

Towards a New Library of Resources for Higher Education Learning and Teaching

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The online Resource Library of the Australian Federal Government's Office for Learning and Teaching (OLT; www.olt.gov.au/resource-library) contains many valuable resources that are the product of hundreds of learning and teaching research projects funded in the past two decades by the OLT and its predecessors, including the Australian Learning and Teaching Council and the Carrick Institute. However, the Resource Library is not systematically organised and the most relevant resources in the database, for any given topic, can be very hard to find. The National Learning and Teaching Resource Audit and Classification is itself an OLT-funded project with a brief to re-organise the materials in the OLT Resource Library so as to optimise its use, as well as to identify gaps and strengths in its coverage. This paper reports on the main outcomes of the project to date, with a focus on the selection, and adaptation, of a suitable subject thesaurus to be used in the re-indexing. It also provides an analysis of the ICT-related content in the Resource Library, as indicated by the existing keywords, comparing these with the themes of recent THETA conferences and topics covered by the New Media Consortium's Horizon Higher Education reports.

Background

The Australian government's Office for Learning and Teaching (OLT) is mandated to help improve the quality of learning and teaching in the higher education sector, and does so by conferring awards that recognise teaching excellence and by providing grants to support curricular and pedagogical innovation. The outcomes of these grants, such as project reports containing recommendations for best practice, are made available to the sector at large via the OLT's website: they can be accessed in its "Resource Library" at <http://www.olt.gov.au/resources>, along with the documents produced by similar projects funded by the OLT's predecessors, including the Australian Learning and Teaching Council (ALTC; 2008-2011) and the Carrick Institute for Learning and Teaching in Higher Education (2004-2008). The Resource Library currently houses resources from over 600 projects completed between 1994 and 2015.

The OLT considers its Resource Library to be an important means of promoting the projects it supports and of sharing their findings and improving practice across the sector. However, the OLT recognises that the database's organisation, and in particular its indexing, does not make for optimal access. In other words, users cannot always find all the relevant resources in the Resource Library. This situation has resulted in the OLT commissioning a project to re-organise and re-index the database, which commenced in early 2014 and is being carried out by a team of academics and librarians from Charles Sturt University, the University of Wollongong and the Australian Council for Educational Research (ACER). The project also involves an audit of the Resource Library collection, in order to identify gaps, as well as strengths, which might inform future funding decisions.

The initial phases of the project, which involved the construction of a new metadata schema to describe the collection's resources, as well as a systematic evaluation of the search performance of the existing database, have been reported elsewhere (e.g. Hider, Dalgarno, Bennett, et al., 2014; Hider, Liu, Gerts, et al., 2014). Briefly, a survey of over a hundred users and prospective users of the OLT Resource Library, an analysis of the existing resources, and consultation with experts in the higher education field, resulted in the following element set (or schema) being recommended for adoption. It may be noted that 97% of survey respondents considered topic or subject as a useful field by which to search.

- Project identifier
- Project title
- Project acronym
- Project summary
- Topic

Discipline
Author keyword
Year of completion
Lead researcher
Co-researcher
Lead institution
Partner institution
Funding body
Grant type
Project website URL
Related project
International Standard Book Number
Digital Object Identifier
Resource title
Resource type
Year of publication
Resource author

Meanwhile, the evaluation of the current keywords used in the system indicated that typical search queries retrieved, on average, less than half of the relevant resources from the database, and of those resources that were retrieved, only about one third were relevant (the study was partly based on the methodology used by Hider and Freeman (2009)). The lack of control over the current keywords was considered to be one of the main problems with the system's search performance. Around 1,600 keywords have been used to describe the subjects of the OLT resources, including both common and proper nouns, with many topics being represented by variant terms (e.g. both singular and plural forms, abbreviations and long form, etc.).

Controlled indexing has been shown to increase both recall and precision in searching. For instance, Gross, Taylor and Joudrey (2015) report on a study of keyword searching in a library catalogue that found an average of 35.9% of hits are lost in the absence of controlled subject terms. Hedden (2008) points out the particular benefits of a controlled vocabulary when multiple indexers are involved. A database built up over many years requires a controlled vocabulary to mitigate against the "synonym problem" – indexers as well as searchers using different terms and word forms for the same concept – and the "homonym" problem – indexers as well as searchers using the same terms for different concepts (Hider, 2012).

Review of historical documents shows that use of controlled vocabularies was considered important by the original developers of the Carrick repository from which OLT Resource Library emerged: "An important aspect is use of controlled vocabulary or thesauri as this will ensure consistency in resource description and then in resource discovery" (Ivanova & Millea, 2003). Through the current project, several other fields have also been identified where a controlled vocabulary would be of value.

This paper reports on how the controlled subject vocabulary for the OLT Resource Library was arrived at, through systematic selection of an appropriate thesaurus, and the mapping of the existing keywords onto it. The paper looks in particular at those keywords which represent ICT-related concepts, and compares them to lists of THETA conference themes and topics from the New Media Consortium's Horizon Higher Education reports, in order to gauge how the contents of the OLT database align with the preoccupations of those involved in using ICT in the higher education field.

Thesaurus evaluation

A number of controlled subject vocabularies have already been constructed and published for the purposes of indexing resources in the field of education. Those based on natural language (as opposed to notation, used in classification schemes) and that build in structure through the use of cross-references are generally known as subject *thesauri*. Aitchison, Gilchrist and Bawden (2000) recommend that a pre-existing thesaurus is considered for adoption before a new thesaurus is developed, given the large amount of time and effort required to both construct and maintain a thesaurus of any significant size.

Identification of thesauri for evaluation

A search was carried out for subject thesauri that might be considered for use in the Resource Library. They had to focus on the field of education, include English terms, and be freely accessible online. Eleven thesauri were identified for the evaluation exercise, as follows:

1. ATED: *Australian Thesaurus of Education Descriptors*
<http://cunningham.acer.edu.au/multites2007/index.html>
2. BET: *British Education Thesaurus*
<http://www.leeds.ac.uk/educol/BEID.html>
3. EDU: *ÉDUthès: thésaurus de l'éducation*
http://www.cdc.qc.ca/multites_en.htm
4. EET: *European Education Thesaurus*
<http://www.freethesaurus.info/redined/en/index.php>
5. ERIC: *ERIC Thesaurus*
<http://eric.ed.gov/?ti=all>
6. ETT: *CEDEFOP – European Training Thesaurus*
http://www.cedefop.europa.eu/EN/Files/3049_en.pdf
7. IBE: *UNESCO-IBE Education Thesaurus*
<http://www.ibe.unesco.org/en/services/online-materials/publications/ibe-education-thesaurus.html>
8. ScOT: *Schools Online Thesaurus*
<http://scot.curriculum.edu.au>
9. TESE: *Thesaurus for Education Systems in Europe*
http://eacea.ec.europa.eu/education/eurydice/tese_en.php
10. UK: “Education terms” from the UK Dept of Education
<http://webarchive.nationalarchives.gov.uk/20130123124929/http://www.education.gov.uk/vocabularies/educationtermsandtags>
11. VOC: *VOCED Thesaurus*
<http://www.voced.edu.au/content/ngv45775>

The thesauri were evaluated in two ways, namely, by expert analysis and by search query matching.

Expert analysis

Expert evaluation of the thesauri was based on a predetermined set of criteria. These criteria were compiled with reference to guides to thesaurus construction such as that authored by Aitchison, Gilchrist and Bawden (2000), although no clear set of criteria has been established in the literature. Owens and Cochrane (2004) consider categories of criteria for evaluating a thesaurus, including structural criteria based on adherence to particular vocabulary standards, and criteria related to the specific terms selected, such as the control of synonyms. The category referred to as “comparative evaluation criteria” was particularly relevant in this project where the purpose was to select an existing vocabulary to suit a particular audience and collection. “Observational evaluation criteria” were also considered important, i.e. whether user needs and expectations were met.

In addition to evaluation criteria that apply to all thesauri, certain criteria were identified that pertained specifically to the vocabulary required for the OLT project, such as “locality”. The following nine evaluation criteria were agreed upon by the project team:

1. *Terminology*
Are the terms those used by the audience?
2. *Structure*
Is the vocabulary structured consistently, and does it follow vocabulary standards?
3. *Scope*
Does the breadth of the vocabulary cover the field?
4. *Depth*
Does the depth of the vocabulary meet the requirements of specificity? Is it broad enough for

- general users, and reasonably but not overly specific for more expert users?
5. *Locality*
Does the vocabulary reflect the geographic context?
 6. *Maintenance*
Is there evidence of ongoing revision and editions of the vocabulary by an established organisation?
 7. *Cost*
Does use of the vocabulary require payment of upfront or ongoing fees?
 8. *Usability and support*
Can the online vocabulary be reliably and effectively searched, and is user support available?
 9. *Interoperability*
Does the vocabulary meet industry standards and requirements of interoperability in terms of its formatting, publication, transmission and encoding?

The thesauri were evaluated by two indexing experts from the project team, independently, according to the above criteria. A rating scale of 5-1 was used for each criterion.

- 5 = excellent
- 4 = good
- 3 = satisfactory
- 2 = less than satisfactory
- 1 = completely unsatisfactory

Table 1 shows the combined scores for each thesauri and criterion.

Table 1
Overall scores of thesauri

	ATED	BET	EDU	EET	ERIC	ETT	IBE	SCOT	TESE	UK	VOC
Terminology	10	7	7	6	9	6	7	9	8	8	8
Structure	8	6	7	7	8	8	9	8	8	6	6
Scope	7	6	7	6	7	6	7	4	8	6	6
Depth	10	9	8	7	10	5	8	5	8	6	6
Locality	10	7	6	6	7	6	7	10	6	5	10
Maintenance	10	7	8	6	10	7	9	9	9	9	6
Cost	8	6	8	6	7	6	10	10	10	9	9
Usability and support	9	6	7	6	10	5	6	10	5	9	5
Interoperability	9	6	8	7	7	5	6	10	8	10	8
RATING	81	60	66	57	75	54	69	75	70	68	64

ATED scored highest with 81 points, followed by ERIC and SCOT together on 75. The next highest was TESE on 70. The other seven thesauri scored below 70 out of a possible 90.

Both experts individually rated ATED highest, scoring it 42 and 39 points.

The nine criteria were not weighted, though it is quite possible that some criteria were more important than others. While the first five criteria (Terminology, Structure, Scope, Depth, Locality) all relate to the content of the vocabulary, the last four criteria (Maintenance, Cost, Usability and support, Interoperability) relate to “carrier” aspects. Importantly, ATED’s lowest score for any of the criteria was 7 – above satisfactory. The only other thesaurus that achieved this was ERIC.

Search term matching

To triangulate the results of the expert analyses, each thesaurus was tested for its coverage of a list of the most common search terms logged by the Resource Library system in two one-week periods. For those terms consisting of one word, the following codes were employed:

Y = match, with the word matching exactly a word amongst the thesaurus’s entry terms or references
 N = no match, with the word not matching exactly any word amongst thesaurus’s entry terms or references.

For those terms consisting of more than one word, one of three levels of matching – full, partial and none – was identified for each of the terms, defined as follows:

F = full match, with all the words in the phrase matching exactly words amongst the thesaurus’s entry terms or references; the words may come from different phrases
 P = partial match, with at least one but not all the words in the phrase matching exactly words amongst the thesaurus’s entry terms or references; the words may come from different phrases
 N = no match, with none of the words in the phrase matching exactly any of the words amongst the thesaurus’s entry terms or references.

Essentially, the exercise examined the terminological and conceptual *user-centredness* of the thesauri, touching on the criteria of Terminology, Scope, Depth and Locality used in the expert evaluation. The results are presented in tables 2 and 3.

Table 2
Matching of single word query terms

<i>Search term</i>	ATED	BET	EDU	EET	ERIC	ETT	IBE	SCOT	TESE	UK	VOC
TOTAL - Y	19	14	13	10	18	10	15	19	14	15	13
TOTAL - N	3	8	9	12	4	12	7	3	8	7	9

Table 3
Matching of multi word query terms

<i>Search term</i>	ATED	BET	EDU	EET	ERIC	ETT	IBE	SCOT	TESE	UK	VOC
TOTAL - Y	18	13	8	9	13	9	11	10	7	12	12
TOTAL - P	3	7	11	10	8	11	9	10	13	9	7
TOTAL - N	1	2	3	3	1	2	2	2	2	1	3

ATED and SCOT covered the most one-word terms; for the multi-word terms, ATED again comes out in front, with the most full matches, by some distance, and also the equal most full and partial matches combined.

Selection of thesaurus

The Australian Thesaurus of Education Descriptors (ATED) was assessed as most closely meeting the needs of Resource Library users (and prospective users), and was adopted for the project. ATED is used to compile the Australian Education Index, amongst other databases in the education field. It is also worth noting that ATED was originally based on ERIC, one of the other thesauri that scored well in the evaluation. SCOT, which also scored well, was developed by the Education Services Australia specifically for use in the Australian school curriculum.

Mapping of keywords to ATED

ATED's scope is the broader field of education, not just higher education, and so consideration was given to "forking" the thesaurus to use a particular subset of it for the OLT Resource Library. However, close inspection indicated that many of the terms in most of its facets could, potentially, be applicable to OLT resources, so it was decided to adopt the thesaurus as a whole, but to add any extra terms that were needed to adequately cover all of the resources. To this end, the existing keywords that had been used to index the collection were mapped to ATED, prior to re-indexing the resources using the thesaurus.

A total of 1,593 terms were extracted from the keyword index and initially examined for exact matches with ATED terms. Exact matches, as well as near matches that were different only in syntax, were identified and mostly discarded; a few matches were retained where a conceptual difference was considered possible. The remaining 1,160 terms were scrutinised by members of the project team from ACER, who were expert in the application, and development, of ATED, as well as by domain and other indexing experts. This resulted in a classification, with reference to ATED, that is summarised in table 4. The concept of "literary warrant", as used in the classification, is commonly applied in the development of thesauri, allowing the inclusion of new terms if they are represented by existing resources; conversely, if a term does not pertain to existing resources, it may be deemed not to qualify for inclusion. ATED policy is for new terms to be added as cross-references if at least five resources (from any source, not necessarily the OLT Resource Library) are found that use the term (in the same way), or as descriptors (entry terms) if at least ten resources are found whose content is about the concept (topic) the term represents.

Table 4
Categories of keyword terms

Category	Definition	<i>n</i>
A	Terms conceptually and terminologically adequately covered by ATED	934
B	Terms out of scope (i.e. proper nouns)	108
C	Terms in scope and not conceptually covered by ATED, lacking sufficient literary warrant	65
D	Terms in scope and not conceptually covered by ATED, with sufficient literary warrant	30
E	Terms in scope, conceptually but not terminologically covered by ATED, lacking sufficient literary warrant	2
F	Terms in scope, conceptually but not terminologically covered by ATED, with sufficient literary warrant	21
		1160

Terms in categories D and F were added to the thesaurus, as descriptors and USE references respectively; terms in categories C and E were kept in view for possible later inclusion, if and when the literature warrants it.

The category D terms are listed below:

- Acupuncture
- Associate degrees

Authorship
 Avatars
 Chinese medicine
 Chiropractic
 Commerce
 Data mining
 Design based research
 Distributed leadership
 Double degrees
 Environmental engineering
 Environmental science
 Exercise science
 Final year students
 Frameworks
 Histology
 Hospitality education
 Landscape architecture
 Learning analytics
 Naturopathy
 Process engineering
 Quantity surveying
 Reciprocity
 Spatial sciences
 Studios
 Synchronous communication
 Teaching research relationship
 Variables
 Variation theory

It may be assumed that many of these terms represent concepts that are of particular importance to higher education, and less so to education more broadly, given their non-existence in ATED, which is used to index many thousands of resources, such as those covered by Australian Educational Index. It is perhaps not surprising that many of the terms are for disciplines that would not usually be studied in schools, or for particular levels of tertiary education, or pertain to online education or to research, which again are more prevalent in higher education than in schools. However, several other terms are less obviously linked to university education, including “distributed leadership”, “frameworks” and “reciprocity”.

The category F terms are listed in table 5, together with their preferred terms (descriptors).

Table 5
Category F terms

Category F term	Preferred term
Academic analytics	USE Learning analytics
Assessment for learning	USE Formative evaluation
Assessment through participation	USE Performance based assessment
Assessment tools	USE Measures (Individual) and Student assessment
Capabilities	USE Ability
Combined degrees	USE Double degrees
Cultural capital	USE Cultural literacy
Cultural competence	USE Cultural literacy
Digital immigrants	USE Digital literacy and Generation gap

Category F term	Preferred term
Digital natives	USE Digital literacy and Generation gap
Dispute resolution	USE Grievance procedures
Distributive leadership	USE Distributed leadership
Emerging technologies	USE Technological change
Interactive multimedia	USE Multimedia and Interactivity
Multiuser virtual environments	USE Virtual learning environments
Net generation	USE Digital literacy and Generation gap
Personal digital assistants	USE Mobile devices
Second life	USE Virtual reality
Threshold concepts	USE Fundamental concepts
Web 2.0	USE Internet and Interactivity
Work integrated learning	USE Work based learning

Topical analysis: ICT in higher education learning and teaching

One of the benefits of professional or industry partnerships within OLT projects is the potential for work beyond the original scope of the project when partners recognise value from the methodology or outcomes of the project. The mapping process undertaken for this project was of significant value to ACER in terms of improving ATED. As a result, the ACER members of the project team were interested in investigating questions that arose during the OLT project but were not part of the original scope.

One such question was the extent to which the ICT-related keywords used in the OLT Resource Library were aligned with other lists of key topics of interest in this area. This question was prompted by the number of technology terms that appeared in the list of category F terms above. The ACER researchers decided to review all of the ICT-related keywords (or terms) from the OLT Resource Library and compare them against others lists of ICT-in-higher-education concepts that were also based on natural language. Topics of interest in the field of education have previously been analysed by examining indexes of controlled vocabulary, but these tend to be heavily influenced by particular indexing policies and practices (Sheffield & Saunders, 2010; Holbrook, Findlay & Misson, 2000). Potential ‘user-generated’ sources were technology conferences, journals and the New Media Consortium’s Horizon Higher Education reports (Johnston et al., 2015). The purpose of this research was in fact three-fold: (1) to verify the warrant for ICT-related terms; (2) to inform decisions on the preferred terms for ATED, in the case of synonyms or near-synonyms; and (3) to compare the ICT-related work in OLT projects with the work and writings in the field of ICT in higher education more broadly. If divergence between the topics of OLT resources and those discussed in relevant conferences and reports was found, this would suggest that a wider variety of sources may be needed to gauge literary warrant.

ICT-related topics in the OLT Resource Library

To undertake additional analysis of the ICT-related subject terms in the OLT Resource Library, the relevant terms were identified from the full list of 1,593 terms in the Library’s keyword index. Where a term’s relationship with ICT was ambiguous, examination of the resource(s) indexed with the term was carried out. Some terms (e.g. *inputs*) were used in multiple senses, as no attempt had been made to disambiguate homonyms. If at least one of the meanings was ICT-related, the term was included for analysis.

The resulting set of terms totalled 232. The terms were then normalised, i.e. controlled for variant word forms (e.g. *e-portfolio* and *eportfolios*) and synonyms (e.g. *web conferencing*, *web-based conferencing* and *webinar*). Proper nouns (e.g. names of specific products and projects) were also discarded at this stage. Again, in some cases, decisions around synonymy were made after consulting the resources the keywords were linked to. The result was a final list of 174 terms that represented a range of ICT-related concepts.

Mapping against THETA conference themes

Conferences provide thesaurus developers with a source of warrant that can indicate currency, as well as topicality more generally. For ATED, conferences such as the THETA conference are a useful source of current ICT-related terminology. As “THETA conferences seek to explore new territory in technology in higher education” (CAUDIT, 2012), they provide a distillation of key issues facing the Australian higher education teaching profession, in a field that is rapidly changing.

The set of ICT-related concepts from the keywords used in the OLT Resource Library were mapped against themes from the 2015 THETA Conference and those from the two previous conferences: the 2013 THETA Conference, “The Edge of the World”, and the 2011 CCA-EDUCAUSE Australasia Conference, “The Game has Changed”. Fifty-six themes from the conferences with an ICT-related element were identified; of these, 54 were used in the mapping, as two (*crowdsourcing* and *cloud*) were duplicates, (i.e. repeated across conferences).

Eighteen, or one third, of the conference themes matched exactly with a term from the OLT list. These are shown in table 6, along with the year(s) of the resource(s) in the Library that the keywords link to, and the year(s) of the relevant conference(s).

Table 6
OLT topics matching THETA themes 2011-2015

OLT Resource Library topics	Date of resources	THETA conference
academic analytics	2011	2013
big data	2013	2013
blended learning	2011	2015
bring your own device	2014	2013
copyright	2014	2015
digital media	2011-2014	2013
educational technology	2009, 2010	2011
e-learning	2000-2014	2011
games	1997-2014	2015
immersive learning	2009-2011	2013
learning analytics	2007-2014	2015
learning spaces	2007-2014	2013,2015
learning technology	2013	2013
mobility	2009-2014	2013
open educational resources	1997-2014	2015
service-related IT education	2011	2011
social media	2009-2013	2013,2015
virtuality	1998-2014	2013

There were several themes where OLT keywords represented a partial match, conceptually. These included *data mining* as an element of the 2011 theme of “data management, business intelligence, storage and archiving”, and *electronic text* as part of the 2015 theme “ePublishing”. Obviously a conference theme needs to provide breadth to cover a range of papers, whereas OLT keywords are applied to individual project documents, so it is expected that THETA themes will tend to be broader in scope than OLT keywords.

Among the two thirds of the conference themes where OLT did not have a completely matching term were a range of policy and administrative concepts which were either beyond OLT’s scope of learning and teaching,

or too universal to have been identified as ICT-related terms for this exercise. Examples include themes such as “access and increasing participation”, “business continuity”, “competition from new educational models” and “workforce planning”. Technical themes such as “broadband applications”, “cloud computing”, “enterprise architecture” and “identity and access management” would also generally be outside the scope of OLT projects. The OLT list included the terms *open content*, *open educational resources* and *open source*, but did not include the broader *open education* concept that was a theme of the 2013 THETA conference. Conversely, while the OLT index includes several terms related to *mobile technologies*, it does not specifically cover the “Mobile services / applications” theme of THETA 2015.

The increasing interconnectedness of higher education libraries, ICT directorates, and learning and teaching centres is well-represented in the THETA themes (e.g. “Research digital outputs as resource collections”, 2015), but is not so apparent in the OLT Resource Library. The OLT keywords *libraries*, *library*, and *library and information science* are used to describe project resources related to the teaching of librarianship and information science and to libraries as learning spaces. *Digital literacy* has been used twice as a keyword in the Resource Library, but concepts such as “transliteracy” are currently not represented in the index.

Mapping against the NMC Horizon Higher Education reports

The series on trends in education technology known as the “Horizon reports” is produced annually by the New Media Consortium and Educause, who describe its contribution as “the world’s longest-running exploration of emerging technology trends and uptake in education” (Johnson et al, 2015, p. 1). As such, the Horizon reports represent another useful source of ICT-related topics against which to compare the OLT Resource Library.

Long-term, mid-term and short-term “trends” from each of the annual Horizon Higher Education reports from 2004-2015 were collated, and then mapped to the list of OLT ICT-related topics. A number of trends and issues appear in more than one year of the Horizon reports. Of the sixty-eight unique topics across these years, sixteen (23.5%) conceptually matched terms in the OLT list. This is lower than the 33.3% exact match with THETA conference themes, and may indicate that THETA conferences more closely reflect the Australian agenda than do the global, but US-centric, Horizon Reports. Table 7 shows the sixteen matching topics.

Table 7
OLT topics matching Horizon report topics (2004-2015)

Horizon report topic	OLT topic
adaptive learning technologies (2015)	adaptive tutorials (2010)
augmented reality (2006, 2010, 2011)	augmented reality (2011, 2014)
blended learning (2015)	blended learning (2011)
bring your own device (2015)	bring your own device (2015)
electronic books (2010, 2011)	ebooks (2014), electronic text (1997)
educational gaming (2005, 2006)	games (1997-2014)
games-based learning (2011, 2012)	
games and gamification (2013, 2014)	
learning analytics (2011)	learning analytics (2012)
learning objects (2004)	learning objects (1994-2015)
learning spaces (2015)	learning spaces (2007-2014)
massively open online courses (2013)	MOOCs (2014)
mobile phones (2007), mobiles (2009, 2011), mobile computing (2010)	mobile technologies (2009-2014)
open content (2010)	open content; open educational resources; open source

Horizon report topic	OLT topic
open educational resources (2015)	resources (2014)
social media (2014)	social media (2009-2013)
social networking (2005, 2007)	social networking (2008-2014)
user-created content (2007)	user-generated content (2009)
virtual worlds (2007)	virtual world teaching (1998-2014); Second Life (2011)

The matching concepts are represented by the same or very similar terms in many cases. It is interesting to note the Horizon reports' changes in terminology related to games, with changes in two phases from "educational gaming" in 2005-2006, through "games-based learning" in 2011-2012, to "games and gamification" in 2013-2014.

The Horizon report topics that did not match OLT keywords are listed in table 8. Both "context-aware computing" and "gesture-based computing" have been topics treated in three Horizon reports, yet neither of these concepts is represented in the OLT index, nor in the THETA conference themes for that matter. The "Internet of Things", "3D printing" and "wearable technology" are other topics covered in at least two of the recent Horizon reports, but not in the other two sources. While these three technologies may be peripheral to the OLT's scope of learning and teaching, it is surprising that "tablet computing" and "flipped classroom" had not appeared amongst the OLT's keywords.

Table 8
Horizon report topics not covered by OLT keywords

Horizon report topic	Years
3D printing	2013, 2014
access	2014
agile approaches to change	2014
cloud computing	2009
collaboration webs	2008
collective intelligence	2008
competing models of education	2014, 2015
context-aware computing	2004, 2005, 2006
cross-institution collaboration	2015
cultures of change and innovation	2015
data mashups	2008
data-driven learning and assessment	2014
digital literacy	2015
evolution of online learning	2014
extended learning	2005
flipped classroom	2014, 2015
geo-everything	2009
gesture-based computing	2010, 2011, 2012
grassroots video	2008
growing focus on measuring learning	2015
intelligent searching	2005
internet of things	2012, 2015

Horizon report topic	Years
keeping education relevant	2014
knowledge webs	2004
low digital fluency of faculty	2014
makerspaces	2015
mobile apps	2012
mobile broadband	2008
multimodal interfaces	2004
new scholarship and emerging forms of publication	2007
personal broadcasting	2006
personal web	2009
personalizing learning	2015
quantified self	2014
rapid prototyping	2004
rewarding teaching	2014, 2015
scalable vector graphics (SVG)	2004
scaling teaching innovations	2014
semantic-aware applications	2009
shift from students as consumers to students as creators	2014
smart objects	2009
tablet computing	2012, 2013
teaching complex thinking	2015
ubiquitous wireless	2005
virtual assistants	2014
visual data analysis	2010
wearable technology	2013, 2015

Six topics are represented in both the Horizon reports and the THETA conferences, but not in the OLT Resource Library, as listed in table 9.

Table 9
Topics covered by Horizon and THETA, but not OLT

Horizon report topics	Years	THETA themes	Years
Access	2014	Access and increasing participation	2011
Cloud computing	2009	Cloud computing	2011
Competing Models of Education	2014, 2015	Competition from new educational models	2015
Data-Driven Learning and Assessment	2014	Data-driven learning / assessment	2015
Cross-Institution Collaboration	2015	Cross institutional research communities	2015
New Scholarship and Emerging Forms of Publication	2007	eResearch and eScholarship	2011

ICT-related topics unique to OLT Resource Library

Analysis found a total of 116 (66%) ICT-related topics represented in the OLT Resource Library, but not in either of the THETA or Horizon topic lists. The uniqueness of topics covered by the OLT is likely due in large part to the more specific nature of many OLT projects, relative to conference themes and “future trends”. One would not expect to see *avatar*, *CD-ROM*, or *screen* as conference themes in their own right, but these terms have been used as keywords for OLT project resources. There are also discipline-specific concepts such as *electronic arts*, *e-science*, *STEM education* and *computational science* represented in the OLT keywords which would be unlikely to feature in conferences and reports aiming for a broader, and non-discipline-specific audience.

However, some of the OLT topics, such as *accessibility*, represent major themes that would be appropriate for a technology trends’ report or a technology-related learning and teaching conference. In this category there is a long list of technologies that support teaching, including *animations*, *videoconferencing*, *virtual simulation* and *virtual microscopy*, as well as concepts relating to teaching strategy such as *video analysis* and *online tutorials*.

The OLT Resource Library has a significant proportion of keywords related to assessment, from the broad term *e-assessment* to narrower concepts such as *automated problem generation*, *computer aided assessment*, *interactive assessment*, *virtual assessment*, *online diagnostic tests*, *electronic marking systems*, *online feedback*, *PDF annotations*, *e-portfolios* and *e-submission*. While THETA 2015 includes the theme “data-driven assessment”, this is a specific element of assessment more akin to OLT’s *learning outcome mapping* or *learning outcome tracking*.

There are also examples of emerging concepts appearing in the OLT keywords which would not yet meet literary warrant requirements for a thesaurus, but may do in the future. Terms of this type include: *produsage* (Richardson, 2013, p.4) and *slowmation* (Clark & Hoban, 2012, p.4).

Common topics across sources

Key topics which feature in more than one of the lists of ICT-related concepts are presented in table 10. Where available the equivalent term from ATED has also been included.

Table 10
OLT-THETA-Horizon-ATED mapping

OLT Resource Library keywords	THETA conference themes	Horizon report trends	ATED descriptors
adaptive tutorials (2010)		adaptive learning technologies (2015)	no exact match adaptive testing (1995) assistive technology (2008)
augmented reality (2011, 2014)		augmented reality (2006, 2011)	virtual reality (2001)
big data (2013)	big data (2013)	data-driven learning and assessment (2014) visual data analysis (2010)	data (1984)
blended learning (2011)	online, hybrid, collaborative learning (2015)	blended learning (2015)	blended learning (2008)
bring your own device (2014)	bring your own device (2013)	bring your own device (2015)	

OLT Resource Library keywords	THETA conference themes	Horizon report trends	ATED descriptors
educational technology (2009, 2010)	educational technology (2011)		educational technology (1984)
ebooks (2014) electronic text (1997)	ePublishing (2015)	electronic books (2011)	electronic books (2004)
games (1997-2014)	games & gamification (2015)	educational gaming (2005, 2006); games-based learning (2011, 2012); games and gamification (2013, 2014)	educational games (1984)
learning analytics (2008-2013) academic analytics (2011)	learning analytics (2015) academic analytics (2013)	learning analytics (2011-2014)	learning analytics (2014)
learning objects (1994-2015)		learning objects (2004)	learning objects (2008)
learning spaces (2007-2014)	learning spaces (2013)	learning spaces (2015)	educational facilities design (1984)
MOOCs (2014)		MOOCs (2013)	massive open online courses (2014)
mobile technologies (2009-2014) mobility (2009-2014)	mobile services / applications (2015) mobility (2013)	mobile phones (2007), mobiles (2009, 2011), mobile computing (2010)	mobile technology (2014) mobile learning (2008)
open content; open educational resources (2014)	open educational resources (2015)	open content (2010)	open educational resources (2014)
social media (2009-2013)	social media (2013,2015)	social media (2014)	social media (2012)
social networking (2009-2014)		social networking (2007) social networks (2005)	social networking (2012) social networks (1995)
user-generated content (2009)	creator society (2015)	user-created content (2007)	
virtual world teaching (1998-2014) Second Life (2011)	virtuality (2013)	virtual worlds (2007)	virtual reality (2001)

There are some common priorities that show up clearly in this table, with *ebooks*, *learning analytics*, *learning spaces*, *mobile technologies*, *open content*, *social media* and *virtual worlds/virtuality* appearing consistently across all four columns. Both *academic analytics* and *learning analytics* are in use across the sector, with *learning analytics* becoming the more used term. *Blended learning* appears to be established as a term too. *Games and gamification* and *games-based learning* also appear across these sources, with consistent attention given to the area in the Horizon reports.

From this summary it appears that ATED should consider including *user-generated content* in some form, and also *Bring Your Own Device* to accommodate the current interest in that area within higher education (especially as it is also gaining momentum in the school sector). It would also be worth investigating the

addition of a broader term for “adaptive testing”, to cover adaptive tutorials and machine-teaching developments in the future.

A term like *big data* is a difficult call. A thesaurus developer tends to be wary of generic adjectives such as “big” and particularly wary of “buzz phrases”. Data is a long-standing concept in ATED with many nuanced meanings. Will this concept remain important for searchers, and is there a need for additional narrower terms related to data as the information environment evolves?

Conclusion

The OLT “promotes and supports change in higher education institutions for the enhancement of learning and teaching” (OLT, 2013). One of its stated responsibilities is “disseminating resources on innovations in learning and teaching”. The OLT’s Resource Library is being re-indexed to support this responsibility. Several subject thesauri could have been profitably used for the re-indexing, but the Australian Thesaurus of Education Descriptors was chosen for the purpose following a systematic evaluation exercise. Its suitability was confirmed by the extent to which the existing keywords used in the Resource Library mapped onto the ATED descriptors, with only a relatively small number of new terms being added to cover those keywords that did not properly map across.

ICT-related topics are well represented amongst the keywords in the OLT Resource Library; the Library is thus a valuable source of literary warrant in this subject area. This was confirmed by a number of topics represented by the Library, but yet to appear as a THETA conference theme or a Horizon Higher Education report. Conversely, there were THETA themes and Horizon report topics that were not represented amongst the OLT keywords, suggesting that each of the three sources represent valuable sources of warrant for ATED in the field of ICT in higher education. At the same time, the topics that do coincide, such as those listed in table 9, are probably of particular importance to the field, and worthy of prioritisation.

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