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3D virtual geology field trips: opportunities and limitations

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3D virtual Geology field trip: opportunities and limitations

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<http://www.open.ac.uk/researchprojects/open-science/>



[Background: In Science modules at The Open University (OU), we provide students with a number of interactive online experiments – such as using a virtual microscope to view rocks to carrying out flame to remotely controlling a microscope in an astronomical observatory.]

Before we discuss with you about the 3D virtual geology field trip and our reflections on its design and development, we will give you a brief background of our 3D initiatives in teaching, learning and research at our university.

I think for us, as a distance education institution, 3D virtual environments provided a number of opportunities: we were able to bring our students for tutorials – specifically those students who were unable to attend tutorial face-to-face due to mobility or family constraints.

We were able to provide students with a platform for meetings for groups projects.

Students formed their own self-help groups and were supporting one another.

Why virtual fieldwork?



<http://www.see.leeds.ac.uk/current/fieldwork/equipment.htm>

Against this backdrop of our being convinced about the significance of 3D virtual worlds in education, peer-to-peer learning, procedural learning, and so on, we have still had this resistance at the institution level

So, when we received this funding, we wanted to use a Science activity that had scope to demonstrate interactivity...

We could show the realism and high degree of fidelity..

Give students the sense of being there...

But also help internalise the sense of exploration...

And the scope to integrate non-realism for enhancing learning and student engagement...

We chose the 3D virtual geology field trip when the Wolfson Funding came through and for the 3D immersive environments strand

Why virtual fieldwork?



- distance learning – sparse provision
- accessibility
- support real fieldwork
 - familiarisation before
 - revision/reflection after
- introduction to fieldwork
- 'beyond fieldwork'
- Resources (costs)...



Distance education – there is anyway a sparse provision of real field trips

Accessibility and mobility are constraints

Also virtual field trips can support real field work

Such as preparation and familiarisation

Revision and reflection after a field trip

It can be a key introduction to basic fieldwork skills

Also, schools and higher education institutions may have resource-constraints

Field trips at our university



Attribution: <http://www.flickr.com/photos/neilt/58566273/in/set-1264989/>, and <http://www.flickr.com/photos/itsaboyd/6040957070/sizes/l/in/photostream/>

- real world field trips two or three times a year (tutor-led)
- DVD to facilitate reflection and activities
- DVD also helpful for students who are unable to go for real world field trips

At our university, we have field trips two or three times in a year which are tutor-led

But if the weather is not helpful, students are not able to cover all the sites that had been planned for them

Not all students can go for the field trip

It is very much a first-come-first-served scenario


Some can't go because of age, mobility, family constraints...

We provide students with a DVD that covers all the sites of the field trip – this DVD is for reflection for students who were able to make it to the field trip.

For other students who were unable to go, DVD helps in knowing more about the field trip and for carrying out activities

What we built?

Unity Web Player | WebPlayer



- 100 km² area**
low- res terrain maps, X-section
- 6 detailed sites**
higher res hand specimens task lists
- Navigation**
guided (linear) free-roaming teleports
- Chat**
range adjustable
- Support**
manual, transcripts

The Skiddaw field trip in the Lake District of the UK is an integral part of Earth science teaching at the OU

Students carry out a field trip with their Geology educators in the Lake District.

The application that we developed in Unity 3D is based around a 10km x 10km low/medium detail model of the terrain and LiDAR data around Skiddaw...

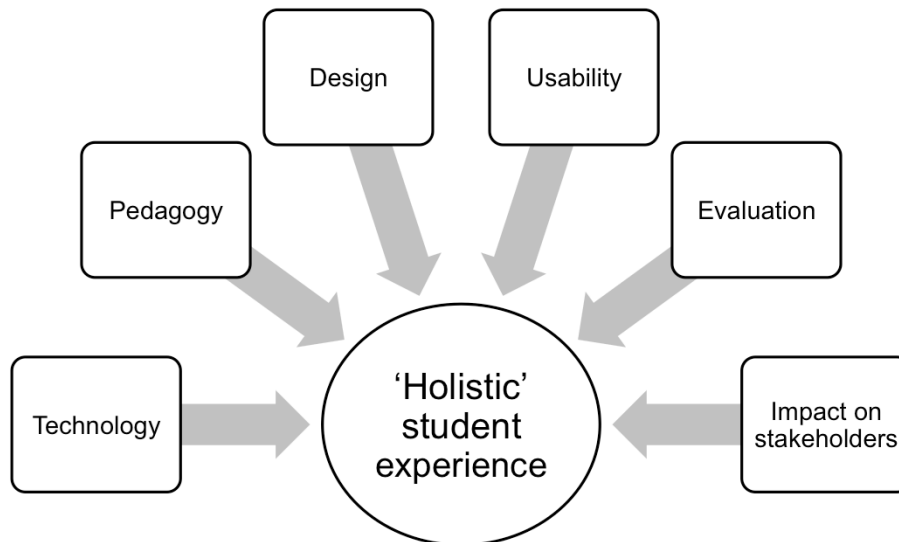
...with overlaid aerial photography, and including walls, trees, buildings etc.

There are six sites; students can go from one site to another; or they can teleport to any site

each site has rock specimens that you can pick up and view under a virtual microscope

There are rock sketching activities

Framework of student experience



This framework has various aspects that we considered during the design and development: which guided our decisions and work on the project

Technology: Second Life, Unity 3D or Open Sim

Pedagogy: existing activities that we had in S276 (OU's Geology Module) and which we adapted for the 3D environment

Design: Tutor briefings within the application; fieldwork toolkit; transcriptions on the website; study guide on the website; (not included pdfs within the environment so that users don't have to move between 2D and 3D which may influence their immersive experience)

Scope for contextual learning within the application by integrating the maps and virtual microscope

Usability: Navigation, Wayfinding, Design of the HUD (menus),

Evaluation: by the OU team; graphics designer; informal evaluations with PhD students

Technology: Unity 3D gaming engine

- '3D' landscape – geology in context; spatial literacy
- Web-based application and integrated within Open Science Lab
- Rich interface – interactivity, rich resources, guidance, scaffolding
- 'More than fieldwork' – do something different:
 - flying
 - aerial views, map overlays
 - in-world cross-section
 - teleports (time-saving)
 - fadable avatars

Technology

Using Unity 3D gaming engine

Build a '3D' landscape – students are learning geology in context; spatial literacy

Browser-based application within the Open Science Lab

Develop a rich interface – interactivity, rich resources, guidance, scaffolding

'More than fieldwork' – do something different:

Flying

aerial views, map overlays over mountains: geological map, ordnance survey map

in-world cross-section of a mountain that shows the variety of rocks in the area

teleports (time-saving)

Pedagogy: principles



- adapted learning activities of OU's Geology module (code: S276)
- designing in-world and web-based materials
- contextual learning through the integration of maps, rocks and virtual microscope
- collaborative learning through a multi-user avatar-based environment
 - transforms virtual field trip experience, especially for distance learners

Pedagogy

Integrating subject or discipline specific principles: Pedagogy: existing activities that we had in OU's Geology Module S276 and which we adapted for the 3D environment

Tutor briefings within the application; fieldwork toolkit; transcriptions on the website; study guide on the website

Scope for contextual learning within the application by integrating the maps and virtual microscope

Collaborative learning through a multi-user avatar-based environment:
transforms virtual field trip experience, especially for distance learners

Design of the App



- self-contained (mostly) to enhance the sense of immersion
 - limited external or linked material
- integrating realism
- non-realism design aspects

Design

What should be included in the virtual world? what should be on the website?

Or which aspects students should practise in the real world rather than in a virtual environment...

So, in this project, Tom insisted that students should learn to sketch in real notebooks; how they should learn to maintain a geological field notebook

not included pdfs within the environment so that users don't have to move between 2D and 3D which may influence their immersive experience

Integrated both realistic and non-realistic aspects to enhance the learning experience

Realism in the design



- Realism
 - design of the environment or landscape
 - LIDaR data
 - Photogrammetry data
 - 3D modeling to weave it together
 - learning activities (similar to a real world field trip)
 - choosing the equipment, learning to use the compass, sketching rocks

Realism characteristics are:

In the design of the environment or landscape

LIDaR data

Photogrammetry data

3D modeling to weave it together

learning activities (similar to a real field trip)

choosing the equipment, learning to use the compass,
sketching rocks



Non-realism in the design

- Non-realism (things you can't do in a real world field trip)
 - microscopic views of rocks within the environment
 - draping maps on the landscape
 - cutaways into the mountainside to see the geology underneath

Non-realism (things you can't do in a real world field trip)

microscopic views of rocks within the environment

draping maps on the landscape

cutaways into the mountainside to see the geology underneath

Video 1 shows the realism aspects

http://youtu.be/5_h4NI3AvCY

Video 2 shows the non-realism aspects:

<http://youtu.be/MOdu5jQukUk>

Usability: design principles



- user experience: navigation, wayfinding
- interaction design of the HUD
- principles of consistency, feedback, simplicity and accessibility

Usability

Usability of the environment is paramount – as students will be mostly coming on their own to practise and learn

Design of HUD was fundamental to the user experience as it is the most important interaction interface in the entire application

Followed the principle of consistency – so, after we designed the first site, the other five sites were designed around the same principles for interaction design and navigation

Feedback: message boxes to alert the user

Simplicity: the design is simple in the sense that we have emulated the behaviour with 2D interfaces that users would already be familiar with

Accessibility: the app is fully keyboard navigable

Evaluation: on-going initiatives



- iterative evaluations from multiple perspectives
- informal evaluations with colleagues outside the project team
- workshop at the OU (Esteem Conference)
- planned evaluations: schools, Second Life users

Evaluation

iterative evaluations – throughout the process of design and development, as a team, we were performing different roles: Tom looking at the pedagogy

For example, Shailey was looking at the 3D aspects; Brian was looking at the accessibility of the application

One colleague was focussed on the graphic design (Sara Hack) – the design of the Head-up Display (HUD), the design of the menus, the design of the avatars

Impact on stakeholders



- Field Study Council
- copyrights and IP issues
- educators, students
- OU module teams
- introducing in schools
- administrative costs of setting up accounts

Impact on stakeholders

Overcoming the concerns of FSC that we were trying to replace real world fieldwork trips.

Copyrights (for the maps used) and IP issues (developer vs. OU)

Educators: training and adapting the environment for their curriculum and activities

Students: some may not be familiar with the 3D environments (user manuals); some might not like avatars (first person and third person views); study guide and transcripts for preparation

Technology that they would need: such as the Chrome Browser; Unity 3D plug-in

OU module teams: how it can be introduced in OU modules: the 3D virtual Geology trip, has become an integral part of OU's Earth Science teaching: in S276 *Geology*, S288 *Practical Science* and in S209 *Earth Science*. For the first time, students will have an authentic experience of a field trip within a 3D realistic, interactive and collaborative space.

Opportunities for students and educators



- practice/training for real world field trips
- reflect on your experiences of real world field trips
- fly across the landscape
- additional field trip to a real world field trip
- could replace a real world field trip if resources are limited

A rich assemblage of linked learning resources within the context of a real-world landscape

A convenient place for students to engage with innovative practical science activities

A personal learning environment that will help internalise the sense of exploration

A group learning environment and, hence, a social experience – resulting in the building of team spirit and staff-student relationships

The capability for conducting activities above and beyond what is feasible during a real world field trip – for instance, aerial fly-throughs for panoramic views, seasonal changes, scale changes from regional geology to close-up and microscopic views of rocks, or cutaways into a mountainside to see the geology beneath

An opportunity for contextual learning, that is, being able to explore, observe and gather data within the context, e.g. using a virtual microscope

Limitations: student learning and experiences



- risk awareness skills
- challenges of being outdoors
- challenges posed by the weather
- challenges of using the equipment in real life
- bonding with other students

Limitations are:

Risk-awareness skills – falling, being aware of the edges of mountains

Challenges of being outdoors – whether it is the clothing and shoes; how to protect yourself in intense heat; what to do in emergency situations?...

...the limitations of conducting observations and measurements in a real world field environment

Challenges posed by the weather – to keep your field notebook and other instruments dry

Challenges of using the equipment – encountering unfavourable weather conditions - for example, reading the instruments in strong sunshine

How to work collaboratively under the challenging conditions of weather or just being outdoors? It requires a different kind of social skills than collaborating online

Lessons learned



- trade-off: detail vs performance
 - limited high-resolution sites
 - hand samples data-heavy – alternatives?
- intense development
 - prepare comprehensive spec
 - frequent Skype meetings
 - site visit essential for developers
- multi-user functionality transforms experience
- combat fear that virtual field trips will replace real fieldwork teaching



Some lessons that we learned

We could not have high resolution environment everywhere

Compromise between the size of the build/file and the resolution

So only those places where the students carry out the activities are highly high-res but the rest of the environment is low-res

Rocks – real samples were photographed and brought in the environment – again very data-intensive

Therefore: Trade-off between realism, student learning and experience and size of the file that has to be run

It was quite an intensive development process: it was a funded project – but could we devote so much of time and energy in non-funded projects?

Reflections on the project



- internal team roles
- external development team (Daden: <http://www.daden.co.uk/>)
- communication technologies and protocols
- log of all decisions and next steps
- requirements creep
- flexibility in the funding

We had two teams – an internal team – project manager, subject expert, a production manager

External team consisted of colleagues at Daden who had the flexibility to bring in experts as and when required

They brought in a 3D modeller at a very short notice

They had two Unity 3D experts on their team

We also set up regular meetings and protocols: so, every Friday early afternoon, we would get the build from the developers; on Monday, we had a project meeting over Skype where we shared our thoughts

The meeting notes were recorded and logged as actions for the developers

Requirements did creep as we wanted avatar names to appear, or we wanted users to be able to have texting facility, or we added a number of accessibility features – so, our entire application is keyboard navigable

Resources



- 3D Virtual Field Trip:
https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=skiddaw_1
- Demonstrations on YouTube:
Video 1 (realism aspects): http://youtu.be/5_h4NI3AvCY
Video 2 (non-realism): <http://youtu.be/MOdu5jQukUk>
Video on Vimeo by Daden <http://vimeo.com/78057630>
- Papers and other presentations are available on:
<http://oro.open.ac.uk/view/person/sm577.html>

Details of the 3D application

The Open Science Laboratory (introduction): <
<http://www.open.ac.uk/researchprojects/open-science/>>

The Open Science Laboratory (activities): <
<https://learn5.open.ac.uk/course/view.php?id=2&page=1>>

3D Virtual Field Trip: < : <
https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=skiddaw_1>

Demonstrations on YouTube:

Video 1 (realism aspects): http://youtu.be/5_h4NI3AvCY

Video 2 (non-realism): <http://youtu.be/MOdu5jQukUk>

Video on Vimeo by Daden: