Museum literacy that is virtually engaging

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Abstract

Objects have underpinned pedagogic strategies in the arts and sciences. While recent online units of study enable isolated students to experience higher education, they are usually unable to examine collections. A 3D laser scanning project at Macquarie University creating a 'virtual museum' will enable distance students to experiment with curatorial approaches by working with virtual objects in virtual spaces. There are also opportunities for cross-disciplinary experimentation through the juxtaposition of objects from different museum collections. This will help students develop a new form of museum literacy appropriate to the hyper-connected learning laboratories of the future in higher education.

Collections and pedagogy

Engaging with objects, either directly or through digital media, has long been recognised as a viable constructivist pedagogy capable of providing significant meaning and context (HOOPER-GREENHILL 2007). Object-based learning in higher education has been a source of much recent research (e.g. CHATERJEE 2010; MARIE 2010). It is well documented that the main purpose for the development of many university museums and collections was to support discipline-specific academic instruction (SIMPSON 2012).

In recent decades significant advances in digital technologies have spurred many museums to establish an online presence, often including access to individual collection items. The motivation to do this has been to provide better access. A digital presence for collections obviously gives significant exposure to a web audience that are unlikely to be traditional museum visitors. Arguments in favour of digital engagement for mainstream museums have therefore been understood in terms of audience development. The growth of new digital audiences may or may not convert into new physical audiences.

Digital audiences however can have very specialised needs. For example, access to online collections can provide invaluable information to researchers, but critical information may or may not be represented in a digital format or individual items may be difficult to locate or may not be represented online. Accessibility to data can also depend on sites that aggregate significant quantities of metadata for those with specific needs in sourcing online information or representation of objects and specimens. The effectiveness of these sites depend on the comprehensiveness of standardised cross-sectoral metadata protocols, and there is always debate about the efficacy and comprehensiveness of such systems.[1]

Some authors have argued that museums and university museums in particular, have been slow to take up the immense challenge and opportunities provided by the expanding digital horizon. CARNALL (2009) outlined a number of circumstances to explain this including (a) the high cost of employing web literate personnel in the early 1990s, (b) museum curators resistant to change and (c) a fear that increased digital access would reduce the number of physical visitors. For university museums, can be added (d), the low priorities museums and collections receive for funding for digital developments from university administrators in comparison with other sections of the academy.

[1] An Australian site is the Museums Metadata Exchange that aggregates collection level data from across Australia, see: museumex.org. At the time of reviewing this site for this paper (December 2012) there was only information from four Australian university museums incorporated into the database.

Despite the fickle nature of financial support, university museums have tried to digitally represent their collections and many individual projects based on specialised collections have been documented. Given that many university museums and collections originated to support object-based pedagogies, it is not surprising that many of the recent developments in what MASSE & MASSE (2009) refer to as 'cybermuseology' are oriented towards support for teaching.

MASSE & MASSE (2009) noted that the enthusiasm for cybermuseology was driven by the cheapness of digital storage space in comparison with the cost of physical storage space. While this may be something of an oversimplification, the main point of their paper was the elaboration of wiki style web 2.0 tools that allowed collaborative online teaching and research focussed on collection data. Wake Forest University's anthropology collection of over 28,000 objects (WHITTINGTON & AL. 2010) were made freely accessible online and museum staff offered stipends to other educational organisations at different levels to incorporate their material into teaching programs. They reported that apart from anthropology, the database was also incorporated into the delivery of university programs in acting, education, history, religion and Spanish. This is an excellent illustration of the cross-disciplinary value of object based pedagogies in either real or physical form.

The Wake Forest University example only included two-dimensional images of objects. Expanding digital capacity now allows for three-dimensional representation of digital surrogates of physical objects. Three-dimensional objects are particularly useful in taxonomy where type specimens can be examined by scientists all over the world without having to leave their computer. But the quality of three-dimensional digital representation is dependent on the density of information that can be captured and stored. More detailed data will allow the development of a more comprehensive and therefore more useful digital image, but dense data sets chew up capacity and can become unwieldy, so a balance between detail and capacity must be struck. This in itself is a moveable target with the increasing capacity for systems to handle progressively larger volumes of data.

One of the few university museums that has experimented with three-dimensional digital surrogates and reported on the results is the Petrie Museum at the University College London (NELSON & MACDONALD 2012). The Petrie Museum's three-dimensional imaging of collection objects was done in conjunction with their Department of Civil, Environmental and Geomatic Engineering in a 3D scanning initiative that covered a number of different disciplines. They (NELSON & MACDONALD 2012) report that while the scanning technology allowed the capture of data rich material, the development of end user applications, particularly web-based applications, within feasible costs and at an appropriate scale was far more challenging. They also noted that the production and availability of 3D images of Petrie Museum collection objects was not seen as a replacement for engagement with the real object as far as most of the museum's audience was concerned. While Nelson and MacDonald (2012) did not specifically discuss the pedagogic potential of 3D digital surrogates, they did conclude that improvements in technical capabilities would inevitably lead to a far greater uptake by a variety of different audiences.

Recent research from a Learning and Teaching Priority project at Macquarie University (SIMPSON & HAMMOND 2012) investigated the retention of didactic information through comparative engagement, comparing responses to (a) physical objects and (b) two two-dimensional images per object under controlled conditions. This research showed increased retention of information among students exposed to the physical objects in comparison with students exposed to two-dimensional images of the same objects. To explore the effectiveness of online educational engagement of objects it is necessary to repeat a similar experiment in which students are exposed to original objects and three-dimensional digital surrogates. This is a complex issue allied with a range of visual, object and other

literacies associated with the new learning pathways experienced by digital natives, or millennial learners, that some authors consider may be significantly different from that of previous generations.

Despite the fact that the research is yet to be done on teaching with three-dimensional digital surrogates, now is a good time to experiment with their usage – to promote further significance of the teaching value of university museums and collections. Other developments such as the recent phenomena of Massive Open Online Courses (MOOCs), that represent an industrial scale educational opportunity and, according to some, challenge the traditional business models of higher education, also pose challenges and opportunities for university museums and collections.

While the research into retention of didactic information (SIMPSON & HAMMOND 2012) indicated better results through object than image engagement, a second aspect of the study involved the potential for the use of collections in cross-disciplinary teaching applications. The content of various units of study were mapped against specific collections on campus as a way of testing the unused potential of existing museum collections at Macquarie University. From the mapping exercise it was clear from the outset that some academic disciplines use objects for teaching more than others. Discussions with unit convenors revealed that there is significant interest in using objects for teaching but this was hampered by two factors: (a) a distinct lack of knowledge about the content of academic collections at Macquarie, and (b) the existence of units where there is a high turnover of staff and a subsequent tendency to undertake minimal changes to content and pedagogy.

The mapping exercise above follows a standard pattern of establishing any existing object usage in tutorial or practical sessions during teaching programs, listing learning outcomes and linking key words to collection database searches. This is a standard methodology used by museum education developers and taught as part of both undergraduate and postgraduate Museum Studies programs at Macquarie University. More complex search methodologies can be devised but this mapping project was limited by the nature of collection information architecture at Macquarie University.

The mapping demonstrated the potential use of objects in the University's Australian History Museum in the teaching of psychology, anthropology, sociology and environmental science and management. Works in the university's Art Collection had potential for use in sociology, environmental science and history. Similarly, objects in the Biological Sciences Museum had use in early childhood education, indigenous studies, sociology and Australian history.

Sector investigations during the course of the project revealed a number of successful information management capacity building projects that would be useful models for possible adoption. The State owned Australian Museum has a volunteer program for digital capture. Macquarie University requires greater visual content capacity for the collections to be used more effectively in learning and teaching, particularly with the growth in delivery of online content. In education literature, 'Millennial learners' are perceived as having a higher threshold for visual data but not necessarily a more refined sense of visual literacy (BRUMBERGER 2011). The results from the Macquarie students exposed only to two-dimensional visual images confirms this and indicates that simply increasing visual content per se does not improve pedagogical outcomes. Apart from direct exposure to objects, this can only be done by improved integration of data and digital images. As noted above, an obvious extension to the experiment conducted for this project is to test information retention with students exposed to three-dimensional digital surrogates in comparison with those exposed to physical objects.

The project also involved an examination of best practices from around Australia (through the Council of Australian University Museums and Collections) and internationally where possible. There are many variations, but in general, with a few exceptions, cross-disciplinary learning and teaching strategies

using museum collections are often serendipitous rather than a result of institutional planning.[2] They may be restricted to arts or science,[3] but often involve integration into problem-based learning strategies.[4] Some programs are clearly focussed on singular cross-disciplinary issues,[5] and may involve external museum partners[6] and occasionally extend to exposing students to research in learning and teaching strategies[7].

Successfully utilising the cross-disciplinary potential of museums and collections requires the recognition that the university's collections are learning and teaching infrastructure (JANDL 2012). Small academic units, with discipline-specific collections often do not have the resources to maintain collections in a way that effectively incorporates them into widespread teaching strategies (SIMPSON 2012).[8] The best example of cross-institutional integration in Australia is undoubtedly the University of Melbourne (ARNOLDI 2012). Collections come under a centrally funded 'cultural collections' program[9] and the university has recently established (through philanthropy) a new position of 'academic curator' whose job is to utilize more effectively the 20 collections in learning and teaching programs with a focus on cross-disciplinary engagement. A similar privately funded national scheme among German universities was in late 2012.[10]

Extending the Macquarie University project

Macquarie has a range of museums and collections within the Faculty of Arts and the Faculty of Science, which were originally established to underpin learning and teaching programs – such as the Museum of Ancient Cultures, the Australian History Museum, the Biological Sciences Museum and the Macquarie University Art Collection. The recent purchase of updated collection management software by the university's informatics section allows for developing vast stores of collection data including images. Collection objects (documents, artwork) can be readily made available through two-dimensional imagery, potent pedagogical tools for a generation of learners with an altered sense of visual literacy (BRUMBERGER 2011) through immersion in social media technologies.

Recently, the Department of Ancient History commenced 3D laser scanning of selected objects in the Museum of Ancient Cultures to provide material for teaching programs. Three-dimensional images need to be sufficiently detailed so that the physical features of the object can be observed clearly at magnification. Consequently a Konica Minolta Range7 laser scanner was used in this project – because it provides instantaneous capture capability and enables the reproduction of the fine detail necessary for online research and study.

Using a Lenovar ThinkPad W520 workstation with Core 2 Duo processor, 4Gb RAM and a NVidia GT9000 graphics card, the Range7 was used to scan a group of artefacts from the museum collection. Raw scan data was manipulated in Geomagic Qualifier, a specialised software program which allows the scans to be aligned and digital photographic images to be wrapped around each object. The resulting images can then be converted into 3D PDFs using Tetra 4D 3D PDF Convertor. In this initial project however, because of time constraints, only the primed blank images were converted into 3D PDFs.

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[2] E.g. Mt Holyoke College US, ALVORD & FRIEDLANDER 2012; Deloit College US, BARTLETT 2012; University of Glasgow UK, GAIMSTER & FLETCHER 2012.
[3] E.g. RICCIO 2012; VOLK & MILKOVA 2012.
[4] E.g. GANGULY & AL. 2003.
[5] E.g. Yale University US, PICKERING 2012.
[6] E.g. LEMELIN & BENCZE 2010; MARSTINE 2007.
[7] E.g. GRAHAM & JOMPHE 2010.
[8] MARES made the same point in his 2011 UMAC conference presentation entitled *The weakness of small units: why Sun Tzu could have been writing about university natural history museums*".
[9] NEMEC, pers comm., 2011.
[10] WEBER, pers. comm., 2012.

The use of 3D laser scanning for online teaching enables students to manipulate the 3D PDFs in order to examine, measure and quantify the artefacts – offering viewers a much more focussed interaction with the object depicted than can be achieved with 2D imagery. The images can be enlarged on screen to identify aspects of manufacture, structure and surface treatment. The condition of each artefact can also be assessed in this manner without the associated risks of damage and breakage inherent with a physical examination of the object.

We contend that Macquarie's rapidly increasing digital capacity (storage and delivery), positions it to enhance learning experiences and accessibility to a cross-disciplinary range of three-dimensional objects in a 'virtual object storeroom'. This could be part of a series of working virtual museum spaces enabling a diverse pedagogical experimentation and educational research.

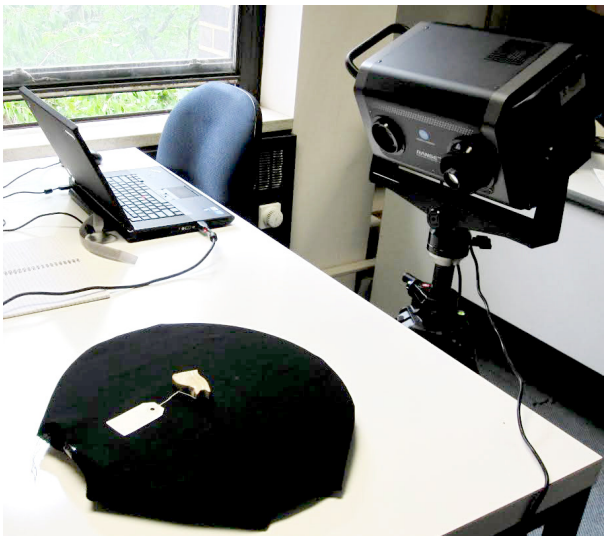

Fig. 1 - 3D laser scanner, turntable with artefact and laptop with Geomagic processing files. Photo: Jaye McKenzie-Clark

This process of facilitating the development of virtual museum spaces will be enhanced by a program of accelerated digital capture of museum objects by Museum Studies students and digital volunteers (modelled on a program currently underway at the Australian Museum). Three-dimensional image capture using the scanner in the Museum of Ancient Cultures will form digital surrogates that, along with two-dimensional images in the Adlib database will form a cross-disciplinary virtual museum storeroom available for a range of innovative teaching applications.

The virtual museum storeroom will eventually be available to unit convenors.[11] They will select and curate learning and teaching materials for the delivery of units on the University's *iLearn* platform. Objects in the virtual storeroom will have a depth of linked data that will enable cross-disciplinary utilisation of single objects and the development of comparative learning contexts across varied units of study. Unit conveners and students will be able to tag objects as a means of building contextual linkages and tracing the history of utilisation of virtual objects in learning and teaching programs.

The virtual object storeroom will represent the 'back of house' area of the virtual museum space. A planned virtual front of house areas would also be designed to enable easy access to a range of discipline-specific or cross-disciplinary options. There are already many good examples of virtual exhibition spaces[12] that allow multifaceted engagement by diverse online audiences that can be examined during the design phase of such a project. In recent years museum and educational researchers have given examples of the value of learning and teaching strategies that incorporate collaborative group work on exhibition development as a way of engendering deeper understanding within specific disciplines (MARSTINE 2007). For example, through using this platform, distance students would be able to select objects from the storeroom and collaborate in the production of exhibitions within modern or ancient history. Similarly, the development of virtual cross-disciplinary exhibitions will be possible for Museum Studies students. The platform will also enable the exploration

[11] The concept outlined here formed part of an internal grant submission to Macquarie University in 2012, although unsuccessful at that time, the proposers intend submitting a revised request in 2013.
[12] One example is the Museum of Virtual Art at muva.elpais.com.uy (accessed July 4, 2013)

of new pedagogic concepts referred to by some theorists[13] as 'museum literacy' conceptualised as embracing both object literacy and visual literacy.

Concluding remarks

While research on the educational value of engagement with 3D objects online is yet to be done, it is worth considering that other technological advances may render the question meaningless. The technology associated with three-dimensional printing is advancing rapidly (JONES 2012) with an expanding number of applications in manufacturing. Through the use of different materials and different printing methods, accessibility to this technology has increased to the point where small desk top units can produce intricate three-dimensional replicas of a vast diversity of human made and natural objects. Eventually this technology will find educational application.

Perhaps the university museums of the future will be digital storehouses of three-dimensional objects, available in a physical form on demand. These objects could be made from a recyclable material and used many times over. The same material could have a temporary existence as objects offering students direct engagement with a physical surrogate of the original object. Digital storage could provide material from collections anywhere in the world. The ability to access replicas of irreplaceable originals from some of the best collections could have a profound impact on the future of higher education. Imagine what downloading the Pharaoh's Mask could do for the study of Egyptology, or a Tyrannosaurus skull for the study of palaeontology? The future options for collections linked to university teaching seem limitless.

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Literature cited

ALVORD, E. & L. FRIEDLANDER 2012. Visual literacy and the art of scientific inquiry: A case study for institutional and cross disciplinary collaboration. In: *A Handbook for Academic Museums: Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 144–165.

ARNOLDI, H. 2012. A mutually beneficial exchange: The University of Melbourne's Cultural Collections Projects Program. In: *A Handbook for Academic Museums: Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 512–526.

BARTLETT, D. 2012. Coaxing them out of the box: Removing disciplinary barriers to collection use. In: *A Handbook for Academic Museums: Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 190–218.

BRUMBERGER, E. 2011. Visual literacy and the digital native: An examination of the Millenial Learner. *Journal of Visual Literacy* 30: 19–46.

CARNALL, M. 2009. Chasing the online audience. *University Museums and Collections Journal* 2: 37–39. edoc.hu-berlin.de/umacj/2/carnall-mark-37/PDF/carnall.pdf (accessed May 30, 2013).

CHATERJEE, H. 2010. Object-based learning in higher education: The pedagogical power of museums. *University Museums and Collections Journal* 3: 179–182. edoc.hu-berlin.de/umacj/2010/chatterjee-179/PDF/chatterjee.pdf (accessed May 30, 2013).

GAIMSTER, D. & R. FLETCHER 2012. Using collections to enhance the student experience: developing a new learning offer at The Hunterian, University of Glasgow. In: *A Handbook for Academic*

[13] These issues are discussed in greater detail by JACOBS & AL. 2009.

Museums: Exhibitions and Education, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 38–53.

GANGULY, P., M. CHAKRAVARTY, N. LATIF, M. OSMAN & M. ABU-HIJLEH 2003. Teaching of anatomy in a problem-based curriculum at the Arabian Gulf University: The new face of the museum. *Clinical Anatomy* 16: 256–261.

GRAHAM, M. & D. JOMPHE 2010. A museum and a university co-staff a research scientist. *Museum Management and Curatorship* 25:107–116.

HOOPER-GREENHILL, E. 2007. *Museums and education: Purpose, pedagogy, performance*. London: Routledge.

JACOBS, C., J. ANDREWS, M. C. CASTLE, N. MEISTER, W. GREEN, K. OLSON, A. SIMPSON & R. SMITH 2009. Beyond the field trip: Museum literacy and higher education. *Museum Management and Curatorship* 24: 5–27.

JANDL, S. 2012. Five strategies for strengthening the teaching role of an academic art museum. In*: A Handbook for Academic Museums: Exhibitions and education,* eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 121–141.

JONES, N. 2012. Science in three dimensions: The print revolution. *Nature* 487, 7405: 22.

LEMELIN, N. & L. BENCZE 2010. Reflection-on-action at a science and technology museum: Findings from a university-museum partnership*. Canadian Journal of Science, Mathematics and Technology Education* 4: 467–81.

MARIE, J. 2010. The role of object-based learning in transferable skills development. *University Museums and Collections Journal* 3: 187–190. edoc.hu-berlin.de/umacj/2010/marie-187/PDF/marie.pdf (accessed May 30, 2013).

MARSTINE, J. 2007. What a mess! Claiming a space for undergraduate student experimentation in the university museum. *Museum Management and Curatorship* 22: 303–315.

MASSE, A. & W. H. MASSE 2009. Online collaboration and knowledge dissemination for university collections. *University Museums and Collections Journal* 3: 91–95. edoc.hu-berlin.de/umacj/2010/masse-91/PDF/masse.pdf (accessed May 30, 2013).

NELSON, T. & M. MACDONALD 2012. A space for innovation and experimentation: University museums as test beds for new digital technologies. In: *A Handbook for Academic Museums*: *Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 418–444.

PICKERING, J. 2012. Beyond collections: Big issues and university museums. In: *A Handbook for Academic Museums: Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 404–431.

RICCIO, E. 2012. Where art and history meet: A perspective and an approach. In: *A Handbook for Academic Museums: Exhibitions and education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 490–509.

SIMPSON, A. 2012. Modelling governance structures for university museums and collections. In: *A Handbook for Academic Museums: Beyond Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 178–218.

SIMPSON, A. & G. HAMMOND 2012. *Object-based engagement in cross-disciplinary pedagogies. University Museums and Collections Journal* 5: 75–81. edoc.hu-berlin.de/umacj/2012/simpson-75/PDF/simpson.pdf (accessed May 30, 2013).

VOLK, S. & L. MILKOVA 2012. Crossing the street pedagogy: Using College Art Museums to leverage significant learning across the campus. In*: A handbook for academic museums: Exhibitions and Education*, eds. S. JANDL & M. GOLD (Edinburgh & Boston: MuseumsEtc), 88–118.

WHITTINGTON, S., K. BRYNER, B. HANCOCK & T. SMITH 2010. Supporting interdisciplinary teaching and research with the Museum of Anthropology's Online Artifact Database. *University Museums and*

Collections Journal 3: 105–111. edoc.hu-berlin.de/umacj/2010/whittington-105/PDF/whittington.pdf (accessed May 30, 2013).

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