Gordon Museum e-Learning App

A KCL College Teaching Fund Project 2013
12-Month Progress Report

1 Introduction

This report summarises the one year of progress of the Gordon e-Learning App project. The project started on 5th August 2013 and employs Michael Truong, a former PhD student of Dr. Kawal Rhode, the project PI.

The report will give a brief overview of the project, and then describe the three parts that have been worked on for the year including two versions of an online cataloguing system and two e-learning platforms, one using augmented-reality and the other using an interactive story. A list of publication outputs is provided at the end of this report.

2 Overview

A multidisciplinary team was assembled for this project, which is heavily student driven and supported by members of staff from the College. Michael was been employed on this project since 5 August 2014 and was responsible for the software development and day-to-day running of the project.

The students involved in the project were Siddharth Agarwal, Marina Kossmann Ferraz, Asha Pavithran, Alvin Nelson, Victor Lung and 28 year-1-or-2 medical students.

Siddharth is a 4th year medical student and did a self-designed SSC module titled "Evaluation of ELearning Gordon Museum App for Teaching and Learning of Pathology". For his module, he developed augmented-reality-based content and conducted a study to evaluate this as an e-learning platform. Asha will carry on Siddharth’s work in augmented reality and will be starting an SSC on this topic.
Marina is a 2nd year medical student from the Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil. She worked on this project as part of a Vocational Module to develop the interactive story-based learning scenario using Storyline (Articulate Global Inc, New York, NY, US), which is part of her one-year Forensic Science placement at the University of Derby.

The members of the staff from the College involved in this project include Kawal Rhode who is project lead; William Edwards, the curator of the Museum; Elena Hernandez-Martin and Stylianos Hatzipanagos, from Centre for Technology Enhanced Learning (CTEL); and Martin Holland and Ian Johns, from Information Technology Services (ITS).

Ian & Martin assisted with integration into the College’s e-learning systems and other technical aspects. Elena assisted with the front-end development and also in development of scripted learning scenarios and Stylianos assisted with evaluation of the e-learning tools.

2.1 Online Cataloguing System and Website

This project started off as a year 4 SSC project to load the data from the Gordon museum into an electronic database so that it can be viewed on an iPad.

The new design is to have the data stored in a separate database where it can be accessed via a host of applications, including a web browser, on mobile device as a downloadable app, and e-Learning platforms developed using Layar and Storyline. The new design is graphically depicted in Figure 1.

![Diagram of the cataloguing system components](image_url)
This part of project was developed by Michael, who first designed and implemented the database, and then developed a website which can access the content and allow certain users to modify it. There are two major versions of the website and database.

### Version 1.0

The first version was developed in the first six months of this project. In this version, both the website and database are hosted on a server in the Division of Imaging Sciences and Biomedical Engineering, and can be accessed via [https://gordon.isd.kcl.ac.uk](https://gordon.isd.kcl.ac.uk).

The database is a MySQL relational database and content can be accessed directly with a web browser with phpMyAdmin, or programmatically using SQL. The website is written in a combination of HTML5, CSS, PHP and JavaScript; and is designed to be dynamic, responsive and secure.

In order to access the content, students will need to log in using their KCL username and password. The login details are authenticated against the KCL staff and student database (SITS) server. Normally, users are not able to modify the contents of the online catalogue, but the website supports a second mode, called curator mode, which provides editing functionality. Only special users, for example the Museum curator, staff and the web developers, will be able to enter via this mode.

#### Landing Page

All users start at the landing page (Figure 2), which gives a short description of the museum and basic contact information. However, users cannot go beyond this page unless they log in.
2.1.1.2 The Collection, Catalogue and Section Pages

Once logged in, the user can then access the digitalised specimens which are organised to reflect the way they are on display at the Museum: first by catalogue, and then by section. There are approximately 27 catalogues and 60 sections within the museum.

A catalogue can be selected from the Collection page (Figure 3). If the user is a curator, then catalogues can be added, removed or edited from here.

Once a catalogue is selected, the user can browse through the sections contained within it (Figure 3). If the user was a curator, then sections can be added, deleted or edited from here.
Figure 3) The Catalogue page displaying sections available within, in this case, the cardiovascular catalogue.

When a catalogue and section are selected, the specimens within them are displayed in grid format (Figure 4). If the user is a curator, then specimens can be added, removed or edited from here.

Figure 4. The Section page displaying specimens contained within, in this case, the cardiac revision section.
2.1.1.3 The Specimen Page

After a specimen is selected from the Section page, detailed information of the specimen is displayed in the Specimen page (Figure 5). The information available to each specimen may include a textual description, questions and answers, a collection of images, an MR or CT image stack, and video.

![Specimen Page](image)

Figure 5. Specimen Page showing details of Museum specimen RC 13.

2.1.1.4 Website Design

The design of the website is inspired by the ivy growing on the front wall of the Hodgkin building in which the Gordon Museum is located (Figure 6). However, a number of test users, including first and second year medical students, who have never visited the Museum could not make this connection and were confused. In response to this, the website theme is currently being redeveloped to have a more relevant medical theme.
2.1.2 Version 2.0

In order to enhance scalability of the website and database, Ian Johns from the College’s ITS department suggested migrating the website onto a content management framework known as Drupal (https://www.drupal.org). Based on this recommendation, a second version of the website was developed and is currently hosted on a separate provisional server: http://gordon.michaeltruong.net.

In this version, a contemporary design was chosen to reflect the Gordon Museum’s embrace for new technologies (Figure 7).

Figure 6. a) Contact page of the Website showing a photo of the Hodgkin Building in which the Museum is housed. b) Landing page of the website with the new medical theme using some of the Museum artefacts in the design.

Figure 7. Screen shot of the landing page of the Museum’s website.
2.1.2.1 Content Navigation

Content in the museum can be accessed by first selecting a catalogue of interest (for example, the ‘C’-series Cardiovascular System) and then the relevant sections of interest (for example, normal or revision specimens), or by first selection a section of interest, and then related catalogues (Figure 8 a & b respectively). Alternatively, the user can access the entire collection, or choose a combination of catalogues and specimens, by applying an appropriate selection filters (Figure 9).

![Figure 8. Filtering a view of the specimens based on a) catalogue and b) section.](image)

![Figure 9. Filtering a view of the specimens based on any combination of catalogues and sections.](image)

When the desired catalogue and sections have been selected, the specimens that suit the selection criteria are displayed for selection.

2.1.2.2 Specimen View

Once a specimen has been selected, a page showing the specimen details are shown (Figure 10). The view contains the specimens label, subtitle, catalogue, section, rarity, description, history, reference and any related images and videos.
Figure 10. A view of a single specimen. Images are intentionally blurred, since the site is not yet hosted by the College and therefore publicly available, in compliance to the Human Tissue Act 2004.

2.1.2.3 Editing a Specimen

Curators who log in have an “edit” button that appears when viewing a specimen. When they click on this button, the specimen view goes into “edit” mode (Figure 11) and the curator is free to change the text, photos and videos related to the specimen.

Figure 11. Editing mode allows curators to edit the textual and multimedia information of a specimen, in addition to other administrative tasks.
2.2 Augmented Reality e-Learning Platform using Layar

This part of the project was developed by Siddharth Agarwal as part of his 4th year SSC module.

For this module, interactive augmented reality (IAR) content was developed for six specimens from the Museum using a commercial piece of software called Layar Creator (Layar BV, Amsterdam, the Netherlands). The content included annotations and segmentations of the specimen’s anatomical and pathological features, which could then be automatically overlaid onto a live capture of the specimen through the screen of a mobile tablet or smartphone device. An example of the overlay is shown in Figure 11. Additional content, including audio and text descriptions of the specimens could also been selected through the mobile device.

![Overlay of a specimen](image1)

Figure 11. An "augmented" specimen from the Gordon Museum. a) A sagittal section of a heart. b) The same specimen, but with visual labels, as would be seen through an AR-enabled mobile device. Interactive buttons on the right allow for different overlays, audio and text descriptions.

A study was carried out augmented reality was recently presented at the Open MEC, CARS poster night, AMEE conference and the MECBioeng conference (see Research Outputs below). This study aimed to determine whether augmented reality (AR) devices benefit medical students when studying gross histopathology in specimens from the Gordon Museum of Pathology.

To do this, twenty medical students from King’s College London were block randomised to either an intervention or control group. The intervention used the augmented reality software, Layar, and delivered on an iPad tablet device. The control used text-only descriptions similar to those provided in the Gordon Museum. All participants completed a small examination before and after using a learning medium, to measure improvement. This process was repeated twice, for three specimens.
featuring myocardial infarction (MI) and another three specimens with cerebrovascular accidents (CVA). Subjective assessment followed in the form of rating scales and comments sections.

AR was shown to improve marks in both anatomy (MI mean improvement of 13%; CVA mean improvement of 24%) and pathology sections (MI mean improvement of 9.2%; CVA mean improvement of 20%). Subjective analysis showed that students preferred AR (68% positive comments) to the control (85% negative comments).

The trial has shown the potential benefit of using AR, and future work with larger samples could change the way medical schools teach pathology from gross specimens. The next step of this part of the project is to expand the size of the study with aims to publish to the 8th Excellence in Teaching Conference, which will be held on Monday 16 June of this year at the Strand Campus.

### 2.3 Interactive Story e-Learning Platform using Storyline

This part of the project was developed by Marina Kossmann Ferraz as a Vocational Module from the University of Derby. Marina finished the module with top marks in her class.

This module involved developing an interactive story related to medico-legal specimens available in the Museum using a piece of software called Storyline (Articulate Global Inc, New York, NY, US). In this method, the students would study the specimens in a role-playing-based scenario on their personal computers at home, but their presence in the Museum would be necessary in the course of the activity in order to obtain key information to complete the story. In this way, the students have a more active role. The stories developed in Storyline are meant to be an engaging and an interactive way of learning medicine with resources available throughout that link to useful scientific publication references. This follows the format of MBBS 1st and 2nd year scenarios.

The interactive story chosen to be recreated was based around the famous Church Cellar murder which took place in south-east London during the 1940’s. This choice was based on the information available at the museum, including the several specimens and artefacts relating to the case, and a book titled The Trial of Harry Dobkin (Benchhofer Roberts, 1944), which was a summarised transcription of the murder trial.

The main goal of recreating the trial of the Church Cellar murder was to join the facts, transcripts and evidence of the case in order to give the students a better understanding and knowledge of the evidence and processes involved in the forensic and legal examination of the case. This would allow the student to reach conclusions that corroborates the facts and evidence surrounding the case. Another goal is to reanimate the evidence in the Museum in order to encourage the student to observe those specimens with a critical but also human approach.
The story is accessible from the website once they have logged in with their King’s username and password. When students clicks on the link in the website to initiate the story, an e-mail is sent to them with a mock Juror summons letter requesting their presence at the Old Bailey for the 1943 trial of *Rex v. Dobkin*. The letter will give basic instructions on how to go through the interactive story.

Once the letter is read by the student, the story begins at the entrance of the Old Bailey (Figure 13). From here, the student is asked to enter their name and unique juror ID number found in the letter. Once entered, the student find themselves sitting in the courtroom of the Old Bailey (Figure 14) and have a chance to familiarise him or herself with the important figures present at the trial, including the famous Home Office Pathologist, Dr Kieth Simpson, a Professor based at the Guy’s Campus.

Figure 13. A screenshot of a scene in Storyline showing the entrance of the Old Bailey and a personalized text indicating their role designated in the story.
Figure 14. A screenshot of a scene in Storyline showing the courtroom with interactive buttons representing the real people who were present in the trial. Subtitles appear in the top, corresponding to the audio that is playing at that time.

Eventually, the student will be presented with the evidence of the trial, many of which are on display at the Museum (Figure 15). Some of the evidences will lead to a learning activity that the student will have to complete (Figure 16). Some activities involve the student needing to go to the museum in order to find the necessary information to move forward. Furthermore, some of these details hidden in augmented-reality based content where the student will need to use Layar in order to find it.
Figure 15. A screenshot of a scene in Storyline showing interactive content, which introduces the evidence presented in court. Numbers in green indicate complementary information of the case using audio and images, while numbers in blue indicate interactive activities.

Figure 16. A screenshot of a scene in Storyline showing a drag-and-drop interactive activity that needs to be performed by the students. In the right, possible answers are available that need to be dropped in the correct boxes on the left.

To add realism to the story, the approach taken was to record real voices and use photos of colleagues to represent real people involved in the trial (Figure 17). The colleagues were photographed in different poses, such as thinking, surprised and frustrated, for creating different expressions while the audio is playing. The audios are also always accompanied by text, in consideration of learners with hearing disabilities, and colours present in the diagrams used in the content where chosen with varying contrast in consideration of colour-blind learners.
Figure 17. A screenshot of a scene in Storyline showing members of the jury, which are interactive, in the discussion room. Photographs of colleagues were taken to add realism to the story.

The fact that they could start the study of those stories at their home and then, at some point during the course of it, a journey to the Museum would be compulsory for continuing the story is meant to discontinue the common approach of self-studying in a single environment.

3 Summary

The e-learning methods used to reanimate the forensic story and the presentation of the specimens in Layar would be the key to attract the attention of students, especially first and second year medical students whose visits to the Museum are not compulsory in the Curriculum, and encourage them to explore the Museum in more depth. This would initiate the contact with the Museum and probably contribute and facilitate their studies in the following years.

Our next steps in this project are to:

1) finalise the design of the website and complete the functionality,
2) populate the database with all ten revision sections of the museum,
3) develop an iOS app for exploring the Museum specimens which connects to the database, and
4) publish results to a journal such as the Medical Education Journal or Academic Medicine.

4 Research Output

Authors: Michael Truong & Kawal Rhode

21 September 2014


