Virtual Reality: An Efficient Way in GIS Classroom Teaching

Jiangfan Feng

**College of Computer Science and Technology, Chongqing University of Posts and Telecommunications
Chongqing, 400065, China**

Abstract

Although geographic information system (GIS) education has been spread widely, it becomes increasingly apparent that two-dimensional maps cannot be precisely present multidimensional and dynamic spatial phenomena. It seems that merging GIS and Virtual Reality (VR) is a way to deal with these issues in terms of GIS classroom teaching. Virtual learning environment is the simulation of teaching method, thinking model, cognition manner and control means in the actual learning environment. This paper introduces virtual reality technology and the necessity of applying in GIS education and instruction, which explain the basic method and achieving a way of VR technology applying in the GIS classroom teaching with the instance of VR. The purpose of this paper is to analyze the application of virtual realistic learning environment for GIS education and establish a classroom teaching model accordingly.

Keywords: *Geographic information system, Education, Virtual Reality, Problem.*

1. Introduction

It's well-known that making decisions based on geography is natural to human thinking. For example, where shall we go, what will it shall be, or what shall we do when we get there are applying for the simple event of going to the cinema. By understanding geography and people's relationship to location, we can make informed decisions about the way we live on the earth. Geographic information system (GIS) is such a technology tool for comprehending geography and making intelligent decisions.

GIS organizes geographic data so that a person reading a map can select the data necessary for a specific project or task. A thematic map has a table of contents that allows the reader to add layers of information to a base map of real-world locations. For instance, a social analyst might use the base map of the province, and select datasets from the National Bureau of Statistics of China to add data layers to a map that shows residents' education levels, ages, and employment status. With an ability to combine a variety of datasets in an infinite number of ways, GIS is a useful tool for nearly every field of knowledge of archaeology to zoology.

When students are learning and using GIS, they develop analysis and critical thinking skills, regardless of their field. GIS is a learning platform for conceptual modeling. Students also learn technical skills that will help them in their future employment. Spatial thinking skills acquired in the classroom deepen their understanding of the relationships that exist in the world and the complex problems facing society today.

On the other hand, the potential of VR technology for supporting education is widely recognized. Several programs designed to introduce large numbers of students and teachers with the technology have been established, a number of academic institutions have developed research programs to investigate key issues, and some public schools are evaluating the technology. It has already seen everyday use in an estimated twenty or more public schools and colleges, and many more have been involved in evaluation or research efforts [1, 2].

From the view of education, VR is based on a complete teaching environment learner-centered. The learner is able to control the side of the target environment to observe or study a bit, that the learner is an active observer. The way reflects a kind of new teaching mode, and work with teachers to constitute a new teaching system, students and teachers with the VR system linked to student learning in a VR environment, by sensing devices to operate directly on the virtual environment, teachers, and students learning through the center console of the system and make the appropriate instruction. Its greatest feature is the students along with their own way in the VR environment to learn. VR is able to provide students with a new observation point self-centered. The characteristics of each student

access and adjust the three-dimensional data in the real world, and thus constitute a virtual environment. From the view of information system, it is to accomplish the teaching, feedback control and inspection functions, individualized learning real implementation and experience in the VR system.

2. Related Work

2.1 Teacher Education Programs of VR

VR has been already used in a variety of educational, training, and entertainment settings [3]. The highly visual and interactive nature of VR has been proven to be useful in understanding complex 3D structures and for training in visual tasks [4]. Recognition of this has led to increasing interest in developing VR-based applications for higher education and training.

There are many programs that provide the type of education for teachers regarding the use of VR technology, such as VRRV/Nebraska, Educators' VR Series, QuickTime VR(QTVR), VR in the schools, and virtual education - science and math of Texas (VESAMOTEX), and VR Concentration, M.A. in Education [5].

Virtual reality in education is a leap forward in the development of educational technology. It created a "self-learning" environment, by substituting the traditional way of learning about a new approach through the information environment interaction. VR provides a vivid and realistic learning environment for the students, further, it provides unlimited virtual experience in a wide range of subject areas, in order to accelerate and consolidate the process of learning. Students feel more convincing than the purposeless, abstract teaching, it takes the initiative to go to the inculcation of interactive and passive nature of the difference. Virtual experiments using virtual reality technology create a variety of virtual laboratories, which have advantages of low cost, low risk and limited venues.

2.2 Higher Education in GIS

The role of higher education is to assist students in becoming effective thinkers with the knowledge and skills that will lead them toward becoming meaningful contributors to society. Geographic Information Systems in higher education provide an integrated solution to assist faculty and students with their educational goals.

GIS is no longer just for geography departments. By putting information in the context of geography, it can also be applied across several fields of study to enhance learning and teaching. GIS can give students the skills they need for careers in health, marketing, environmental studies, engineering, natural resource management and, of course, geography.

Although many GIS have been successfully implemented for storage, management, analysis and presentation of spatial data, it becomes increasingly apparent that two-dimensional maps cannot be precisely present multidimensional and dynamic spatial phenomena. Moreover, there is a growing need towards accessing spatial data not only by cartographers and surveyors but also by other users, including naturalists. It seems that merging GIS and multimedia is a way to deal with these issues [6, 7].

Further, education of naturalists is a field where integration of multimedia and GIS can bring enormous benefits. Students will learn faster and more efficiently, using tools that they are likely to meet in their future jobs. In addition, it will be possible to individualize learning and tune it to particular preferences of each student. In this model, a teacher becomes a guide rather than a repository of facts. It is the computer that takes on a role of "an infinitely patient teacher."

In addition, there is a need for teaching professionals to apply the new technology in their fields of expertise. It calls for on-site and just-in-time training. Multimedia GIS could be a very useful tool for such a task. Specialized, tailored courses could be delivered and learnt at a suitable time and adjustable pace. Assuming that some of the trainees would know computer and GIS technologies one can expect the learning process to be fast. And for those new to computers, and GIS in particular, it should be easier to acquire the new knowledge.

Researchers are also demonstrating some really efficient ways that Second Life can benefit the GIS learner. The University of Texas, Arlington, has created a kiosk for its GIS users to get help with the software and even individual teaching or research applications. The University of Illinois has a site that displays GIS-derived maps of the state for people to examine, shown as Fig.1.

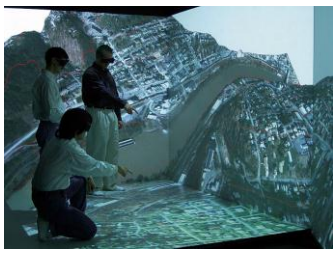

Fig. 1 Visualizing information using the FLEX system.

3. Cognitive learning in virtual reality

3.1 The Process of Learning

Characteristics, the process of learning for medical students, who account for a large proportion of the closed-loop interaction (learner-centered interaction), has obvious advantages in the process of learning. The virtual reality learning environment in which students can take advantage of the process of learning the feedback generated by the various stages of learning self-regulation and control. It's very favorable in the process of learning.

3.2 Learning of Motion Perception Skills

Learning goal is some movement perception skills. For example, the training of geographic procedures, this type of learning skills is important for students to participate in the control link, at the same time, in view of the GIS particularity, feedback is necessary for this type of learning.

3.3 The spatial learning and rehearsal

Virtual reality allows medical students to rehearse certain operations, such as a specific surgical internship example, in brain surgery in the learning process; the students were asked to understand the structure of the brain of a spatial location, shape and contains the tumor or foreign body. This kind of study is very important for medical students in the establishment of human organ structures and spatial location, as well as the brain's ability to form a human "concept map".

3.4 Conceptual Learning

When using virtual reality systems to aid in the understanding of a phenomenon, the two features, both teachers, designers or learners are very important, first of all, with other forms of learning, an effective initiative to explore, rather than passively observed, are very important. Secondly, we must get strong conceptual knowledge; students need different manifestations of the same content. These concepts in the virtual reality experience should be by means of a more abstract representation. For example, in the experience of clinical signs should be by way of illustration, the test data and the language to describe the experience of the same phenomenon at the same time, understand the correlation between the different manifestations of the students are also very important.

4. Teaching Model

Teaching model is shown in Figure 3

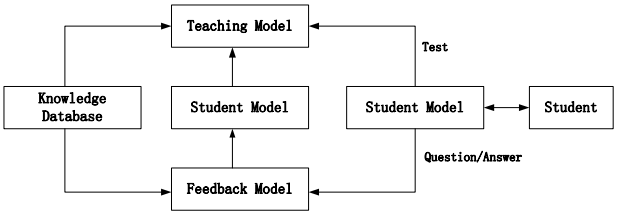

Fig. 2 The using of visualizing information.

Knowledge database includes knowledge of this course (text, 3D database, graphics, etc.), the module can be used to answer students' questions, and provide for the detection, diagnosis, and feedback module factual knowledge.

Feedback module operating or answer the detection student use of diagnostic rules, based on the reaction of the students to determine what knowledge students have mastered what is the error of the students, all of this information are reflected in the student model.

The student model is a record of the students' understanding of the subject knowledge, but also records the student's learning history, for example, the success rate, academic records, test results.

Teaching modules include courses systemic thinking environment, control environment, cognitive, and its role is to select the information according to the student model, a teaching strategy, decide what kind of intervention in the next step of the process of learning when and where. Correct in the teaching process, students' cognitive abilities, they continue to do so, student learning time, cognitive ability evaluation to amend Finally, gradually approaching the accurate value.

5. Case Study

5.1 The Simulation of Environmental Process

Fig. 3, below, is from a model developed as a demonstration of the proposals for the dispersion of air pollution. Embedded within the model is the facility to view the 'before' and 'after' scenes in which some stages of pollution situation are represented to give a third dimension.

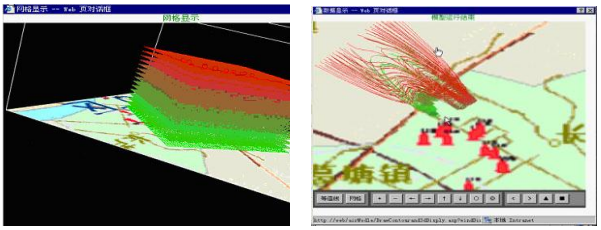

Fig. 3 The simulation of environmental process

The results make the teaching of these new media content to get more real and visual effect, and the technology is able to establish a virtual learning environment for students, which can be called at any time the content of interest.

5.2 Virtual Campus

Fig. 4, below, shows academic buildings, digital library, playground scene is selected as a pilot area, all components of the scene at the specified location on the scene, and the establishment of a virtual campus environment model, dynamic virtual scene roaming. The virtual campus roaming system, as long as the user through the keyboard operation random roaming can be a stroll in the sports arena, on the steps of the building, in a small river viewing.

Fig. 4 The simulation of campus

With the emphasis now placed on high-impact practices, teachers face a sometimes daunting task of developing and offering engaging, impact learning experiences for their students. VR can serve as an excellent tool to enhance such lessons and complement high-impact experiences in a variety of fields and disciplines.

5.3 Geographic Process Simulation

Geographic process models have been increasingly featured in the next generation geographic information science (system), as a method for phenomena simulation and mechanism analysis of the physical environment and its live activities, thereby driving conventional GIS based on data manipulation in the world of dynamic and computational processes.

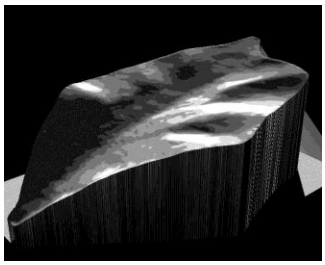

Fig. 5 The simulation of soil erosion

Fig. 5, above, is from a simulation model of soil erosion by reason of rainfall. Rainfall is one of the main agents driving the soil erosion on sloping cropland. VR helps the teachers and students to find out the law of soil erosion under different rainfall process.

6. Conclusions

In the current transition from an industrial society to an information society, traditional instructional approaches based on the use of textbooks in classrooms have been called into question. Instead of memorizing facts, more emphasis is being placed on the high-level thinking skills needed to construct and apply knowledge. Students must learn to locate, interpret, and creatively combine information, and to isolate, define, and solve problems. Additionally, education is no longer seen as something limited to a classroom or to a certain period in a person's life. Instead, education will be life long and must meet the needs of a flexible workforce.

VR as a two-way communication tool offers considerable potential particularly in the area of GIS education. The results clearly show that teachers should do everything possible to give students the ability to incorporate acknowledged good practices such as providing multiple representations and placing at least some instruction under the learner's control. While these latter attributes are not

unique to VR technology, the technology does facilitate their use more than many traditional educational practices [8, 9].

References

[1] Huber M., 1994. Multimedia enhances GIS applications. GIS World, August.
[2] Jacobson R., 1994. Virtual worlds capture spatial reality. GIS World, December.
[3] Vince J. Virtual Reality Systems. Reading, Mass Addison-Wesley Publishing Co1995.
[4] Wei B D, Li L, Hu F. "Research on intelligent GIS services in ubiquitous environment", Journal of Chongqing University of Posts and Telecommunications (Natural Science Edition), vol. 21, n. 5, 2009, pp.1-6.
[5] Brown, D.J., S.V.G. Cobb, and R.M Eastgate. 1995. Learning in Virtual Environments(LIVE)." In Virtual Reality Applications, pp. 245-252. Academic Press: San Diego,CA.
[6] United Nations (2003) United Nations Decade of Education for Sustainable Development, Resolution Adopted by the General Assembly, A/RES/57/254, Fifty-Seventh Session, 21st February, 2003,United Nations Documentation.
[7] Kneebone, R. (2003) 'Simulation in surgical training: educational issues and practical implications', Medical Education 37 (3), pp. 267–277.
[8] Bell, J.T. and H.S. Fogler. 1996. "Preliminary Testing of a Virtual Reality Based Educational Module for Safety and Hazard Evaluation Training." In Proc. American Society for Engineering Education Annual Conference, Indiana Sectional Meeting, Peoria, IL.
[9] Application of Virtual Reality as an Educational Tool." In Proc. American Society for Engineering Education Annual Conference, Session 2513, June, Anaheim, CA.

JiangFan Feng He received his B.S. degree from Southwest Agricultural University, and his Ph.D. degree from Nanjing Normal University, in 2002 and 2007. He works as associate professor of Chongqing University of Posts and Telecommunications. His main research area include spatial information integration and multimedia geographical information system.