Designing Location-based Educational Services for School Students at Cultural Institutions: The case of the National Portrait Gallery of Australia

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Abstract. *Cultural institutions provide important benefits for society and for the visitors who come to them. Their staff need to understand how information technology can augment the visitor experience, and how to engage with their visitors to design programs that will meet visitors' expectations for greater interaction. Using an iterative, design science based approach, coupled with design thinking workshops bringing stakeholders together, we showed how location-based educational services coupled with mobile apps on handheld devices could be designed to enrich the experience for school students visiting the National Portrait Gallery of Australia.*
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1 Introduction

Cultural institutions such as Australia's National Portrait Gallery provide important benefits to society and to the visitors who come to experience them. Due to resource constraints, many visitors tour the galleries without the benefit of expert guidance that would help to fulfil the Gallery's purpose: "to increase the understanding and appreciation of the Australian people … through portraiture." [1, p. 14]. This is especially true for school students visiting the Gallery. While 11,000 of the 18,500 school students who visited the National Portrait Gallery in 2013-14 participated in facilitated programs [1], the other 7,500 students went on self-guided tours with only an orientation session and the help of a simple app on a supplied handheld device. Our research sought to solve the problem of how to engage those students on self-guided tours using location-based educational services: enriching experiences that could be delivered to students depending on their location within the Gallery and their proximity to particular works.

The community invests heavily in cultural institutions, their collections and staff. Funding pressure from government requires institutions to show value for their activities, something that is currently addressed mainly through quantitative metrics like visitor numbers and the quantified results of exit surveys. While a large scale visitor experience survey was done in the past [3], the Gallery has no formal means to gather qualitative data from visiting school groups to help it design experiences that suit the

purpose of the institution and the interests of the visitors. Our process seeks to provide staff at cultural institutions with the skills and techniques to include input from visitors in the design and development of the programs provided by the institutions.

Prior studies have looked at the effectiveness of museum visits for promoting learning [2, 3, 4], but little research has been done on designing information technology-based solutions, particularly those using location-based technologies or social networking techniques, to assist self-guided groups of school students visiting museums [5]. Many cultural institutions have developed mobile apps to augment their visitors' experience [6, 7, 8, 9, 10]. By and large, these apps provide visitors with written, visual and auditory information to supplement what is available in the galleries and exhibitions. Missing from these apps are layers of active engagement and cocreation that educational theory tells us [11, 12, 13] are important for learning to take place.

Learning is a social experience [11], [13]. In *Designing Social Interfaces* [14], Crumlish and Malone provide us with a theory of patterns, principles and practices judged to be 'best practice' in designing social experiences. We used their work as a foundation to design and develop a social experience using location-based technologies to assist the Gallery to better serve visiting self-guided school groups. By abstracting from observation to theory and then developing practical solutions [15], we refined and extended Crumlish and Malone's patterns to support collaborative student leaning.

This paper presents the design of *You2*: a mobile app that guides the experience for school students visiting the National Portrait Gallery of Australia. The team sought to answer two questions in its action research project: how can location-based educational services engage students visiting the Gallery in more meaningful ways when compared with existing arrangements; and how can the Gallery design visitor experiences that take into account the perspectives of all stakeholders?

The paper's theoretical significance is twofold: in the recording of previously unreported design patterns for social interaction to improve the user experience; and in the methods introduced to museum stakeholders to help them include visitors in the design of better visitor experiences.

2 Method

As a research methodology, design is defined as the development of "incrementally effective applicable problem solutions" [16, p. 47]. The project partners investigated the problem of engaging school students visiting the National Portrait Gallery on self-guided visits using an iterative process involving design thinking workshops, observations, discussions, prototyping, video recording and revisions of a 'problem solution': the *You2* app. The workshop design was also refined each time one was held.

Workshop 1. We surveyed the ideas of those involved using a design thinking workshop [17] with 25 representatives of cultural institutions, the researchers, teachers and developers. Design thinking is a process where people from a range of backgrounds all actively work together, even competitively, to address design issues [18]. Participants

were taken through a design thinking process and completed worksheets based originally on IDEO's Design Thinking for Educators [19] and Strategyzer's Business Model Canvas [20].

Observations. 450 11-13 year-old students from 10 schools were observed visiting the Gallery on organised visits. Each group was given an introductory briefing and iPad tablet containing the *Reading Portraits* app. *Reading Portraits* is a simple app developed by the Gallery staff to provide groups of up to 15 students with some directions to engage them with the Gallery's collection.

Workshop 2. A second design thinking workshop was held with Gallery staff from a range of disciplines, along with museum researchers, educators, developers and members of the research team. The workshop was briefed on the outcome of the observations and tasked with coming up with ideas for the design of a suitable experience for visiting students.

Software Requirements Specification. The suggestions from these workshops, observations, and discussions with stakeholders were mapped to patterns from Crumlish and Malone' *Designing Social Interfaces* [14] to see how the suggestions fit with established practices, identify best practice solutions, and to see where existing theory was lacking. A Software Requirements Specification (SRS) for a location-based educational services app, *You2*, was developed.

Prototype. An initial prototype *You2* app was developed in Evernote to demonstrate the solution proposed in the SRS. The prototype was evaluated with 15 11-13 year-old students from a local school by observation and video recording of their use of the prototype during a one-hour tour of the Gallery. Each group of three students shared one tablet containing the prototype app. The prototype directed each group to specific galleries, and contained detailed instructions on their tasks. Students entered their responses to the tasks in the prototype itself in text, audio recordings, and with photos. The prototype also contained a survey for the students to complete at the end of their tour of the Gallery. The student responses to the tasks and the survey were collected and analysed after their visit.

Student Design Thinking Workshop. After their tour of the Gallery, the students then participated in a two-hour design thinking workshop based on Institute of Design Stanford's *Gift-Giving Project* [21]. The aims of the workshop were to get their feedback on the experience of using the *You2* prototype and to give them the opportunity to design their own experience of visiting the Gallery. This workshop was video recorded and observed by Gallery staff, the researchers and teachers.

The Final You2 app. The Software Requirement Specification was revised following reflection on the outcomes of the observations of the students using the initial prototype in the Gallery, and their contributions through the design thinking workshop. Further evaluation by observation and survey with students visiting the Gallery will be made once the next iteration of the app is ready.

3 Outcomes

Workshop One. Pattern analysis of transcripts of presentations and content of workshop sheets from the initial workshop using AntConc (text analysis toolkit), TagAnt (part-of-speech tagger), and Wordle (an online word cloud visualisation tool) [22, 23, 24] showed that the participants felt the need for an experience for *groups* visiting the *gallery* that was a *journey* (*tour*, *trail*) through the space *interacting* with *augmented works* and *creating* a response. The analysis also showed workshop participants agreed that visitors should *experience works* in the *galleries* and *exhibitions*; had access to a *map*, *stories*, and *history*; could *find* out more about *people* (*subjects* and *artists*) and *music* related to them; complete a *quiz*; *connect* with each other; take a *selfie*; *compile* their responses and *send* them to or *exchange* them with other people through the Gallery *website*; and *review* what they themselves and others have done.

Observations at the National Portrait Gallery. Observations of school students visiting the Gallery on self-guided tours showed that both the students and accompanying adults enjoyed their experiences, even though most of them were tired; not prepared; and did not understand what they would experience. The large groups of up to 15 students meant that most students made no contribution to discussions raised as a result of using the *Reading Portraits* app. There was also scope to *prepare students (and accompanying adults) so that they better understood how to behave in a gallery*.

Workshop Two. Participants in the second design thinking workshop agreed that the focus of the experience should be on the *students* rather than *teachers* or *accompanying adults*. To overcome the students' and teachers' weariness, lack of preparation and understanding seen during the observations, it was agreed that visiting groups should be offered programs that would *energise*, *motivate*, *engage* and *entertain* them quickly and without assuming that they had done any preparation for the visit.

Software Requirements Specification. Functions in the SRS for the *You2* app were mapped to Crumlish and Malone's framework to look for patterns of best practice for user experience to help with the development of the app. During this process a number of patterns that were not readily apparent in the framework were identified. These new patterns were:

Production User creates content (audio, photos, text) and selects media for Saving and Displaying

Photographing	User accesses their device's camera through the app to capture full-view and close-up images of selected works, editing and cropping if necessary. The user can choose from the shots taken those to be saved, shared and displayed.
Selfies	User accesses their device's camera through the app to create, choose and edit a selfie to share.
Audio Recording	User uses their device's microphone through the app to create, edit and choose audio to share.
Writing	User adds text to their exhibition to save and display.
Presentation	User organises, saves and exports the materials they have created, and presents them to an audience.

The initial draft SRS defined an experience for the *students* working in *groups* that *actively engaged* them in *tasks* requiring them to *look closely at portraits* and to *record their responses*.

Evernote prototype app. Direct observation and analysis of video recording of students using the prototype showed that the *You2* design worked well. The students enjoyed the experience and carried out the tasks with competence. It was, however, thought that the experience could be simplified a little to reduce the number of separate steps required; and that when making an audio recording of their responses, students should be able to see and review their notes. The students' response to the experience can be best summed up with the following quote from one of the students:

> … The experience we had at the National Portrait Gallery was really excellent. We had loads of fun and we got to look at loads of different portraits, and it was really interesting to look at all the different styles, the way people did them. (Year 6 student after using the prototype *You2* app, September, 2015)

Student Design Thinking workshop. In the student design thinking workshop, the students provided valuable feedback on the prototype and came up with a number of their own ideas for augmenting a visit to the Gallery. Social networking features were high on their list of suggestions, especially more sharing options, and tagging and rating portraits. The students also suggested that there be details of the portraits included in the app.

Revised Software Requirements Specification. Only minor revisions were made to the SRS after reflecting on the experience of the students using the prototype and their feedback via the survey and workshop. The main change was that rather than repeating the same process for two portraits, it was streamlined for the second portrait so the students had a novel experience the second time around. The final SRS included the Scope and Functions for the *You2* app as follows:

Scope. The *You2* app should: enhance the level of engagement from self-guided groups; help users understand how to read a portrait; be enjoyable to use, and motivate users to

complete the experience; be accessible to visiting students of diverse ages and abilities; and function regardless of the current hang in the gallery.

Functions. During a 45 minute to one-hour tour of the Gallery, the *You2* mobile app will help small groups of students create their own short audio tour of several portraits. The app will ask the students a series of questions and collect their responses (as selections, text input, photos, and audio recordings). The students' responses can be played on the device or emailed to them.

4 Discussion

The success of the *You2* app for students is reflected in their response to the experience as evidenced by observation, video recording, survey results, and feedback from teachers and Gallery staff. The students expected that the experience would not be engaging, but they loved it and were happy to encourage other students to visit the Gallery in the future. It was clear that the shared experiential learning model was successful. More students were engaged actively compared with the case where students visited the Gallery in larger groups facilitated by the *Reading Portraits* mobile app.

For teachers, success is measured immediately by their observations that the students are more engaged when using the *You2* app when compared with the alternatives (no app or using the *Reading Portraits* app). For the Gallery, success is measured by their observations that the students learned to look closely at the works and came up with their own interpretations of the artists' intentions. For the researchers, validation of the process of developing the experience was demonstrated by the positive responses of the Gallery staff to the input provided by the students and teachers when given the opportunity to test prototypes and workshop their own ideas.

We questioned whether any of Crumlish and Malone' 126 patterns gave us guidance on what constitutes best practice for the media production and presentation aspects of the *You2* app. While most of the functions proposed for the app can be matched to Crumlish and Malone's patterns, there are no specific principles or patterns for taking photographs (including selfies); recording audio; typing in text (apart from in a blog); and creating and giving presentations, even though these things are common activities in social apps. We believe the *You2* app demonstrates effective user experiences for these patterns that will be useful to other developers that seeks to engage users in a social experience, such as support for informal learning in museums and galleries.

It could be argued that Crumlish and Malone's Broadcasting/Publishing and Communication patterns cover the required functions. There is, however, a sufficient difference between what Crumlish and Malone saw as constituting Broadcasting/Publishing and Communication, and what was required for the *You2* app.

5 Conclusion

Emerging communication devices and embedded technologies that provide location and proximity services give us new opportunities to enrich the experience of visitors to galleries and museums. These services not only help institutions to communicate with visitors in ways not previously possible – potentially satisfying demand for greater and more active engagement with institutional staff – they also provide opportunities for visitors to communicate among themselves and with their families, fellow students, teachers and friends. We set out to improve the design process for the experiences visitors – particularly school groups – had when they visited the National Portrait Gallery. The *You2* app differs from most other museum apps by actively engaging visitors rather than just providing information. By introducing the Gallery staff to design thinking workshops, particularly those involving the customers themselves – school students – in the design of the experiences they wanted to have when they visited the Gallery, we showed Gallery staff how working together on problems with other stakeholders (particularly the students themselves) helped them to come up with better solutions, and to see the issues they were dealing with from a number of perspectives. The process helped them to understand they could use a common language to describe the experiences they wanted to deliver, based on established 'best practice' frameworks with extensions to accommodate their circumstances.

The new design patterns that we have proposed here are applicable to a broader range of social interfaces beyond apps to support school students visiting cultural institutions. These design patterns differentiate the user experience from one where the user is a passive receiver of information to one where the user is a contributor of nuanced artefacts (audio, text and photo). They should therefore be important considerations for any experience where developers want to engage with their users to cocreate materials and encourage users to actively participate in the development and interpretation of shared media, from transitory virtual objects through to canonical works of art. What these design patterns add to the corpus are references to techniques that actively engage users in ways that help them to learn more from their involvement by doing something other than just hearing or seeing information or responding to existing interpretations. Examples might include application environments for shared proposals to develop community space; for school field-trip social and scientific data acquisition, sharing and interpretation; or for gathering indigenous knowledge of place through collecting and embedding stories in particular locations.

References

1. National Portrait Gallery of Australia, "National Portrait Gallery of Australia Annual Report 13/14," NPGA, Canberra, 2014.
2. J. H. Falk and L. D. Dierking, *Public institutions for personal learning: establishing a research agenda*. Washington: American Association of Museums, 1995.
3. J. H. Falk and L. D. Dierking, "School field trips: assessing their long-term impact," *Curator Mus. J.*, vol. 40, no. 3, pp. 211–218, 1997.

4. L. Kelly, “Student Learning in Museums: what do we know?,” Sovereign Hill Museums Association, Jun. 2011.
5. T. Roppola, *Designing for the museum visitor experience.* New York: Routledge, 2014.
6. Museum of Modern Art, “MoMA | The MoMA iPhone App.” [Online]. Available: http://www.moma.org/explore/mobile/iphoneapp. [Accessed: 27-Jan-2016].
7. Guggenheim Museum, “Guggenheim App Adds Feature to Highlight Artworks Near Users,” 15-Dec-2015. [Online]. Available: http://www.guggenheim.org/new-york/press-room/news/6707-guggenheim-app-adds-feature-to-highlight-artworks-near-users?utm_source=hootsuite&utm_medium=social&utm_campaign=srgm-twitter. [Accessed: 27-Jan-2016].
8. Canadian Museum for Human Rights, “Mobile app,” 27-Feb-2015. [Online]. Available: https://humanrights.ca/visit/tours/mobile-app. [Accessed: 27-Jan-2016].
9. Museum of Old and New Art, “Mona » The O.” [Online]. Available: https://www.mona.net.au/theo. [Accessed: 27-Jan-2016].
10. Apple, Inc, “Art Gallery of New South Wales Apps on the App Store,” *iTunes*. [Online]. Available: https://itunes.apple.com/au/developer/art-gallery-of-new-south-wales/id459345055. [Accessed: 27-Jan-2016].
11. C. H. Crouch and E. Mazur, “Peer Instruction: Ten years of experience and results,” *Am. J. Phys.*, vol. 69, no. 9, p. 970, 2001.
12. D. A. Kolb, *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, N.J.: Prentice-Hall, 1984.
13. D. A. Kolb, R. E. Boyatzis, and C. Mainemelis, “Experiential Learning Theory: Previous Research and New Directions,” in *Perspectives on cognitive, learning, and thinking styles*, R. Sternberg and L. Zhang, Eds. New Jersey: Lawrence Erlbaum, 2000.
14. C. Crumlish and E. Malone, *Designing Social Interfaces: Principles, Patterns, and Practices for Improving the User Experience*, 2nd ed. Sebastopol, CA: O’Reilly Media, 2015.
15. J. S. Lee, J. Pries-Heje, and R. Baskerville, “Theorizing in design science research,” in *Service-Oriented Perspectives in Design Science Research*, Springer, 2011, pp. 1–16.
16. K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, “A Design Science Research Methodology for Information Systems Research,” *J. Manag. Inf. Syst.*, vol. 24, no. 3, pp. 45–77, 2008.
17. D. Munnerley, M. Bacon, R. Fitzgerald, A. Wilson, J. Hedberg, and J. Steele, “Augmented Reality: application in Higher Education,” Office for Learning and Teaching, 2015.
18. T. Brown and B. Katz, *Change by design: how design thinking transforms organizations and inspires innovation*, 1st ed. New York: Harper Business, 2009.
19. IDEO, “Design Thinking for Educators,” 2013. [Online]. Available: http://designthinkingforeducators.com/. [Accessed: 19-Feb-2014].
20. Strategyzer, “Value Propositions & Business Models,” 2016. [Online]. Available: https://strategyzer.com/. [Accessed: 23-Apr-2016].
21. H. Plattner, “The Gift-Giving Project,” 2015. [Online]. Available: https://dschool.stanford.edu/groups/designresources/wiki/ed894/The_GiftGiving_Project.html. [Accessed: 24-Apr-2016].
22. L. Anthony, *AntConc*. Tokyo, Japan: Waseda University, 2014.
23. L. Anthony, *TagAnt*. Tokyo, Japan: Waseda University, 2014.
24. J. Feinberg, “Wordle – Beautiful Word Clouds,” 2014. [Online]. Available: http://www.wordle.net/. [Accessed: 23-Apr-2016].