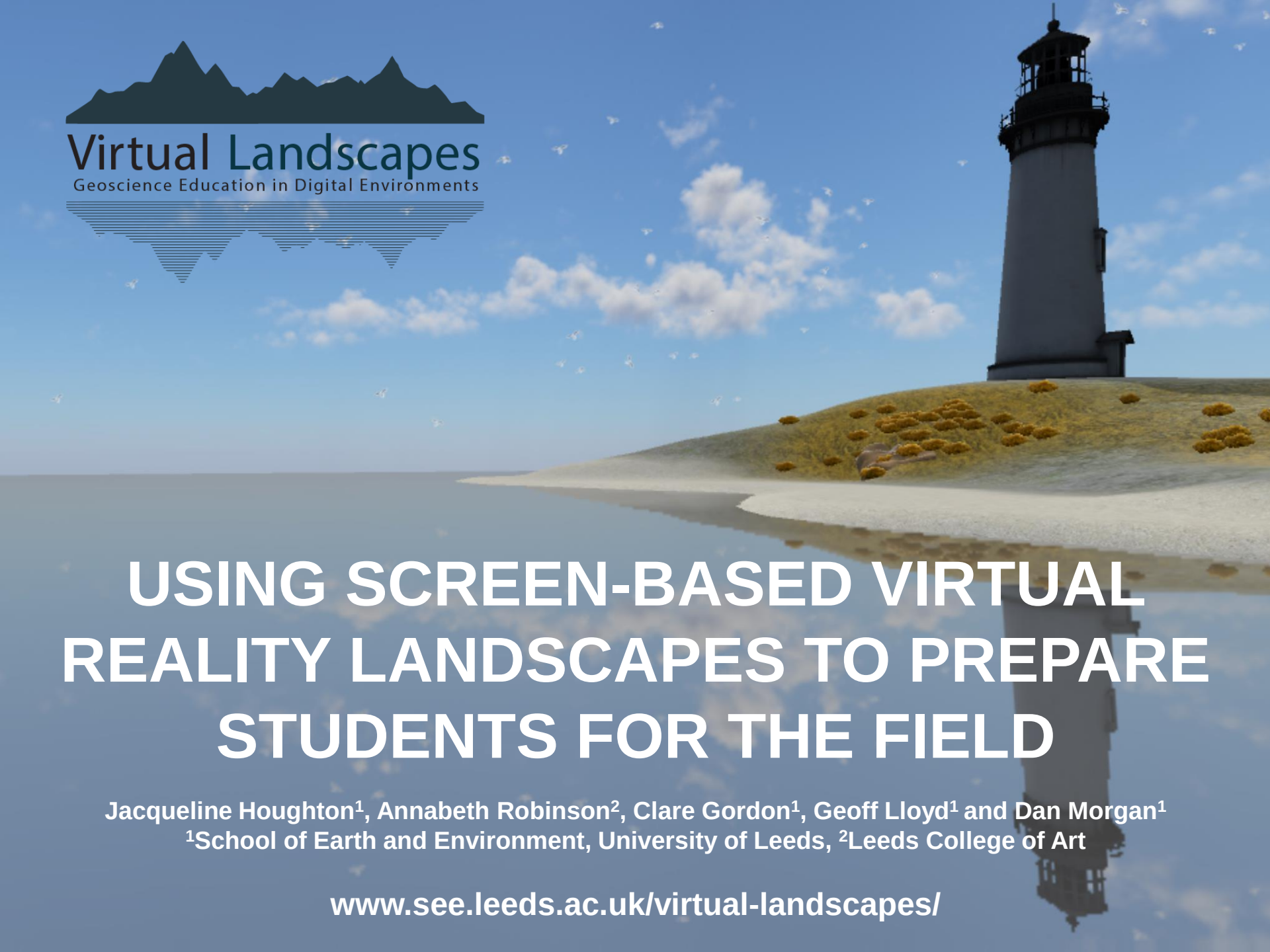

USING SCREEN-BASED VIRTUAL REALITY LANDSCAPES TO PREPARE STUDENTS FOR THE FIELD

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Virtual Landscapes

- Create screen-based virtual reality environments.
- Built with Unity 3D.
- Enhance training students receive in preparation for fieldwork.
- Replicate aspects of the mapping experience - ***not a fieldwork replacement*** as they cannot teach key observational skills.

Mapping & Field Skills

- Designed as in-class exercises with paper field slips and notebooks.
- Virtual landscapes populated with ‘outcrops’ with ‘notebook’ entries giving information on the rocks.
- “Three River Hills”: original world, complex geology.
- “Lighthouse Bay”: simple geology, better looking.

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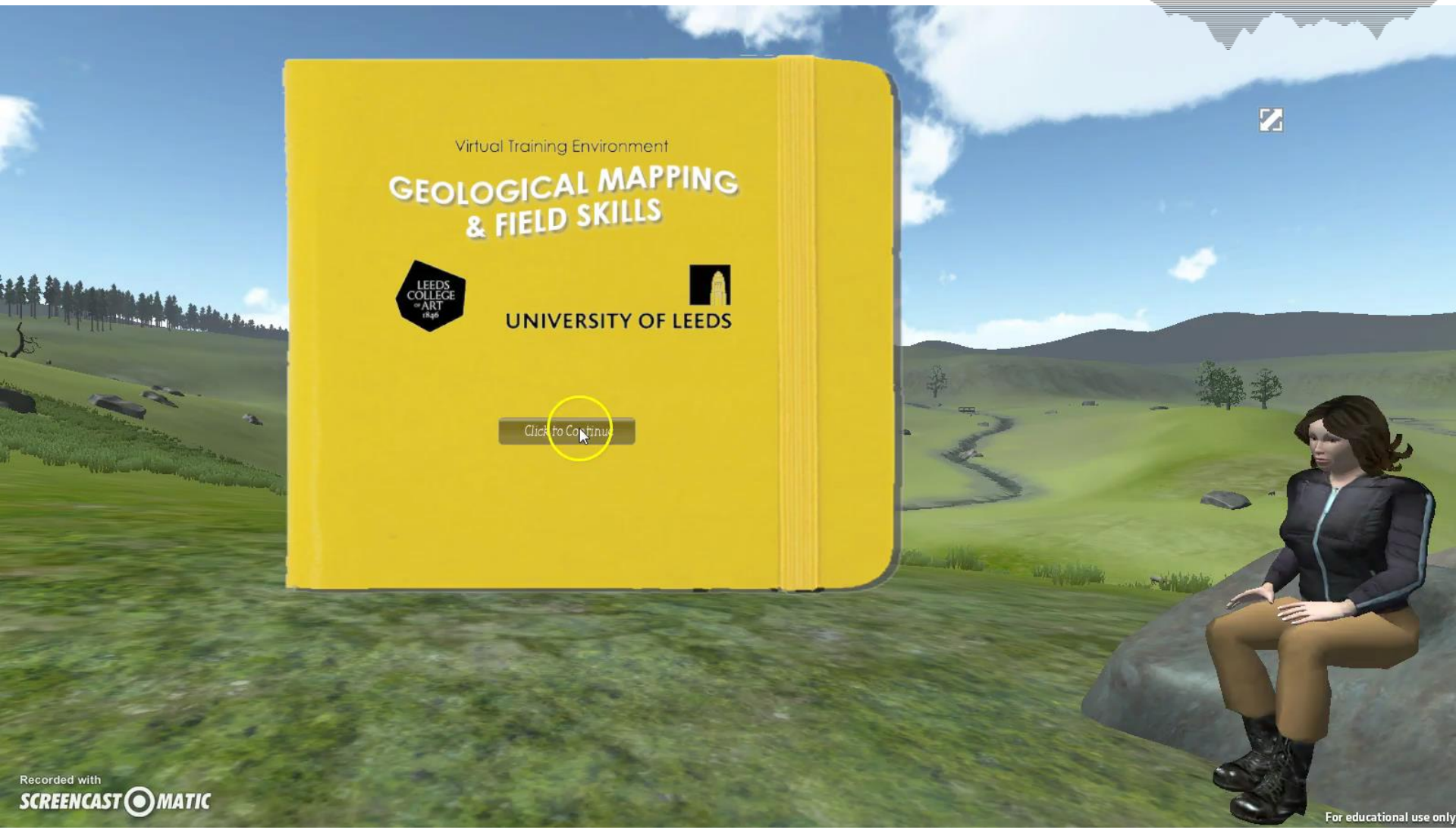
Virtual Landscapes
Geoscience Education in Digital Environments



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Mapping & Field Skills

- Using grid references.
- Plotting outcrops and readings on a field slip.
- Interpret data and decision making skills.
- Thinking in 3D.
- Constructing a geological map, cross section and stratigraphic column from own data.

Use in the Class Room

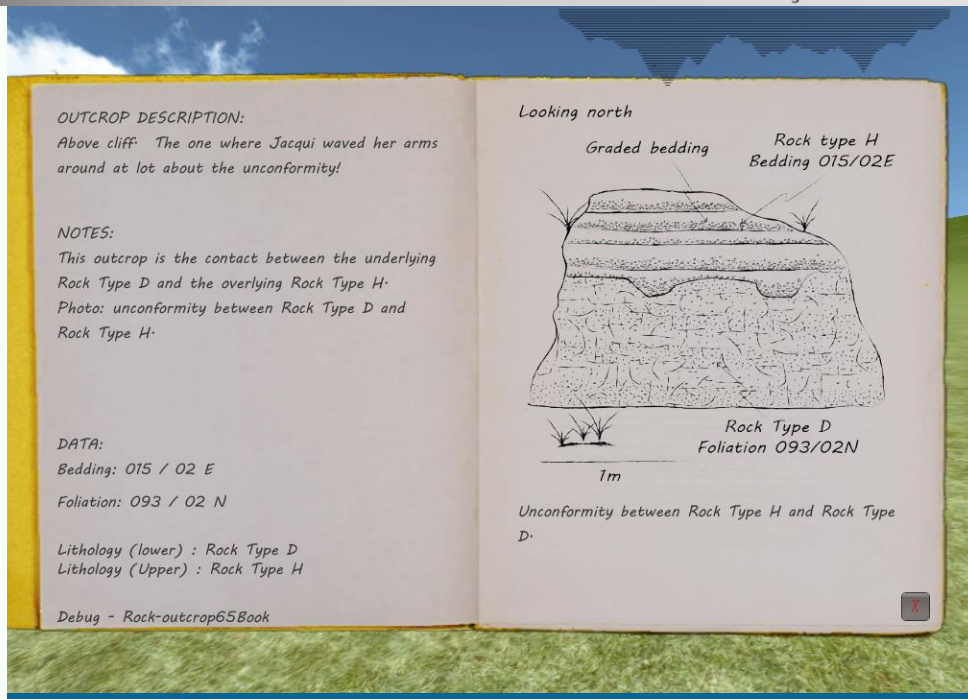
- Easier to focus on learning and teaching the skills in a classroom than in the field.
- Students made the same mistakes they make when learning in the field.
- “Outcrop capture” – get ’em on the map fast; worry about the geology later.

Results in the field

- Staff reported time saved in the field as basic skills already embedded and increase in student confidence.
- “I feel/felt better prepared for the field”
  - Pre-trip 69%
  - Post-trip 60%
- “I found the virtual training a useful experience mapping”
  - Pre–trip 80%
  - Post–trip 71%

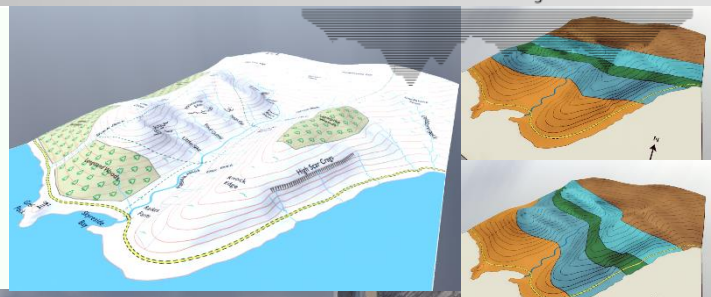
Accessibility Benefits

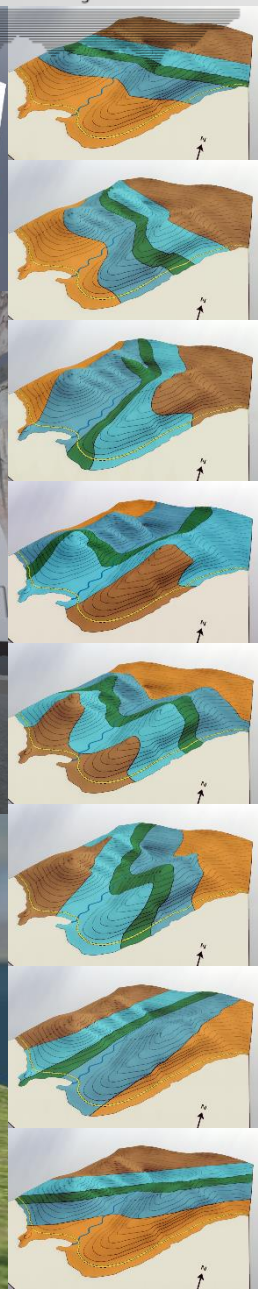
- Create alternative field trips for students with health/mobility issues.
- Hand specimens and thin sections, photographs.
- Assessment : Field report, map, cross section etc.
- More closely matches learning outcomes.
- “Hybrid trips”: Recreate specific localities for students who can attend field trip but not reach every outcrop.



Other worlds and future plans

- More alternative and hybrid field trips.
- Site investigation type fieldwork.
- Interactive block models demonstrating outcrop patterns.
- Other subjects.
- Research.





Summary

- Game-based training environments.
- Learn basic skills before going into the field.
- Develop 3D visualisation skills.
- Field skills training for those unable to access the field.
- Results:
  - Increased confidence in field skills.
  - Time saved in the field.
  - Improved performance.

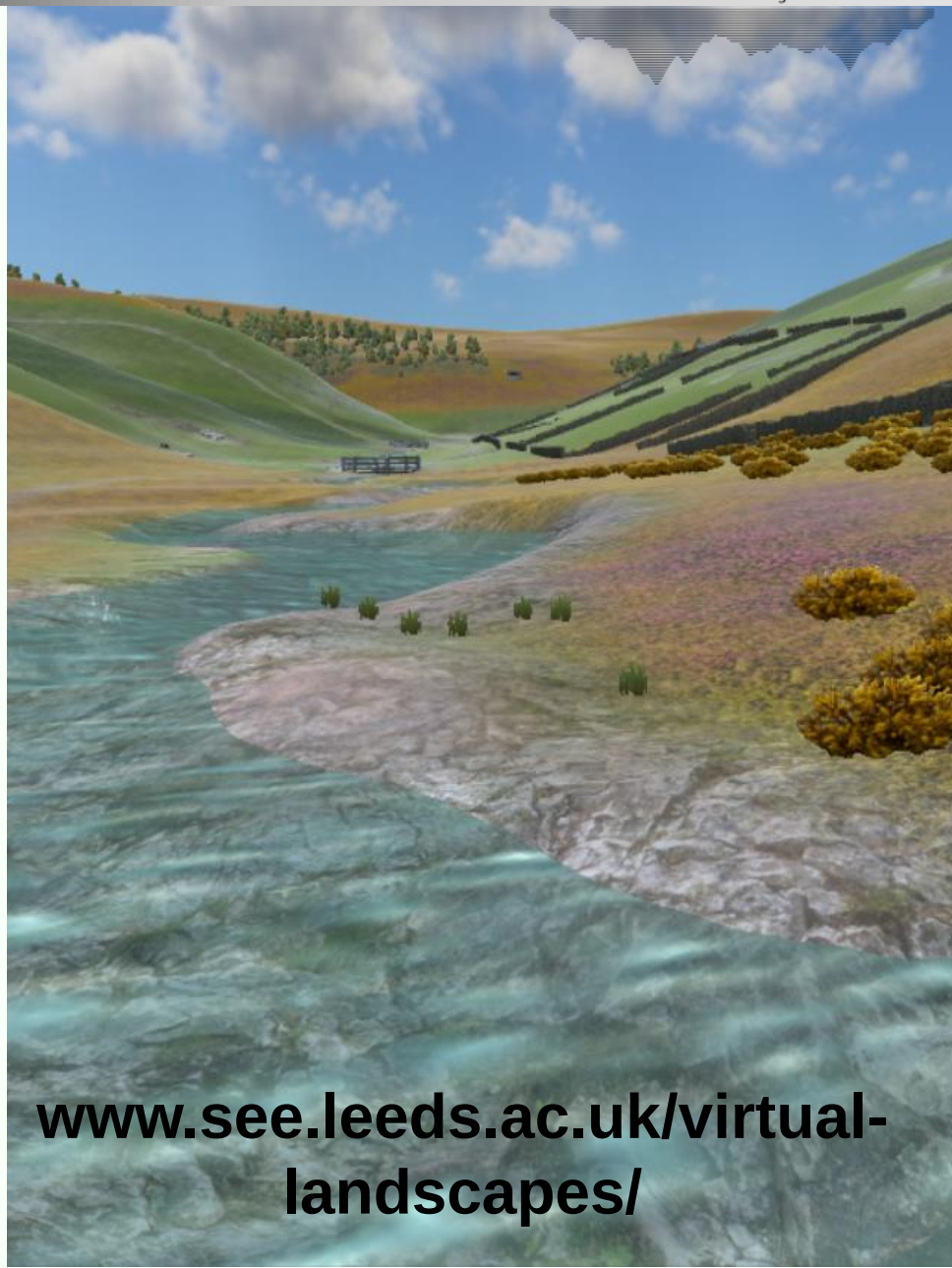


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Figure 1: View of the lighthouse.

Using **Interactive 3D Block Models** of **Geological Maps** in **Geoscience Education**

Jacqueline J. Houghton[1], Annabeth Robinson[2], Clare E. Gordon[1], Geoffrey E. Lloyd[1] and Dan Morgan[1].

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1. Introduction

We have created a series of screen-based virtual reality terrains, using the Unity 3D game engine, to demonstrate the 3D interaction of geology with topography and the outcrop patterns produced. These interactive block models can be rotated, enlarged, walked and flown around.

A geological map expresses the 3D relationship between geology and topography in a 2D form; to understand and interpret a geological map it is necessary to be able to visualize the 2D map in 3D. However, 3D visualisation and 3D/2D relationships are concepts many students struggle with and only fully appreciate once in the field.

The worlds are built using the Unity development platform and require the Unity Player (https://unity3d.com/webplayer) to play. Unity 5 is software, produced by Unity Technologies, that provides the basic 3D graphics technology needed to develop a computer game (https://unity3d.com/). Our worlds are designed for PC/laptops, but not mobile platforms (yet).

Figure 2: Outcrop alongside the gorse. Clicking on the outcrops brings up information on the rock type.

Virtual Landscapes is a project to develop screen-based virtual reality environments, using the Unity 3D game engine. These games are used to enhance the training students receive in preparation for fieldwork, and to help them develop their 3D visualisation skills.

The project is a collaboration between the School of Earth and Environment, University of Leeds and the Leeds College of Art, UK.

Virtual Landscapes
Geoscience education in Digital Environments

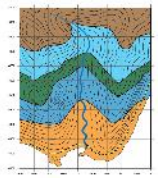

Figure 4: 2D geology map of the natural landscape.

2. 3D Geological Maps

We have taken the traditional block diagram of a valley with two hills and a geological unit running through it used to teach outcrop patterns and created:

1) A natural vegetated landscape complete with rock outcrops can be mapped, allowing a student to create their own field map, which can then be compared with the 3D answer (figures 1, 2 and 3).

2) A series of interactive 3D geological map block models (figures 4, 5 and 6).

3) A 3D block model of the topographic map / field slip (figure 7 and 8).

Figure 7: 2D topographic map.

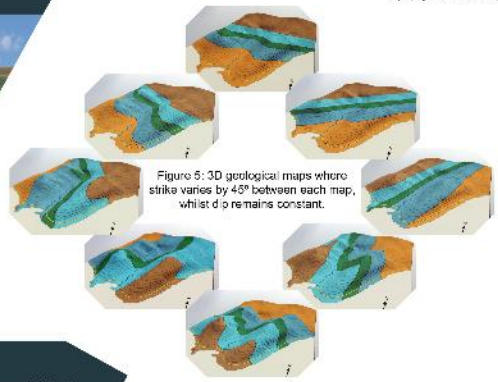

Figure 5: 3D geological maps where strike varies by 45° between each map, whilst dip remains constant.

Figure 8: Distant view of the 3D topographic map (left), ground view of the 3D topographic map (centre) and ground view of the geological map (right).

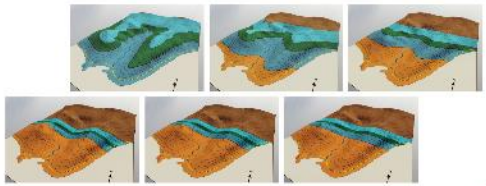

Figure 6: 3D geological maps showing the variation in outcrop pattern with changing dip. Dips: 0°, 11°, 22°, 45°, 64° and 90° (clockwise from top left).

3. Classroom Use

These interactive block models of geological maps have been used in a first year undergraduate geological sciences maps course at Leeds, UK (photo above). They were used in class to cover the concepts of outcrop patterns, such as v-ing in the valleys, the variations in apparent thickness of units with dip and how changes in strike effect the outcrop patterns. These were introduced by the lecturer, with the students given a paper copy of the map and time to explore the maps both during and outside of class time.

The natural landscape version was used with a group of twenty schoolchildren (17-18 year olds) (photo below). They created their own geological maps of the area then compared how they had done against the answer. This was followed by a discussion on how understanding the relationship between the geology and the topography shown by outcrop patterns can help in the creation of geological maps.

All our virtual landscapes are freely available online at www.see.leeds.ac.uk/virtual-landscapes/.

4. Evaluating Student Response

A direct comparison between the student cohort using the interactive maps and the previous year's cohort is difficult due to a change in teaching staff. However, the lecturer concerned felt using the interactive block models engaged the students with the subject as well as developing their 3D visualisation skills and was at least partly responsible for the increase in the average exam mark from 53 -73%.

The schoolchildren's response was also positive.

"Exploring how geology patterns are actually mapped."

"Seeing the geological maps in 3D it made it easier to understand and visualise."

Watching both groups use the landscapes has enabled us to refine and update their appearance and interface.

Figure 3: Panoramic view up the valley, taken from the bridge on the coast.

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