School of Physical and Geographical Sciences

2007

INNOVATION IN TEACHING PROJECT REPORT

Simulated Crime Scenes

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Project Background

Active learning through field practicals should emphasise deep learning and understanding and will reinforce prior knowledge gained through the various theoretical lectures given. Students should also be able to individually evaluate the different location techniques. Providing student-led, group problem-solving exercises should significantly enhance the students’ learning experience. The relevant key transferable and employability skills learnt will include student critical thinking, team-working, problem-solving, communication skills, active learning in a field-based environment, and importantly, forensic work-related learning. This type of investigation also emphasises the multi-disciplinarily nature of forensic investigations, which has been shown to be really important in the ‘real-world’. Using the field site for student research purposes will also allow feedback of results back into the undergraduate degree programme, showing the students the importance of this link for their studies.

Project Aims & Methodology

The project aims were therefore:

- Create simulated outdoor campus crime scene facility;
  - Allows taught students to gain practical experience on a variety of simulated forensic case studies in ‘real-world’ working environments;
  - Allows students to practice forensic observational, data collection, processing & interpreting transferable skills;
  - Allows student-led, group problem-solved practicals;
- Provide test site for student under- and post-graduate research projects
- Use for out-reach & widening participation

A reduced budget of £1000 allowed the setting up of the study site after the proposal had been approved by both Keele University Ethics and Health & Safety Committees and by DEFRA. A specific site within the walled garden on campus was selected as it has limited use and the access gates are locked after normal Keele working hours (Figure 1a).

Three human-sized pig cadavers were buried in December 2007 at 0.5m below ground level to simulate clandestine human burials (Figure 1b). Pig carcasses are typically used as human proxies as they have similar skin type and hair, size and body fat:mass ratios. One pig acted as a ‘control’ outside the survey area for research purposes, to collect leachate by use of a lysimeter and to record cadaver temperature data (Figure 2). A lysimeter is a vertically orientated tube with a porous end cap that is under a vacuum, so therefore preferentially withdraws fluid from surrounding soil when inserted into the ground. A ‘blank’ grave was also created (with the same parameters as the pig graves but simply refilled) within the survey grid to add complexity. Smaller simulated weapons have been sourced but not emplaced to-date; these will be added for 2008-9 teaching courses.

Professor John Cassella from Staffordshire University, a forensic pathologist, then inspected the site and verified it was both realistic and gave students a location challenge (as their Forensic Science course has been running forensic recovery modules for many years).
Figure 1. (A) Location map and (B) site plan of the simulated crime scene site.

Figure 2. (A) Photograph of one wrapped pig and (B) the resulting crime scene.
This module course aims to provide advanced understanding of some specialist topic areas within forensic science which complement the core curriculum. Within the geoscience area, this includes understanding of local soil types, their classification and use of soil probes, standard surveying and forensic geophysical methods to detect buried objects. Intended outcomes are that students become familiar with geoscientific applications to a forensic arena, the ability to research areas within relevant disciplines and skills in writing a scientific report on field investigations.

JP is now module leader for this final year option course, now in its 2nd year of being run. The varying geoscience and computing disciplines were generally very well received by the student cohort, except for the field practicals. In the 2007-8 Spring semester, the 45 students were split into groups and tasked to conduct a search of a specified area and compile a scientific report. Their background was that “reports of individual acting suspiciously on campus at night. Witnesses state wide tracked, loaded vehicle & carrying spade. Preliminary investigations found surface tyre tracks over a specific area on campus”.

Their objectives were to:
- Split into 4 groups, lead non-invasive investigations under simulated crime scene conditions, decide upon appropriate techniques (using newly acquired knowledge from lectures & literature) and divide project tasks appropriately between group members;
- Limited numbers onsite & appropriate clothing to prevent site contamination;
- Use SOPs (Standard Operating Procedures);
- Each group member assigned task, signed in & out of site;
- Process & interpret results & compile scientific report for Senior Investigative Officer (submit via WebCT)

Students decided themselves which investigative technique(s) were used. These typically included standard topographic surveying using a total station theodolite (to determine if any ‘humps’ or ‘dips’ were present that could indicate a buried object), a soil probe survey (disturbed ground having less resistance to a metal pole than undisturbed ground) and a forensic geophysical technique (typically resistivity or Ground Penetrating Radar). Resistivity surveys are good for resolving decomposing material and GPR surveys are excellent for detecting buried objects. Students thus collected the field data (Figure 3), processed and interpreted results and compiled their investigative group reports. These were professionally compiled, most groups correctly identifying the target positions and prioritised them for the subsequent intrusive investigations, having a 65% mean mark. Student feedback was very positive and marks have improved from 2006-7 to 2007-8:

<table>
<thead>
<tr>
<th>Questionnaire Feedback (75% returns)</th>
<th>2006-7</th>
<th>2007-8 (out of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course content &amp; lecture averages</td>
<td>7.04</td>
<td>7.21</td>
</tr>
<tr>
<td>Practical sessions &amp; problem classes</td>
<td>7.38</td>
<td>7.07</td>
</tr>
<tr>
<td>Assessment</td>
<td>5.96</td>
<td>6.52</td>
</tr>
</tbody>
</table>

In-course evaluation was undertaken to ensure students were familiar with theory and available equipment, with field assistance and data processing advice through a seminar. Post-course feedback comments were generally very positive, examples: “practicals very enjoyable & gave great insight into CSH work” and “provided impetus for background reading”. Students learnt transferable and employability skills by ‘doing’ rather than learning about concepts. Most of the current 2nd year Forensic Science undergraduates have now signed up for this module for 2008-9! Improvements for the 2008-9 cohort will be to have smaller-sized
groups and individual report components. The simulated weapons will also be buried. There is enough protective overalls for the 2008-9 cohort (see budget).

![Figure 3. CHE-30013 students in crime scene clothing acquiring (A) Total Station survey, (B) GPR data and (C) Resistivity data.](image)

**ESC-10026 Structural Geology & Environmental Geophysics Module**

This module course aims to introduce key concepts in environmental geophysics through theory and practice. Geophysical outcomes are to enable students to understand how geophysical instruments work and used in the near-surface environment and how to interpret the resultant data.

This 1st year undergraduate Geology Degree module involved six environmental geophysical practicals. Previous years practicals either demonstrated geophysical equipment or used unrelated datasets that, whilst useful, did not enhance the student's environmental geophysics experience. In 2007-8, the student cohort was tasked to ‘solve’ where a clandestine burial may be located within a specified study site.

Their objectives were to:

- Assist in collection of bulk ground resistivity, GPR and magnetic gradiometry surveys;
- Digitise data within Excel & become familiar with data processing methods;
- Visualise data within ArcGIS ArcMap software;
- Interpret geophysical results and compile a prioritised target plan of the study site;
- Use geophysical results & supplied background material to generate a Powerpoint Poster to be submitted via WebCT.

In-course evaluation was also undertaken to ensure students were familiar with equipment and sufficient field assistance was given when acquiring the geophysical data. Significant support was needed for the data processing, interpretation and visualisation stages but this time was felt to be well spent as both the procedure and exposure to various software packages will greatly benefit students for their second and third undergraduate years. Post-course evaluation showed the project went down very well with the student cohort, anonymous comments: “really enjoyed forensic topic”, “learnt a lot of new skills in short time”, “want to do geophysics as a career!”. Interestingly the mean course evaluation went down 5 points within the ES&G marking system; this may improve once the practicals are run again for the 2008-9 student cohort. The mean submitted poster mark of 61% however reflected the enthusiasm for this practical.
Student Research Projects

A 2007-8 ESC-40006 Final year M.Geoscience student project student used the simulated crime scene as one of four sites to test the likelihood of magnetics being used as a forensic geophysical technique to locate a clandestine burial. The 1st class project outcome suggested limited success of the magnetics geophysical method in locating fresh burials if there are limited buried metallic objects associated with them, but is more detectable the older the burial is. This student also won the Geology Myers prize (assessed by an external panel) for the best student project.

Pig leachate has been collected every two weeks since burial and frozen (together with a control soilwater sample from nearby) which will be used as the basis for 2008-9 CHE-30011 Forensic Science Team Projects to analyse and see how elements, lipids, conductivity and pH may change over time as the cadavers progressively decompose (Figure 4). This will also use weather data from the nearby Keele Weather observatory and geophysical surveys also collected from the crime scene site every two weeks by an ES&G PhD student (Figure 5). Research will feed back results into the undergraduate degree programme, showing the students the importance of research in their studies.

This research is collaborating with other academic institutions and various Police Service Agencies to assist location of clandestine burials of murder victims and shows real promise. Two research papers are already in press (see list at end of report) with another in preparation based on this research area.

A robust series of forensic geophysical surveys will also be collected by a 2008-9 ESC-40004/5/6 Final year M.Geoscience student project over late summer, to see if there are significant differences from collecting resistivity surveys from different orientations (termed anisotropy) over a clandestine burial.

Figure 4. The 4-stages of decomposition that are suggested that may change geophysical signature. Stage (C) may be optimal for resistivity surveys.
Figure 5. Mapview example of a bulk ground resistivity survey acquired over the study site. Note the resistivity low associated with the naked pig and the resistivity high associated with the wrapped pig compared to background normalised values. Courtesy of J. Jervis.

Widening Participation & Outreach Activities

The simulated crime scene was also used to demonstrate forensic geophysical techniques to Mid-Cheshire College HNC and HND students in Spring 2008 after a theoretical lecture was given. Informal feedback from accompanying teachers showed that field-based demonstrations really gave the students an appreciation of the different techniques used and their operation. This activity will hopefully lead to more Keele University applications from these visitors!

Budget & Justification:

The School of Physical & Geographical Sciences (SPGS) had the necessary staff expertise, having been involved in collaborative simulated crime scene creation with Staffordshire University in 2006-7, so the principal project costs were dominated by the material needed to be buried and site safety equipment, both listed below. All site material was prepared, hand-excavated, buried and re-filled to keep costs down and crime scene realism (rather than using mechanical excavators for example). It was important to provide a variety of materials, buried at different depths so that the breadth of student abilities can be realized and different degree course module practicals could fully utilise the resource.

<table>
<thead>
<tr>
<th>Material</th>
<th>Costs</th>
</tr>
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<tbody>
<tr>
<td>Purchase of 3 pig carcasses</td>
<td>£300.00</td>
</tr>
<tr>
<td>5 x Tarpaulins</td>
<td>£26.04</td>
</tr>
<tr>
<td>2 x monitoring lysimeters and extraction kit</td>
<td>£269.26</td>
</tr>
<tr>
<td>100 x Vinyl gloves, protective suits, overshoes, mob caps &amp; 3 x PVC gauntlets</td>
<td>259.98</td>
</tr>
<tr>
<td>1 x 100m measuring tape</td>
<td>£42.37</td>
</tr>
<tr>
<td>4 x waterproof field notebooks</td>
<td>£28.40</td>
</tr>
<tr>
<td>1 x conduit, fittings box &amp; thermo-couple (already had thermometers)</td>
<td>£34.32</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>£960.37</strong></td>
</tr>
</tbody>
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Obviously the biological material will degrade with time, so it is proposed that another pig carcass will be buried in Autumn 2008 to demonstrate the effects of progressive corpse decomposition. This will be funded as part of a current SPGS PhD forensic geophysics project.
The next stage:

Web-based, case study resources are still in the process of being written, although the data (vod-casts etc.) have already been collected, and these will be uploaded onto the web once complete. An initial web-site page has already been written (see www.esci.keele.ac.uk/geophysics/Research/forensic) with more material added once completed.

Acknowledgements

The 2007-8 CHE-30013 and ESC-10026 module student cohorts, John Jervis, Victoria Lane, Tim Millington and Malcolm Wright for crime scene set-up and student practical assistance. Amy Cowles and Victoria Hill are thanked for laboratory assistance with leachate samples.

Research Papers

