

Future Landscapes

Research report



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1. INTRODUCTION

This document provides a brief overview of the origination, development and prototype of Future Landscapes, and raises some issues for consideration in the further development of this and other such resources. It does not provide a detailed analysis of the interactions observed with the tool or any evaluation of learning gains in using the tool but is intended primarily to give an insight into the prototype created and a flavour of some of the issues and ideas arising from its development.

2. ORIGINAL IDEAS FOR THE PROJECT

The Future Landscapes project was an original idea from Fred Martin of Bath Spa University College. In his initial proposal, he suggested the following goals for the project:

The proposal is to create software that would combine a number of ICT technologies in order to allow the user to ask 'what if' questions about their environment, ie to simulate change from present landscapes in specific locations to several options for future landscapes.

The project would combine digital mapping and photo images to create landscape options as an aid for decision taking. This could, for example, relate to evaluating a landscape as a possible location for a new housing area or other development. Elements of the technologies to do this already exist, for example, the ability to change landscapes in games such as Sim City, the use of GIS technology to create both plan view and 3D landscapes, and the ability to morph between images. Programs that allow the user to plan gardens and kitchens also contain elements of what I envisage. These elements, however, do not appear to exist in a single program that would allow the user to visualise and perhaps also to 'walk through' a simulated landscape. The program would be capable of selecting a base layer of contours to create a 3D image. It could simulate the landscape of an OS map as it is at present by using a range of standard images, perhaps supplemented by photos, both ground and vertical air. It would then be capable of being manipulated to create a future landscape by inputting different options for future land use. Links could be made to a GPS system to create accurate locations for the landscape. The user would be able to create scenarios based on different approaches to planning, eg to create high-tech or a 'green' sustainable future. This would involve creating an extensive bank of images on which to draw, either simplified or based on photos. These would fit into the landscape at an appropriate scale to create a realistic effect. An additional facility could be to create an evaluation system based on numeric weightings, ie to 'score' different landscapes according to their aesthetic, economic and other values. The weightings could be varied depending on the type of future that is envisaged.

The educational rationale for this project was the perceived need in both subject disciplines and cross-curricular activities to enable children to engage in 'future thinking' activities about the environment they live in. As Martin outlined in his proposal to Futurelab:

A stated aim of the National Curriculum is to prepare students in schools for their future. Yet few subjects on the school curriculum adequately encourage students to consider the possible future environment in which they could be living. Perhaps work in geography comes the closest to encouraging students to think about this and the way in which they have a part in creating it over the next few decades. It is difficult to engage students in future thinking. It involves a high degree of creativity and for many, the ability to visualise the future. The software would enable students to become active participants in the planning process, something they are encouraged to do through the citizenship agenda. The links with thinking skills are also obvious as the students would be engaged in

prediction and applying ideas. Some ICT-literate teachers currently attempt to engage their students in this kind of work by using existing 'odds and ends' of technologies (see above). An alternative approach is to get the students to draw diagrams or build models. In the USA, there are state competitions to engage the students in planning future landscapes. Similar projects have appeared in the UK from time to time, eg as part of millennium events. An approach I have used with my own students is to use Lego blocks; hardly 21st century technology, though it works!

3. THE FUTURE LANDSCAPES PROTOTYPE

The Future Landscapes prototype was created in response to these early ideas and in collaboration with teachers, children, developers (Geomantics) and Fred Martin. While not all elements of the original vision were achievable within the time and financial limits of the project, the prototype does enable children to create a bridge between 2D and 3D representations of environments, to add elements (supermarkets and wind turbines) into that environment, to explore the different features and factors which might contribute to decisions on where to locate such elements, and to see the outcome of their decisions in 3D photorealistic form. All of which, with appropriate teacher support, can form the basis for the sorts of future thinking about their environment envisaged in the original proposal. In summary, the prototype aims to combine modelling, landscape realism and the ability to use the graphical information systems (GIS) principle of being able to overlay data. It is *not* just software that allows a 3D model to be added to a landscape.

To date, we have conducted only usability trials with the prototype, but it is envisaged that as a resource the Future Landscapes prototype should be used in the context of field activities and with teacher support.

3.1 Installation requirements

The final prototype runs on PCs with high graphic capabilities (specifically using a GeForce FX5700/version 6 or above graphics card). It is a standalone application installed on the hard disk. It has to be installed in a fixed location as the file locations are hard coded. This dependence on the specific graphics card, while appropriate for early trials, is an issue that would require further consideration if a practical classroom tool is to be developed.

3.2 Software functionality

The student begins by selecting an activity. Currently they can choose where to locate three wind farms in a rural setting or a shopping mall in an urban setting.



Figure 1: Future Landscapes, choice of task

Once the task is selected they are then asked to select up to six information sets that they consider will influence their decision. The information sets contain choropleth data, that is, data concerning the status of a geographic area, for example population densities, land use etc, and can be edited or new ones added by the teacher. There are two types of sets:

- GIS data, that is, choropleth maps shaded by category, for example areas with the same range of wind speeds, population or scientific value listing – these require a key.
- General terrain data, for example, maps showing the location of woodland where there are no categories within the data set but that would influence the appearance of the landscape.

Scaffolding for this selection is provided externally by the teacher.

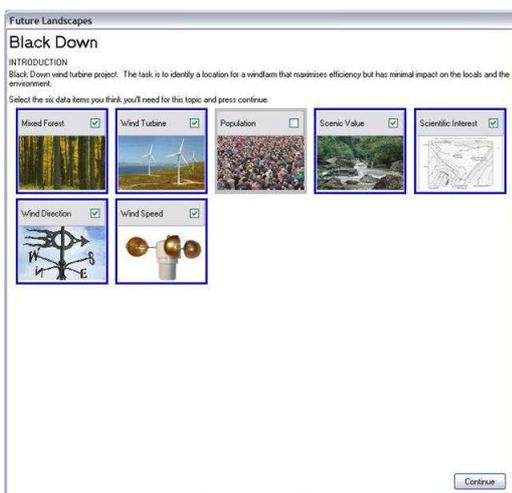
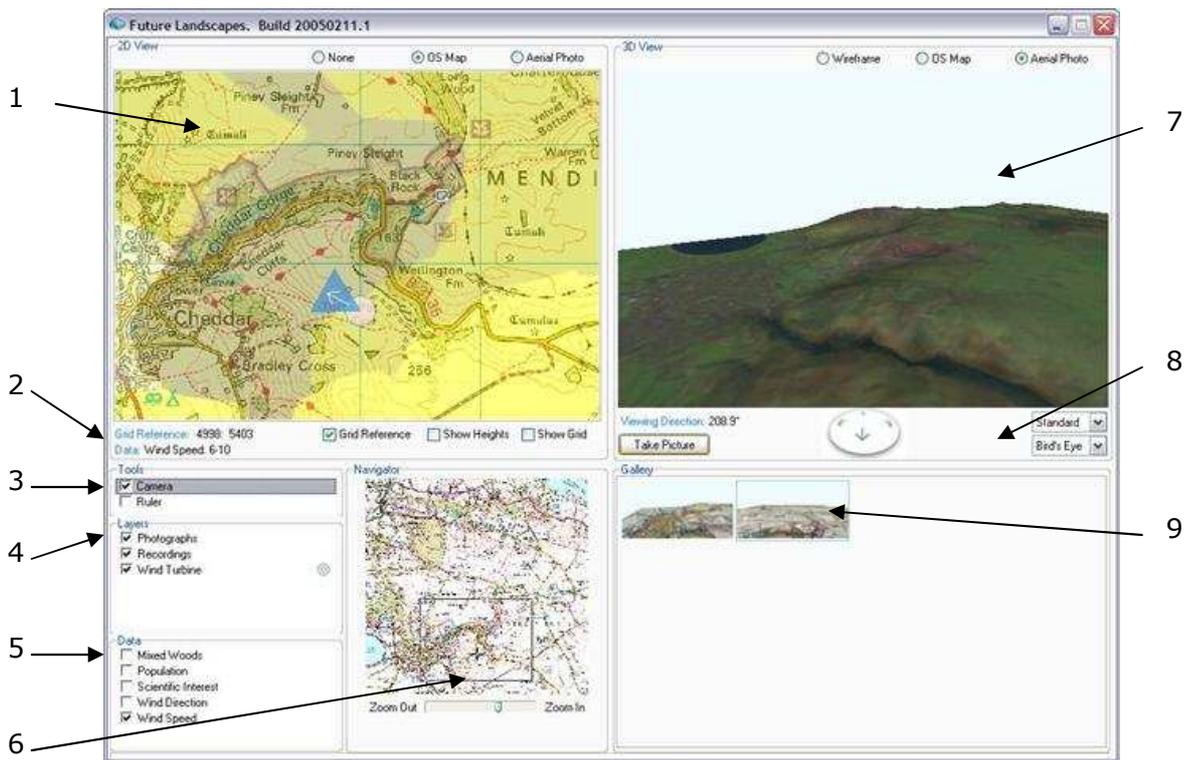


Figure 2: Future Landscapes, choice of data sets

These choices appear on the main Future Landscapes screen. Figure 3 shows a screenshot from the wind turbines task.



1. 2D map
2. 2D map functions
3. Tools options
4. Layers options
5. Data options
6. Navigator
7. 3D image
8. Navigating options for 3D image
9. Gallery of images

Figure 3: Future Landscapes, prototype main screen

The key features of this screen are the 2D image on the left (1). This defaults to an OS map of the area. By using the navigator (6) found at the bottom of this side the students can zoom in and out. A box in the navigator shows the location of the large map at the top of this side on the overall area. The orientation remains constant, ie north is always at the top. The 3D image on the right (7) is the relief of the complete 2D map. It can be viewed as a wireframe¹ or with the OS map or aerial photograph draped over. In Figure 3 it is the aerial photograph. The student can fly over the 3D image by dragging the mouse over the image or using the control beneath (8), which allows them to change direction facing and the height the picture is taken from and camera width. Unless the camera is switched on the 2D and 3D views are independent.

¹ A 3D grey image that represents height field data contours

To view a tool or information on the 2D map the student must select it by clicking in the check box by the description. The OS map in Figure 3 shows the wind speed choropleth data overlaid. To enable the student to interact with that information it must also be highlighted, shown by a grey line around that area. In Figure 3 (1) the student can see the location of the camera, which is shown as the pink circle with blue triangle – the arrow denotes the direction the camera is facing. Students can add photographs and recordings which are shown as icons on the 2D map; the icon/models for wind turbines and the shopping mall can be seen on the 2D and 3D maps.

Working through the screen the remaining functionality of the software is listed below.

(2) 2D map functions

The students can view the grid reference using an eight-digit reference. This gives a unique reference to any point in the United Kingdom. Selecting 'show heights' overlays a coloured map onto the OS map, with red denoting height and blue depth. There is no key for this. The 'show grid' option overlays grid squares onto the OS map. The 'data' function only displays information if a data map containing data with a key has been chosen. It displays the key for that grid reference (in Figure 3 the wind speed at grid reference 4703 5998 is 6-10).

(3) Tools options

Once selected, dragging the camera to the appropriate position in the 2D view is reflected automatically in the 3D view. Alternatively, if students move through the 3D view the camera symbol moves in the 2D view. The height and width of view of the camera can be adjusted from the 3D view, and is represented by the size and angle of the arrow in the 2D view.

The ruler is used to measure distances between locations on the 2D map. It is manipulated by dragging the end of the rule to stretch or shorten, or from the middle in order to move the entire ruler.

(4) Layers options

The student can choose from an array of photographs or sound files already stored in the project to illustrate the location. These can be provided by the teacher or gathered by the students. To insert a photograph or sound file the student selects 'photograph' or 'recording' and clicks on the appropriate location on the map, they are asked to confirm they wish to add a photograph or sound. To view a photograph or listen to a sound the student double clicks on a photograph or sound icon when the option is highlighted. They can add comments or delete when the photograph or sound interface is viewed.

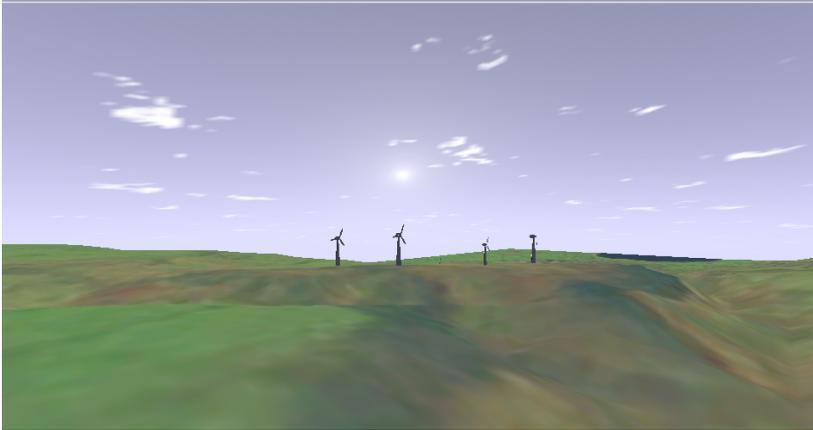
To insert a 3D model, a wind turbine or mall, the user selects the option and clicks on the appropriate location on the 2D map. They must confirm that this is where the model is to go, and can then add information about the model, its size, and the direction it is facing. Once added it can be dragged to another location. To remove it must be opened and deleted.

(5) Data options

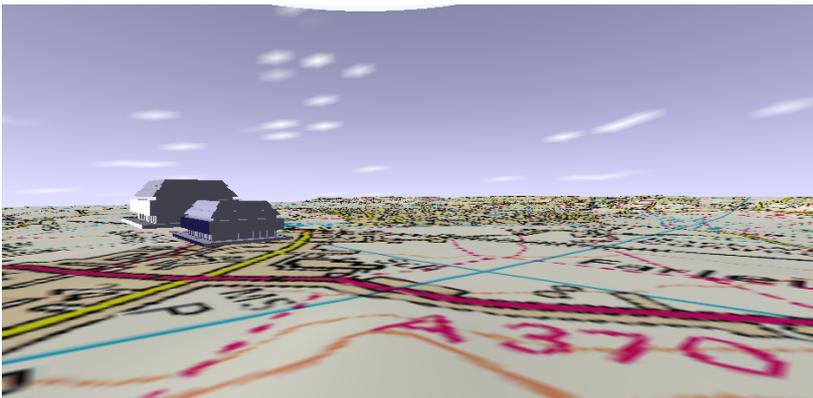
By selecting a category from the 'data' options the chosen map is superimposed over the base map in the 2D view (1). Using this GIS allows students to choose what data to display and allows them to explore the implications of each data set without having one highly cluttered map. The data requiring a key (eg population, scientific interest, wind direction, wind speed) was created by the teacher prior to the task. Data without categories, in this case the mixed forest, can be added by the student when selected. However, the areas of mixed forest that are added do not appear in the 3D image (7) but do appear in the rendering if a picture of the 3D view is taken (9).

(9) Gallery of images

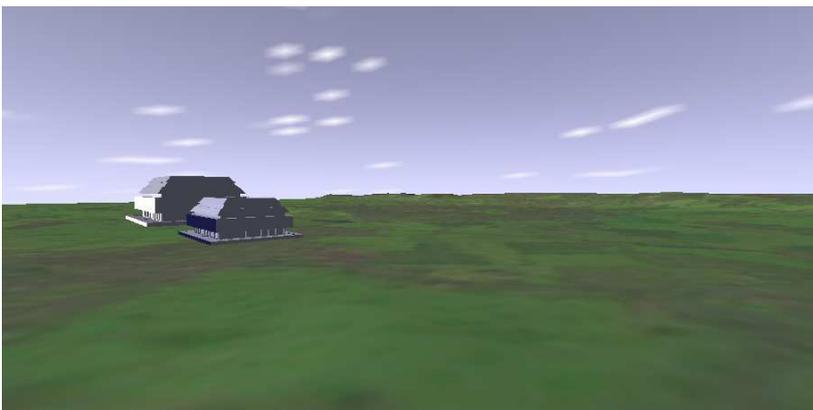
At any point the student can take a picture of the 3D view. They can choose to record the image shown in the view or render it to represent the actual environment which would show added data. These images are stored in the gallery along with any comments. At this point the software displays a randomly selected comment designed to make the students reflect, for example, asking if they have considered the ease of building on that site. Figure 4 gives some examples of student work.



a) Wind turbine model superimposed on an aerial photograph



b) Supermarket superimposed on an OS map



c) Supermarket superimposed on aerial photo

Note: aerial photo used to create this image was free and of low resolution, higher resolution photos are recommended but costly

Figure 4: Examples of gallery images taken by students

4. EARLY USABILITY TRIALS

The Future Landscapes software was designed to enable teachers to add data from their own area to create meaningful activities for students that reflected specific field studies. To replicate this functionality two trial tasks were created based in the local area, to locate:

- three wind farms in a rural location
- one shopping mall in an urban setting.

The tasks were introduced with hints about what to consider; the students were told, for example, that the supermarket needed to be located so it makes a profit (thus people should be able to reach it easily, it should not be expensive to build etc) and it should receive planning permission (for example, it should be far enough away not to disturb those living nearby or disturb sites of scientific interest).

In order to introduce students to the capabilities of the software prior to completing the task they were given structured questions that introduced them to the functionality within the software. These were related to the later task, for example having to locate the highest point and identify the wind direction and speed when identifying suitable places for wind farms, or identifying the population around various roads for the supermarket location. These worksheets were used to compensate for the lack of help provided in the software and make the students aware of the functionality of the software. Completing the tasks took approximately 25 minutes.

This trial was conducted with 22 students, aged 11-12. We followed this with detailed interviews with six of the students at a later date, asking them to talk us through and 'teach' us how to use the software.

5. REFLECTIONS ON FIRST PHASES OF DEVELOPMENT

As the prototype was not subject to detailed trialling in schools within a programme of work, the following reflections are intended simply to identify a number of points that arose during early usability trials which may inform further developments of both Future Landscapes and other such resources.

Using Future Landscapes

Some 'Eureka moments' were observed when students realised how to interpret information on the 2D map because of the 3D version. For example, decoding the colour scheme of height data by identifying lakes on the 3D version, realising that this is the lowest point on the map, and therefore inferring that the areas in blue on the 2D map must indicate low-lying land. Another student worked from the opposite view: the Mendip must be the highest point so all land in red was high.

The ability to switch layers on and off to simplify the map and thus work through factors systematically means that each data set is considered by children in turn and there is an opportunity to discuss its significance.

The advantage of setting activities in the location where students live is that the students relate to the task, for example, Backwell Lake is: "where I go fishing – it's got an island", and in the Black Down scenario one pair told the researchers that it was: "a reservoir not a lake". In the supermarket task some children spent time exploring the map and identifying their own houses before beginning the exercise.

The trials show that students' need support when it comes to recognising map symbols. They can relate the 2D and 3D image, but at the scale used the students cannot distinguish a church, for example, on the rendered or 3D image in order to understand how it is represented on the 2D OS map. This suggests that the aerial photographs need to be at a higher resolution and that more models need to be introduced into the rendered environment. Introducing models would also benefit the students by giving a sense of scale to the task. To support the visualisation of alternate futures, as required by the new geography curriculum, would require students to see how their input related to the existing geography.

The use of eight-digit grid references is confusing to students, who focus on getting these exactly right rather than having an understanding of what they mean. The standard six digits used by most software should be sufficient.

Teaching with Future Landscapes

Teachers and the idea originator would like the software to be integrated into an actual activity. In order to be useful the students need to be briefed on the activity prior to the task and have had some discussion on the sort of areas to be considered.

When using the software there needs to be additional resources, access to a web page for example, that explains the power produced by various-sized wind turbines or the significance of drainage on building costs.

Those involved in teaching with this sort of software need to be aware of the faith that some students have in the validity of data stored on a computer, regardless of where it came from. Teachers need to emphasis that data is added by individuals who have gathered or calculated it. In Future Landscapes this would ideally be done by students having to decide on appropriate data required, gathering it, and then adding to illustrate the process.

The study suggests that any learning environment developed to raise awareness of alternate futures should encourage students to collaborate when deciding where to place man-made structures. Having to justify to a partner ensures that students reach a shared understanding, and incorporating a presentation phase allows students to assess their peers' justifications as well as provide further information to inform their own arguments.

Finally, the task of identifying where to locate structures within an environment needs scaffolding. Year 7 students (11 and 12 year-olds) are capable of systematically working through the data explicitly presented to make a decision, but are less good at inferring information that would assist them or recognising what further information is needed. For example, relating building costs to contours, or the efficiency of various-sized wind turbines.