The Advantages and Disadvantages of Virtual Field Trips in Geoscience Education

Weili Qiu
Department of Resource and Environmental Science
Beijing Normal University
Beijing 100875
People's Republic of China

Tom Hubble
School of Geosciences
The University of Sydney
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Australia

Abstract

Virtual field trips (VFTs) have become popular with both university students and teachers as a means of learning and teaching during the last decade. They are generally presented on computer by means of the Internet or on CD-ROM and generally take the form of a set of hot-linked web pages or a purpose specific computer aided learning package generated in *Authorware* or a similar package. VFTs are currently a 'hot topic' in discussions about the reform of geoscience teaching in China. They are thought to be convenient for students to practice on and to be a worthwhile teaching and learning experience. Many university teachers in China are coming to expect a VFT CD-ROM to be included in textbooks and there is a growing tendency to regard the provision of such resources as an indicator that the book is a particularly good or advanced one. There have even been suggestions by some that virtual field trips will probably replace traditional field excursions at some time in the medium-term to long-term future. It is true that the abundance, variety and relative ease of delivery of VFTs do provide some advantages over traditional excursions. They also provide the great benefit of diversity of experience to students. Nevertheless, and despite these obvious advantages, it is our opinion that students must take traditional hands-on excursions in order to provide them with the necessary experience to take advantage of the opportunities provided by virtual field trips. It is important for teachers and students to be aware of both the advantages and disadvantages of VFTs from the standpoint of the users so that they can choose suitable VFTs and so that university teachers can make the best use of them as a learning and teaching tool.

Fieldwork

Fieldwork is a fundamental aspect of geoscience research and activity. It consists of surveying, observing, describing, and mapping the geometrical or geological relationships of rock units and landforms at the site of their occurrence. This is generally done to collect data appropriate to solving some geological, geomorphological or environmental problem or to locate some needed natural resource. Consequently field methods training by means of field trips or excursions is an important component of student training in the geosciences. This need is recognized worldwide and consequently field trips have traditionally formed an important part of Bachelor's degree curricula in the geosciences.

Virtual field trips

So then, what is a virtual field trip and how is one used in geoscience teaching? A particularly good set of examples are given in the DigiTRIP web site (http://oliver.geology.adelaide.edu.au/info/DigiTAL/digitrip/triphome.html) of the Department of Geology and Geophysics in the University of Adelaide. These are regional geology VFTs and there are four of them ranging in complexity from 1st year to 3rd year courses. They are both information-rich and activity-rich as well as being well designed. Each field trip has explicit learning objectives, a related glossary, landscape images, video clips, quizzes and so on. Students learn at their own pace and are able to practice, in the virtual sense, a variety of the basic field skills during their virtual field trip.

Thus, a typical virtual field trip for geoscience teaching is composed of a set of elements, such as, instructions, images and accompanying texts, videos, glossary and illustrations, quizzes, etc. All these elements are practically connected in a logical way by links and intellectually by task specific activities.

It is obvious then that VFTs are based on computer and web technologies, and they can broadly be considered a type of virtual reality. In a more narrow sense, 'virtual field trips' can be described as being an electronic exhibition of diverse

natural and cultural phenomena that also provide digital simulations of the three-dimensional processes of surveying, observing, exploring and 'adventuring' in some actual field site. As there is no specific definition of VFTs or restriction on the use of the name, the term 'virtual field trip' is often used in a much broader sense. The term is commonly used to describe any activities on computer, that a user browses, step-by-step, link-by-link, click-by-click through a set of linked web-pages to acquire information about a field site or location. Perhaps the name 'Virtual Tour' (or VT) is more appropriate to such sites. If both VFTs and VTs are grouped together under the banner of virtual field trip the number of websites presenting VFTs on the Internet is vast while their form, content and quality is highly varied.

Current status of virtual trips

An examination of a large number of VFTs and VTs on the Internet and on textbook CD-ROM leads us to identify the following points about VFTs and VTs. These describe the current status of VFTs.

- The number of VFTs and VTs is enormous. If students search for VFT and VT websites on the Internet using a search engine, such as Google, they will find 307,000 websites that have 'virtual field trips' as keywords. A limited search undertaken in October 2002, using three conditions: a) English-language site; b) the site was updated within the last six months; and c) the keyword is 'virtual field trips' found 18,300 records that met the three critiera. When the last update condition was reduced to three months 10,400 records of VFTs and VTs that met the three criteria. Students and teachers wanting to use VFTs, want to find a suitable virtual field trip. But with so many websites, this is not an easy task and searchers would inevitably get lost trying to find one.
- The quality of VFTs turned-up by such searches is highly variable. Some provide simple text and a few photographs, while others employ interactive, joystick-driven, digital elevation models (DEM), toggle animation of movies, and animated maps of temporal change (Shroder et al. 2002). For example, the information about different countries and places around the world available at http://surfaquarium.com/virtual.htm, is mainly just photographs and descriptive text. The GSH Fieldtrips Project at http://216.87.182.205/project/fieldtrips, licensed by the Global Schoolnet Foundation, is designed for children with interactive activities.
- Virtual Hawaii, http://www.satlab.hawaii.edu/space/hawaii/virtual.field.trips.html provides three-dimensional maps (DEM) that show parts of Hawaii from space and the air.
- DigiTRIP, at http://oliver.geology.adelaide.edu.au/info/DigiTAL/digitrip/triphome.html, was written by Pat James of the University of Adelaide and uses a variety of activities and media such as video clips to enable virtual surveying and virtual measurement of geological phenomena.
- VFTs are differently designed and have different aims and contents.
    - Some VFTs focus on a specific topic such as the geology of a specific location.
    - Many VFTs are connected with textbooks or are tied to a particular course. For example, the media edition of Physical Geography: A Landscape Appreciation 7/E (McKnight and Hess 2002) is a CD-ROM that provides several VFTs. McGraw Hill Higher Education's Online Learning Center offers students virtual field trips of World Regional Geography at http://highered.mcgraw-hill.com/sites/007239031x/student_view0/virtual_field_trips.html. Butler (2001) gives several VFTs for regional geology and geological survey courses at http://www.uh.edu/~jbutler/anon/gpvirtual.html. Regional geological information about continents and oceans is available at http://college.hmco.com/geology/resources/geologylink/fieldtrips.html.
    - Other websites try to integrate web resources and offer users (e.g. students, teachers, and public) general information about the world and its different regions by establishing links between various websites. The following sites, http://surfaquarium/virtual.htm, http://www.geog.le.ac.uk/cti/virt.html, http://www.tramline.com/cross/world/tr.htm are good examples of this kind.
    - VFTs are also designed for a variety of purposes. For example: public education; school education; entertainment and recreation; or advertising. The content provided by this sort of VFTs is generally broader than that provided by tertiary education sites and often include tours of buildings or museums and art galleries, virtual exhibits, virtual libraries, regional tours, time travel tours, nature and science tours, factory tours, web cams, and so on. Users can visit the following sites to experience a variety of these VFTs at http://www.woolleysoft.co.uk/vrml.html, http://ldshomeschoolinginca.org, http://dir.yahoo.com/recreation/Travel/Virtual_Field_Trips and http://www.field-guides.com/trips.htm.

From the above summary of VFTs, it can be seen that virtual field trips and virtual tours abound in a variety of different configurations and contain a similar variety of content. They can form a valuable resource for learning and teaching. They are widely used. Nevertheless this point must be kept in mind, surveys show that while students enjoy VFTs, they do not want the real field trips to be replaced (Spicer and Stratford 2001). Why is this so? We think it is because actual field trips provide a real experience. If you want to examine a rock you need to pick it up and hit it with a geology hammer – this then is your experience. Dealing appropriately with the snake or mouse hiding beneath the rock is another real experience that also is a necessary part of field training. These benefits are absent from VFTs.

The advantages and disadvantages of VFTs

A few authors have addressed the advantages and disadvantages of VFTs in geoscience teaching (Hurst 1998; Shroder et al. 2002). Their findings, as perceived from the viewpoint of the user are summarized in Table 1.

The most important advantage of virtual field trips seems to be that they can present data at a variety of scales and present images from a variety of viewpoints simultaneously (e.g. aerial views, cross-sectional views, animated rotating block diagrams, etc.). Thus, highly diverse types of data from the field, laboratory or library can be integrated together to form instantly available material. VFTs are also helpful for trips to inaccessible areas, such as the moon, the ocean floor, and to places where hazardous processes are the object of interest, e.g. volcanoes, floods, and landslides.

The permanency of digital presentation also makes it possible for students to repeat their VFT 'site visit' repeatedly which allows them to practice and learn the various skills a particular VFT presents. VFTs provide a useful way to both preview and review real field trips that the students will go on or have been on facilitating a better learning outcome. The exploitation of the advantages of VFTs, enabled Steinberg et al. (2002) to develop a course called, 'Global Change, Local Places', at Florida State University which successfully fused thematic and regional approaches in geographic education using virtual field trips.

Features of VFTs	**Advantages of VFTs**	**Disadvantages of VFTs**
Use digital and computer visualization techniques	• Integrate diverse types of data in instantly available ways • Present images from a variety of viewpoints and at many different scales • Display non-visual data (geochemistry, etc.) • Helpful for presenting trips to inaccessible areas • Provide an alternative of fieldwork, when time, expenses, and/or logistics are real issues • Enable presentation of extensive field trips and great variety of landform diversity • Enhance and expand students' experience	• Do not convey the true three-dimensional nature of objects • Do not convey the non-visual and aural feelings of touch, smell, etc. • Less beneficial than really being in the field • Lack the serendipitous nature of discovery
Based on the personal computer and Internet	• Enable flexibility of access (time and place) • Provides a repeatable experience which can be used to reinforce concepts in class • Provides an easily experienced preview or review of real field trips	• Having limited interaction with a computer • Not interacting with people in a flexible manner
Multiple styles of access e.g. CD-ROM and websites	• CD-ROMs are convenient to acquire and use • Information rich	• CD-ROMs can only provide a finite limited amount of information • Visiting a website can be difficult and depends on many factors, such as availability of computers, load on the network, number of connections, reliability of service provision, etc.
Wide variety available on the Internet	• Hold abundant materials and information • Offer rich resources of learning and teaching	• Easy for students to get lost among lots of websites • Many websites are ephemeral rather than permanent
Variable quality	• Available for users of different levels and demands	• Often difficult to find a suitable one for teaching and learning • The abundant websites are not quality controlled
Designed to be interactive like computer games	• Interesting and attractive to students and an alternative experience for users	• It is easy for students to wallow, or obsess over particular sites, which raises the problem of time management

Table 1. The advantages and disadvantages from users' standpoint

Unsurprisingly, the obvious and most serious disadvantage of VFTs is that they are less effective at imparting field-based skills than actual field trips (Shroder et al. 2002). To quote them 'the material presented on a computer is only an abstraction of the real thing' and 'being on a virtual field trip does not have the same impact as a real field trip'. Similarly Hurst (1998) indicates that VFTs '… do not, and cannot convey the true three-dimensional nature of the location or object, nor can they convey the touch-texture, smell or a myriad of other subtle clues that aid us to interpret information in the field'. VFTs can be designed to be interactive, but 'there is limited give-and-take interaction with a computer, in contrast to the interaction between real field trip leaders and participants' (Hurst 1998). We feel that, in addition to these points, VFTs also lack the serendipitous nature of discovery, which is one of the most attractive things on real field trips.

In a special issue of the *Geographical Review*, a collection of fifty-six essays shows that real fieldwork consists of challenges, pitfalls, and rewards. People can learn about themselves in the field and learn about particular places by doing fieldwork there (DeLyser and Starrs 2001). Even in a digital world, fieldwork is still a basic requirement for the geosciences. Just as Dobson (2001) emphasized, 'we continue to seek the field because we enjoy it and believe in it. We believe … that many real-world problems … cannot be solved without direct observation and engagement in the field. … field stations, combining GPS and GIS technology in powerful colour laptop computers, are supporting the field tradition as never before. In the next phase, geographical analysis, as well as data collection, will be done in the field'. This means that the implementation of technology will be of great help to both research and education in geosciences, but fieldwork and excursions in real world cannot be, and should not be replaced. What we should do is to exploit the advantages of both VFTs and real field trips and avoid their disadvantages. VFTs should be used to enhance the amount of field experience by providing additional experiences rather than to diminish and replace real field experiences.

The future of VFTs

Virtual field trips will play an important role in geoscience education in the future. There are two ways to enhance the effects of using VFTs. One is to make the best use of the VFTs currently available. The other is to develop better and more effective VFTs.

To make the best use of VFTs in geoscience learning and teaching, there is much work for users (students and teachers) to do. Teachers should inform the students of appropriate VFT websites. Just as McKenzie (2001) suggests in 'Virtual Field Trip Guidelines', teachers need to prepare carefully and ahead of their lessons. They must select trips which have clear connections to the content presented in class. They must preview the site and check all links up to at least three levels. Teachers should also provide step-by-step tasks for students to accomplish and they have to have a review session after students complete the VFT. It is the teachers' task to develop the students' ability to evaluate the quality of VFTs and to make proper choices about using them. Students need to learn how to manage their time and follow task guides conscientiously when they interact with group members, teachers, or the computer. The most important benefit accruing to VFTs is the additional 'field' experience but this only occurs if the students have real field experience to build upon. Teachers have to provide students with opportunities to get enough field experience from the real world. These experienced people will then learn effectively from VFTs.

The development of high quality and effective VFTs requires that the following three questions be considered: (1) What do students need to learn? (2) How will these students best learn the material? (3) What is an appropriate design for this VFT? The first answer will be related to the aims and contents of the particular course and the degree program. The second answer must deal with the learning strategies that the students will employ or in deciding which skills and abilities the teacher wishes to develop. The third will be dependent on the sophistication of the computers and programming techniques available to the designer. So, the design of VFTs must be based on good educational practice that employs the appropriate theories and the demands of the course. The quality of the VFT produced will depend on the available information technology and will be influenced by other things, such as the resources and time available to produce it. There are no agreed standards to judge the degree of quality of VFTs. But it is expected that a good virtual field trip should have high quality images and will offer as many chances for users to investigate in detail the location or phenomenon they are interested in. Then, they can learn to organize information along their virtual surveying route just as they would on a real field trip. This is what we think a proper simulation of real activity in the virtual field should be. To achieve this aim requires a large information and image database as an absolute necessity. Provision of such a database is probably not so much a technological problem as a financial one.

Conclusion

Virtual field trips have many advantages and can be useful in many aspects in teaching the geosciences. They are especially good for pre-study and review. They will be helpful or even powerful tools for reforming geoscience teaching in the universities of the People's Republic of China reformation. The potential benefits of using VFTs are dependent on and closely related to the users' skills and experience of real field trips. Students love field trips because they can learn knowledge and skills while having unforgettable and irreplaceable experiences. The greatest disadvantage of VFTs is that they cannot simulate many of the real sensory aspects of fieldwork and consequently should not ever be used to replace real field trips. It is possible to design high quality, effective VFTs but the size of the database, money and time required to produce them makes this an expensive process.

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