views. *Journal of Learning Analytics*, 6(3), 43-59. <https://epress.lib.uts.edu.au/journals/index.php/JLA/article/view/6162>

3.4 Grigorov, A., Bontchev, B. P. BoyTchev,P., Stefanov,K., Westera, W Nyamsuren,E., Bahreini,K. Prada,R., Hollins, P. Moreno,P. (2018) The RAGE Game Software Components Repository for Supporting Applied Game Development, *International Journal of Serious Games* Vol 4 Issue 3 Page 59 https://www.researchgate.net/publication/320105208_The_RAGE_Game_Software_Components_Repository_for_Supporting_Applied_Game_Development

3.5 Hollins, P., Griffiths, D., Vander Vegt, W., Manjon, B., Stefanov, K., Westera, W., Wilson, S. Martinez- Ortiz, I., Glass, J., Cooke,J., Paton, T. Hemnje,M.,Pomazansky,A. (2018) RAGE Asset Integration Methodology D1.2 Public Deliverable <https://research.ou.nl/en/publications/d12asset-integration-methodology>

3.6 Kraan, W., Paul, A. (2015) *The Higher Education Classification of Subjects (HECoS) vocabulary*. HEDIP project public deliverable 4. <http://ubir.bolton.ac.uk/2768/>

4. Details of the impact (indicative maximum 750 words)

Work has contributed to enhanced teaching and learning through improvements in system interoperability, and been instrumental in supporting Open Educational Resources (OER), practice, development of analytics. Impact of the 2014 case study continues, but the inclusion of new research and impact means that it is not a continuing case study. In order to achieve maximum impact, the work is closely aligned to interoperability initiatives of key international partners, Jisc (UK), CEN (Europe), and IMS GLC (USA).

This work is important to stakeholders (1) Learners, (2) Tutors, (3) Institutions and (4) Industry; as a lack of interoperability can leave educational content, e-portfolios, course information and data locked into proprietary systems. This limits flexibility, freedom of choice, and prevents learners, tutors and institutions from communicating freely or exchanging data across educational platforms. The impact of the UoB work in specifications is as follows:

IMS Question and Test Interoperability (QTI) (Paper 3.1) and **IMS learning Tools interoperability (LTI)** (p3.6)

IMS is an international educational technology specifications membership consortium with over 500 members. UoB work informed the development of specifications including **QTI** and **LTI**. The contributions of Griffiths, Hollins, Cooper and Kraan into the development of the **QTI** specifications since 2010 cumulated in the publication of **QTI 2.2** in 2015, with Kraan as author. **QTI** is the world's only open interoperability format for computer aided assessment, and has been adopted by many of the world's major eLearning companies (890 QTI and 262 LTI certified products) <https://site.imsglobal.org/certifications> (Accessed September 2020)

Benefits: **(1)** Access to digital assessment and assessment item banks across most VLE's to improve learning outcomes. Seamless access to digital tools via their VLE.

(2) An ability to incorporate a variety of digital assessment pedagogic activities in most VLE's. An ability to incorporate external pedagogic digital tools for deployment within their VLE.

(3) Effective and efficient application of digital assessment with seamless technical integration to their VLE of choice. An ability to extend the functionality of their VLE to tutors through the addition of digital tools.

HECOS (p3.7)

UoB was engaged by HESA as part of the HEDIP project in 2014 to undertake technical and social research to inform the development of a new course coding system. The HECOS system reflected both technical and community requirements for more flexibility than the previous set of fields and subjects in JACS. In 2019 HESA confirmed the requirement for all HE to move from the existing JACS system and to adopt HECOS as their primary coding for identifying the area of study of all courses. The system is now used in every Higher Education institution (165 in total) in the UK and used by University and College Admission Systems (UCAS), the students loan company and the Foreign and Commonwealth Office.

Benefits: **(1)** Greater clarity for applicants to HE on the course content and modules.

(2) To provide clear information relating to students relating to their course, content.

(3) Efficient coding and clarity relating to their course content and module offerings.

Learning Analytics Community Exchange (LACE) (p3.2,3.3,3.5) and **experience Application Profile Interface (xAPI)** (p3.2,3.3,3.5)

UoB led interoperability work in LACE, researching the emerging landscape of specifications, particularly xAPI, and reflecting this back to the communities of practice working in the field. The work of LACE has contributed to the increase in the use of learning analytics in educational domains. The work has also stimulated and supported the use of learning analytics by a number of other European projects.

Benefits: **(1)** Improved learning outcomes supported by formative analytics.

(2) The ability to monitor student progress to make appropriate interventions

(3) Improve student retention through interventions and data information.

Realising an Applied Gaming Ecosystem (RAGE) project (Papers 3.4 ,3.6)

The project evaluated the use of **xAPI** in applied games and **LTI** for data exchange with VLE's. creating demonstrators for the use of **LTI** in conjunction with serious games and learning analytics. The recommended scenario of **xAPI** integration into Moodle stimulated early adoption by international games development companies in France, Germany and the UK. The success of the research, in collaboration with other partners (UCM), led to the inclusion in the RAGE asset portal of a number of demonstrations of the **xAPI** service as a viable asset in the RAGE ecosystem.

LTI Benefits: **(1)** Access to immersive learning activities through their VLE.

(2) The ability to incorporate immersive learning experiences through their VLE

(3) Improved data exchange across their systems and the ability to support pedagogic approaches involving immersive digital technologies.

(4) The ability to integrate their products with institutional VLE's

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

XCRI: Alan Paull Associates: <https://www.xcri.alanpaull.co.uk/>. Alan Paull will provide a statement of support.

HECOS. <https://www.hesa.ac.uk/innovation/hecos>. We believe that statements of support would be forthcoming. (Andy Youell)

Jisc xAPI: https://github.com/jiscdev/xapi/blob/master/common_structures.md

<https://www.jisc.ac.uk/learning-analytics>

<http://www.laceproject.eu/deliverables/d7-1-interoperability-studies.pdf> Ruth

Drysdale of Jisc

Rob Abel of IMS Global Learning and <https://site.imslobal.org/certifications>

Games companies involved in RAGE

Tore Hoel

Projects working with LACE

Alan Berg, University of Amsterdam and Apereo Foundation