Exploration and Research on Online Teaching under the Background of the Normalization COVID-19 Epidemic Prevention -Take Teaching Reform of the Crime Scene Investigation Training Course as an Example

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Abstract—Crime scene investigation is the starting point and foundation of criminal procedure enforcement, which is a comprehensive work with practicality and applicability, training course play is an important role in the curriculum system. In order to solve the traditional training course deficiencies during the COVID-19 epidemic, such as simulation scenes lack of contents and kinds, space-time limitations, weak-experience, descent capacity of participant willing, non-predominance indicators for performance appraisal, etc. This paper provides a new online training course teaching reform based on 3D virtual simulation technology. The results show that the our method has advantages in enriched simulative cases scenes, meet the demands of the online teaching during COVID-19, makes up the deficiency of training time, free space-time limitations, easy to quantitative assessment, saving education cost, which provide a new mode of the crime scene investigation training course.

Keywords—3D virtual simulation technology, crime scene investigation training course, COVID-19 epidemic prevention, online teaching reform

1 INTRODUCTION

Crime scene investigation is the core curriculum of public security department, according to the requirement of ministry of public security of PRC, such as *strengthening the public security professional's crime scene ability of public security colleges*, *the public security professional's crime scene ability of public security colleges standard*, et al. the material and documentary evidence's finding, extracting, storing and analyzing ability training is very important for crime scene investigation. Crime scene investigation is the foundation required course for all subject specially students in criminal investigation police university of china, which including 64 class hours and average 32 class hours by theoretical course and training course. Crime scene investigation theoretical course need students summarizing the practice experience from the simulation crime scene which play a decisive role in the crime scene investigation system[1].

Offline teaching was seriously disturbed under the background of COVID-19 epidemic.

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Epidemic prevention normalized management is becoming trend which is a complex, arduous and persistent work, objectively, lots of students can't return to school on time. The crime scene training course mode has changed at the special time, together with experimental condition limitations which have influence on the teaching effect. Online teaching reform of crime scene investigation training course has become an urgent key problem.

ZHANG [2] use Unity3D platform to create 3DS simulation interactive environment which can reduce training and teaching costs and improve efficiency. WANG[3], etc. adopt 3DS Max software and Unity3D create virtual railway site working environment to help user intuitively master and understand facilities and equipment of the railway system. Reference [4] using 3DS Max modeling tools and Unity3D game engine create interactive virtual digital circuit which stimulates students' creativity and imagination. Gao, etc. realize the welding robot virtual reality simulation system based on Uninty3D and C# for reduce the operating risk of the operator in the welding process as in [5]. Based on the above analysis, this paper provides an online crime scene investigation virtual reality training system solution which combine the 3DS Max and Unity3D technology.

2 CURRENT SITUATION OF CRIME SCENE INVESTIGTION TRAINING COURSE

The influence of the judicial system reform of the "Trial-Centered" requires more strict evidence's finding, extracting, storing, identification and recording normative ability in criminal procedure. Crimes scene investigation is the starting point and foundation of criminal investigation, training course is an importance step to foster students' practical skill. In order to implement the *public security education supporting the police force* guiding ideology, crime scene investigation simulated training course is the most important practical teaching method for public security colleges to foster applied talents, which has important significance to improve students team cooperation ability, enhance individual theoretical literacy, site visit, field investigation ability. Restricted with various objective factors, training course still facing with the following problems:

2.1 Influence of the COVID-19 Epidemic

Offline teaching can't massive performance since December 2019, online teaching become the only choice due to student spread on-campus and off-campus. The ministry of education of China has proposed the pertinence proposal, such as *guiding opinions on organization and management of online teaching during the COVID-19 epidemic prevention and control period* in early 2020 which demands the national colleges and universities actively developing online teaching and learning. In order to response the relevant requirements and certain practical difficulty which crime scene investigation training course has to be faced with, online teaching reform must implementation.

2.2 Lack of the Various Simulation Scenes Design

Traditional offline training course only includes several typical simulation scenes (e.g., homicide, burglary and robbery cases, etc.). The simulation scenes design is limited to some objective factors, for example cost, space and personal safety, etc. some specific cases such as

arson, explosion, disaster relief, kidnapping and shooting cases can't simulate realistically by traditional ways. In addition, problems such as props setting too simple and trace evidence too obvious also restricts training course's teaching quality. Lack of sense of substitution real crime scenes will reduce enthusiasm of the participants.

2.3 Consumption with Facilities and Equipment

Students will use specific apparatus, tools and equipment for seeking, observing, analyzing, measuring, recording, showing, extracting and preserving various trace and material evidence in field investigation process. Moreover, crime scene investigators need some specific disposable individual personal protective suits such as mask, glove and shoe bags in order to prevent contamination. With the consumption of year after year, door, window, ground, furniture, and other facilities will damage and destroy by intentional and nonintentional behaviors which bring about massive waste.

2.4 Space-time Limitations in Field Using

Public security colleges training places are generally fixed structure which can't frequently recovery or decoration because of infrastructure construction and budget. Besides, there exist site conflicting with different specialty students in the same time which delay teaching schedule and reduce the participant operation ability.

2.5 Non-quantitative Indexes with Training Assessment

Take Criminal Investigation Police University of China as an example there about 40 students which divided into 4 groups and assign different rooms in training course. Each student play a role such as organization and command, emergency disposal, crime scene protection, field investigation, site visit, crime scene search and investigation test items in the division of labor and cooperation, separately. Teacher can't master in time each participant's progress and quality, the theoretical and practical binding capacity, the traditional scoring method by group will reduce student enthusiasm and difficult to make objective appraisal of for each student.

3 ADVANTAGES OF ONLINE TRAINING COURSE BASED ON 3D VIRTUAL SIMULATION TECHNOLOGY

The 3D virtual simulation technology relying on the internet and combine with computer science and information science, with the advantages of high degrees of freedom, vivid immersive, interactivity, expandability and perceptional. Training course's learning object which generally hold open characteristic with information technology and innovation. Using 3D model database to simulate the real scene can achieve immersion feeling, active the participant's creative thinking and innovation ability and only requires small cost to maintain the serve, update scripts, etc. The 3D virtual simulation technology provides a new path and platform for crime scene investigation training course during the COVID-19 epidemic which an effective way to improve the students of the public security professional crime scene investigation capability, its main advantages as follows.

3.1 Free of Space-Time Limitations in Field Using

With the corona virus disease 2019(COVID-19) spreads all of world, national personnel mobility restriction entered normalized management stage. The 3D virtual simulation technology can free of time, space, environment, population, period limitations, etc. Meanwhile, maintained a preferable online teaching quality, trainee can completely grasped the specification for certain type (e.g. unacquaintance, interesting, etc.) crime scene investigation by repetition training and break the problem of training period deficiency [6].

3.2 Flexible Design Different Type of Crime Scenes

Through integrate investigation, trace examination and forensic medicine courses knowledges points combine with virtual reality human-computer interactive technology we can design different type of crime scenes which bring us immersive environment into reality experience. It can meet completely the field investigation needs of specific cases (explosion, arson, violence, etc.) which can help students to get a better understanding of the theoretical knowledge. Moreover, the 3D virtual simulation technology unique characteristic can ensure all kind equipment long-term repeated using and reduce the education costs.

3.3 Improves Student Pre-class Learning Enthusiasm and initiative

The students generally operating after teacher's explaining and demonstration in the traditional passive teaching crime scene investigation training teaching method. The online teaching method can fully arouse activeness of the students. The system can set certain rules in advance, so student can't enter the final examination unless they accumulating the demand score. There is time limitation for online training which can urge the participants must pre-class preparation bring good effect on enhance students' concentration.

3.4 Useful Tool for Quantitative Assessment

The online system can help rapid analyze training learning effect such as support teacher momentarily checking student training's process, procedure and approach quality of crime scene investigation, giving real-time scores report. Teachers can be liberated by this system such as avoiding frequently guide student in different simulated rooms, besides, some behaviors in traditional training course, for instance, someone unintentional disturbing others and destroy scene can be completely avoided, etc.

4 SYSTEM ARCHITECTURE

There are many factors need to be comprehensively considered, such as advancement, practicability and safety, with function of 3D model database, human-computer interaction, training and evaluating and data analyzing[7], etc. As shown in Figure 1, the crime scene investigation training and testing system overall technical architecture is based on B/S. By adopting 3D Max and combine texture mapping technology to achieve scenes, facilities, trace, evidence, and corpse vivid modeling, etc. Meanwhile, the system efficiency improvement method is based on Unity3D virtual reality technology platform which dynamic loading various resources[8]. Furthermore, new simulant crime scene can be momentarily expansion according the training course requirement.

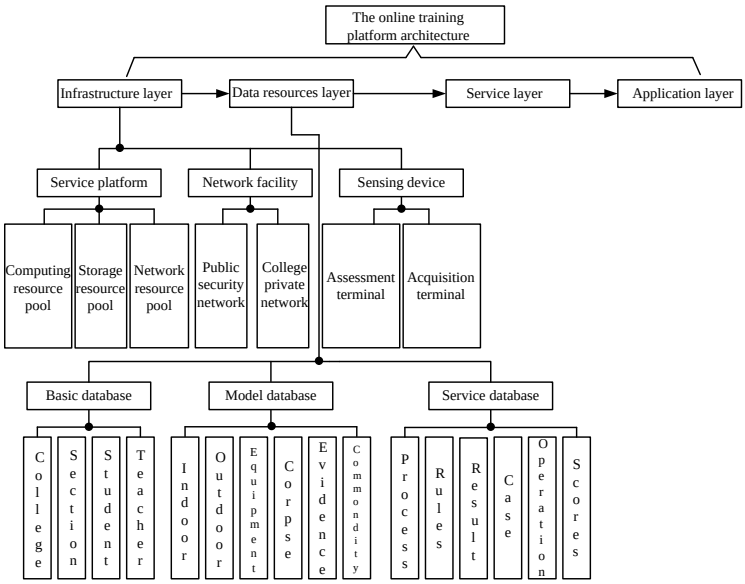


Figure 1. The crime scene investigation training and testing system architecture

The core part of training and testing system is the model database which should have certain complexity, besides the above-mentioned models, new evidences which produced by the related crime behavior should also be included. In the meantime, the trace evidences should have the characteristic of diversity (e.g., fingerprint, footprint, biological evidence, micro material evidence, corpse and material evidence, etc.). Another essential of the system is real-time interactive, operation interface left side virtual keyboard can help manipulator autonomous roaming in the virtual 3D crime scene to realize forward, backward, left-turn, right-turn, parallel translation lateral shaking, longitudinal swing and horizontal level bias navigation functions, etc. and the focus can be enlarge/reduce to help observing and browsing at a different angle[9].

The indoor scene including living room, bed room, kitchen and bathroom, etc. with an emphasis of entrance and exit, ground, objective surface and facilities status. The outdoor scene including buildings, park, road and vegetation, etc. and the climate, environment should be considering. As mentioned above the trace evidences data should including fingerprint, footprint, tool mark, bullet mark, special trace, biological evidence, micro material evidence, corpse and material evidence, etc. The equipment including disposable headset, gloves, shoe bags and warning line etc. crime scene protection tools, finger print brush, electrostatic adsorption and moist swab etc. crime scene extraction tools, DSLR camera, illumination source, right-angled proportional scale, non-drying glue proportional scale, measuring tape and laser rangefinder etc. crime scene fixing and recording tools. The flow chart and the interface are as shown in Figure 2. and Figure 3., respectively.

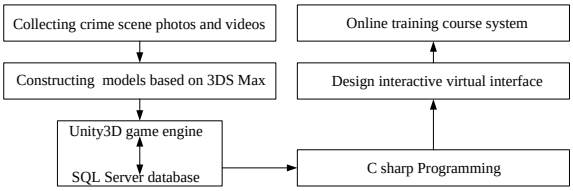


Figure 2. Flow chart of the system development

Figure 3. The user operating interface

5 CRIME SCENE INVESTIGATION TRAINING COURSE TEACHING REFORM DESIGN BASED ON 3D VIRTUAL SIMULATIION TECHNOLOGY

5.1 Training Teaching Mode

The online teaching method will change traditional evaluation method and need to redesign teaching and testing items, simulated scene should including typical and universal case types, teacher can establish new scene freely, through task base leaning to inspire students' positivity [10].

The online teaching specific flow as follows:

Step 1 Installing software: user follows the basic operation process and installing video to install crime scene investigation virtual simulation training system and in accordance with android system or ios system.

Step 2 System demonstration: the specification operation video will send to student for lesson preparation in advance.

Step3 Software operation: student need finish theory test and challenge test in 10 teaching hours which including crime scene investigation and criminal scientific technology basic theory knowledge, material evidence treatment experiment, field investigation special training, serious case special training and open challenge competition challenges, etc.

Step4 Online training carrying out formally: teacher through background database on-line monitoring exercise status and response related problems.

Step5 Online final examination: each student should finish the random crime scene investigation examination in 40 minutes.

The concrete teaching mode design scheme as shown in Table 1 and Table 2:

Table 1. Comparison of Online and Offline Teaching Mode

Design project	Comparison		Specific teaching content
Teaching class hour design	offline	12 class hours	1.Familiar crime scene investigation within 4 class hours; 2.Familiar trace, material evidence extracting method with 4 class hours; 3.Finish the final examination by group in the last 4 class hours.
	online	10 class hours	1.Earning scores by theory test in the first 2 class hours; 2.Complete some simple crime scenes online investigation (burglary, robbery etc.) between 3rd to 5th class hours; 3.Complete some relatively complicated crime scenes online investigation (burglary, robbery etc.) between 6th to 8th class hours; 4.Each student must complete the random crime scene investigation alone within the required time in the last 2 hours.
Teaching method design	offline	teacher demonstration in the class	Take teacher as the key field investigator and section chief as the attendant field investigator to handle a simulated crime scene for all trainees.
	online	teacher provide operating before class	Providing operation video in advance for student reference.

5.2 Course Assessment Mode

The grading performance appraisal of the public security college between the different specialties, such as criminal science and technology, investigation, forensic science, network security, anti-drug discipline and science of public security to meet its professional requirement. According to the grade of difficulty of theory test, challenge test and special training test which was trained. The participants must satisfy the attendance rate and accuracy rate to achieve final examination qualifying.

Table 2 Examination Mode

Examination item	Examination contents	Proportion of score values
Theory test (including crime scene investigation and criminal scientific technology basic theory knowledge)	Mainly check students early theory knowledge (including crime scene investigation, criminal science and technology and forensic science)	For accumulating scores which doesn't occupy the final examination result, only activate the simple simulated scene and with slow lifting of scores
Challenge test (including material evidence treatment experiment, field investigation special training, serious case special training and open	Mainly check students trace and material evidence processing ability	For accumulating scores which doesn't occupy the final examination result, only activate the complex simulated scene and with fast lifting of

challenge competition challenges)		scores
Special training test (including different types crime scenes)	Mainly check students whole flow capacity of crime scene investigation	For final examination with the percentage 20% of the total score for crime scene investigation training course

5.3Teaching effect of the training course

Depending on the online training system statistical data analysis capacity, which can real-time collecting student score for teacher examination, guiding the students with the deducting score place, correcting shortages with system review.

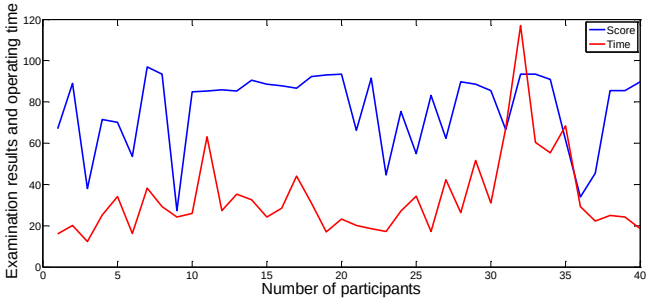
Take 5 classes with 196 students' (which specialty including anti-drug discipline and science of public security) detail online final examination scores as example which final examination scores as shown in Table 3 and the optimal value of each row use coarse font to represent.

Through Table 3 we find Class 2 with the highest average score (88.21) and lowest scores variance (119.71) which means this district team with the best and stable performance. Class 3 with the fastest average operation time (27.00), lowest operation variance (135.84) and the highest efficiency value (2.99), but the whole team average score is none-ideal.

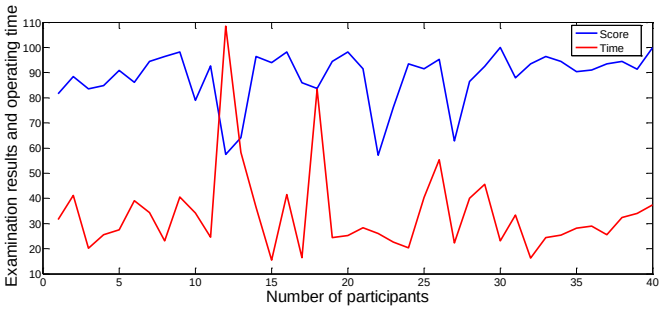
Table 3. The Final Examination Results

Class number	Average score	Average operation time	Scores variance	Operation variance	Efficiency value
Class 1	76.70	33.54	353.18	397.64	2.29
Class 2	**88.21**	34.03	**119.71**	309.28	2.599
Class 3	80.82	**27.00**	341.39	**135.84**	**2.99**
Class 4	82.38	33.40	558.05	224.85	2.47
Class 5	84.02	37.45	452.36	247.99	2.24

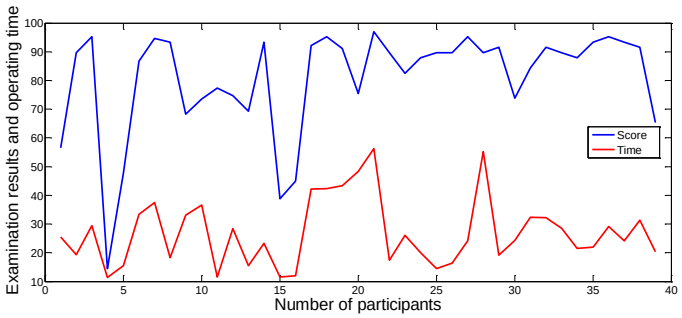
We also provide the performance of all 5 participation classes which the blue curve and red curve denote score and time, respectively. We find the most stable blue curve in Figure 4 (b). Some outliers with red curve in Figure 4 (d) and (e) cause the breakdown of system for some reason.



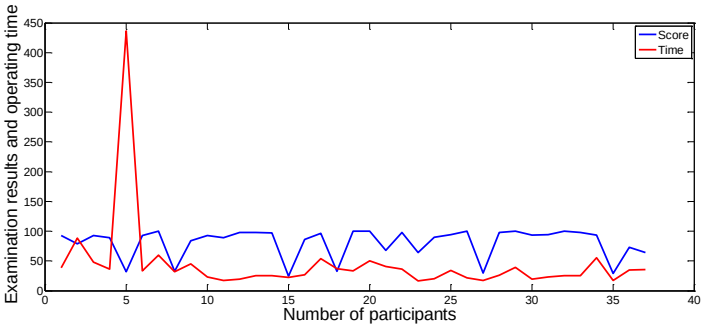
a) Class 1



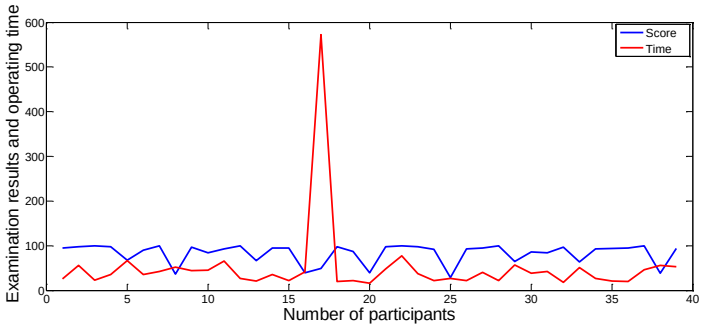
(b) Class 2



(c) Class 3



(d) Class 4



(e) Class 5

Figure 4. Performance of all participation classes

The crime investigation scene training course can achieve lesion preparation and mission assignment, class testing and review after class three phases' "seamless cohesion" via this online training and examination system. Teacher can carry out teaching reform and promote teaching quality with pertinence according to the on-line monitoring students' exercise status through background database. Even for some students who home-based quarantine in remote areas, they can perform the test and examination until the network improving.

After the end of epidemic, the online training system can still combine with the traditional offline training method and complement each other.

6 CONCLUSION

This paper transfer the crime scene investigation training course from traditional offline physical space into online virtual space based on 3D virtual simulation technology. With the advantages of autonomous learning, quickly mastering, precisely scoring, synchronous feedback and timely adjustment etc., and the teaching aims have realized which innovatively completed expected teaching effect.

The online training course' examination results show that all participants could well master the crime scene investigation operation specification of our 3D virtual system, which can guarantee teaching progress and teaching quality during the epidemic period.

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