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Teaching Mode Based on Multi-Data Fusion Algorithm and Virtual Simulation Technology

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Keywords: Teaching Model; Virtual Simulation; Data Fusion; Traditional Teaching

Abstract: Teaching Model is the oldest and most far-reaching theoretical work in the world. It contains many unique insights, is full of philosophical thinking, and is still of great significance in modern life. Therefore, until now, many people are still exploring the ideas in it. There are many esoteric theories in teaching mode that are difficult to understand in a traditional way, so they need to be explained with the help of other methods. As a special data processing method, multi-data fusion has received great attention and development in the field of target recognition. This text focused on the teaching mode of teaching mode on account of multi-data fusion algorithm and virtual simulation technology (VST). This paper interprets its profound theories with the help of data fusion and VSTs in a pedagogical mode to enhance students' understanding and interest in the course. In this paper, a data fusion estimation model based on Kalman filtering was established, simulation experiments were carried out on data of different structures, and the estimation accuracy of the system was improved through multi-sensor data fusion. The simulation virtual system was introduced in the teaching, and the role of the virtual simulation system was explored in the teaching process by comparing teaching between parallel classes and experimental classes. The experimental results of this paper showed that, from the perspective of traditional teaching methods, the ability level between 40-45 was 13.6%, and between 45-50 was 4.2%. In the virtual simulation teaching mode, the ability level was 6% between 45-50, and 15% between 40-45.

1. Introduction

The progress of teaching effect requires the selection of different teaching modes according to the course content. The benefits of Zhong B's introduction of the O2O model in English teaching include providing a more innovative teaching model, a more reasonable curriculum, and starting with the application of flipped classrooms, trying to build O2O higher vocational education. The English teaching mode based on MOOC starts from three aspects: guiding students to prepare before class, choosing more reasonable teaching resources, and carrying out extracurricular activities. He proposed the evaluation and evaluation system of O2O higher vocational English teaching mode based on MOOC, which provided a learning platform for students to explore and create learning situations independently. Experiments showed that O2O teaching provided a feasible choice for mass education and significantly enriched English teaching tools [1]. M ünl ü's aim was

to explore the impact of specific microteaching exercises, exemplifying "pre-teachers" beliefs about "self-efficacy" using a specific model and defining pre-teachers' perceptions of the subject. In the present study, he used a hybrid method, Convergent Design (Inserted). Study participants included 41 pre-school math teachers in college-enrolled math teachers. In this study, he used the application of the math teacher's practical beliefs and the interview form as a data collection tool. Research showed that the practice of micro-teaching with specific models has a positive effect on the self-efficacy beliefs of teachers who continue to use specific models. Educators believed that these low-level training practices have a positive effect on teaching skills [2]. Addressing the current challenges of mobile learning in big data environments and the current state of research on Teaching Intelligent Services (TIS), Jia Q discussed the construction of mobile learning in the Teaching Intelligent Service System (TISS) in colleges and universities [3]. Zhang J based on the comprehensive analysis of school teaching evaluation, learning evaluation and guidance system based on mobile GIS terminal, uses mobile GIS terminal to analyze classroom teaching and courses, and improves teaching efficiency through research on teaching evaluation [4]. Although these theories discussed the teaching model, it was not possible to combine it with VST.

Virtual simulation experiments have been widely used in the field of education with good results. Zhao Y used 3DS MAX modeling and animation software to build a virtual design room using the Unreal Engine 4 game engine, designed interactive operations, and simulated system operations. The results showed that the virtual simulation system has obtained good experimental feedback [5]. The development of information technology, especially virtual reality (VR) technology, has brought profound changes to all aspects of urban life. It will play an important role in future urban construction and so on. Diao J analyzed the application of VR and simulation technology in 3D urban landscape environment design. In terms of urban planning, VR technology has been applied to major urban planning and construction activities such as urban development and project site selection. At the same time, for urban designers, the urban VR landscape system is an excellent tool. Designers can create virtual cities through 3D simulation and modify the design in real time, thus providing a basis for urban planning and architectural design [6]. Wang C used VR simulation technology to conduct preliminary research on the repetition of sports dance and found a virtual simulation program for repetitive dance exercises. Strong support was provided to the musician for sports and these three elements were integrated into the ultimate sports game system ultimately [7]. In recent years, acting has become the basis for medical students who do not receive a degree in radiology. Gunn T aimed to explore the impact of new VR learning environments on the development of students' technological skills. Each student's educational experience is either through laboratory simulations or through VR simulations for two specific anatomical techniques. After the educational experience, students influence and evaluate their level of intelligence. The data showed that students trained in VR software simulations have improved their overall grades compared to traditional laboratory simulations. VR training tools facilitate the acquisition of technologies that are better compared or improved than traditional laboratory training [8]. Although these theories have expounded the VST, their combination with the data fusion is too little, so it is not practical.

The multi-data fusion algorithm and VST are used to change the infection teaching mode, and the hardware system is transformed from the teaching materials and equipment. Using different teaching modes for different courses can improve the teaching effect. According to the research, from the perspective of virtual simulation teaching mode, 57% think that traditional teaching is generally attractive, 6% think that traditional teaching is very attractive, and 59% think that it is relatively attractive, indicating that VST can attract students' attention more and is more conducive to improving the effect of classroom teaching. 22% think that the traditional teaching mode can stimulate the interest of learning, and 70% think that the ability to stimulate interest is relatively

general. When the virtual simulation teaching mode is adopted, 8% think it can stimulate interest very much, and 55% think it can stimulate learning interest, indicating that the virtual simulation teaching mode is more effective in stimulating learning interest.

2. Methods of Multi-data Fusion Algorithm and VST Teaching Mode

The teaching mode is the epitome of the broad and profound Chinese culture, which fully demonstrates the charm of Chinese culture [9]. However, there are many delicate theories that are difficult to realize in the modern teaching mode of teaching and need to be supplemented by other equipment [10-11].

VR technology is widely used in the field of social production due to its powerful functions [12]. In the field of education, this technology can change materials, equipment and other conditions, can use virtual studio software and hardware systems to train students in TV program production skills, and use very economical means to solve high-cost experimental problems [13-14]. Especially in relatively threatening scenarios, it can achieve similar results to actual teaching through situational simulation. Figure 1 shows the system structure of VST:

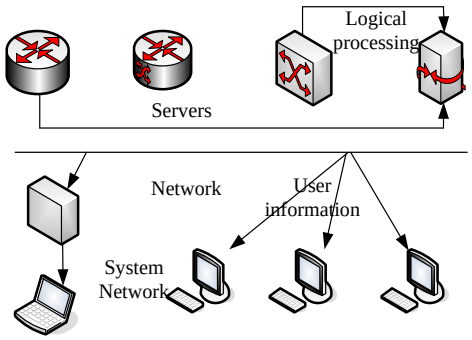


Figure 1: System architecture of VST

In fact, China's research on VST started as early as the end of the last century, but the combination of it and the teaching model was launched in this century [15]. According to the data, in 2017, the application and exchange of VST has been carried out well, and advanced technologies, concepts and high-quality resources have been shared in a wide range. The overall level of teaching in colleges, and the cultivation of students' innovation, entrepreneurship and ability have been well promoted [16-17].

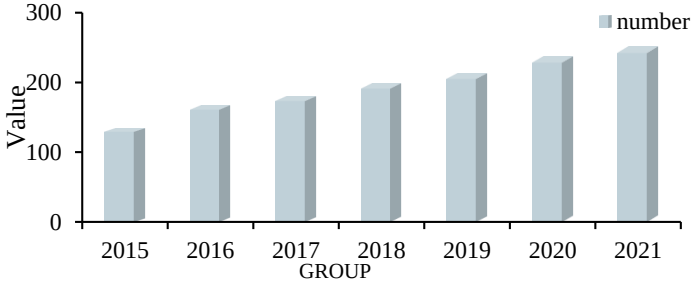


Figure 2: Related literature on VST teaching

According to the data in Figure 2, the relevant literature on VST teaching has been found. According to the data trend, although the development in the field of education is relatively late, the relevant literature is increasing year by year, indicating that the application of VST in teaching is gradually popularized, and it is relatively mature in use [18-19]. According to the actual use, this technology is usually used in more experimental subjects, and how to combine it with the traditional

teaching mode is the current problem.

VR first originated in the 1950s and 1960s, but its computing power is obviously insufficient. Virtual simulation is a familiar VR technology, which originated from the military combat system of the United States. It was not widely used in various fields until the technology was continuously improved and promoted. Some scholars have found through research that the platform has a significant role in improving students' motivation, participation and learning performance, and thus launched the exploration of VST in the field of education [20].

VR technology is mainly used in scientific and technological development, business, medical, military, entertainment and so on. Since VST is involved in various fields, there are many related definitions of it. It is the product of the combination of multiple technologies, and it is a breakthrough in modern simulation technology. The user enhances the immersive feeling generated by the related device. The activities of teaching and learning carried out in the virtual environment are all virtual simulation teaching. The space limitation can be broken through VST, which combines VST with network technology. Figure 3 shows the teaching mode demonstration of VST:

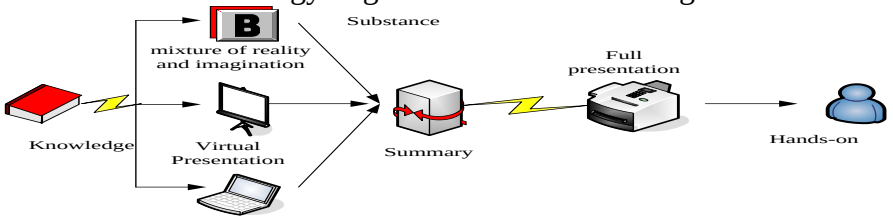


Figure 3: Demonstration of the teaching model of VST

Data fusion is more accurate, more complete, and more reliable estimation and judgment than a single source of information. Data fusion is a multi-sensor processing technology, which was first used in the military field. The data fusion system processes the detected data on the battlefield to obtain war information to assist people in decision-making. With the continuous progress of data fusion technology, its application scope has expanded from the military field to other fields. For example, the field of automated manufacturing, the commercial sector, and even the home have extremely broad application prospects. The data fusion model involved in this paper is developed from the general model, including data preprocessing and data feedback. The data fusion model is shown in Figure 4:

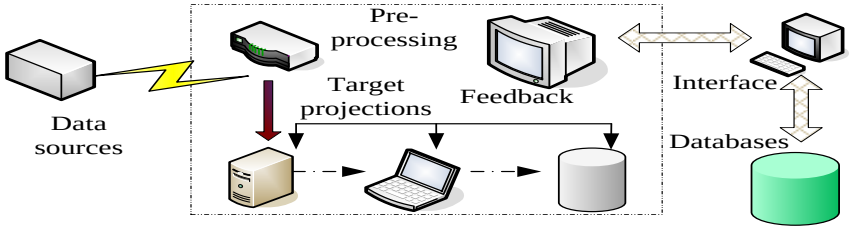


Figure 4: Data fusion model

The benefit of data preprocessing is that human errors, limitations of measurement equipment, or loopholes in the data collection process can all cause various problems, resulting in the loss of the value of the data to the entire data object. The data that needs to be analyzed in data preprocessing may come from different types of sensors. These data can be different in content and form, and they need to be simply processed before formal data analysis. Data fusion needs to involve various inference theories:

$$\breve{a} = \beta(h_1, h_2, \cdots, h_\delta) \tag{1}$$

In Formula (1), a belongs to an unknown vector, h is a random vector, h_δ represents the estimator of a, and $\beta(*)$ represents the statistical rule.

$$\mathrm{Q}\left(\breve{\mathrm{a}}^{(\delta)}\right) = \mathrm{a} \tag{2}$$

In Formula (2), $\breve{\mathrm{a}}^{(\delta)}$ represents an unbiased estimate of parameter a.

$$\lim_{\delta\to\infty} \mathrm{Q}\left(\breve{\mathrm{a}}^{(\delta)}\right) = \mathrm{a} \tag{3}$$

When it satisfies Formula (3), $\breve{\mathrm{a}}^{(\delta)}$ represents an asymptotic unbiased estimate of parameter a.

$$\lim_{\delta\to\infty} \breve{\mathrm{a}}^{(\delta)} \to \mathrm{a} \tag{4}$$

When it satisfies Formula (4), $\breve{\mathrm{a}}^{(\delta)}$ represents the consistent estimator of the parameter.

Least squares estimation is a relatively long-term method. This method does not require any prior knowledge. Only the observed signal model about the estimated quantity is needed to realize the estimation of the signal parameters, which is easy to realize and can minimize the sum of squares of errors.

$$\mathrm{g} = \mathrm{Qa} + \mathrm{b} \tag{5}$$

Data g represents a linear function of parameter a, and both Q and b are random vectors.

$$\breve{\mathrm{a}}^{\mathrm{WLS}} = \arg\min \frac{2}{\mathrm{k}} (\mathrm{g} - \mathrm{Q}\breve{\mathrm{a}})\mathrm{T}(\mathrm{g} - \mathrm{Q}\breve{\mathrm{a}}) \tag{6}$$

In Formula (6), $\breve{\mathrm{a}}^{\mathrm{WLS}}$ represents the weighted square estimation of the parameter a. When $\mathrm{T} = 1$, it is called the least squares estimation.

$$a_{u+1} = R_u a_u + P_u g_u \tag{7}$$

$$s_u = B_u a_u + d_u \tag{8}$$

In the formula, u represents the time index, s_u represents the system state vector, R_u represents the system state transition matrix, g_u represents the process evolution noise, P_u represents the noise matrix, B_u represents the measurement matrix, and d_u represents the measurement noise.

$$S^u = (s_1, s_2, \cdots, s_k) \tag{9}$$

In Formula (9), S^u represents the measurement information, which represents the estimation of a_u, which is called the state filtering problem. If a_{u-1}, and $\mathrm{k} > 0$, it is called the state smoothing problem.

$$\widehat{s_u} = Q(s_u | s^{u-1}) \tag{10}$$

$$s_{u-1} = s_u - \widehat{s_{u-1}} \tag{11}$$

Formula (10) represents the advance prediction of random vectors, and Formula (11) represents the prediction error sequence.

$$\widehat{s_{u-1}} = Q^*(s_u | s^{u-1}) \tag{12}$$

$$\mathrm{s_{u,u-1}} = \mathrm{s_u} - \widehat{\mathrm{s_{u,u-1}}} \tag{13}$$

The formula represents a pseudo-information sequence. The advance prediction sequence and the innovation sequence constitute an advance predictor, which has a feedback linear system, and its structure is shown in Figure 5:

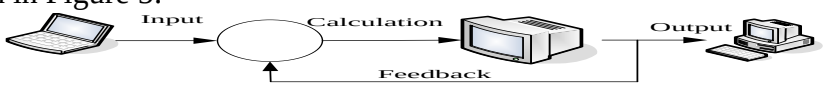


Figure 5: Advance predictor mechanism

$$a_{u/u-2} = Q(s_u|s^{u-1}) \tag{14}$$

$$B_{u/u-2} = cov(a_{u/u-2}) \tag{15}$$

The formulas are the one-step ahead forecast value and the forecast error, respectively.

$$U_u = B_{u/u-2}G_L^O\left(G_L B_{u/u-2}G_L^O + B_u\right) \tag{16}$$

The principle of Kalman filtering is to use observations to dynamically generate statistical prediction parameters. In Formula (16), U_u represents the Kalman gain matrix at time u.

3. Experiment of VST Teaching Mode

Virtual simulation system refers to a computer system that uses VST to achieve specific application value. With the continuous improvement of its technology and functions, the technology has been used in the teaching field. Virtual simulation teaching is a new type of teaching. It uses VST to simulate a realistic virtual learning environment, mobilize students' vision, hearing and other senses to receive various information related to learning, carry out independent exploration and innovative learning activities, and improve students' performance.

In order to understand the attitude of students to combine VST with teaching mode teaching mode, a week-long virtual simulation teaching was conducted for students. For the situation at this stage, information was collected from the 110 students who participated in the experiment. The details are as follows:

Table 1: Students' attitudes towards the teaching model combining virtual technology with teaching mode

Content	Number of people	Proportion
Very satisfied	33	30
Quite satisfied	48	43.5
Dissatisfied	29	26.5
Abstract	10	33
Presentation is not clear	3	12
Reduce hands-on	15	50
Other	1	5

According to the data in Table 1, 10 people think that the teaching mode is too abstract and difficult to understand the content of the professor; 3 people think that the picture displayed by this teaching model is not clear enough to achieve a real sense of picture; 15 people think that the use of VST reduces teaching Students' practical operation, which is not conducive to students' understanding to a certain extent. It can be seen from this situation that although VST can bring vitality to the classroom, it still needs improvement and running-in in terms of equipment and students' habits.

Table 2: Students' attitudes to different teaching methods

Content	like		Difficult	
	Number of people	Proportion	Number of people	Proportion
VR	20	18	25	23
Teacher drill	25	23	21	19
Practical	62	56	32	29
Theory	17	15	48	44

According to the data in Table 2, students' attitudes were investigated for different teaching methods. According to the specific situation, from the perspective of VST, 20 people think this method is very good, up to 18%, and 25 people hope to use this method to teach when the teaching content is difficult to understand, up to 23%. From the perspective of teachers' demonstration teaching, 25 people think this method is very good, up to 23%, and 21 people hope that when the teaching content is difficult to understand, they can use this method to teach, up to 19%. From a practical point of view, 62 people think this method is very good, up to 56%, and 32 people hope to use this method to teach when the teaching content is difficult to understand, up to 29%. From the perspective of theoretical teaching courses, 17 people think this method is very good, up to 15%, and 48 people hope to use this method to teach when the teaching content is difficult to understand, up to 44%. According to this situation, for the content that is difficult to understand, students prefer to do it by themselves, or the teacher can explain the relevant theories.

Table 3: Whether students have the conditions and attitudes of virtual simulation teaching

Content	Options	Number of people	Proportion
Electronic equipment	No	0	0
	Yes	110	100
Virtual simulation attitude	Dislike	13	12
	It doesn't matter	39	35
	Like	58	53
Understanding of the curriculum	Have	94	85
	No	17	15

According to the data in Table 3, it can be seen whether students have the conditions and attitudes of virtual simulation. According to the data, all students participating in the experimental investigation have electronic equipment, which provides a material basis for students to conduct virtual simulation teaching at home. Regarding the students' attitude towards the virtual simulation teaching mode, 13 students were dissatisfied with it, accounting for 12%; 39 students held an indifferent attitude, accounting for 35%; 58 students thought the teaching mode was very interesting, accounting for 53%.

Table 4: School hardware

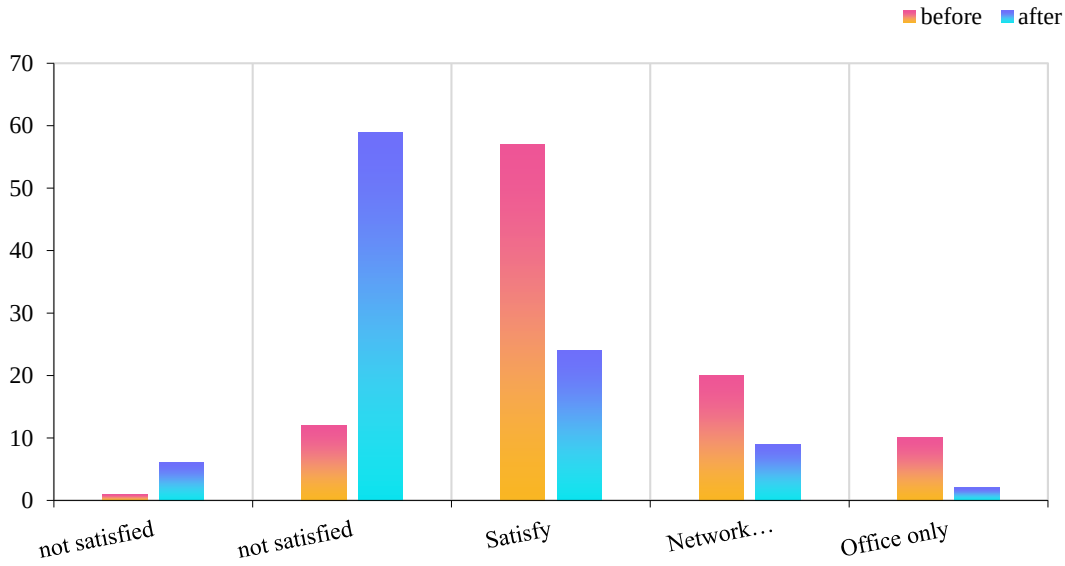
Content	Options	Number of people	Proportion
Whether the equipment is suitable for teaching	Not satisfied	15	25
	Not satisfied	28	47
	Satisfy	17	28
Network situation	Network coverage	13	21
	Office only	38	63
	No	10	16

According to the situation in Table 4, the hardware situation of the school was investigated. According to the opinions of 60 teachers, in terms of equipment configuration, 25% of teachers believe that campus equipment does not meet the requirements of virtual simulation teaching, 47% of teachers think that campus equipment is not comprehensive enough, and there are certain restrictions on virtual simulation teaching; only 28% of teachers think that campus equipment meets virtual simulation teaching. From the perspective of campus network configuration, only 21% of teachers believed that the school has full network coverage, 63% of teachers said that only the office has network coverage, and 16% of teachers said that the school has no network coverage. According to this situation, only a small number of schools can support the virtual teaching model,

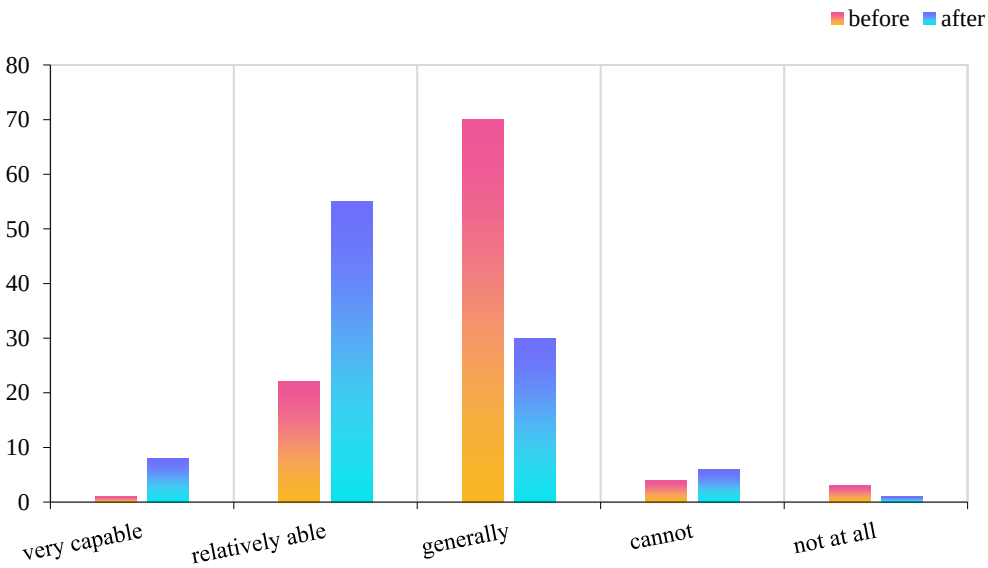
and most schools cannot adopt this model.

4. Teaching Mode of VST

The teaching effect of the teaching mode is one of the important basis for its adoption. To investigate the teaching situation of VST, the situation of students in different teaching methods was compared and analyzed, and the specific situation is as follows Figure.



(a) VST teaching



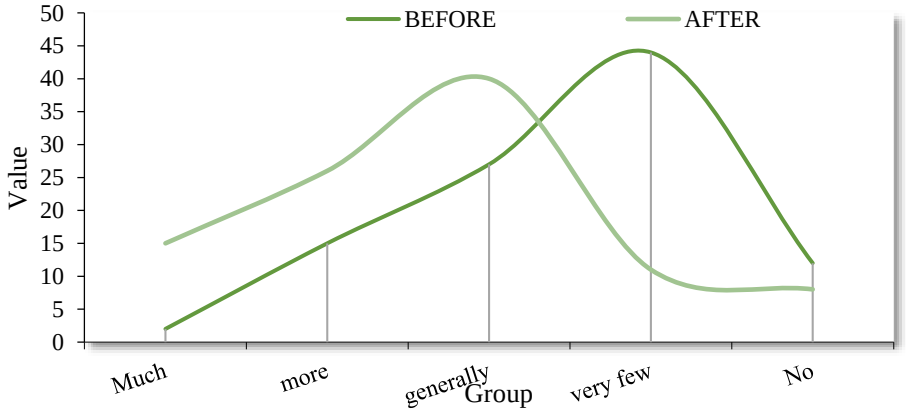
(b) traditional teaching

Figure 6: Effect of VST teaching mode on attractiveness and interest

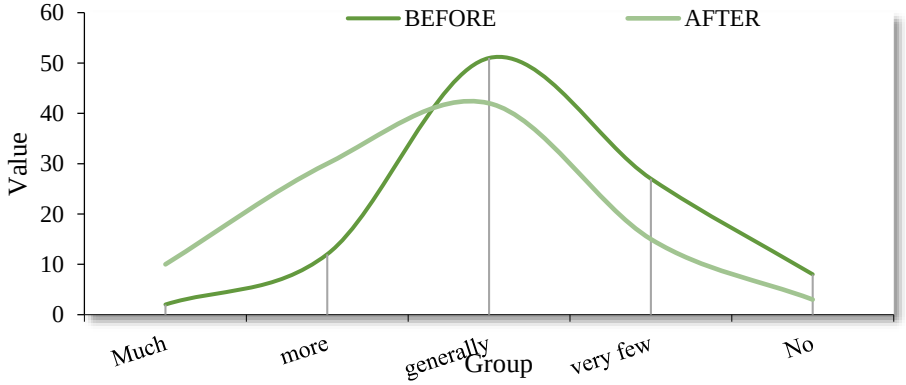
According to the data in Figure 6, the attractiveness and ability to stimulate interest in the teaching mode of VST are discussed. First of all, from the perspective of the attractiveness of the VST teaching mode, 1% think that traditional teaching is very attractive, 12% think it is relatively attractive, 57% think it is generally attractive, 20% think it is not very attractive, and 10% think it is completely unattractive. From the perspective of traditional teaching mode, most people think that the attraction of traditional teaching mode is relatively general and cannot attract students' attention

to a large extent in the classroom. From the perspective of virtual simulation teaching mode, 6% think traditional teaching is very attractive, 59% think it is relatively attractive, 24% think it is generally attractive, 9% think it is not very attractive, and 2% think it is completely unattractive. According to the two teaching modes, VST is more able to attract students' attention.

From the perspective of stimulating interest in learning, 1% think that traditional teaching is very able to stimulate interest, 22% think that it can stimulate interest in learning, 70% think that the ability to stimulate interest is relatively general, 4% think that cannot able to stimulate interest, and 3% think that cannot stimulate interest at all. According to the data, the vast majority of students think that the traditional teaching mode is relatively general in terms of the students' interest and ability. When the virtual simulation teaching mode is adopted, 8% think it can stimulate interest very much, 55% think it can stimulate interest in learning relatively, 30% think it can stimulate interest in general, 6% cannot stimulate interest, and 1% cannot stimulate interest at all. According to the comparison of the two data, the virtual simulation teaching mode is more effective in stimulating learning interest.



(a)Communication between teachers and students under VST



(b)Teacher-student communication in the traditional way

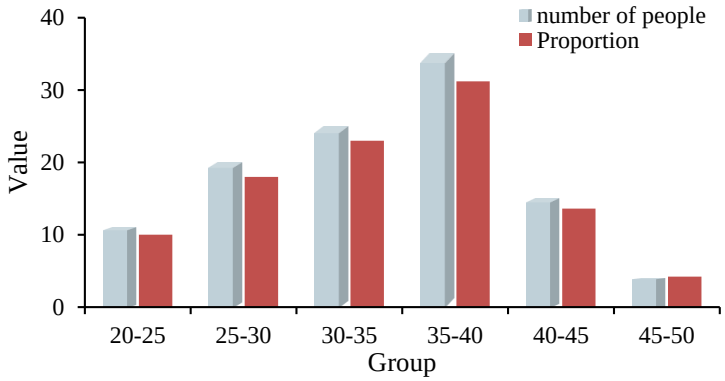
Figure 7: Comparison of teacher-student communication and guidance

According to the data in Figure 7, the teacher-student communication and guidance under the virtual simulation teaching mode is compared with the traditional teaching mode. From the perspective of teachers' guidance, when using the traditional teaching model, only 2% have very much teacher guidance, 12% have more teacher guidance, 51% have teacher guidance in general, 27% have very little teacher guidance, and 8% have no teacher guidance at all. According to this situation, in the traditional teaching mode, the frequency of teachers' guidance is very low, which may be related to the frequency of communication. When the virtual simulation teaching mode is adopted, 10% have a lot of teacher guidance, 30% have a lot of teacher guidance, 42% have teacher

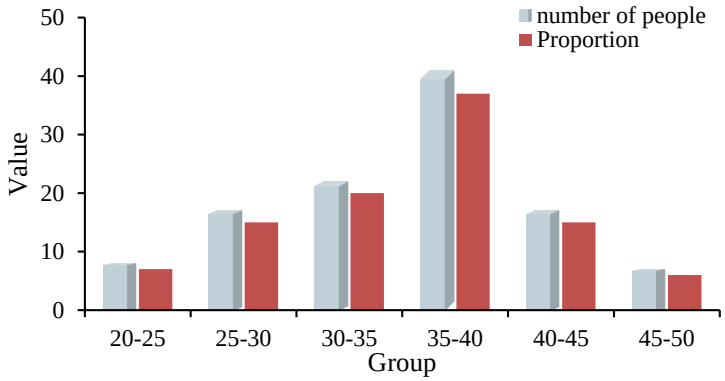
guidance in general, 15% have very little teacher guidance, and 3% have no teacher guidance at all. According to the comparison of the two sets of data, it can be seen that the virtual simulation teaching mode can enhance the communication between teachers and students, and allow students to get more guidance from teachers.

In order to explore the cultivation of students' autonomous learning ability under the virtual simulation teaching mode, a comparative analysis was made between it and the traditional teaching mode.

The students' autonomous learning ability under different teaching modes was tested. The ability level is divided into different categories in Figure 8. First of all, from the perspective of traditional teaching methods, there are 11 people with ability level between 20-25, up to 10%; 20 people with ability level between 25-30, up to 18%; 25 people with ability level between 30-35, up to 23%; 35 people with ability level between 35-40, up to 31.2%; 15 people with ability level between 40-45, up to 13.6%; 4 people with ability level between 45-50, up to 4.2 %. According to the data, the number of people between 35 and 40 is the largest, indicating that the level of students' autonomous learning ability is relatively general.



(a)Students' autonomous learning ability under VST



(b)Students' autonomous learning ability under traditional methods

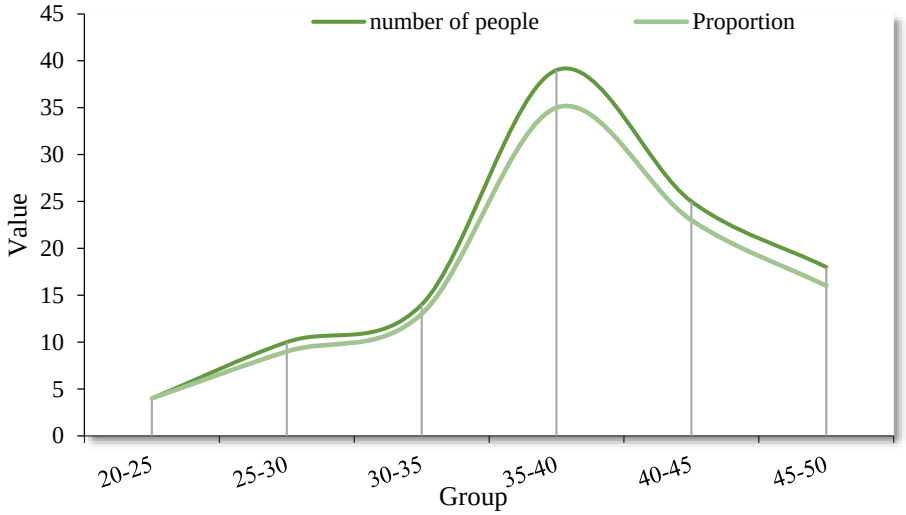
Figure 8: Results of students' autonomous learning ability test

In the virtual simulation teaching mode, there are 7 people with an ability level between 45-50, up to 6%, and 17 people with an ability level between 40-45, up to 15%. In the high-segment group, the proportion of students increases, indicating a decrease in the number of low-segment students. It can be seen that the virtual simulation teaching mode plays a role in the cultivation of students' autonomous learning ability to a certain extent. This model requires students to have high autonomy in the teaching process, so it improves students' autonomous learning ability in the subtle learning process.

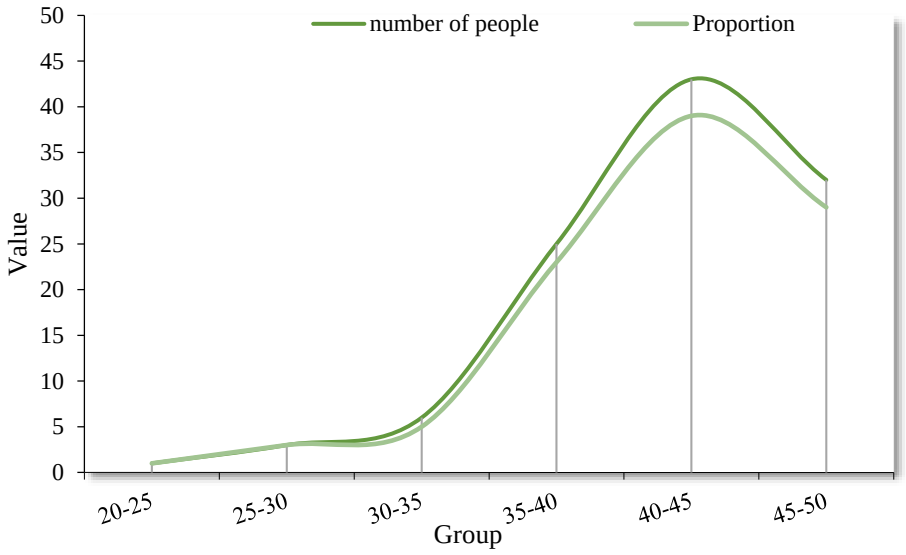
Creating efficient classrooms and improving classroom efficiency are the goals that every

teacher hopes to achieve. It is important to create an efficient classroom that requires students to have a sense of cooperation and team spirit. In order to explore the students' cooperation ability under the virtual simulation teaching mode, a comparative analysis was made between it and the traditional mode.

The students' cooperation ability under the two teaching modes is tested in Figure 9. First of all, from the perspective of the traditional teaching model, 4 people with cooperation ability between 20-25, up to 4%; 10 people with cooperation ability between 25-30, up to 9%; 14 people with cooperation ability between 30-35, up to 13%; 39 people with cooperation ability between 35-40, up to 35%; 25 people with cooperation ability between 40-45, up to 23%; 18 people with cooperation ability between 45-50, up to 16 %. According to the data, in the traditional mode, the students' awareness of cooperation is average, and there is a lot of room for improvement.



(a)Students' cooperation ability under VST



(b)Students' ability to cooperate in the traditional way

Figure 9: Results of the student cooperation ability test

In the virtual simulation teaching mode, 43 people have a cooperation ability between 40-45, up to 39%, and 32 people have a cooperation ability between 45-50, up to 29%. It shows that in this

mode, students' cooperation ability is beneficially improved significantly. In the teaching mode, the pre-class question-solving, group cooperation and after-class question-answering enhance the students' awareness of cooperation and improve the students' cooperation ability.

5. Conclusion

The development of the economy and the progress of science and technology make it possible to obtain various kinds of information, and the scope of learning is also expanding. The society's emphasis on learning is also increasing, and the requirements for classroom teaching effects are also getting higher and higher. Teaching is a more esoteric subject, parts of which cannot be explained by improved teaching methods. This paper aims to study the teaching mode based on multi-data fusion algorithm and VST. It is expected that with the help of data fusion and VST, esoteric theories will be explained in the teaching mode. The research shows that, compared with the traditional teaching mode, the virtual simulation teaching mode will significantly increase the interaction between teachers and students, and the students' autonomous learning ability and unity and cooperation ability will be significantly improved. Although some achievements have been made in this paper, there are still some deficiencies. Due to limited time and energy, the scope of this study is narrow, and the lack of different subjects may affect the experimental results.

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