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Study on optimization and innovation of swimming technique

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Abstract

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As one of the major foundations of modern competitive sports, competitive swimming is known as the "king of sports". Because of its wide popularity and great influence, competitive swimming has become the second largest project in the Olympic Games and also in the Guangzhou Games. In order to improve the swimming level of our school team and improve the performance and competitiveness of our school swimming, it is imperative to optimize the research technology. This paper expounds the necessity of technological optimization and innovation through the students' swimming situation and weak links observed during the internship in Qianjin Road Primary School. This paper analyzes the factors affecting students' swimming speed, proposes the improved method, discusses the training methods, and analyzes the technology.

Sun Yang, who has won numerous medals and honors at the world championships, is a symbol of success. Of course, swimming is also his career in the only. More and more primary school students participate in swimming training after the class in Guangzhou. This is not just their hobbies but instead, they are able to insist on daily training to participate in the competition and finally achieve their grade certificates after the competition. In this way, they will not be unable to go to a good school because of family difficulties or poor grades.

Therefore , they as the research project and the subjects were 8 to 10years old students of the school swimming team in this study. In competitive swimming, the students were studied and analyzed on the wrong movements and wrong butterfly techniques. With the correction action in technical movements and new system training programs to increase the speed of the swim, the study has a big breakthrough in the future of the swim team. This study has carried out data analysis of the swimming team of a primary school in Guangzhou and national team of China, so as to study the training program of the most suitable members to improve the performance of the team members of the swimming team. These data were collected using a form to register various data collection starting from June 1, so as to analyze the strengths and weaknesses of each team member and develop different plans for training. For example, break down the butterfly, let the students experience and understand every basic action detail of the butterfly, re-do the basic training, and improve the overall technique from the micro-movements. There is also training to increase the explosive power on land, to reduce the time of warm-up, and not to waste time in a chat game.

The conclusion of this paper is that the performance of the studied studentsh who is significantly improved by improving the basic technical movements, improving the swimming technique and increasing the explosive power. In addition, the students' speed is also significantly improved in other additional items. Swimming performance depends mainly on physical fitness and technology. Physical fitness is the foundation and technology is the guarantee. There is always a limit to physical fitness. To further improve their speed and performance when students' exercise and exercise intensity reach their limits, they must rely on technological optimization and innovation.

Keywords
Swimming technique, teaching, method, innovate

Table of contents

1 Introduction

1.1 Background information

Since the 1984 Los Angeles Olympic Games, China's competitive swimming has achieved rapid development and presented a good situation. The swimming team has won a total of 43 medals so far. Among these medals are 13 gold medals, 19 silver medals and 11 bronze medals. In 1988, the Seoul Olympic Games won 3 silver and 1 bronze medals. In 1992, the Barcelona Olympic Games won 4 gold and 5 silver medals. In 1996, the Atlanta Olympic Games won 1gold, 3 silver and 2 bronze medals. In 2004, the Athens Olympic Games won 1 gold and 1 silver medals, and the 2008 Olympic Games won 1 gold, 3 silver and 2 bronze medals. In 2012, the London Olympics won 5 gold, 2 silver and 3 bronze medals, and the 2016 Rio Olympic Games won 1gold, 2 silver and 3 bronze medals.

Swimming now has entered a period of rapid development in the world. With the constant improvement of sports performance, the average age of excellent athletes is also growing, and the sports life of athletes is gradually prolonged. The countries of the world have invested a lot of funds, manpower and technologies for the sport of swimming, and at the same time pay more attention to scientific research. These are the weak links in the development of China's swimming industry. Therefore, improving swimming technology and providing comprehensive technical support for daily training is a place where the development of swimming in China needs improvement.

From September 13 to 14, 2018, a total of 588 athletes from 49 primary schools participated in the Haizhu District Primary School Swimming Championships hosted by the Haizhu District Sports Bureau. In the end, my school won the 5th place in the total score of the group. In this competition, 28 of the team members of our swimming team won the top eight individual awards, and 11 of them won the top eight of the group relay awards.

1.2 Purpose of research

In recent years, the sport of swimming in China has developed rapidly and the technical level of swimming has been continuously enhanced. In order to improve the swimming skills and competition results of athletes, we should continuously optimize and develop swimming sports techniques according to the characteristics of swimming techniques and the laws of movement, so as to improve the level of swimming competition and promote the rapid development of swimming sports in China. Today, the concept of quality

education has been continuously promoted and deepened. The swimming program has become one of the must-test items for the Guangzhou Junior High School Entrance Examination. Students can choose one of the two must-have items for swimming and middle and long distance running according to their actual situation. Both of these projects have a very good effect on improving the physical fitness of young people, and are also the most responsive to students' basic physical fitness. Primary school swimming training is inevitably an important part of primary school quality education. In the limited training time, progress must be made from technology. Swimming is one of the world-class competitive sports, and its technical characteristics are dynamic and versatile. Therefore, in order to improve the performance of swimming competitions, it is necessary to combine the rules of swimming movements, proceed from the actual situation of athletes, cultivate the awareness of sports technology innovation and optimization, and improve the level of swimming athletes.

1.3   Research significance

Further enriching the theoretical connotation of swimming is of great significance for expanding the theoretical extension of competitive swimming in our school. With the continuous advancement of society, the constant support of the state's financial resources, and the rapid development of science and technology, competitive swimming has become a competitive sports project that is by no means a single factor. It is more reflected in the comprehensive input effect of comprehensive national strength on competitive swimming projects. The changes in swimming competition rules, the development and application of new technologies or new equipment have largely contributed to the development and transformation of the field related to competitive swimming development. Whether it is the innovation and optimization of competitive swimming technology or the innovation of training theory and method, it constantly promotes the swimming special theory and the similar disciplines to blend and extend outward, further enriching the optimization and innovation of swimming projects, providing strong theoretical support for the development of our school and even our national competitive swimming.

2   Theoretical Foundation

2.1   The necessity of swimming technology innovation

Although China's swimming industry has made remarkable progress in recent years, we still have a lot of work to do to consolidate our position as a swimming power and even beyond Europe and the United States. Judging from the overall understanding of swimming in China, the technological innovation of swimming has played an important role in improving the swimming speed and swimming performance, and this has already attracted our attention, but our theoretical understanding is insufficient, which limits our understanding and mastery of international advanced technology. Therefore, the optimization and innovation of swimming training technology is the weak link of swimming training in China, and it is also the most important. (Yun 2010, 2-4.)

The general technical principles of swimming apply to every ordinary person, but to achieve excellent results in racing swimming, it is necessary to consider the individual differences of each athlete. In the training, we should explore the potential ability and outstanding advantages of different aspects of the athletes from the actual conditions of the individual, and tailor the tactics suitable for the athletes to maximize the athletes' level.

According to domestic research, the contribution rate of China's competitive swimming program to the total number of Olympic medals is still small. The key to swimming training lies in technology. The intensity, quantity and interval time of training depend on technology. Only by continuously renovating swimming technology can we improve the swimming performance and lay a solid foundation for our swimmers to achieve excellent results in future competitions. (Jingwei 2000, 24-30.)

Swimming technology optimization and innovation as a basic research topic, it is necessary to collect literature and research on outstanding athletes at home and abroad to optimize it based on the current status of swimming technology. The paper analyzes and studies swimming technology theory, technology optimization methods and means, summarizes the various elements of ideal technology, lays the foundation for the optimization and innovation of swimming technology, and provides theoretical basis for the reform and innovation of swimming industry in China.

2.2 Development of swimming techniques

2.2.1 Butterfly srtoke

The butterfly, which is swimming when the swimmer swims like a gracefully dancing and flying butterfly. The butterfly is second only to the freestyle and the favorite of the swimming events for its grace and power. The butterfly was developed from the frog style, which was the period from 1937 to 1952 when the frog style technique reached its second stage. Some swimmers stroke until their thighs is above the water. From the perspective of appearance, the athletes look like a dancing butterfly flying high from the front, while from the side, they look like a mermaid walking gracefully in the water, and from the back, they look like a dolphin playing in the water, so it is called "butterfly stroke". The butterfly stroke of this period, though with a little fame, was only called the breaststroke together with the frog style, and the two did not separate. It was not until that fifteenth Olympic Games of the fifteenth Olympic 200m that the athlete used the butterfly technology, and the characteristic of the butterfly phoresis was that it was not only of a more considerable speed but also of great appreciation. This also prompted the butterfly and frog style to be played separately. After separating the butterfly from the frog style, the butterfly became an independent event, and the technique of the butterfly was rapidly developed. (Yuanyang 2005, 10-11.)

The body posture of the butterfly is required that the shoulder must remain on the surface of the water, the hip is close to the surface, the head is lower than rams when entering the water, and the head is low. (Zhenglun 2013, 65.)

The butterfly's arm moves into the water -- holding the water -- stroking the water -- pushing the water--getting out of the water-- moving the arms. (Zhenglun 2013, 65.)

The leg of the butterfly can't bend the kneel at the start of the butterfly, and the legs shall close together, and once the heel is exposed to the water, bend the legs down to the water immediately and hit the water. (Zhenglun 2013, 66.)

The breathing action in the butterfly stroke requires you to start breathing while moving upward. (Zhenglun 2013, 66.)

The coordination rhythm of the butterfly shall require to move the arm once while swinging of leg twice at the same time. (Zhenglun 2013, 66-67.)

From the first stroke after the departure and each turn, the body must remain in a prone position, and the shoulders must be kept parallel to the water surface, but the legs are allowed to kick water laterally under the water, and the body must not be turned into back floating position (back down) at any time. Both arms must swing forward simultaneously on the surface of the water while pulling backwards under water. The two-legged kick action must be consistent at the same time. The two legs or the two feet may not be on the same level, but no alternate action and breaststroke kick are allowed. At each turn and at the end of the journey, both hands must touch the deck edge at the same time on the water or under the water. The shoulders must be kept on the same water. Allow shoulders at different heights or sloping shoulders to increase freedom of movement. After the departure and each turn, the athlete is allowed to make one or more kicks underwater, and to draw water through the arms to make the body surface. Allow diving after departure and after each turn, but not more than 15 meters. Before 15 meters, the head must be exposed to the water to keep the body above the water until the next turn or reach the end. (Yuanyang 2005, 20-21.)

2.2.2 Backstroke

Since the historical record, the existence of backstroke has been more than three centuries. The initial backstroke was to make prone float as a break during swimming. Later, the backstroke slowly developed to use the two arms while pulling backwards on the side of the body, thus becoming a swimming stroke. In the second Olympic Games in 1900, the backstroke was officially listed as an Olympic sports event. At the 5th Stockholm Olympic Games in 1912, the American athlete Herbneil used alternate arm strokes and alternate kicks, and won the 100m championship with a score of 1 minute and 21 seconds, which proved the superiority of the crawl backstroke technique. At the 11th Berlin Olympic Games in 1936, the American player Kefir won the 100m championship with a score of 1 minute and 5seconds 9. His backstroke movement was perfect and laid the foundation for the modern backstroke. Subsequently, the action of the backstroke was gradually standardized, and the technical level was continuously improved. In 1968, the German athlete Master, who was 180cm tall, using the bent arm, deep stroke, strong kicking, stretching, flat and high-profile, streamlined technique, won the men's 100m backstroke champion, and broke the record of 1min with 58.7 seconds, which became a turning point in the development of backstroke technology. Master is known as the best backstroke athlete of the 1970s. Therefore, the current backstroke technique is two times bent arm pull, 6 times or 4 times kicks, and a coordinated technique of breathe, which completely imitate the actions of Master. (Zhiyuan 2010, 8-9.)

The backstroke is unique in the four swimming stroke. It can be divided into propulsion phase consisting of hand entry, catch, and an ending portion, and recovery phase. In backstroke, the rotation of the shoulder causes the little finger to first enter the water. In combination with the straightening posture of the elbow joint, the student presents an overall elongated posture when starting the propulsion phase of the water. The difference between backstroke and freestyle and butterfly is that the catch begins with the contraction of the latissimus dorsi. The pectoralis major plays a supporting role in maintaining the wrist joint in a neutral to slightly extended position. By the pressure of the water combined with the contraction of the biceps and diaphragm, the elbow maintains a flexion of nearly 45° at the beginning of the catch. At the end of the catch, the elbow joint may bend to nearly 60 degrees and then enter the end. As same as the final stage of the butterfly, the last part of the backstroke propulsion phase focuses on the strong extension of the elbow joint, which places high demands on the triceps. (Ruoyun 1982, 50-51.)

2.2.3 Breaststroke

Breaststroke is a swimming technique created by the ancients to imitate the frog swimming posture. The speed of the breaststroke is slow, but the actual effect is obvious, so it is widely spread and people are more interested in it. The early breaststrokes were very simple, including the thighs that bent to the abdomen, the arms that stroked to the sides of the thighs, and the body undulating. In 1936, according to the international swimming regulations, the breaststroke arm could be moved forward in the air after pulling, which was similar to the old-fashioned butterfly, so the speed was greatly improved, and the original swimming stroke was gradually eliminated. In 1952, it was re-specified that breaststroke and butterfly swimming were separately contested, and breaststroke could be used for underwater diving. This was a technological change in the early breaststroke. In 1956, it was again stipulated that underwater breaststroke was prohibited. Only once hand and leg diving movements were allowed after starting and turning. During the whole swimming process, part of the athlete's head should be exposed to the water surface, and the breaststroke technique was newly developed. The technical movement of the breaststroke has gradually evolved from the original to the high sail, half high sail, flat sail, and piston-type, which has greatly improved the competition results. As of December 31, 1997, China's competition record in the 100m breaststroke was 1 minute 1 second 66 for men and 1 minute 8 seconds 26 for women, as well as the world record was 1 minute 0.6 seconds for men and 1 minute 7 seconds 2 for women. (Yuanyang 2005, 56-60.)

Two arms naturally extend forward, open the hands, palms are down, parallel to the horizontal plane, and the body is naturally stretched.

The arm is stroked outwards, and the palm is slowly turned outward from the top to the bottom. The palm is tilted by about 45°, and turned to the obliquely downward direction. At this time, there is no forward propulsion, and it is not necessary to use too much force to avoid wasting your physical power. You should relax when you are pulling, and don't use too much force.

High elbows catch. You can start to catch water when the palms and arms feel pressure. This is the most critical step in catch propulsion. Premature catch will shorten the internal stroke distance and affect the speed.

Insweep and close hand. When the arm is open about 45°, the wrist begins to bend, the palm is from the outside to the inside, and the arm drives the elbow to accelerate the inward stroke, pushing the water to the inside of the body. At this time, due to the water thrust, the upper body can be in a higher position. When the action is completed, the elbow will be placed under the armpit, and the arms will be close to the body to reduce the resistance of the water; the palm is also placed from the outside to the top, in front of the head. During the stroke, the hand speed is fast and smooth, and at the end, the elbow joint must be lower than the hand.

Stretch your arms forward and turn your palms from upward to opposite, then merge and stretch with dark force.

Recovery of the legs, turn the feet, kick and insweep, and sliding with hands and feet overlapping togethe

2.2.4 Freestyle

According to the records, the first use of alternate arm stroke is a British athlete. Then there was an action of kick up and down combined with the legs. In the 1900 Olympics, a Hungarian athlete won the gold medal in alternate arm stroke, and he won the gold medal in the same way in the next Olympic Games. A British man later created a new swimming stroke that used two legs alternate kicking water, opening a new path for the development of freestyle. In 1922, an American athlete broke the world record with the technique of alternate arm stroke and alternate kick, and became the fastest freestyle swimmer who

could complete 100m. The American champion's technology laid the foundation for the development of modern freestyle. In the 1930s, the swimming stroke of catch-up was very popular in countries around the world and it was passed down to the 1950s. With the gradual improvement of the national sports, there had been more advanced four-beat kick. This kind of technology was first adopted by a Japanese athlete in 1949. He used this technique for freestyle and created a new world record for the 1500-meter project. Swimming session of people had two views on the use of this technique. On the one hand, the use of this technique could speed up the swimming movement, but on the other hand, it was feared that the technique of using this four-beat kick would ultimately affect the performance. So this technology was not widely adopted at the time. In 1956, an Australian athlete once again used this technique to break the world record of the 1,500-meter freestyle, and in the Melbourne Olympics of the same year, an American athlete used four-beat kick to create a faster world record of freestyle. Thus, this technology had drawn the attention of the swimming circle around the world. With the rapid development of swimming technology, people were eager to swim faster, and they were not only satisfied with four-beat kick. In the Tokyo Olympics in 1964, an Australian athlete used this technique to achieve good results. Since then, this technology has developed rapidly, and so far, more and more athletes in the world have chosen it. (Weiying 2010, 78-80.)

2.3 Dry diving training

A particular factor to consider in training is the age of the athlete. Not so long ago, strength and endurance training was considered inappropriate or dangerous for young athletes, antagonistic training was thought to increase the risk of growth plate damage, which can have a negative impact on children's growth. But now antagonistic training performed with young athletes has proven to be effective and safe, which can be stated and supported by the following organizations, including the American Academy of Sports Medicine, the American Customer Association, the American Orthopaedic Association of Sports Medicine and the National Union of Strength and Fitness. (Ian 2015, 13.)

Antagonistic training can increase the chances of successful training by promoting sports level and reducing the risk of injury, and ultimately helping young swimmers to increase their sports interest and positive attitude. While endurance training focuses on basic physical fitness, helping them to comply with the requirements of underwater exercises completion. Other special benefits include: promotion for muscle strength, muscle endurance, overall body strength, stability around joints, body composition and bone mineral density, all of which can promote exercise levels.

It has long been a long time for people to pay attention to that physical explosive power. At least since the ancient Greeks, athletes have found a way to increase people's speed and power. After all, the explosive power is a mixture of strength and speed, the product of power and velocity. It is a power applied within a certain range of motion per unit of time. (James&Robert 1999, 3.)

Explosive power is essential to most athletic skills, whether it's the serve of tennis or the clean and jerk of weightlifting. As a result, people have long designed targeted exercises to reinforce quick and explosive movements. But it was only in recent decades that training to systematically enhance explosive reactive forces began to develop. (James&Robert 1999, 4.)

Power itself can be naturally a beautiful experience and appreciation for human beings. People seem to be natural will appreciate people who have strong power in his own heart. Power is an invisible thing, even if there is one, if it does not have a carrier, it is invisible and untouchable. However, when we see a person's muscular body, we assume that the person must be very powerful. It can be said that a person's arm is a good carrier for the demonstration of power. And the butterfly stroke is a very visible display of arms in the air, and it shows the power of the arm without being stingy with it. As a general rule, people are strong in the butterfly. Some people say that the butterfly is slower than the freestyle but more energy consuming. There's no wrong way to say that, but the butterfly has more body movements, and it has a lot of ups and downs, so it's going to cost you more energy. So, do you want to know the secret to speed up the swimming? To increase the speed of the butterfly, you have to train hard to make it work. However, good training methods are also useful for increasing the speed of the butterfly, as technology determines everything.

A good combination plan can not only increase strength and speed but also avoid injuries. Proper training can not only improve performance but also significantly reduce the number of devastating sports injuries. But none of the students I trained had explosive power training. In the randomly tested 50-meter butterfly, the burst was almost exhausted in the first 20 meters, resulting in no sprint effect in the last 15 meters.

2.4 Short-course and long-course

The formal swimming pool is 50 meters, but the pool in the short course is 25 meters. The swimming pool of the Olympic and World Championships is 50 meters, while the pool in

the short-course meet is 25 meters long, so it is named "short course". However, the distance of all swimming competitions will not change due to the shortening of the venue. Only one point, in the short-course meet, the butterfly swimmer needs to turn twice as often as the long course (50 meters), so this puts a higher requirement on the athlete's own skills and the physical distribution during the swimming.

In the butterfly competition, the results in the short-course meet are a little worse than those in the 50-meter long course. Because the 25-meter pool has more turns, the requirements for physical fitness are greater, and the technical requirements for butterfly are also higher. For butterfly, both technical and physical strength are indispensable. Therefore, the short-course butterfly competition is more difficult than the long-course butterfly competition.

In fact, turn and pushoff are the key to accelerate. If the technology is in place, there will be a lot of people who are overtaking when they are pushoff. Therefore, the short-course meet is also more intense. But at the same time, in the butterfly competition in the short course, the requirements for the physical strength of athletes have been improved to a certain level. For example, in the 100-meter butterfly race, it is enough to turn around only once in the long-course meet, but it must be turned over three times in the short-course meet. Before each turn, the athlete must make adjustments to the action festival, and there are higher requirements on breathing coordination.

2.5 Athlete technical diagnosis and optimization system

Many new research results have led to a significant innovation in our understanding of the project, and the grasp of special features has changed from traditional qualitative understanding to scientific quantitative understanding. In recent years, there has been a new understanding of the role of swimming technique in improving competitive swimming ability. In the United States, there has been a consensus on the understanding of swimming techniques: swimming is a technique-based exercise. Technical training is the basis of all sports training, and technical training can effectively ensure the stable performance of athletes' competitive level. In Australia, people think of a technique-driven sport. First of all, swimming training is a technique. Training must focus on the technique. The intensity, quantity, gap time and time of training all depend on technique. Training intensity is too high and quantity is too much, which break technique rules and will have a negative impact on performance. Therefore, the technical diagnosis in swimming competitions and training and the improvement of movement efficiency by optimizing the techniques have

become the key factors to improve the competitive level of swimmers. According to the characteristics of athletes' technical formation and optimization process, the system is divided into three subsystems. (Xiaoping 2005, 35.)

Sports technique is a process with quantitative and qualitative characteristics. The characteristics of quantity include kinematics and dynamics, which can be measured, analyzed and assessed by corresponding instruments and methods. Qualitative features include rhythm, accuracy and amplitude, which can be analyzed and evaluated qualitatively by coaches and athletes. Whether the technical analysis can objectively and accurately reflect the technical status of the athletes is not only the basis for diagnosing the athletes' technique, but also the important basis for putting forward the suggestions and countermeasures for improving and perfecting the technique. According to the interrelation between athlete's skill and competitive performance, the athlete's technique analysis subsystem is divided into two modules: training module, technical explanation module and technical and tactical index analysis module. (Xiaoping 2005, 36.)

The technical diagnosis of swimmer is the key factor to determine the technical optimization and training method of the swimmer. In diagnosing technical problems, it is necessary to clearly distinguish and grasp whether Athlete's technical performance restricts their technical ability, or whether their ability restricts their ability to perform competitive level, and draw accurate and objective conclusion within that first time after prepare for training and competition. In order to realize the reliability of technical diagnosis, the sub-system combines the analysis report of the sub-system of technical analysis of athletes and the multimedia technology analysis courseware, and relies on the discussion with coaches and athletes to improve the awareness of competitive swimming technique. The development of swimming sports, the technical characteristics of world excellent swimmers; The technical library of the world elite swimmers establishes the optimization of the athletes, and improves the countermeasures and training programs of the competitiveness.

Athletes' Technique Optimization Control Subsystem is based on the fundamental research for competitive swimming, swimming technique new dynamic and developing advanced knowledge, and resolve a variety of new software for sports techniques, multimedia and other advanced tools mature application, as well as scientific research personnel and coaches and athletes to reach consensus, and establishment of key players to perfect

the technology improve the competitive level of scheme and countermeasures of technical optimization goal control system

2.6 Reality technology

In the United States, the VR boom in the sports industry has brought a lot of money to start-ups. Comcast, parent of US cable company NBC sports, and Generation Warner invest $30 million in virtual reality company Jaunt. These are exactly what will happen in the sports world after 2016, a revolution in VR technology that makes it possible to lie on the couch and play baseball games, and its impact on sports is not just perceptual and visual. The rules of the game for many sports will be changed. For more relaxed and pleasant sports events, such as sailing, rowing, skiing and so on, after the popularity of virtual reality technology will usher in a renaissance, through virtual reality technology, can make the competition process become exciting and dizzying. (Jianbing 2015, 94-96.)

2.6.1 3DMax rendering technique

In 3D Max's design work, the common procedure is : modeling-lighting- material and rendering. Rendering is the final step and the most critical step to realize the virtual effect. Rendering is actually the process of rendering the scene, projecting the virtual 3D scene on the 2D plane through complex calculations and attribute settings. There are many rendering engines currently in use, such as VRay renderer, mentalRay renderer, renderman renderer and so on, while VRay renderer is currently the most commonly used. The 3D MAX material design is mainly aimed at the selection and setting of color, texture and texture of the object to be made, transparency and light blending, etc. Depending on various materials, any object in the real world can be made. The first step to follow in making a material is to make a material name and select a material type. The second is to select the rendering type, and the third is to set various rendering parameters such as diffuse color, glossiness and opacity. The fourth is to set the material channel adjustment parameters of the map and apply them to the object. Fifth, adjust the UV map coordinates, position the map, and finish the material setting. (Jing&Hongzong 2013, 124-126.)

2.6.2 Unity 3D ShaderLab Technology

Unity3D as a platform as the best development engine, using Mono, the open source NET to achieve. For Shader to adapt to different GPU, Unity uses custom ShaderLab to organize the content of Shader, and will compile for different platforms. Shader shader is a program running on GPU. Through the ShaderLab can change the shape, size, position, rotation and so on, through the unity engine to provide support, ShaderLab can also do Post Effects post-processing, similar to the function of Photoshop. (Haoyu 2014, 31.)

3.Empirical part

3.1 Details on technical optimization of butterfly srtoke basic exercises

I arranged intensified training for 16 students in the course of internship. They have fundamental swimming style, but some students' action is not standard. That leads to poor grades. So I focused on training one swimming style every week. With the research object of students between 8 years old and 10 years old, this thesis studies the grades improvement of swimming skills. The class hour is 90 minutes. The Table 1 shows the project details.

Table 1. The focusing points and objectives during the training time.

Time	The Focus of Training	The objectives
4 weeks	Basic（One swimming style, one week.）	Lay a foundation and make sure the students' action is right.
1 week	Technology	Improve the personal technology, and enter the competition mode.
7 weeks	physical agility （explosive power）	To gradually cultivate the strength, speed, endurance, agility and so on.
1week	Preparation before testing	To reduce training and improve the playing condition.

During the first month of my internship, I broke down their butterfly movements and kept consolidating my basic skills. Our swim training is from Monday to Friday after school. I break the butterfly into ten parts and practice two parts per day. These include land water stroke, backstroke, streamline backstroke, land-based stroke ,dolphin kicking and arm lifting, single arm butterfly, full butterfly, gliding butterfly, the practice of starting the stroke, and touch.

3.1.1 Practice of the land water stroke

The objective is to get the students to experience the wave movements of the butterfly. So what to do? Lie on the edge of the pool and put your hands on your hips. To ensure

proper back posture throughout the movement to avoid bending the back and shoulders, the eyes should always look straight ahead. Be sure to keep your back and legs straight, then move your hips back and chest forward. The feeling should be like standing in front of a faucet and getting ready to lean out and drink. The hips should move as far back as possible while keeping their balance. Return to an upright position with your hips slightly bent forward with your knees so that your back slightly reverses the bow and returns to an upright position. This exercise mainly involves keeping the neck flexible and always looking forward. The hip joint is forward and the jaw is closed at the same time, and the back is always in a slightly inverted arch state. Move your hips as far back and forth as possible, then increase the total movement back and forth and slow down the hip movement.

3.1.2 Practice of the backstroke

The objective is to get the students to experience the wave movements of the butterfly. So what to do? The first is to wear fins and float by the side of the pool on your back with arms on the sid e. Start from the abdomen and open up the knee and stroke the water, and start the whip from the abdomen. Head and hands rise and fall slightly. Remember, one hand touches the wall and the other reaches out to protect the head. This exercise is mainly about pulling the belly up to the surface of the water. The knee bends slightly, drawing water up with the force of the hip instead of pulling from the knee. Start at the edge of the pool and work your way up to the surface to see if the surface feels the same way. Start the exercise by slowly hitting the water with your feet, then go over to a large, powerful stroke, and then gradually increase.

3.1.3 Practice of the streamline backstroke

The objective is to get the students to experience the wave movements of the butterfly. The first thing to do is to put on fins, lie on your back on the side of the pool and float with arms forward into streamline. Start stroking the water with your belly up, then your knees and feet up. This way is similar to the backstroke butterfly exercise mentioned above. But the point is that the belly comes out of the water every time you stroke. The knee bends slightly, stroking upward from the hip but not from the knee. As you hit and stroke the water, pushing away from the side of the pool and gradually rise to the surface to feel whether they are the same feeling on the surface and under the water. You can start with a relatively slow speed, then a big and strong stroke, finally gradually speed up. As the speed increases, the amount of water stroking decreases, and the frequency increases.

3.1.4 Land-based stroke practice

The purpose is to correct the arm movements of the butterfly, especially the recover of the arm and entry. The most common mistake in the movement of the butterfly is to "hug" the arm, which is to raise the thumb when recover the arm, and palm forward, as if it is a gesture of embracing others, so this exercise is to avoid this mistake. In the stroke stage, efforts should be made to maintain the strength of the wrist and the wrist should be straight. At the end of the stroke, the palm of the hand is upward. Relax your wrists when you recover your arms. The wrist leads the action of the recover with the thumb moving backwards.

The waist is slightly bent forward with your hands on your knees. Raise your arm so that the back of the hand is turned inward. The arms are separated outward at the same time, and the distance is about twice as wide as the shoulders. The elbows are slightly curved, the hands are internally rotated, and the arms are swung back across the hips. Continue to pull your arms back until they reach very straight, palms up, and the distance between the hands is as close as possible. When starting recover of the arm in the air, first relax the wrist and rotate the arm with the thumb facing the back. Keep your elbows straight and arms straight until you move arms forward to your shoulders, which are finished when one cycle is completed.

3.1.5 Practice of the dolphin kicking and arm lifting

The purpose of this exercise is based on the trunk movement plus the arm movement. Wear fins and add a stroke while breathing. When the two arms are paddling, the trunk will rise and inhale when it reaches the highest position. When the stroke is over and the arm is moved in the air, the head begins to lead back into the water with the forehead. When starting to dive, the arm should return to the forward position, the head is submerged in the water, and the two thumbs are interlocked. Make sure your hips rise. You should look at the floor of the pool when you are underwater kick.

In this practice, in order to increase the fun and motivation of butterfly training, we train by crossing the swimming pool and the lane rope. When you reach the lane, you start to pull. You don't touch the lane rope, but pass above it. The contact between the body and the lane line was as small as possible. After familiarizing yourself with the rules, increase the difficulty by not diving into the water and moving your hips to a higher position each time you kick.

3.1.6 One-armed butterfly practice

The purpose of this exercise is to transform the underwater trunk movement into a wave motion on the water surface, and gradually master the coordination with the arm movement. Wear flippers, one arm reaches forward and the other is used for paddling. Keep prone position on the water and do exercises in the following order: paddling, breathing, dive, and kick. When inhaling, keep the same direction as the stroke arm. Each dive the thumbs are interlocked for a short time until the kick is completed. Look at the floor of the pool while diving. When inhaling, raise your hips to a certain position. The other arm repeats the same action. The point is that the rhythm cannot be disorderly. The eyes look at the front when inhaling, and you can squint at the left and right when competing. The buttocks should be removed from the water and practice with one hand every 25 meters.

3.1.7 Full butterfly practice

This exercise is aim to continue the transition to a full butterfly, focusing on the trunk movements. First, use one arm to do two movements, and later change the other arm to do the same, then make two moves with both arms, one to kick twice, two to kick four times, breathe in while kick for the third time. Inhale forward as you pull both arms together, and turn your head to the direction of one-armed stroke as you inhale. Slow down and feel your hips elevated to a level that is consistent.

3.1.8 Sliding butterfly practice

This exercise is still focused on the trunk movements. Wear fins and do only two-handed strokes. Inhale once every two strokes. Change the rhythm: diving and kick. That is, when the hand is entry while do the downbeat, as well as the entry and kick are required to be coherent. When the speed is increased, it is not necessary to consider the second and fourth kick. Its role is to balance the rhythm of the movement. Focus on the coherence and fluency of the butterfly movements.

3.1.9 Starting swim

Master the correct butterfly starting techniques and starting after turn skills, correcting irregular movements. The basic mistakes made by students are that the body cannot guarantee the streamline and the distance of underwater kicks is not enough. So every time you push off from the pool wall, your body is streamlined. What you have to do at this time is to control the depth. When the body is fully sleek and stretched out, it is necessary

to start the dolphin kick immediately. Before stroke, do kick at least six times and turn at least three times. The secret is only one word "fast".

3.1.10 Touch

Emphasize the touch technology to eliminate unnecessary mistakes. Many students will reduce the range of movements and increase the number of movements when they swim near the pool wall. The method I teach is to use a small number of movements and a powerful kick action, and keep the streamlined posture to the side.

When you are 13 meters away from the edge, you must start full speed. When you reach the marking line, try to reduce the number of movements to the side and not inhale at the last 5 meters. After the last stroke, the arm should be fully extended forward into a streamlined, while do the dolphin kick to the side. When you are about to get to the side, you should bow your head in a streamline. The fingertips should touch underwater. The most important point is that both hands touch the wall at the same time. If you can't touch yet, immediately advance the dolphin kicks and touch the wall with your hands. When you touch from the water, you still need to reduce the number of movements to the side.

3.2 Details on technical optimization of backstroke basic exercises

The aim is to practice the action of shoulder turn of backstroke. First put your arms on both sides of your body, and then float your body on your back with legs pumping water alternately. Keep the head steady and then slowly turn the shoulder so that one side of it gradually surfaces upward, and the higher the shoulder on this side, the better the effect. And moreover, the limbs from the neck to the bottom of the body needs to turn, and it should be able to see your own shoulders on the surface of the water. When the shoulder turns to the highest point as it can, turn slowly to the other side.

3.2.1 "Shark-style" backstroke water hiting

The aim is to develop the ability to maintain body posture and balance under the arm posture changes, improving the water hiting strength. With arms at your sides, float your entire body on your back with legs pumping water alternately. Keep the head steady and then slowly turn the shoulder so that one side of it can surface the water gradually, and at the same time, lift up another arm to the point perpendicular to the body, and then keep this action to practise water hiting. Due to the arm lifting up, when watching students

training as a coach, they are like a shark swimming fast, therefore it is called "shark-style" backstroke water hiting.

3.2.2 Leg pressure action

The aim is to perform the leg pressure action to keep your body streamlined. This action is completed with the contraction of the hip muscles. In the whole leg pressure action, the first 2/3 of legs can make the knee fully expanded and leg muscles relax due to water resistance. When it is pressed to a certain extent, stop down due to the control of the abdominal and psoas muscles, and make the transition to move up, but the lower leg is still downward because of inertia, causing knee bend, so the last 1/3 of the legs after performing the leg pressure action is bent. With the gradual weakening of inertia and the upper leg driving, the lower leg began to move upward, but at this time the foot continued to go down until the inertia disappears and the upper and lower leg, and the feet end action downward at once, forming a downward whipping.

3.2.3 Backstroke arm movement exercises

The aim is to practice the correct arm movement and the position and movement of the body to exercise physical control. One arm goes forward with another at the side of the body, and two arms moves from the air at the same time with one forward and another backward. The rhythm is easily confused, causing the body to sink, rise too high, and eager to paddle.

3.2.4 Matching Action

The aim is to make the two arms move in air and do water strokes in different directions and positions simultaneously. When the left hand reaches the shoulder extension line to make the whole arm become the most favorable position in the stroke direction, with the hand taking forces and accelerating to make a strong water pushing action backward down, the elbow and the upper arm are gradually approaching the side of the body, and at the end of the upper leg push pressure, a natural hand pressure can form and immediately be relaxed to ready to lift the arm out of the action, while the right arm in the shoulder extension line into the water. At the end of the stroke on the left arm, the wrist is naturally bent and relaxed. Driven by the shoulder and the upper arm, raise the water immediately with the back of your hand up. At the same time, the right arm goes into the water and do a forward stroke action. When the left arm is out of water, it is relaxed by the straight arm, swinging rapidly along the horizontal plane at an angle of about 45 degrees.

At the same time, the right arm forces to speed up the backward stroke. When the left arm is out of water, the straight arm is relaxed and swinging rapidly along the horizontal plane at an angle of about 45°. At the same time, the right arm forces to speed up the backward stroke. With the rapid migration of the left arm through the air, the upper arm gradually rotates inside, making the palm face outward, the little finger facing forward, and the shoulder strap fully extended so that the palm is ready to enter the water, and the right arm pushes the water towards the end. The left arm is cut into the water by the extension line in front of the shoulder and restored to the original backstroke position.

The aim is to keep the breath in line with the arm stroke. Backstroke breathing is relatively simple, generally two strokes one breath. When one arm moves, the swimmer begins to inhale, the rest of the time is slowly exhaling. At full speed, it is necessary to change the technique of one stroke to one breath, but it should not be too frequent, otherwise insufficient breathing will result in a disorder of rhythm.

3.3 Details on technical optimization of freestyle basic exercises

The aim is to decompose the techniques of freestyle practices. Put on the flippers to hit water in sideways. One arm is streamlined forward and the other is placed on one side of the body. To stroke and move the arm with both arms. Pay attention to the head position and turn the shoulders with force. Inhale into one side of the paddle arm and turn the other side of the shoulder so that it appears above the water and perpendicular to the water. Do the same with the other arm. When doing this exercise, remember to extend your body in every move, long ahead and long back. In order to improve the students' oxygen use ability and lactic acid resistance to reinforce its control over the head and body. In one-arm practice, one-side breathing requires three or six strokes to breathe once.

The aim is to control the turn of shoulders and body movements after mastering the water strokes action matched with two arms. After sliding off the bottom of the pool, the two arms are paddled, and the head breathing technique is carried out at the same time. The position of the body and head must be kept steady and the shoulders exposed to the surface of the water each time the arm is moved.

The aim is to better control the body, improve body self-control, and maintain head stability and coordination. In freestyle, lift your head. The right position for the head raised should be mouth, chin, head and nose on the water in a distance. I am training students in four small sections.

The aim is to better maintain the balance and control of the body, improve the ability to control the body rhythm and position of the head, improve the ability to use oxygen and carbon dioxide tolerance. Students wear nasal clamp and respiratory tube to do 8 short shots in 25m.

The aim is to improve the body's control and keep the body in a reasonable position. When one arm paddles, the other extends forward. At the end of the stroke, touch the hips with your hands, slowly move the arm to the elbow of the front arm, and move the arm from the front to the rear until you move to the leg. Do a move that moves your arm forward into the water while rolling your body.

The aim is to improve the arm-moving technique of the elbow. In each arm movement, keep the elbow steady like a shark fin for about 3 seconds as the hips move to the shoulder, and then do a dive. It is to note that the legs are always in the state of beating during this process.

The aim is to better improve the arm's access to water. One arm is straight forward and the other is doing water strokes exercises. When a student is about to enter the water for the first time, raise his elbow to the rear and then enter the water. Focus on the order in which the hands, wrists, and elbows enter the water.

The purpose is to improve the effect and power of stroke in the water. The students use the special pulling rope to swim 25m, and experience positive traction and negative traction.

The purpose is to improve the efficiency and power of stroke in the water. Use resistance, such as tying a bucket with a rope or something that can bring resistance. The freestyle matches or the two legs clamp the floating plate to stroke the arm 25m, Secondary exercises require long distance exercises, such as 800 or 1500m.

The rules of swimming in freestyle require only one part of the body to touch the pool wall, even if it's by head-hitting also works. Of course I wouldn't ask students to do that. Turning round is to change the way forward more quickly, in all of the ways, rolling is the fastest way to change the way forward movement, So now basically all adopt the slightly touch and rolling round way.

When I see students rolling over, they often stay too far away and can't kick the wall, but getting too close is not conducive to swimming. What position is most suitable for turning around? Because the turning distance will vary according to the height and speed of each person, when swimming fast, the distance should be far away; but when swimming slowly, the distance should be closer. The specific problem of distance is decided according to the difference of each student. In general, there will be an identification line 5 m away from the pool wall, and when reach this position, should start to adjust the stroke. During the competition, adjust the stroke when approaching the mark line at the end of the waterway (at the T - shape 2m away from the pool wall).

At a distance of about 2m from the wall of the freestyle pool, you can bury your head in the water. But notice that instead of burying your head directly below your body, you need to take a little jaw down, as if your body was bent from the waist and folded into two sections, putting your head in the direction of your feet. At the same time, in order to increase the strength of the turning, at that turning moment, you can use dolphin-style diving into water.

When the foot is bent from inside towards the wall of the pool, it can not be stretched too straight, because once stretched, it will form a large whirlpool. Although the tips of the foot will move faster, it will waste a lot of time to form a whirlpool. In addition, when the foot touches the edge of the pool, it will only be bent first to push the wall, which will also waste time. If you bend your knees too early, it will cause your body to turn more slowly, so you must wait until your feet come out of the water before you begin to bend your knees.

In order to increase the strength of the body when rolling, the hands should quickly pull water behind the body, so the hands should be above the head when rolling around. Another way is to turn your hands and body together and place your hands on one side of your body when your feet are in contact with the wall. Since reaching out to your head when you hit the wall and starting, this can waste a lot of time, so keeping your hand above your head is better for freestyle speed. In addition, when the hand is above the head, the action should be like a frying pan, keep the position above the head.

3.4 Chinese Backstroke Swimmers-Fu Yuanhui

From the videos of all the National Championships, Asian games, World Championships and the Olympic Games participated by Fu Yuanhui, it is not difficult to find that her water

strokes are more times than other competitors, proving that she is not very good at water strokes with a relatively low stability and is a typically power swimmer. And in terms of technical characteristics, Fu Yuanhui's performance in the 50m and 100m backstroke events is even comparable to that of the famous former women's backstroke swimmer, Zhao Jing, which is benefited from her innate superior explosive power and upper body strength. However, Fu is slightly inferior on her leg strength, making her suffered a loss in the turn round. Therefore, there still has a lot of room to improve her physical distribution, endurance and competition experience.

4. Research Results

4.1 The error analysis of butterfly stroke action

According to table2, 16 students have different types of error action. Most students' laterally motion is wrong. One third of the students' hand and foot action is out of tune. The 8 years old students' basic is not very strong, especially their most basic leg action. The boy's hand action is very bad, and the girl's breathe method is not ideal. The basic of most 10years old students is stronger than that of 8 years old students, but their situation of foot and hand coordination is worse than that of 8 years old students. The action is the basic which has no relationship with the technology. No strong basic, no higher scores. Thus, if the students want to gain good scores, they have to correct their wrong action. The students with no wrong action should strengthen their basic.

Table 2. Mistakes of my students

8 years old	sex	mistake	10 years	sex	mistake
A1	male	1,2,6	B1	male	1,6
A2	male	3,4,5,6	B2	male	6
A3	male	1,2,6	B3	male	3,5
A4	male	1,2,4	B4	male	3,4
A5	female	1,2,6	B5	female	6
A6	female	2,5,6	B6	female	3
A7	female	2,5,6	B7	female	6
A8	female	3,5,6	B8	female	3,6

1=errors of arm movement

2=wrong led movement

3=arms and legs uncoordinated

4=body posture is wrong

5=wrong way of breathing

6=wrong movements

Arm movements are the most common mistakes that can be made because the action is done too early or too late or because the Angle is wrong. Arms above the water or into the water should be that after the head above water or into the water. The position of the arm into water is on the extension line of the shoulder, the thumb is inserted into the water, and after the operation of the arm is finished, it should be drawn up inward and backward. Arm movements are details, and details cannot be ignored.

The difference between the butterfly and the frog style mainly lies in the leg movement. So the leg movement of the butterfly is particularly important. There are three main reasons why the modern butterfly, also known as the dolphin-butterfly, is not effective. Firstly, it was found that that ability to extend the ankle was insufficient or the ability of the ankle was insufficient. Secondly, when drawing water downward, it will draw water too deep. Thirdly, the knee bends too much when hitting the water up.

The coordination of arm and leg movements is when the arm stroke once while the leg to hit water twice. The coordination of arms and legs tends to make the mistake of hitting the water with the legs early easily. This is because the beginner's movements are stagnant and incoherent. After entering the water, he has completed two kicks before reaching forward with his arms, which is easy to lose balance and cause his hips to sink. It is also easy to make one mistake, in cooperation, to only hit one leg at a time. If you hit the water with your legs only once, it's hard for your hips to reach the surface of the water, and it's difficult for your body to maintain balance, resulting in a slanted posture, increased resistance, and affected speed

.

There are two ways to get the body gestures wrong. One is that the wave action is too small, the cause of this error is the leg, because the leg kick action is not in place to cause the hip to sink, and another is that when the knee is too bent upward to hit the water, this also affects the hip lift. The second is that the wave moves too much, and it increases the body's surface area, so the resistance of the swim increases. Hitting your legs too deep will raise your hips out of the water, making body waves too large. The appropriate speed of wave action will become butterfly wings, taking you to fly faster

The most important thing when swimming is breathing. Because it takes a lot of energy and energy to swim the butterfly, it can easily lead to lack of oxygen. So, breathing is very important. The wrong breathing method is mainly reflected in the low or high position of the head when inhaling, and the low position of the head. When the arms move forward in the air, the arms will encounter more resistance in the water. While inhaling, the shoulder should be above the water. Also, to keep your arms out of the water, keep your head and shoulders in a neutral position as you move your arms.

Besides, breathing too early or too late is also one of the wrong breathing mistakes. Breathing too early will result in incoherent movements, affecting the coordination of arm strokes and legs. Breathing too late is that to breath when the hands are ready to move outward after the arm movement. Breathing too late affects the next move, and can also cause the rhythmic disorder.

In general, many coaches ignore the waist movements when teaching the butterfly, which often leads to the inability to pick up speed and lack of strength when swimming. I found the following mistakes that students often make. When swimming, a bending back and a bending shoulder occur, causing the shoulder to be clamped too tightly to power the waist. The second is to swim faster, which keeps the hips moving forward, which also affects the strength of the waist. In this way, not only it is arduous, but also it would cause lumbar injury, that's as what the ture saying goes "more haste, less speed". Third, when swimming the butterfly, I did not see the waist wave. When swimming, I felt that the waist and abdomen were too tight. Thought It is that lumbar power when swim, no strength will be transmitted to the leg.

4.2 Research and analysis on the technique of butterfly arm stroke

From the professional butterfly training, there are two ways to stroke the arm, which are straight arm stroke and bent arm stroke. Both methods have their advantages and disadvantages, according to the student's body shape, strength, stamina and explosive power depend on.

4.2.1 straight arm stroke

Straight arm stroke is used by most of the students. When entering the water, stretch the palm forward with both arms, and turn to outward at the same time. Then, turn the palm until the center is bent wrist grasp. At this time, the deltoid and dorsi of the shoulders are used immediately. The strength of both muscles pushes the water back to the waist, ends the stroke, and lifts the elbow and shoulders out of the water. Its advantage is that the effective stroke distance is long and fast. The disadvantage is that it is highly demanding for shoulder joint flexibility and shoulder strength, and is prone to cause shoulder damage.

4.2.2 bent arm stroke

This is also a relatively common way of stroke. The entry arm is stretched forward, and the angle between the two arms is about 30°. Then press the shoulders, the palms are everted, the arms are naturally stroked by the force of the shoulders, and do the bent elbow grip when strokes will be parallel to the shoulders. When do the grip to the palms below the chest, the force of the deltoid and latissimus dorsi will be utilized. The arm pushes the water backwards to the sides of the waist, ends the arm, and then lifts the elbow and shoulders out of the water. The advantage of this method is that the muscles in different parts of the arm are moderately relaxed during the forward extension and grip

stage. This method is good for those with insufficient shoulder and arm strength, and the injury to the shoulder is not as large as the straight stroke. The disadvantage is that the technical movement is complicated, and the effective stroke is started from the lower part of the chest to the end of the sides of the waist, and the stroke distance is short.

4.3   Research and analysis on the technique of butterfly leg action

When you fetch the water. The two legs should draw close to each other and the heels should be separated. It is like the Chinese word "八". When the two legs finished paddling the water. They should paddle the water firstly. The two legs should be at the lowest point. The knee joint should be straight. The haunch should be raised to the surface of the water. The hip joint should be bowed with the angle of 160 degrees. Then the two legs should be straight to move upward. The hip joint should unfold, and the haunch should sink. When the two legs go on moving upward. The thighs begin to push. With the push of thighs, the knee joints push too. The movement bent naturally. The thighs accelerated pushing. With the increasing degree of bending knees, when the foot move upward to the surface of the water. The haunch should be declined to the rock point. The knee joints bend to the angle between 110 degrees and 130 degrees. The foot should move upward to the highest point, and get ready to paddle the water with the down and back direction. When the foot paddle the water with the down direction. The ankle joint should be relaxed, and the instep should be stretched. Then, the shank accelerated to paddle the water with the back direction. The double foot go on paddling the water with the back and down direction. The thighs begin to move upward, when the movement doesn't get to the end. When the knee joints is straight, the movement of paddling the water with down direction get to the end.
The paddling movement power is from loin. It goes through the hips, the knees, and the ankle joints, and coordinates with the movement of body and spinal motion. The movement direction of foot is back and down. The degree of moving down is higher than that of moving back. The knee joint should be straight, when the foot moves upward. If it bends slightly, the back of shanks will make big resistance. Besides, you should not exert your strength too hard, when you move your foot upward. It's to reduce the drag. You should focus on paddling water downward. The speed of paddling water downward is more than 3 times quicker than that of paddling water upward.

4.4 Analysis of common errors for students' hand gesture in freestyle

Open your arms outward and increase the section area of the water retaining. The arm stroke is suitable for the beginner, but it is not efficient. In the process of catching and

holding water, if you press the water down directly with a straight arm, just like holding the body up on the top of a plank, it will not only do nothing to move forward, but also cause the body to rise and fall, and the legs will sink. Because the body is like a seesaw, when your palm presses water down, the upper body warms up, and the lower body naturally sinks, forming a body position that is not conducive to moving forward.

Causes the body to swing left and right. Water is like the arm , should not be too far from the body, otherwise the strength will be lost, the direction of the forward will also shift. Because the position of the support point will determine the direction of the student to pull the body forward. If the support point falls out of the center line, the body will not be able to balance and advance on the axis if the water is held to the outside of the body. If the student blinks when it is easy to swim sideways and hit the waterline, the marker runs to the outside of the central axis of the body during the stroke. Finally, you can't hold water beyond the center line of your body.

The position of catching water is too high to form the right feeling under water. If you start to catch water, the palm is above the water line of your body, causing the student to transfer weight to the palm that forms the support point. The center of gravity should be on the forearm, not the chest or anything else. Only when the center of gravity continues to guide the forward arm can the student effectively use gravity to drive the body forward.

The palm is too far from the body when lifting the arm. When the arm is relaxed, the arm must rest as much as possible at this time, in order to re-enter the water and pull the body forward. But the rest is not completely relaxed. If the part of the relaxation is wrong, it will lose the stability of the body and the efficiency of the stroke.

The most common mistake students make when lifting their arms is that they open their arms outwards and leave their palms too far away from their bodies. This will cause the palms to run to the outside of their bodies, and then return to the front of their heads half a circle from their sides to enter the water, thus forming a bad lateral force. Some students with exaggerated arms open like a half circle on the water, because they enter the water from the outside of the body. Although the entry point is kept in front of the head, there will inevitably be lateral forces.

4.5 Analysis of Chinese backstroke swimmers-Fu Yuanhui

Table 3. Fu yuanhui's performance on the 100m backstroke from 2011 to 2015

year	2011	2012	2013	2014	2015
second	1:00:00	59:99	59：64	59：59	59：41

It is shown from Table 3 that from the start of the Nanchang 100 backstroke final in 2011 to 2015, Fu Yuanhui's backstroke performance has been at a very high level in terms of the number of seconds alone, between 59.41 and 59.99 seconds, and has improved steadily.
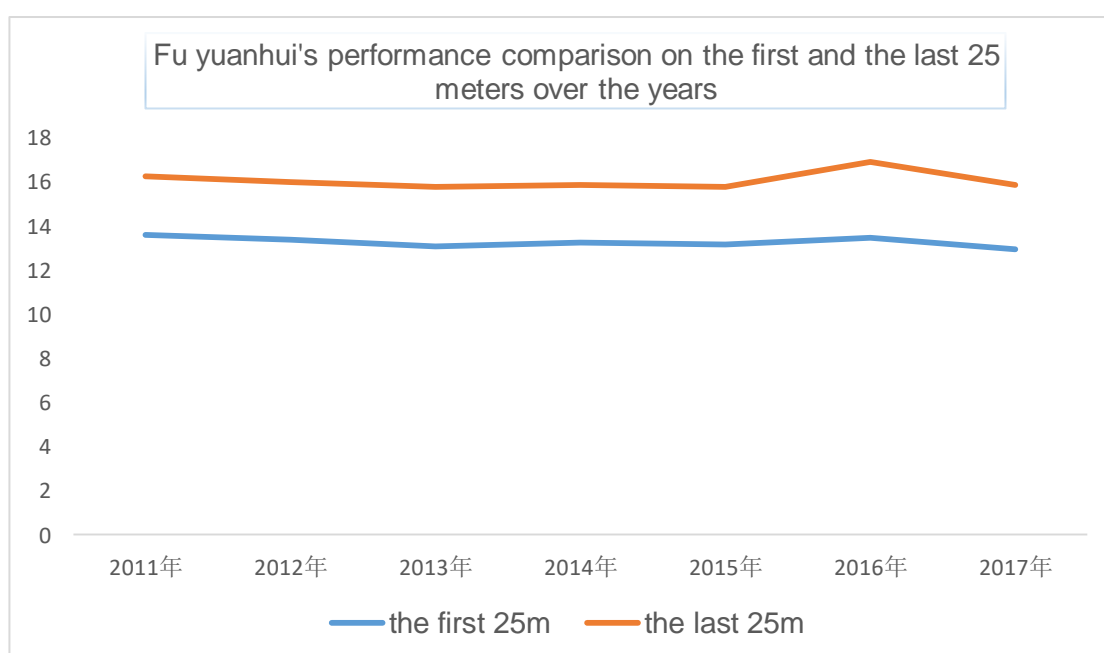

Figure 1. Fu yuanhui's performance comparison on the first and the last 25 meters over the years

It can be seen from the data within the past five years in figure 1 that Fu Yuanhui's performance on the first 25 meters in the 100-meter backstroke can all maintain an upward trend year by year, and that on the last 25 meters is still making progress by 2015, but the number of seconds after 2015 has increased, and in the next two years the results are declining. The reason she can keep scores increased year by year is that there are large differences between the first and the last 25 ones, almost maintained in average around 2.50 seconds. It fully indicates Fu Yuanhui's winning advantage relies on her high outbreaks and turn to kick on the first 50 meters(at a slower speed for 25m to 50m than that for 50m to 70m around the 1 second), and it ends up until the 17th year of Qingdao, the women's 100m backstroke final, Fu Yuanhui improves her personal best performanc to 58.72 seconds, but still showed with nearly 3 seconds difference between the first and the last 25 ones from the data given, the only point is that Fu Yuanhui improves the first

25 meters to an astonishing 12.94 seconds, a full second more than the other runners. It shows that the explosive power is her biggest weapon.
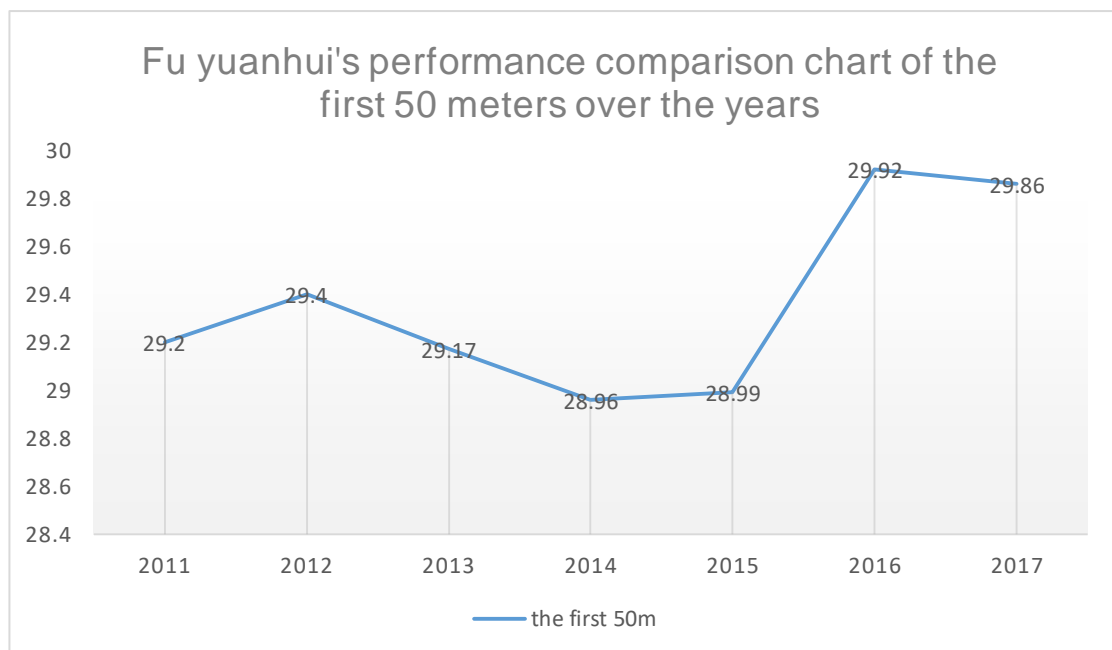

Figure 2. Fu yuanhui's performance comparison chart of the first 50 meters over the years

From the big data in figure 2, Fu kept the average of 29 seconds in the first 50 meters, and even broke 29 seconds in 2014 and 2015, the fastest time-spending in the past 7 years. And it is just in theses two years that got 59.59s and 59.41s on performance. One of the main reasons for this phenomenon is that fu yuanhui is around 18 years old from 2014 to 2015, it is the period when a professional swimmer was most physically active, and it is very normal that she can improve her performance rapidly in the past two years. Despite it is the fact, there are many deficiencies; For example, lack of competition experience with the biggest problem-technology. Therefore, the reason Fu's performance declined in the following time maybe that she encountered a bottleneck period due to his own skills not improved and also that she has to continue to receive various kinds of high-intensity training under the circusmastances that the accumulated injuries after training were not cured, which led to his retreat rather advance.
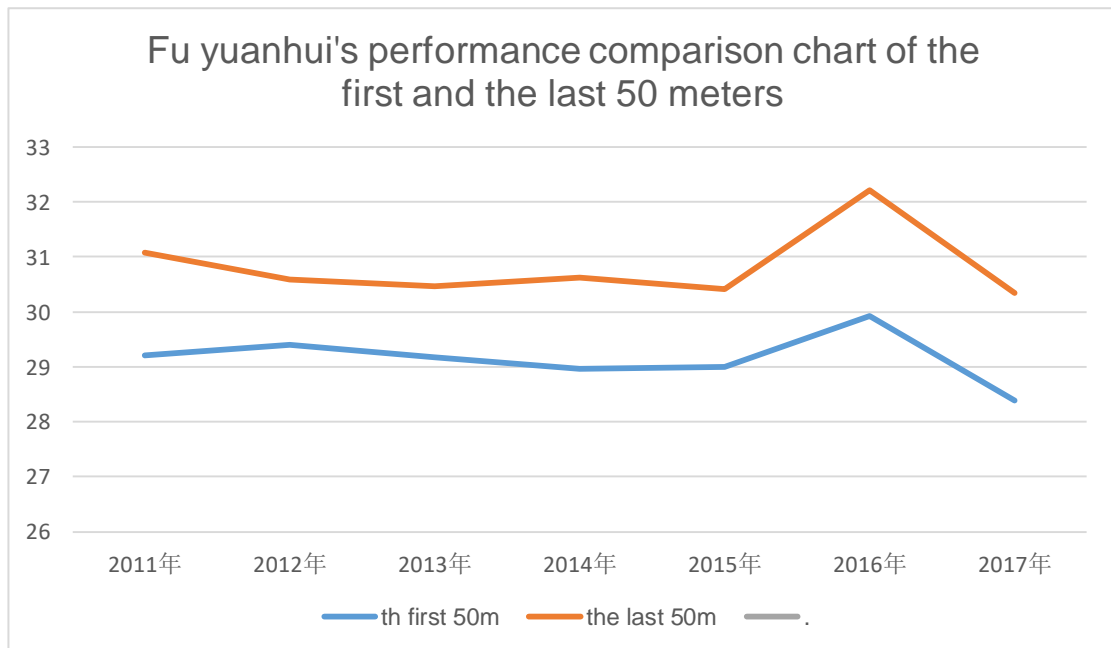
Figure 3. Fu yuanhui's performance comparison chart of the first and the last 50 meters

It can be seen from figure 3, first of all, fu yuanhui's performance on the first and last 50 meters from 2011 to 2017 is all proportional in the growth and decline. This can more confirm the above theory. And also from the fact that the first 50 meters is generally in two to three seconds faster than the last 50 ones, it can be concluded that she has her own focuses on the strength and physical distribution in the 100-meter backstroke. If you want to achieve good results in the 100-meter race, you must try best to finish in the first 50 meters, maximizating your ability, and the score must also be separated from the other runners by between 0.5 and 1.5 seconds, an ideal result and ranking in this race may be achieved.

Based on the detailed performance data, it is believed that Fu Yuanhui's strong power and outbreak of the early stage along with speed changes brought by is related to her high frequency of water strokes, In 2011 and 2015(Nanchang)when Fu Yuanhui maintain high standards of performance, her average frequency of water strokes every ten meters can be up to around 50, including Qingdao's good performance in 2017, all maintaining a higher frequency of water strokes than competitors, and even for the performance not so good, such as the women's 100-m backstroke final held in Foshan in 2016, average frequency of water strokes every ten meters only 46 also makes her grades stay in 1 minute and 2 seconds, ranking sixth. It can indicate that Fu yuanhui is indeed an excellent power player, with skills deficiency leading a not perfect water strokes effect. As a result, she has to increase the number of strokes to improve performance, we can compare the

competition data from the also Chinese women backstroke swimmer Wang Xueer in 2017 with Fu's.
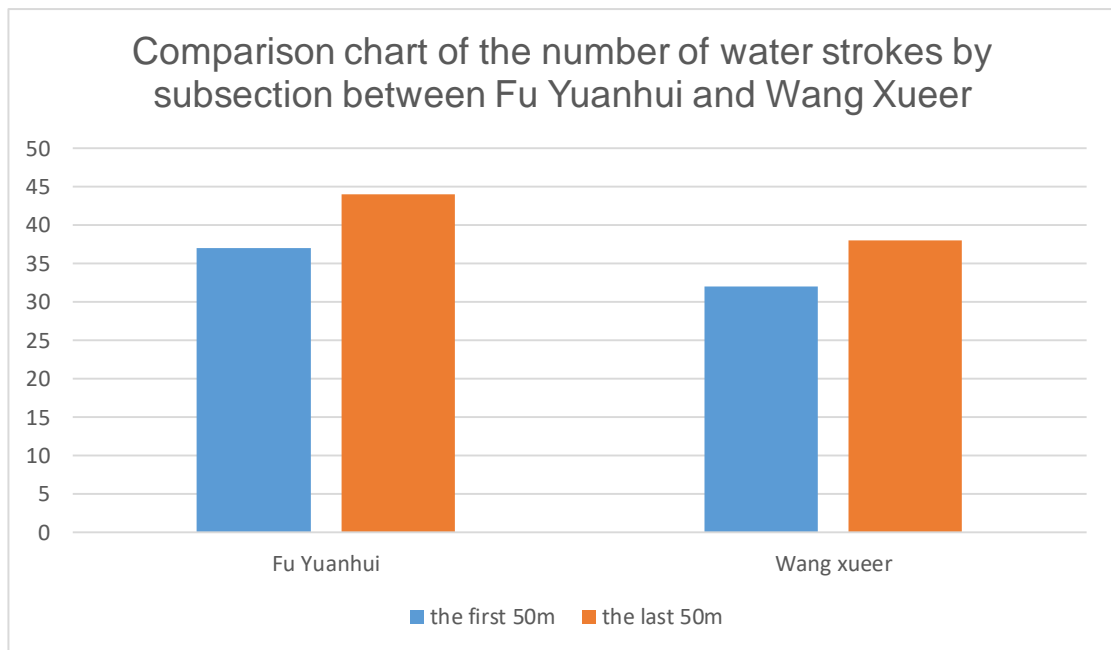

Figure 4. Comparison chart of the number of water strokes by subsection between Fu Yuanhui and Wang Xueer

It can be clearly seen that although wang's final seconds spending is only one minute, almost two seconds slower than Fu's, her water strokes in the first and last 50 meters are five times less than Fu's, and meanwhile she is also the one with the least number of strokes in the final group. Although her final result is not ideal, but it can be seen that she is slightly better than Fu yuanhui in the backstroke technology. Data is objective, Fu Yuanhui has suffered from shoulder injuries in recent years due to her technical features of the stroke frequency by power in high intensity training games, and even also has said in an interview her hands can't be normally working, while the best result is only ranking the third. In light of her frequent dependence on upper body strength with weak leg strength and less endurance, Fu Yuanhui's prospects look slim. Luckily she is only 22 years old this year has a fast injury recovery. But if such power tactics are to be continued, it may not be a long-term solution for her results and health. Therefore, to further improve her performance, she must face up to her weaknesses to improve the backstroke skills

In fact, Fu Yuanhui's all kinds of talents required by swimming is not prominent, except the advantage of explosive strength, which makes her coach guide her focus on transition towards short races like 50m and 100m, and some mixed relay races, and she basically no longer participates the longer race of 200m or more for less endurance and weak physical distribution.

Fu Yuanhui, in fact, has no advantage after a preliminary transition towards backstroke, due to a not prominent wingspan, she needs do more water strokes than her opponent to make up the disadvantages, it also benefits from her super strength and explosive force of the first half, therefore, in the first 25 meters or 50 meters of the game, she must establish a clear advantage to make up the defects of second half lack of power.

In recent years, Fu's shoulder injuries, brought by long-term strength tactics, have gradually affected her performance and even shaken her status as a top backstroke swimmer. And also with the continual loss in the recent games, she is facing with very heavy online public opinion pressure, after all, she becomes an online celebrity because of her optimistic personality. But at this time also hope Fu Yuan hui are able to adjust her own state of mind with health first and agression second principle to face up to her own sports career again.

It is because Fu Yuanhui's backstroke skills still have a certain gap with other players, therefore she should be added to the training for technical improvement in the future. While her advantage on strength should continue to maintain provided shoulder injury not aggravation can be ensured. Now what she needs to face up is her backstroke defects and focus on technical practice in future training programs. Under the circumstances that a long-term shoulder injury exists, what the only way she can use is to improve her weakness if considering for the long-term benefit of her career.

It can be shown from the comparative data of water strokes times that Fu Yuanhui's backstroke has a relatively poor effect in water strokes, which should be optimized in the future training to improve the effect of water stroke. Since most of the athletes taking the strength as their advantage will be accompanied by different degrees of injuries, and the recent interview with her also shows that her shoulder is suffering from injuries, so she should increase the strength training of the shoulder and pay attention to recovery by pulling after each training. Being a good athlete requires a high level of strength and technology to continue to break through and get better results without fear of age and injury.

5 Discussion

5.1 Discussion for students' flexibility increase

Stretching can increase the movable range of the joints and strengthen the muscle's ability to stretch. If the movable range of the joint is too small, the muscle will bear a greater load. In fact stretching is also part of training, not just warming up or relaxing(stretching is often considered as an inessential training). It will be taken an example to prove that a larger range of joints allows students to swim better.

5.1.1 Effective distance extension

As far as the shoulder joint is concerned, if the movable range is enlarged, the arm can be extended longer, equaling to the distance moved of each water stroke. And the flexibility increase of ankle and hip joint can make the action of water hitting closer to that in a whip way, with also an increase for foot swinging amplitude and strength.

5.1.2 Improvement for the body balance and stability

When the joints become soften, it will reduce the effects what water hitting and water strokes action has brought on the body balance destroy. Why some athletes are simply hitting water and their upper half of the body will shake with the action of water hitting? The main reason is that the softness of the waist, back and hip joint is not enough, only the movement of the feet swinging up and down is squeezed into too narrow joint space towards rigid muscles. So their upper body will wobble with the water hitting. If the upper body will swing around, indicating that the front hand stretching is unstable with its gesture in the water invalidly supporting, and the sense of water can not naturally be formed. Take the shoulder joint as an example, if the joint has a small movable range and the surrounding muscles are not soft enough, in order to force to push the arm to the surface of the water, it will cause the spine bends towards sideways to let the torso swing horizontally.

5.1.3 Reduction of muscle loads and energy consumption

Take the action of arm lifting as an example, if the range movable of shoulder joint is too small, the deltoid muscle loads will increase. And if the shoulder flexibility is very sound, each arm lifting can be very easy.

5.1.4 Avoidance of muscle fibrosis

After each training, there are minor lacerations usually senseless between muscles. And the guarding cells in the body's blood will surround these injured muscles, and if you do a lot of long-time training but don't stretch, these muscles surrounded will become fibrous, which we call "muscle formation." This is also why many runners who are diligent in running but stretch too little with their calves becoming into turnip legs. Fibrotic muscles become less effective, like rubber bands picked up on the road, it not only refers to the elasticity becomes harder to pull, but also it's easy to pull pull and break. That means if you are facing up with muscles fibrosis, it not only lower your swimming level, but also make you more vulnerable to injury.

5.2 Discussions for resistance reduce considerations

Students can't swim well after their swimming skills improvement relies on too much resistance when they advance. If you want to move fast in the water, there are two main points, one is reducing resistance and the other is increasing propulsion, like cycling and running on the land. Therefore, it is more important to think about how to reduce resistance than to increase propulsion when moving in the water. This is why student A is obviously greater in strength than B student who always swims faster than the former.

The main cause for resistance relies on an improper body position, including head, shoulders, back, waist, hip, calves and ankles position in the water. The student's back head, upper back and buttocks in three straight lines must be as parallel as possible with the water, keeping the body formed as "one" straight line across the water. If the head is raised too high, the rest of the body sinks in the water, moving like "/", and the propulsion is mostly resisted by the water.

Why it is to consider about reducing resistance? From a mechanical point of view, the water resistance=1/2 water density x moving speed square x water resistance coefficient x area of body cross section. According to the formula, the resistance of the body moving in the water can be determined by four variables: water density, moving speed square, water resistance coefficient and area of body cross section. Among them, although the water density will vary with temperature and ions concentration, and the resistance coefficient will vary with each individual size and the swimsuit material, but the effect what these two variables have brought is not significant. The water resistance is mainly determined by the speed and cross-sectional area of the body moving forward in the water, and among

which, the variable speed plays a decisive and key role, because it can increase the resistance by multiple of square. Even if the athlete swims at twice the speed, the original water resistance will increase to 4 times, and when the speed becomes 4 times, the original water resistance will increase to 16 times.

5.3 Discussions for swimming teaching by augmented reality technology

At present, the implementation of virtual reality enhancement can be accomplished by means of AR SDK such as EasyAR,Vuforia. The principle is not complicated, and the implementation process only takes 6 steps. The first is to capture image and video through optical device and camera. Second digital image. By extracting the feature points of the image, the recognition image is generated. Thirdly, the video and animation multimedia production of enhancement effect is completed with the reference of recognition map. The fourth optical device or camera acquires the virtual information location. The fifth recognition map matches the obtained image. The fifth recognition map matches the obtained image. Sixth virtual information (multimedia / 2D/3D) rendering. Dynamic augmented reality animation effect loading, virtual reality enhancement effect implementation.

In swimming teaching, Flash, video or 3D are used to make multimedia teaching materials, which are loaded into plane teaching materials or three-dimensional teaching instruments. Optical equipment and intelligent equipment are used to enhance the virtual effect, increase the diversity and vividness of swimming teaching and get rid of the limitations of swimming teaching.

The purpose of realizing the effect presentation of augmented virtual reality, whether it is mobile phone or eyes, is to realize the interaction between man and machine virtual reality. Augmented reality devices, represented by mainstream smart eyes such as GOOGLE GLASS, need the participation of interactive technology to complete augmented virtual reality, which is also the bottleneck of the development of augmented reality technology. The augmented reality superposition effect of swimming teaching using Vuforia Qualcomm AR SDK plug-in and Unity 3D system, the swimming video made by the 3D system is enhanced and loaded on the swimming teaching material, which makes the pictures and characters of the action decomposed into continuous and complete swimming movements. The intervention of interactive technology can also add a series of needed functions to the explanation of technical action.

Further study is made on the design methods of 3DMax material rendering and Unity 3D SharderLab shader technology to improve the virtual display enhancement effect of swimming teaching. Compared with the simple use of 3D virtual technology, it can improve the reality, make the scene more vivid and enhance the effect more colorful. Let the students experience the swimming activities in the virtual environment while deepening the understanding of the movements and training the students' practical ability. Virtual mutual can not only stimulate students' interest in learning, but also carry out the teaching and experience of the project in the case of insufficient space. The whole teaching is centered on the task of "how to innovate and optimize swimming technology". The enhanced virtual reality interaction in the virtual reality swimming teaching environment can enable students to watch 3D video and master the technical essentials. Through the virtual physical interaction experience in the system, students' training power is driven, and their swimming performance is improved as soon as possible. Develop students' interest in swimming in teaching. In the process of watching relevant materials and experiencing in person, students' understanding of the main points of swimming techniques and movements is deepened, students' mastery of basic swimming skills is consolidated, and students' motivation for swimming training is enhanced.

5.4 Suggestions on the measures of swimming innovation and optimization

5.4.1 Correct body posture

The body posture play a very important role in series of swimming techniques. The external resistance and swimming speed depends on whether the body posture is correct or not. In order to minimize the resistance, the body should be kept at a high level and parallel to the water surface under the action of water buoyancy. In addition, a streamlined posture present is also very important, the more irregular the posture is, the greater the pressure difference before and after the body forms and the greater the resistance to self-water is. Therefore, to maintain the body streamlined as far as possible when swimming.

Due to the different body postures required by different swimming strokes, the body's movement in progress will also change. For example, the backstroke requires the body to maintain a high level position in the water to make the angle between body and horizontal plane as small as possible and thighs contraction not be too much when moving forward in the conditions of undulating limbs; Take the breaststroke for example, although it does not emphasize a unified posture, yet should also keep the amplitude of its body within a certain range during the course of its progress, and the calves should be completely closed behind the projected section of the thighs as far as possible. And to maintain the

body at a high level position in the water and maximum forward propulsion as much as possible.

5.4.2 Coordinated and rhythmic actions

During swimming, skills mastering of the athletes can be reflected by the coordination and consistency between the limbs, the limbs and the muscle groups connected with each other. According to research, the higher the coordination and consistency is , the more effective energy saving is, which is especially important in long distance swimming. In addition, coordination and sense of rhythm also show a high correlation, and the two influence and promote each other in swimming. The coordination and rhythm in the exercise process are transformed by the excitement and resistance impulse in the neural center of the brain. And athletes can improve the coordination and rhythm by training this section of technique consciously for a long time.

5.4.3 Key points for elbow and hip actions

One of the important characteristics of swimming technique is to focus on cooperation with the elbow and arm, the elbow should be lifted high with the arm bending, the shoulder should be kept relatively fixed in water strokes. And the elbow joint can be raised to bend the arm to do the water strokes, which can increase the sliding distance and the strength of the water strokes, increasing the swimming speed at the highest limit.

5.4.4 Key points for water strokes track

According to the requirements of modern swimming technology, in order to increase the effective time to the water to obtain the best horizontal lifting resistance, so that the body can obtain longer sprint time, less resistance and greater forward momentum, the water strokes track for athlete's palms should be formed in a spiral curve. This stroke is called a spiral curve water stroke.

5.4.5 Emphasis on water strokes by accelerated speed

According to the research of modern swimming technology, the main propulsive force of swimming is mainly originated from the action and the reaction force(the resistance). And based on the formula of water simplified resistance, the resistance is proportional to the projected section of the athlete in the water and the square of the speed of movement. So

the accelerated speed is the key point to determine the swimming speed in water strokes, the greater the accelerated speed is, the larger the propulsion force is and the faster the swimming speed is. Therefore, to obtain better accelerated speed and water strokes effects, it is needed for a faster water strokes speed, greater action impulse and amplitude.

5.4.6 Key points for water strokes amplitude and frequency

Swimming speed in the race determines the final result, except for the small distance when starting and turning around, most of the remaining halfway distance is the key to success or failure. The swimming speed of the halfway distance is determined by the amplitude and frequency of the water strokes actions, with the two complementing each other. A single increase in water strokes amplitude or frequency can improve the swimming speed of, but if blindly emphasizing one of them, regardless of the other factor, it is difficult to achieve good results in the end. Therefore, the amplitude and frequency of water strokes should be reasonably determined according to their own factors and the length of the race.

References

Cao.J.W.2010. A Three-Dimensional Perspective on the Competitive Situation of the Contemporary Summer Olympic Games. Journal of Shangdong Institute of Physical Education.Shangdong.

Chen.X.P.2005. On Sports skills and Technical training.Sports Science.Beijing.

Dong.R.Y.1982.Swiming Dynamics. University of Qinghua Press.Beijing.

Feng.Z.Y. 2010.Teach you to swim.Liaohai Publishing House.Liaohai.

Guo.H.Y.2014. Unity3D ShaderLab development actual combat details.People's Post and Telecommunications Publishing House.Beijing.

Gao.Y.2010. Factors Analysis and Countermeasures of Affecting the Life of Chinese Elite Swimming Athletes.Journal of Chengdu Institute of Physical Education.Chengdu.

Huang.J.&Zhang.H.Z.2013. Application of 3DSMAX in Virtual Reality. Surveying and Mapping and Spatial Geographic Information.Beijing.

Ian.M.2010.Swimming Anatomy.Posts and Telecom Press.Beijing.

James.R&Robert.C.F.1999.Quick stretching compound training with high strength and explosive power.People's Post and Telecommunications Publishing House.Beijing.

Ji.J.B.2015. Research on Universal Realization Method of Virtual Reality Based on Unity 3D. Digital technology and application.Beijing.

Wang.Z.L.2013.Teach you to swim. Jiangsu Phoenix Science and Technology Press.Jiangsu.

Yu.W.Y.2001.Olympic's swimming.People's Sports Publishing House.Beijing.

Zhang.Y.Y.2005. Modern swimming and technology. University of Electronic Science and Technology Press.Hangzhou.