

# Research of a Virtual 3D Study Pattern Based on Constructive Theory in e-Learning

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## Abstract

*E-learning is most important by its role in distance teaching, and as supplementary learning material, it's mainly used in higher education area. Paper first introduced the significance of e-Learning and application of constructive theory. In contrast with traditional education, its application possesses broad prospects. Then we made a systematic exposition of interrelated theory basis, discussed a new 3D virtual study pattern. Lastly, it presented two application systems that we developed. One is a virtual audio-video multimedia teaching center which has good immersion feelings; another is a virtual music appreciation environment which has dynamic interaction performance.*

**Keywords:** *e-learning; virtual study; constructive theory; entity*

## 1. Introduction

What is e-Learning? We can simply define it as digitization study or network study. First we should build a digital network teaching platform, which is mutual linked and activated between instructors and students in the area of higher education. Every participator on the platform, including students and instructors, will play an important role in it. This role will run through all these key links, such as course selection, independent study before teaching, class attendance, and explanatory answer after teaching, homework submission and electronic examination etc.

The most significant difference between e-Learning and traditional education is to pay a good deal of attention to the students themselves. By excavating the

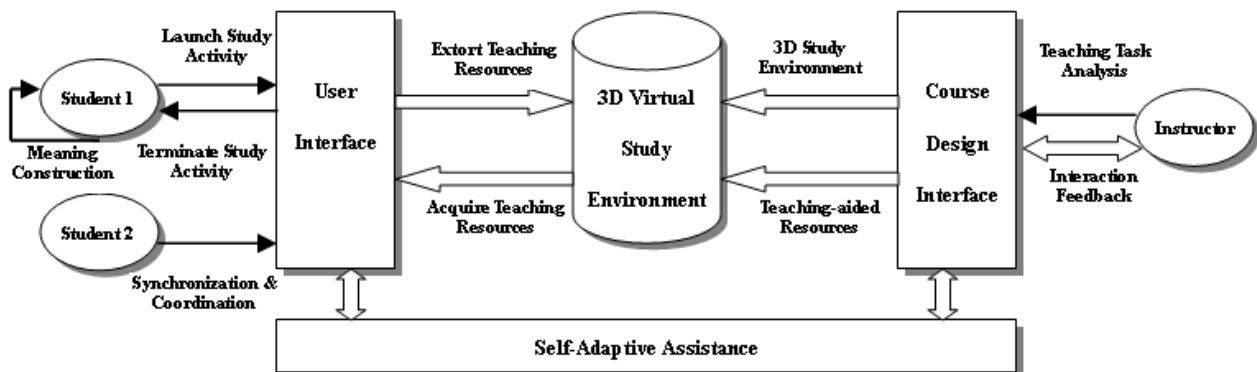
latent energy and creative energy of the students, e-Learning changes the traditional education into social study and network study [1]. Now we are living in a changing years, under the pounding of new technologies and strike of new ideas, the roles of teaching and studying are changing, the media of knowledge propagation are changing, and the concepts for technology and tool are changing. From college study to lifelong study, from teacher leading pattern in the classroom to student initiative study pattern in a wider sphere, e-Learning successfully combine the classroom instruction and network study into a more efficient entirety.

Under the condition of e-Learning, the center of education has transferred from instructor to student. The whole processes of education pay more attention to the student individual character demand, and fully excavate the student individual latent energy. E-Learning is the inevitable choice in the circumstances of information technology, in the process of reforming single education model, in the process of cultivating independent ability, and in the process of constantly bringing forth new ideas. We can further extend e-Learning to e-Live and e-Community, and it will be a great revolution based on information technology. A success example is the realization of movable e-Learning platform (Me-Learning) in Hong Kong City University. In this system, every role can obtain study resources at any time or anywhere, and organize convenient and efficient net meeting by connecting to education network platform. Every role, no matter who is an instructor or a student, can link up with each other. The consequence is that the study scope of a student has been expanded boundlessly [2].

## 2. Constructive theory in e-Learning

Now, an important target of education revolution is the transformation from the tradition behaviorism theory, which is centered with instructor, to the modern cognition theory, which is centered with student. As a main branch of cognition theory, constructive theory considers student, one the principal part of cognition, two the center of education, three the active constructor of knowledge concept. There are four essential factors in constructive theory. They are circumstances of study, coordination and experience exchange in study process, and meaning construction of study. Study is a process of knowledge acquirement, and knowledge acquirement is too a process that the student, with the aid of other's help, having mastered necessary resources, through the way of meaning construction, can master knowledge under a proper circumstances. This idea shows no difference with most of education experts'. They think that the effective methods of knowledge acquirement are exploration study, coordination study and experience study.

Under the prerequisite of a complete set of computer and network hardware resources, it's quite important and significant to build education software resources. But now, most of the digital software



resources are displayed in a manner of two dimensions, and most of the education resources are the simple refurbished version of original textbook and study materials. Under this old classroom teaching refurbished circumstances, the student's knowledge acquiring channels are still limited to mechanical study and spoonfeedable teaching.

In this paper, we put forward a new 3D virtual study pattern in e-Learning [3] [4]. Its target is to constructive a three dimension study environment, and its theory foundation is based on the constructive study cognition theory. The built 3D virtual study environment is a three dimension atmosphere circumstances teaching environment. It offers necessary knowledge acquiring tools and supports the concepts of exploration study, coordination study and experience study, which is based on the constructive study theory. Its main characteristics are enumerated

below. First, the relative relation of body shape and position for every teaching model are expressed with 3D atmosphere vector. Second, the system supports the function of real time wander, and this provides the sustenance for exploration study and experience study. Third, it supplies real time feedback information, including text aided information which is displayed in two dimension type. Fourth, it's equipped with multimedia aided information, such as audio and animation clips. The system is also equipped with abundant theory knowledge and teaching section, designed through practice teaching material and object. All these supply the students every kinds of knowledge acquiring tool of constructive theory, and finally formulate student the meaning construction, which is the highest level of education [5].

### 3. 3D virtual study pattern [6]

We can divide virtual study pattern frame into four parts. They are student(s), instructor(s), three dimension virtual study environment and self adaptive assistance, see reference Fig. 1.

Figure 1. Frame diagram for constructive theory study pattern

#### 3.1. Student and instructor

In the above diagram, a single student can launch or terminate study activity as one pleases, then extort and acquire education resources from 3D virtual study environment, and finally master knowledge in a higher level of meaning construction. Multiple students not only possess a single student's knowledge extorting and acquiring channels, but also are able to exchange ideas and methods with other students. Here, we can adopt synchronization or coordination pattern to control information interchange process among students. The user interface provides students with any kind of activity control technique support.

The instructor is the supplier of teaching resources; he is also the organizer of course design. The instructor's task is to design the teaching objective and content by analyzing education task. Under the basis of education object analysis, teacher also needs to design reasonable course evaluation standards. The course design interface can assist instructor to design three dimension study environment in a manner of visualization. It also interacts in real time with instructor to modify and consummate 3D study environment design.

The students and instructors constitute two major direct user colony of constructive theory study pattern.

### **3.2. 3D virtual study environment**

The built three dimension virtual study environment is a complicated knowledge base rich in education resources. The base embodies course ideology of teacher or teaching materials. Every part in the environment is a three dimension circumstance study atmosphere. The relative relation of body shape and position for every teaching model are expressed with 3D atmosphere vector. It supports the function of real time wander and supplies information feedback in real time, including multimedia aided information. This environment provides abundant knowledge theory study, designing all study models through practice teaching material and object. Some principal factors included in the three dimension study environment are analogue entity, abstract entity, motion entity, artistic entity and information entity. The details are described below.

Analogue entity is the teaching model built by 3D modeling software, with reference to practical material object, such as nature scene in reality life or chemical material in chemistry laboratory.

Abstract entity is the object that doesn't exist ever or can't be observed in reality life, such as planet running in universe, or atom and molecule existing in microcosm. The abstract entity 3D model can supply student with audio-visual object concept, so student is easy to constructive concept module.

The system's motion entity realizes reappearance of object moving process based on the technique of 3D motion emulation. Some examples are the ball moving games in physical textbook, the motion of energy conservation in physics, and some dangerous demolition and exploration movement of daily life. Modeling for motion entity contributes to the expression of abundant teaching thought, and the reflection of multi level teaching knowledge. Under the help of motion entity, the student will be more substantial in the following period of meaning construction.

On the basis of analogue and abstract entity, artistic entity possesses the advantage of expression entity in a more embellish mode, for example the mathematics model in CyberMath, all of them are artistic processing entity.

Information entity includes entity illustration, factor analysis of assessment system, and operation guiding instructions.

### **3.3. Self adaptive assistance**

The self adaptive assistance part provides interfaces with assistant tools, such as text information prompt in two dimensions, FAQ inquiring mechanism, JAVA real time monitor mechanism, and intelligence proxy. The application of above mentioned tools can make students acquire abundant knowledge and fulfill study activities in an easy, correct and efficient mode.

## **4. Application of virtual 3D study pattern**

Virtual technology has a vast reservoir of application probability, and holds infinite vitality in higher education area. It can set up a more natural and more realistic virtual study environment, and break through early WWW remote teaching pattern. Student will be able to derive rich knowledge from virtual 3D study environment, in a manner of net browsing and initiative exploring. Examples are listed below. For example, to study astronomy knowledge by entering virtual firmament, to study geographical knowledge by making use of a virtual globe, to exchange ideas with historical figures by crossing virtual time and space, to fall into a molecule world by touring virtual chemical hall. Through these applications we can conclude that virtual study pattern, under some situation, can greatly reduce the operation difficulties and dangerous in reality space. It will be more important to cut down the training cost, and to endow subject teaching with vividness and interest, immersion and interaction [7] [8].

### **4.1. Virtual multimedia teaching center**

The virtual study pattern application is realized by simulating the authentic multimedia teaching center of a university. By using virtual three dimension modeling language, the realization synthesizes VRML's Transform, Scale, Inline etc scene nodes and some sensor nodes, such as the ProximitySensor, PlaneSensor and TouchSensor node. The size and the position of the virtual objects in a scene could be determined by manual justifying. Some elementary interaction can be realized by using sensor nodes, in

combination with ROUTE sentences, with reference to following programs. An example is the moving of the notebook computers, see reference Fig.2 and pay attention to the mouse shape. For some complicated interaction applications, we use the Script node and embedded it into controlling sentences to input and output necessary events. This kind of application includes the environment curtain movements, the opening and the closing of LCD displays etc. Further consummation of the scene effect also makes use of the Texture, MovieTexture, and Sound nodes of VRML. By using all these techniques, we can enhance the multimedia characteristics through strengthening the visual and audio effects. All of the realization could be managed by using the interaction 3D technology.

Fig.2 shows the effect of the virtual 3D education pattern built based on construction theory. All of the models, including the multimedia classroom, desks, notepad computers, projector and screen curtain etc, are built by using different kind of VRML nodes. The size of the created scene file is 27KB. If it is compressed by VrmlPad, the size is only 4KB, which is quite ideal for network transmission.



Figure 2. Three dimension atmosphere circumstances teaching environment

#### 4.2. Virtual music appreciation environment

The built music environment consists of following sections. They are testing room, facilities table, audio box, acoustics amplifier, CD shelf and discs etc. The environment can be used to virtual audio appreciation on demand.

The accomplishment process is, first to install the whole space and peripheral equipment, second to organize CD shelf by place bottom board, back board and partition boards together, third to manufacture CD discs and make them animation.

Under a Transform node, we can define two neighboring cylinder slices and combine them together to form a single disc, one side be textured with CD reverse side picture and another side be textured with CD obverse picture. The whole effect will be a solid colorful CD disc. For different CD, should texture different pictures, and then define its coordinate into appropriate position of CD shelf. See Fig.3 and Fig.4 for results of the whole appreciation environment, the built CD shelf and positioned discs.



Figure 3. The whole appreciation environment

For embellishment of CD's entering and withdrawing animation effect, first we can use PositionInterpolator and OrientationInterpolator nodes to define every CD disc. That is the foundation for an object's space location and space orientation transforming animation. Second, we should use TouchSensor node to define mouse trigger animation, when single click a disc for odd times, the disc gets out from shelf, spinning and simultaneously playing a set music. When click for even times, the disc moves into its original position. For five discs, the software needs organize five Sound nodes, when triggering one disc, the environment plays a fixed Sound node's music, in the same time shields other disc's Sound nodes.

Relative program section is listed below.

```
DEF pathC Script {
  eventIn SFTime time
  field SFInt32 n 0
  eventOut SFBool k
  eventOut SFBool g
  url "javascript:
  function time(){
    if (n==0)
      k=TRUE;g=FALSE
    if (n==1)
      k=FALSE;g=TRUE
    n=(n+1)&1;}"
}
DEF clock1 TimeSensor {.....}
DEF clock2 TimeSensor {.....}
DEF inter1 OrientationInterpolator {.....}
DEF inter2 PositionInterpolator {.....}
DEF inter21 OrientationInterpolator {.....}
```

```

DEF inter22 PositionInterpolator {.....}
ROUTE mouse1.touchTime TO pathC.time
ROUTE mouse1.touchTime TO clock1.startTime
ROUTE pathC.k TO clock1.enabled
ROUTE      clock1.fraction_changed      TO
inter1.set_fraction
  ROUTE inter1.value_changed TO cd1.set_rotation
  ROUTE      clock1.fraction_changed      TO
inter2.set_fraction
  ROUTE      inter2.value_changed      TO
cd1.set_translation
  ROUTE mouse1.touchTime TO clock2.startTime
  ROUTE pathC.g TO clock2.enabled
  ROUTE      clock2.fraction_changed      TO
inter21.set_fraction
  ROUTE inter21.value_changed TO cd1.set_rotation
  ROUTE      clock2.fraction_changed      TO
inter22.set_fraction
  ROUTE      inter22.value_changed      TO
cd1.set_translation
  Sound {
    source DEF a1 AudioClip {url "01.mid"}
    maxFront 1000.0
    minFront 10.0}
  ROUTE mouse1.touchTime TO a1.startTime

```

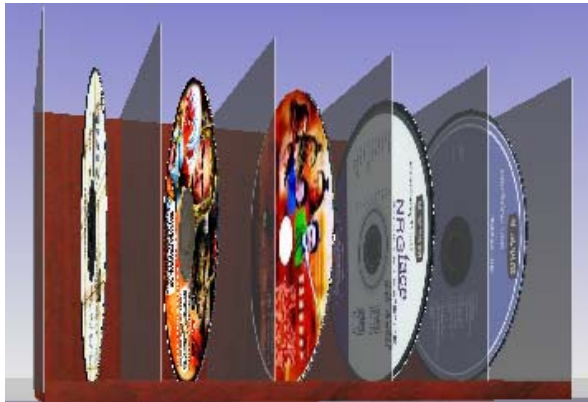


Figure 4. Effects of built CD shelf and discs

Synthetically utilizing virtual modeling technology, realistic emulating technology and people-machine interacting technology, the designed virtual music environment can provide listeners with a cheap, true and immersive appreciation platform [9].

## 5. Conclusion

Along with the constant development and deep application of virtual technology, the 3D study environment and education mode based on the constructive theory have been researched and

developed, quickly and extensively. The exploited three dimension virtual study environment has been provided with distinctive application value in solving education media circumstances and natural interaction characteristics. It is an important enlightenment and promotion for original remote education and teaching content and method, which mainly based on two dimension text mode. So this paper will bring us great applied prospects in education circumstances application and teaching revolution domain.

## 6. References

- [1] Allan Collins, Situated Learning and the Culture of Learning [J], Education Researcher, 1989, 18(1): 32-42.
- [2] Chen Shouman and Jiang Jianguo, Application of Virtual Reality Technology in Teaching [J], Journal of Computer Applications, 2002, 22(4): 111-112.
- [3] Brooks M., Brooks J., In Search of Understanding: the Case for Constructive Classrooms [C], Alexandria, VA: ASCD, 1995.
- [4] Dalgarno, B. J. Developing Constructive Computer Assisted Learning Resources: A Model Drawing on Instructional Design and Software Engineering Principles [R], Work-in-progress paper presented at ASCILITE, 1998.
- [5] Saljo, R., Learning and Understanding: A Study of Differences in Constructing Meaning from a Text, Alta University
- [6] Zhu Jiejie, Hu Weihua, Pan Zhigeng, Design and Realization of Virtual Multimedia Classroom [J], Journal of Computer-Aided Design & Computer Graphics, 2004(1), 1003-9775.
- [7] Livia Szedmina and Robert Pinter, Interactive Multimedia English Course, 2nd Serbian-Hungarian Joint Symposium on Intelligent Systems SISY 2004, Subotica, October 1-2, 2004
- [8] Roach M.P. and Stiles M.J., COSE - A Virtual Learning Environment Founded on a Holistic Pedagogic Approach [J], CTI: Software for Engineering Education, 1998, No 14.
- [9] ISO/IEC 14772-1:1997, VRML97 International Standard [EB/OL], The VRML Consortium, <http://www.vrml.org>.

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