

Interactive Learning Strategies of 3D (Three Dimensional) Space Software Courses in Distance Education

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ABSTRACT

"COVID-19" (coronavirus disease 2019) has invaded the world in early 2020, and it has also caused many schools around the world to switch to distance education. However, the environment of distance education achieves teaching effects through virtual space, which after all is unable to replace the real learning environment of traditional classrooms. Therefore, in a distance education environment, "interactive learning strategy" often affects teaching effect. It can be seen from this that apart from developing a more complete teaching platform, distance education should also attach importance to the development of various interactive strategies in the distance education environment to enhance the learning effect of learners. This research aims to explore the strategy of "best interactive learning" in distance education for 3D space software courses. The paper uses the learning progress of the course to adjust learning strategies through the differences in distance learning platforms. The research method is based on the analysis of multi-factor variance; the independent variables are "video distance education" and "video live teaching", and the questionnaire subjects are full-time students from the Environmental Design Department of a university as a survey sample. The question is designed with a Likert Scale to give different grades according to the tendency of the statement. The research will adjust the interactive learning strategy based on the learning progress of the course through the difference of the distance learning platforms. The questionnaire is divided into four dimensions, which are divided into "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study". The results of this research will not only provide educators as a reference for distance courses, but also explore how to achieve good interactive learning strategies for distance education in the future.

Keywords: distance education, interactive learning, learning effect, learning strategies

I. INTRODUCTION

The emerging network technology and industry at the end of the 20th century brought traditional distance education into a whole new realm. In addition to the expansion of advanced software and hardware functions and the multiple growth of information capacity, the most critical impact is that network distance education completely breaks the teacher-student interaction of traditional distance education (Xu Jingyi, 2003). The traditional distance education is only limited to the transmission of information, which is a teaching mode oriented by the information delivery. In this mode, teachers usually focus on the logical arrangement of teaching materials and the arrangement of course content structure; the purpose is to organize a set of teaching materials with wide applicability. The learning mode of students is to passively receive information,

and the communication with teachers or teaching materials is one-way. On the other hand, students are also prone to lack of interactive learning with peers, unable to understand the diverse meanings of the curriculum from community experience, and can only interpret theoretical knowledge through personal experience. This phenomenon is likely to form a serious educational gap in the humanities field, and indirectly leads to the learning result of the so-called singular thinking model.

The digital information age is coming; the Internet is a tool for humans to enter into interactive communication. Humans use the mode of interpersonal interaction to exchange messages with each other and generate social interaction (Yin Meijun and Liu Zhenzhen, 1998). In the distance education environment, how teachers and students interact with each other often affects the effectiveness of learning.

However, unless it can be clearly pointed out or verified that distance education is beneficial in both teaching and learning, the traditional classroom learning style can't be rashly replaced by the network learning environment (Webb, 1997). In view of this, in addition to developing a more complete teaching platform, distance education should also pay attention to the ability to make good use of various interactive strategies in the network teaching environment to strengthen learners' learning motivation, and learning effectiveness and satisfaction.

II. LITERATURE REVIEW

Since the development of distance education, due to the rapid development of the digital age, it has gradually been dominated by network teaching; in 1898, MIT (Massachusetts Institute of Technology) used e-mail as the beginning of network teaching for the first time, and then in 2000, Tsinghua University in China established and opened the first network university in China. Since the second revolution of distance education in the 21st century, network degrees, which are not restricted by time and space, have been established in universities and colleges all over the world. The establishment of various emerging network courses has become an indicator of the competitiveness of higher education. And in this century, distance education research has turned its attention to students' self-learning and their thinking about interaction with network courses. Teachers are regarded as the role of leading tutoring. This change in research direction is especially obvious in higher education.

Since teachers and students are in different spaces for distance network teaching, the interaction between "teaching" and "learning" between the two should be strengthened to enhance the learning effect of learners. Therefore, if teachers only unilaterally conduct narrative teaching and ignore interaction in distance network classroom teaching, the result will make learners' learning performance depressed. In order to avoid this situation, how to have a good interaction between teachers and students is important. And interaction can make learners feel involved, not just a bystander. According to the research of Moore (1989), the interaction in learning activities can be divided into three types: learners and teachers, learners and textbooks, and learners and learners.

A. *The interaction between teachers and learners*

No matter what teaching strategy or mode is used in the teaching activity, teachers usually assist learners' learning by interacting with them. In network teaching, in different learning stages, the way teachers adopt is also different.

B. *The interaction between learners and textbooks*

The most basic type of interaction in teaching is the interaction between learners and textbooks (Moore, 1989). This kind of interaction method relies on learners' initiative and spontaneous learning. Through the process of interaction with textbooks, learners understand their learning goals, then construct individualized knowledge, and integrate new knowledge into existing cognitive structures.

C. *The interaction between learners and learners*

In the network teaching environment, the interaction between learners and peers is most likely to occur. When teachers don't actively participate in the teaching activities, the mutual communication between learners can maintain the teaching activities. The interactive method can divide the learners into individuals or groups, allowing learners to interact through mutual assistance and cooperation and willingness. The interaction between learners is not limited to the communication of text messages. Through other communication software, such as LINE, learners can communicate with voice or video, which can also help the interaction between learners and increase intimacy.

To sum up: in many researches on distance network teaching, there is a clear analysis of "interaction", but most of them still focus on the curriculum model and teaching style. Therefore, this research hopes to clarify the gaps; after all, the network teaching courses still hope to provide a differentiated learning path and progress due to the characteristics of the course. Furthermore, it can determine the progress of the next stage according to the learner's learning effectiveness. And how to make the interaction among teachers, textbooks, and learners achieve the ultimate teaching goals is also the purpose of this research to adjust and formulate interactive strategies for distance network teaching.

III. RESEARCH METHODS AND MATERIALS

This research uses the multi-factor variation analysis method as the main research method, and the questionnaire survey is conducted among the full-time students in the Environmental Design Department of a university. The questionnaire is designed with the Likert Scale, and different grades are given according to the tendency of the statement. The purpose of this research is to adjust the interactive learning strategy based on the learning progress of the course through the difference of the distance learning platforms. The questionnaire is divided into four dimensions, which are divided into "question understanding analysis", "knowledge internalization application", "case teaching study", and "emotional interaction communication".

A. Independent variables

It adopts multi-factor variance analysis as the basis; independent variables are "video distance education" and "video live teaching", which are explained as follows: 1. video distance education: this research takes the video distance education in interactive learning strategies as an independent variable. It will be divided into four dimensions and 16 questions: "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study". 2. Video live teaching: this research takes video live teaching in the interactive learning strategy as an independent variable. It will be divided into four dimensions and 16 questions: "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study".

B. Control variables

The control variables of this research are "teaching content", "student level", and "teachers", which are explained as follows: firstly, teaching content: 3D computer courses are taught through a distance network, and the overall time is 12 weeks, with a total of 4 unit courses, and the teaching progress is adjusted according to the student's learning efficiency. Secondly, students' level: the research object is two classes in the third year of the Environmental Design Department of a university. Students of this grade have already studied 3D software courses in the second year, so their software application ability level has little difference. Thirdly, teachers: the teachers in this study are all the same person and have been teaching at the university for 8 years.

C. Dependent variables

The dependent variables of this research are "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study", which are explained as follows: firstly, question understanding analysis: the question understanding analysis of this research refers to the progress of students' "model modeling design" in the teaching of network 3D computer courses, if its use of video or live teaching has an impact on the learning effectiveness of the question understanding part. Secondly, knowledge internalization application: the knowledge internalization application of this research refers to the progress of students' "texture mapping application" in the teaching of network 3D computer courses, if it uses video or live teaching to internalize instruction knowledge and apply it to the learning effect of the subsequent design part. Thirdly, case teaching study: the case teaching study in this research refers to the progress of students in the "lighting scene setting" in the teaching of network 3D computer courses, if video or live broadcast teaching is used to demonstrate

the effect of this part of learning. Fourthly, group cooperation study: the emotional interactive communication in this research refers to the progress of students' "post-rendering production" in the teaching of network 3D computer courses, if video or live broadcast and group cooperation study can improve learning efficiency.

D. Research objects

The objects of this research are the full-time undergraduates from the Environmental Design Department of a university. Students from this grade have taken the "Sketch Up Modeling" course in the last semester of 2019. This grade is divided into five classes, and the sampling objects of this research are two of the classes. Among them, the number of students in class 1 is 42 and the number of students in class 2 is 41. The overall sample size is 83, and the effective sample size is 83.

E. Description about 3D space software courses

The 3D space software course of this research is divided into two experiments in this research ("Table I"); the two teaching contents in the first half of the course are mainly "video distance education", while in the second half of the teaching, "video live teaching" is the main content. This software course focuses on cultivating students' expression ability in space simulation design. The "3Ds Max" course is also one of the compulsory courses of the department. This course is to guide the interior simulation design and express the designer's thinking through 3D software. Through continuous course training, the instructions are gradually familiarized and refined.

TABLE I. 3DS MAX COURSE DESCRIPTION

Unit	Theme	Teaching content	Teaching pattern	Time
1	Modeling	Basic instruction explanation operation/deformation instruction operation/movement/rotation/zoom/lock point instruction operation/lock point/lock angle/lock ratio/	Video long distance	12 hours
2	Material	Material instruction explanation/create panel/material and V-Ray material/reflection and diffuse reflection material description/concave-convex material/common material	Video long distance	12 hours
3	Light	Light instruction explanation/georeference setting/V-Ray rendering scene/point light source/spotlight/photometric network (IES) light source	Video live broadcast	12 hours
4	Application	Interior design case/architectural design case/landscape garden case	Video live broadcast	12 hours

F. Curriculum experiment and test tools

The course of the 3D computer course "3Ds Max Actual Combat" in this research is 3 credits and is also one of the required credits of the department. Due to the influence of the "COVID-19" this semester, the network teaching will be adopted. Classes will be held once a week, with four classes each time, and each class lasts 45 minutes. The course will be completed in three months. This course will be arranged in the second semester of the junior year. The questionnaire survey is in the last month of the course., which uses the Internet and mobile phones as sampling tools. The content has been tested on scales such as "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study" and so on. The questionnaire scale used in this research is designed by the author. This scale uses Likert Scale scoring, "strongly disagree" scores 1 point, "disagrees" scores 2 points, "somewhat disagrees" scores 3 points, "general" scores 4 points, "somewhat agree" scores 5 points, "agree" scores 6 points, and "strongly agree" scores 7 points. The questionnaire is divided into four dimensions: "question understanding analysis", "knowledge internalization application", "case teaching study", and "emotional interaction communication". The Cronbach's α coefficient of 83 students in the two classes surveyed on all 16 questions is .897, which shows that this scale has good reliability.

IV. RESULTS AND DISCUSSION

In order to understand the 3D computer course's network teaching strategies with "video distance education" and "video live teaching" as the course, the questionnaire is divided into four aspects; namely, "question understanding analysis", "knowledge internalization application", "case teaching study", and "group cooperation study". This study uses independent sample t test to examine and analyze the differences in learning interests of gender in these two periods of

experimental teaching. It also uses multi-factor variance analysis to observe the differences between the four dimensions.

A. Gender analysis of independent sample t test data in "video distance education" and "video live teaching"

It uses independent samples to examine the differences in learning interests between genders in video distance education and video live teaching. From "Table II", it can be seen that there is no significant difference in the 16 questions in the four dimensions. This shows that since the course used to be based on traditional classroom teaching, the male and female students in the two classes are taught through network teaching for the first time, and there is no obvious sense of difference. At the same time, it is the first time to try video and video live teaching, so it is difficult to distinguish the difference between the two experimental teaching.

TABLE II. T TEST ANALYSIS RESULTS OF GENDER IN INDEPENDENT SAMPLES

Type	Question	Male (43) Average	Female (40) Average	Assuming equal significance of variance (two-tailed)	Do not assume equal significance of variance (two-tailed)
video distance education	1	5.86	6.15	.235	.228
	2	5.86	6.03	.537	.535
	3	5.74	6.13	.182	.177
	4	5.81	6.25	.084	.078
	5	5.70	5.85	.580	.577
	6	5.95	6.15	.406	.400
	7	5.86	5.90	.878	.878
	8	5.56	5.88	.260	.252
Video live teaching	1	5.63	6.08	.086	.081
	2	5.91	6.20	.214	.207
	3	5.70	6.10	.101	.096
	4	5.79	6.03	.315	.309
	5	5.67	6.05	.149	.143
	6	5.84	6.20	.109	.104
	7	5.79	6.13	.156	.151
	8	5.72	5.98	.319	.311

B. Multi-factor analysis of variance in gender and class in "video distance education"

In the analysis and comparison of multi-factor variance, "Table III" can be taken as an example: the interaction between gender and class in the "question understanding analysis" in the "video distance education" teaching method with Q1: "F(1,79)=.022, p=.883", and the interaction of Q2: "F(1,79)=.930, p=.338". And in the "knowledge internalization application", the interaction of Q3: "F(1,79)=.343, p=.560", and the interaction of Q4: "F(1,79)=.711, p=.402". In summary; class and gender have no interaction in these two dimensions in the video distance education method. This can show that the "model modeling" and "texture mapping" in the 3D course have the teaching effect of repeated viewing due to the video. Compared with the traditional classroom instruction and demonstration by the teacher, this teaching method can be more acceptable to students. In the "case teaching study", the interaction of Q5: "F(1,79)=3.932, p=.051", and the interaction of Q6: "F(1,79)=4.038, p=.048". Finally, in "post-rendering production", the interaction of Q7: "F(1,79)=.068, p=.067", and the interaction of Q8: "F(1,79)=.068, p=.795".

There are significant differences in the "Case Teaching Method Demonstration Light Rendering Course" in question 6. This shows that the students are better able to understand the instructions with the case teaching method, especially in the light course part, it is necessary to clearly distinguish the relationship between the space and the light intensity. The author also believes that the use of case teaching method to enhance students' learning interest will ultimately have a significant effect on learning efficiency, and this teaching method can also deepen students' learning

impression. There is no interaction between the two questions in the group cooperation study, which shows that the group cooperation study after watching the video on the Internet can't significantly enhance the emotions among peers. At the same time, this also shows that most students are still used to studying alone in the process of network learning.

TABLE III. STATISTICS OF GENDER AND CLASS IN "VIDEO DISTANCE EDUCATION"

Question	Type III sum of squares	Degrees of freedom df	Mean sum of squares	F	Significance
Q1	.027	1	.027	.022	.883
Error	97.783	79	1.238		
Q2	1.373	1	1.373	.930	.338
Error	116.627	79	1.476		
Q3	.582	1	.582	.343	.560
Error	133.953	79	1.696		
Q4	.924	1	.924	.711	.402
Error	102.661	79	1.300		
Q5	5.962	1	5.962	3.932	.051
Error	119.802	79	1.516		
Q6	4.369	1	4.369	4.038	.048*
Error	85.480	79	1.082		
Q7	4.615	1	4.615	3.456	.067
Error	105.489	79	1.335		
Q8	.113	1	.113	.068	.795
Error	130.712	79	1.655		

C. Multi-factor analysis of variance in gender and class in "video live teaching"

In the video distance education method, the multi-factor variance analysis method of gender and class is compared with "Table IV" as an example. In "question understanding analysis", the interaction of Q1: "F(1,79)=.027, p=.604", and the interaction of Q2:

"F(1,79)=.013, p=.910". In the "knowledge internalization application", the interaction of Q3: "F(1,79)=.587, p=.446", and the interaction of Q4: "F(1,79)=5.049, p=.027". According to the analysis in the first half, there is no interaction between class and gender in the model modeling design progress in the live video teaching method. This shows that because model modeling is a more basic part of 3D courses, no matter whether it is watching videos or live teaching, students feel that the difference is not big. However, in the course of "Texture Mapping", there is a significant difference in the way of video live broadcast, which should be related to "teachers". This is because the material description in the 3D course needs to be understood before it can be used in the design, and the texture instruction part is also the same, indicating that the two parts require teachers to carefully design the teaching content for the students to learn later to effectively improve the efficiency. This also reflects the importance of curriculum design content to learners.

In the "case teaching study", the interaction of Q5: "F(1,79)=1.934, p=.168", and the interaction of Q6: "F(1,79)=.705, p=.404 ". Finally, in the "group cooperation study", the interaction of Q7: "F(1,79)=2.384, p=.127", and the interaction of Q8: "F(1,79)=1.836, p=.179". In the last 4 questions, there is no obvious difference between "lighting scene" and "post-rendering production", which shows that students are still used to the "teacher-centered" approach in the teaching of these two parts. Since students can use live broadcasts to watch teachers, which is not different from traditional classrooms face-to-face lectures, showing that students are more accustomed to staying in computer classrooms to learn software courses.

TABLE IV. STATISTICS OF GENDER AND CLASS IN "VIDEO LIVE TEACHING"

Question	Type III sum of squares	Degrees of freedom	Mean sum of squares	F	Significance
Q1	.379	1	.379	.271	.604
Error	110.246	79	1.396		
Q2	.015	1	.015	.013	.910
Error	91.560	79	1.159		
Q3	.726	1	.726	.587	.446
Error	97.721	79	1.237		
Q4	5.372	1	5.372	5.049	.027*
Error	84.054	79	1.064		
Q5	2.657	1	2.657	1.934	.168
Error	108.567	79	1.374		
Q6	.737	1	.737	.705	.404
Error	82.563	79	1.045		
Q7	2.647	1	2.647	2.384	.127
Error	87.725	79	1.110		
Q8	2.445	1	2.445	1.836	.179
Error	105.181	79	1.331		

V. CONCLUSION

This research aims to explore how to adjust and formulate the best strategies for distance network teaching after the network teaching adopts "video distance education" and "video live teaching" as two teaching methods. After the investigation and research conducted at the completion of the second half of the course, it is found that the two aspects of "knowledge internalization application" and "case teaching study" are more suitable for network teaching through video live broadcast. And in "question understanding analysis" and "group cooperation study", video teaching methods are more suitable. In the era of rapid development of digital information; the "autonomous learning model" of digital learning has already come. And network teaching courses still hope to provide a differentiated learning path and progress due to the characteristics of the course. Therefore, new strategies have also emerged in the network teaching methods after the research and investigation. The progress of the course internalized in knowledge absorption is suitable for "video live teaching" as the main teaching method, and "video distance education" can be used as the main teaching method in the first half of the course. In the author's own computer software course teaching experience, there are significant differences among students in knowledge, literacy and attitude. The best state of network teaching is to achieve the best interaction among teachers, textbooks, and learners.

Network teaching has its advantages and disadvantages as well as its uniqueness. In addition to interactive strategies, the network teaching platform also has its significance. In the follow-up network platform design and research, appropriate audio-visual software should be combined to enrich the content of textbooks, and at the same time humanized interfaces should also be developed. If the interactive strategies of this research and the network platform can be mutually applied, the best self-learning effect will be obtained.

References

- [1] Yin Meijun. Liu Zhenzhen. 1998. A Case Study of Teaching Methods, Learning Strategies and Interaction in Elementary Schools Implementing Distance education. Journal of Elementary Education. 11, 1-45. (in Chinese)
- [2] Lin Bomim. 2005. Application and Development of Interactive Strategies in the Network Teaching Environment. Life Science Education Monthly. 38.7, 13-25. (in Chinese)
- [3] Liang Chaoyun. 1997. A Distance Learning Environment Based on the Global Information Network — Introduction to the Research Findings of the LEAD Pilot Project. Teaching Technology and Media. 34, 28-41. (in Chinese)
- [4] Xu Jingyi. 2003. Research and Introspection: On the Development of Thinking Ability in Art Education Research and the Application of Network Teaching. Research in Arts Education. 6, 59-88. (in Chinese)

- [5] Chen Yanting. 2012. Research on the Interactive Process of Asynchronous Network Mathematics Teaching Case Discussion. *Journal of Educational Science Research*. 57(1), 79-111. (in Chinese)
- [6] Chen Jincheng. Xu Tongan. Liao Lifen. 2004. Research on the Evaluation Model of Distance Education System — Application of AHP Method. *MIS Review*. 13. 207-225. (in Chinese)
- [7] Zhang Qionsui. Chen Yixin. 2003. Discussion on the Interaction of Synchronous Distance Courses in Universities: Take Tamkang University as an Example. 40.4, 525-533. (in Chinese)
- [8] Wen Tingyu. 2011. Discussion on the Factors Affecting the Effectiveness of Network Learning. *Journal of Industrial Technology Education*. (4). 41-48. (in Chinese)
- [9] Xie Wolong. Luo Huiwen. Zhao Yayin. 2000. Why Use Synchronous Distance education? — Talking About the General Course of Gender Education in Universities. *General Education Quarterly*. 7(1), 45-65. (in Chinese)
- [10] Beth, D. U., & Cathy, B. C. 2001. The use of computer-mediated communication to enhance subsequent face-to-face discussions. *Computers in Human Behavior*, 17, 269–283.
- [11] Diane M. Earlya, Kelly L. Maxwellb, Bentley D. Ponderc, Yi Pana. 2017 ,Quarterly Improving teacher-child interactions: A randomized control trial of Making the Most of Classroom Interactions and My Teaching Partnerprofessional development models. *Early Childhood Research Quarterly*. 38, 57-70.
- [12] Jason Dockter, 2016 ,The Problem of Teaching Presence in Transactional Theories of Distance Education. *ScienceDirect*. 40, 73-86.
- [13] J.H. Oliveira, B.F. Giannetti, F. Agostinho, C.M.V.B. Almeida,2017, Decision making under the environmental perspective: Choosing between traditional and distance education courses. *Journal of Cleaner Production*. 1, 1-11.
- [14] John Fitzgerald Ehricha, Stuart Woodcockb, Conor Westc, 2020, *International Journal of Educational Research*. 99, 1-9.
- [15] Moore, M. (1989). Three types of interaction. *The American Journal of Distance Education*. 2, 1-6.
- [16] Webb, G. (1997). A Theoretical Framework for Internet-Based Training at Sydney Institute of Technology. In: *AusWeb97 Third Australian World Wide Web Conference*.
- [17] Yanling Cao, Liisa Postareff, Sari Lindblom-Ylänne, Auli Toom, 2019 ,Teacher educators' approaches to teaching and connections with their perceptions of the closeness of their research and teaching. *Teaching and Teacher Education*. 85, 125-136.