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The Effects of Virtual Reality System Applied to Shooting Training Course for Senior High School Students

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Abstract: The main purpose of this study was to explore the effectiveness of virtual-reality shooting training system and traditional triangle aiming training on students' shooting performance, self-learning achievement and self-learning motivation for senior high school students. Second, the goal was to find out whether the relevance of shooting score to self-learning-performance and self-learning-motivation is positive or not. This study applied Game-Base Learning virtual reality shooting training system to construct human-computer interaction learning environment by utilizing 1:1 real-scale T91 teaching rifles with Bluetooth function, virtual reality shooting training application, which is suitable for Android platform, semi-Google Cardboard head, mounted viewer, TV streaming device with synchronous display function from mobile phone to projector. It combined the advantages of Immersion VR and Projection VR to achieve the purpose of synchronous learning. In this study, it took quasi-experimental design and divided 78 male students into two groups from two general classes in Tainan senior high school. The experimental group (40 students) adopted virtual reality teaching methods and the control group (38 students) adopted traditional triangle aiming training teaching method. The experimental courses were during for seven weeks, once a week, and 50 minutes for once. Finally, it analyzes the date including pre-test and post-test of shooting score, questionnaires, course recording video and interviews. The results showed that virtual reality shooting training system were better than traditional triangle aiming training on students' shooting performance, self-learning achievement and self-learning motivation.

Keywords: **Virtual Reality, Game-Base Learning, Self-Learning Achievement, Self-Learning Motivation**

1. Introduction

The main purpose of this study is to compare the traditional triangle aiming shooting method with the digital game-based virtual reality shooting training system. In the general high school national defense education curriculum, students' learning performance, achievement and self-motivation are explored in this study (Gong, Mei, Xiang, Mei, & Liu, 2017). This research dedicate to find whether there is a difference or correlation between academic performance and learning self-motivation. This study is expected to provide a reference and supplementary material when instructors teach high school national defense curriculum.

2. Literature Review

2.1 Game-Base Learning

The concept of Game-Base Learning is that using a variety of digital media to include the Internet, computers, corporate networks, satellite broadcasts, CDs, video tapes, audio tapes and interactive TVs. The range of this learning includes online learning, computer-assisted learning and collaborative learning of online digital classroom (Alden, 1998).

Game-based learning consists of three parts: learning, simulation, and games (see Figure 1). The Entertainment only consist of simulation and games, like ordinary video games in the world, purely is entertained-only. While Simulation Games consist only learning and games. It is like a simple kids

game and lacks the complexity of real world simulation. On the other hand, Simulation focus on learning and simulation, is like the military pilot training system or the training system of the medical profession (Martens, Diener, & Malo, 2008).

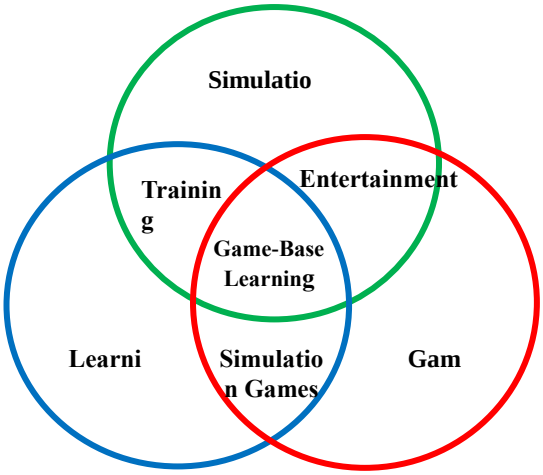

Figure 1. Three factors of Game-Base Learning

2.2 Serious Game

The game used for digital learning is called Serious Game. The term Serious Game was first invented in the United States and it was widely used for policy and management learning (Michael & Chen, 2006). Serious games can simulate the environment of the real world. It is not for entertainment which provide people a happy feeling, but mainly serve as a channel of educating and training operators. Militainment is one kind of Serious Game. It trains army force on the virtual battlefield in a game-like manner, communicate basic training information, and teach skills (Payne, 2014). The virtual reality shooting training system developed in this study belongs to this type of serious game, and the shooting skill of the T91 rifle can be learned through this game.

2.3 VR Military training

There are lots of researches or teaching software for digital information technology application in Taiwan, but are relatively rare for military training courses. On the contrast, the US Army is currently developing some VR Military training platform. Because the development of serious games requires joint cooperation by enterprises, academic institutions, and research institutions. The US Army's famous "America's Army" software is a good example. It is developed under the "US Army Training Guidelines", and allows players to choose between basic infantry or medical training with almost full range of current US equipment. Especially all weapons in the game are simulated using real data (Nichols, 2009). VR Military training can not only repeated exercises, but also to record the learner's training results in detail and to correct the individual's learning status. Similarly, that students can have the opportunity to learn repeatedly through computer simulation during trial and error process. In addition, they can learn independently and focus on the training course greatly.

3. Methodology

3.1 Research Process

This study is mainly to explore the how effective of virtual reality shooting training system compares to traditional teaching method on the students' academic performance, self-learning achievement and self-learning motivation in the national defense course of T91 rifle shooting training. In figure 2, this experiment used quasi-experimental design and organize the two classes of students with the same qualification as the experimental group and the control group. The experimental group were adopted the

virtual reality teaching method, while the control group adopted the traditional triangle aiming teaching method.

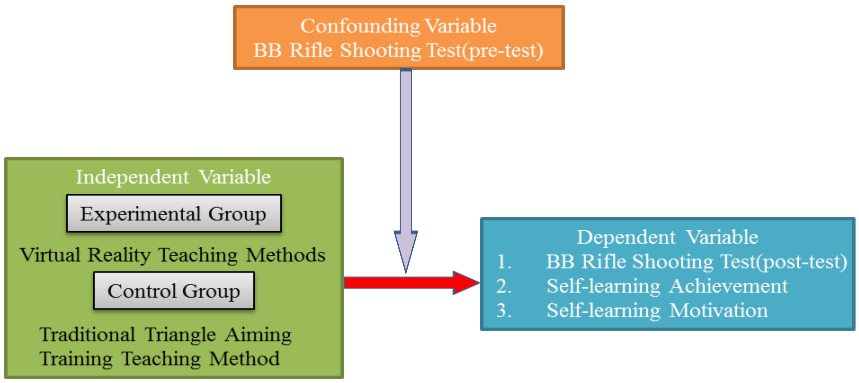

Figure 2. Experiment process

3.2 virtual-reality shooting training system

We used the Unity 5.3.1.f1 ver. to develop the virtual reality aiming shooting training APP Because Unity is a freeware, and there are abundant SDKs with templates (Kim et al., 2014). So we consider Unity ideal for beginners who have never developed any apps.

This research chose a shooting game called "Shooter Area VR", which is an authored free and modifiable template in the "VR Samples". We chose Android as the research platform and ran this VR app on mobile phone, because Android system is designed to adopt novice developers than the APPLE iOS platform (Ciesla, 2017). The components of this training system consist of floating marks and successfully shooting counters (Figure 3).

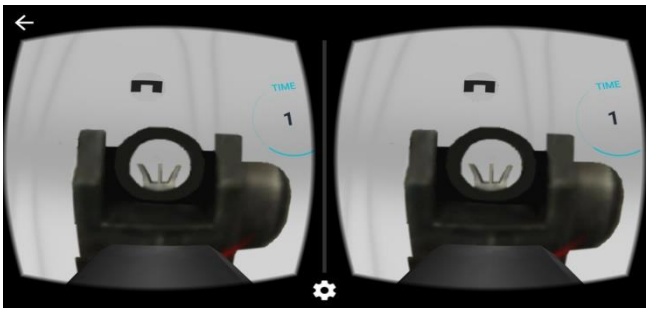

Figure 3. The marks and scores in shooting training system

In order to make students being immersed in the situation, and to get rid of the inconveniences of the wires, we use wireless headset VR BOX (Figure 4). The advantages of wearable device include to avoid suffering from environmental light which affect the aiming positioning, and no interference in the infrared aiming module. The other reason constraint the chosen of devices is the limited space in classroom, so the most economic benefit teaching method is wearable device like the VR headset (Alshaal et al., 2016). The combination of Bluetooth T91 training rifle and the wearable VR device, can be easily portable to any other class even outdoor environment.

Figure 4. VR BOX headset

One of the important factors affecting the accuracy of shooting is whether the posture of the gun holder obeying eight essentials of shooting, such as holding, resisting, holding, sticking, aiming, stopping, buckling, and reporting. Therefore, this research attaches the Bluetooth device with the 1:1 ratio of the T91 training rifle. The appearance, weight and sight of the rifle is identical to real T91 rifle, in which enables students to receive real shooting experience the essentials of operating the real T91 rifle when practically aiming. In addition, in order to enable the students to simultaneously trigger the shooting in virtual reality application, the researcher extends the button of the Bluetooth system remote control rear to the buckle of T91 teaching rifle (Figure 5). When the student buckles the trigger, the trigger forces the button of the Bluetooth remote control backwards, and execute the firing command of the training system (Espada et al., 2015). The advantages of the wireless virtual reality system is the nearly true experience of firing a rifle.

Figure 5. 1:1 real-scale T91 teaching rifles with Bluetooth function

Virtual reality generally require a display helmet or headset to allow its user to merge into an immersive experience. So the researcher used the synchronous display function of the AV bar to connect the current VR screen onto the projector. In this method, we synchronously project images and sound effects on the curtain in the front of classroom (Figure 6). And the operator and all other students in the classroom can learn at the same time. The other students waiting for shooting now could look at the operator's aiming posture and screen, so that they can learn the correct aiming method by observing the shooting score and failure of operator. Moreover, the other students might have verbal competition for the operator and increase the fun of learning (Ravyse, Blignaut, Leendertz, & Woolner, 2017). Other students can simultaneously learn the correct targeting method and increase the motivation in an asynchronous competition. In addition, the real-time display of results also increase the operator's desire to obtain higher scores and thus improve the learning achievement of correct aiming.

Figure 6. Synchronously project image to share VR screen with other classmates

4. Result

Comparing the differences between the two groups to understand whether the self-learning achievement and self-learning motivation are affected by different teaching methods, the independent sample T test is adopted. As shown in Table 1, in terms of self-learning Achievement, the control group who take traditional teaching have an average number 14.74, the standard deviation is 3.531, and the average value of standard error is .573. While experimental group who use virtual reality teaching method have an average 17.98, a standard deviation of 1.981, and a standard error of .313. The average number of experimental group (M=17.98) is higher than the average of control group (M=14.74). And in terms of self-learning motivation, the control group have an average number 10.29, the standard deviation is 2.977, and the average value of standard error is .483. While experimental group have an average 12.13, a standard deviation of 1.800, and a standard error of .285. The average number of experimental group (M=12.13) is higher than the average of control group (M=10.29). The T statistic of the two dependent variables reached a significant level, because both p-values were less than .05, indicating that different teaching methods have significant differences in self-learning achievement and self-learning motivation.

In the independent sample T test, if the T-value reaches a significant difference, the effect value can be further determined. The effect value represents practical significance, while the T statistic and p-value are represent statistical significance. The Eta square value η^2 is the effect value, indicating a highly correlated intensity between the groups and self-learning achievement (.279≧.14) as well as the groups and self-learning motivation are also a highly correlated intensity (.207≧.14).To judge whether the T value of the difference in two groups is significant or not, in addition to consider the value of the T value itself (two-tailed), we could observe the confidence interval of 95% area. If the interval estimate contains a value of 0, it must accept the null hypothesis. On the contrary, if the value of 0 is not included, the null hypothesis can be rejected and the opposite hypothesis can be accepted. In the term of the self-learning achievement, 95% CI are between (-4.545, -1.931), in which does not include 0. This indicate that there is a significant difference between the two groups. In the self-learning motivation, the confidence interval of the 95% are (-2.957, - .714). Without 0 inside this interval, it means a significant difference between the two groups too.

Table 1
Comparison table between self-learning Achievement and self-learning motivation of experimental group and control group

Factor	Group	N	M	σ	SEM	t	η^2	95% CI	
self-learning Achievement	*experimental*	*40*	*17.98*	*1.981*	*.313*	*-4.960****	*.279*	*-4.545*	*-1.931*
	control	*38*	*14.74*	*3.531*	*.573*				
self-learning motivation	*experimental*	*40*	*12.13*	*1.800*	*.285*	*-3.275**	*.207*	*-2.957*	*-.714*
	control	*38*	*10.29*	*2.977*	*.483*				

The SEM is equal to $\frac{SD}{\sqrt{N}}$
*p<0.05, ***p<0.001

5. Conclusion

According to the research results, digital learning method with virtual reality technology is efficient compared with the traditional triangle aiming shooting training method. It can improve the scores of learners and increases the motivation and achievement of students' self-learning. In addition, the head-mounted virtual reality shooting training system is not affected by light damage and wireless, instructors can teach in the general classroom. And those devices are easily to carry to another place and no longer suffer constraints of classroom venues. It can be integrated into a digital game-based teaching

system to enhance the effectiveness of teaching and the motivation of students (Woo & Yeom, 2012). When the creativity and technology are integrated into the teaching content, in addition to making the teaching activities would become more interesting and attractive. It also achieves the ideal state that learning by osmosis(Odom & Kelly, 2001).

5.1 Future Development and Suggestions

1.It is recommended that the future research add real shooting environment in the game. When students immerse in the actual shooting environment background (Lai, Hu, Cui, Sun, & Dai, 2017), they can adapt to the surrounding situation of the actually shooting experience earlier.
2.The actual aiming method is a series of combinations required coordination of both head and hands (Livingston, Ai, & Decker, 2018). So it is recommended to design a motion-sensing detector on the T91's rifle to simulate the actual shooting position of the gun.
3.There are no force feedback or shock response after shooting, they affect the accuracy of shooting. Another benefit of this kind of interacting rifle is that it can simulate the real recoil vibration in the practice, so that the learner can experience it and ease his mood when he shoot the real T91 rifle (Glassner, 2010).

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