Rethinking in Biology Experiment Teaching in Middle School

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Abstract. Experimental teaching is an organizational form of practical teaching.As a natural science, bioscience plays an important role in the junior middle school education and teaching system, which is very interesting and abstract. Experimental teaching is the basic way of biology teaching and the basic learning method for students to acquire knowledge. Through experimental teaching, students can see the essence through the phenomenon and improve their ability to innovate, discover and solve problems.However, at present, all regions in China pay insufficient attention to experimental teaching, blindly pursue achievements, or the supporting experimental facilities can not keep up, which leads to the slow development and low popularity of experimental teaching; In addition, due to the different emphasis on education, there are also great differences in the current situation of experimental teaching between regions and schools.Taking biology teaching in middle school as the main reference point,this paper explores the current situation of domestic experimental teaching and possible intervention measures,in order to better carry out experimental teaching content.

Keywords: Experimental Teaching, Biology, Middle School, Present Situation, Countermeasure.

1. Introduction

Experiment teaching refers to an organizational form of practical teaching. Students use instruments and equipment to cause changes in experimental subjects under artificial control conditions, and gain knowledge and development ability through observation, measurement and analysis. It is widely used in basic courses and professional courses. Its purpose is not only to verify book knowledge, but also to cultivate students' ability to correctly use instruments and equipment, test, adjust, analyze, synthesize and design experimental schemes, and compile experimental reports.

The Ministry of Education of the people's Republic of China issued “The Opinions on Strengthening and Improving Experiment Teaching in Primary and Middle Schools” in 2019 to guide the development of experiment teaching.In the process of teaching, experiments can help students better discover the biological knowledge behind biological phenomena, improve their performance in biology,improve their ability to discover and solve problems and effectively stimulate their interest in learning biology. In addition,self-confidence has also been improved to a certain extent when it is affirmed and harvested [1].

Nowadays,it is common that the experimental development rate is low and the experiment teaching effect is not good in biology teaching in middle school, and there is even a phenomenon that important experiments have not been carried out in some areas.For some experimental courses most of them are mainly explained and demonstrated by teachers. ignore the students' own operation, lack of students' experimental initiative, and do not give full play to the advantages of experiment teaching. Since 2019,Covid-19 has spread widely around the world,affecting human life in different dimensions. At the same time,it also has a great impact on university teaching,especially experimental courses. In fact,both college biology courses and middle school biology courses have been affected by the epidemic to a certain extent,so that he difficulty of experiment teaching has been further increased [2].

However,as one of the natural sciences,biology plays an important role in the junior high school education and teaching system,and has strong interest and abstraction.Experiment teaching is the basic way of biology teaching,which involves many knowledge points that can be proved by experiments,and it is also the basic learning method for students to acquire knowledge.The experiment teaching is divided into two parts, one is the teacher's open demonstration experiment, the other is the students' independent inquiry experiment[3]. This paper summarizes the current

situation of biological experiment teaching in middle school, and looks forward to the future of experimental teaching.

2. The present basic situation of Experiment Teaching

2.1. Do not pay enough attention to experiment teaching

According to the results of a survey in northern Shanxi Province in 2016, in order to improve the enrollment rate, many schools do not pay enough attention to biological experiment teaching, blindly pursuing examination results and neglecting the role of experiments on students' ability training [4]. In the relevant investigations in recent years, this kind of situation still exists, and the experiment teaching of biology is not paid enough attention to. At the same time, different cities and schools attach different importance to experiment teaching. Developed cities and key middle schools pay more attention to experiment teaching.Through consulting relevant literature reports, it is found that there have been many relevant studies on experimental teaching in Jiangsu Province in the past three years, but there are few relevant studies in other provinces. This may reflect the different emphasis on experimental teaching in different regions to some extent, but the specific evidence-based evidence needs to be further explored.

2.2. The investment is small, and the teaching facilities need to be improved

A survey in Shanxi shows that in terms of expenditure, less than 15% of schools fully support biological experiments, and some schools support them only when they respond to examinations. at the same time, some of the experimental equipment, drugs and reagents worn out by schools can not be replenished and updated in a timely manner. In terms of laboratory equipment: nearly 30% of schools have biological laboratories, and a few schools do not have special biological laboratories. In addition to the laboratory, some model high schools are also divided into preparation room, specimen room, observation room, instrument room and so on. Among the schools surveyed, 21.0% are fully equipped and can fully meet the needs of biology experiment teaching, and most of these schools are model high schools. 29.0% of the schools have relatively complete biological experimental equipment, and 19.4% of the schools are not fully equipped, which can only satisfy the opening of a very small number of experiments; even 30.6% of the schools, the experimental equipment can not meet the basic experiment [4].

A survey in Chengdu in 2021 showed that all 38 schools had built specialized biology laboratories. Among them, 74% of the schools are basically equipped with wallcharts, models and specimens, and the remaining 26% of the schools are not well equipped, and the number of the three is missing or not. In terms of funds for biology experiment teaching, 45% of the schools have enough experimental funds, 37% of the schools do not have enough, and 18% of the schools do not even have special funds. This shows that after configuring the instruments and equipment related to experiment eaching, the corresponding experimental funds should be increased to ensure the smooth development of experiment teaching.

At present, 37% of the schools have built biological parks and biological corners, 5% of the schools are under construction, and 58% of the schools do not. Biological garden and biological angle extend the place of biology learning, which can exercise students' practical ability and improve learning efficiency, especially in cultivating students' interest in biology learning. Therefore,the schools can further improve the construction of biological gardens and biological corners [5].

2.3. There is a shortage of experiment teaching professionals or teachers are not professional

There are uneven proportion of male and female teachers, incomplete experimental facilities and shortage of experimental technicians in biology experiment teaching in middle school,also the single way of curriculum evaluation,the lack of teachers' experimental skills training and assessment [6]. Among the 8 schools in the north of Shanxi Province, 2 schools do not have full-time experimenters

and 6 schools have full-time experimenters. Another noteworthy situation is that biology teachers do not match their majors in every region, and other professionals teach biology part-time.

2.4. Single teaching mode, lack of students' initiative (demonstration, evaluation)

A sampling test and questionnaire survey on biology in junior middle school were conducted among 46236 students from 1000 schools in Jiangsu Province. A questionnaire survey was conducted among 3223 biology teachers. The results showed that 27.30% of the students who participated in the questionnaire had not been to the laboratory in two academic years, 4 semesters and 175 class hours, and 44.3% of the students went to the laboratory less than 5 times. Only 8.80% of the students in this area basically reached the required number of experiments (more than 15 times). For the experiments that are clearly required in some national curriculum standards, but the proportion of students who have not done it is 70% Mur80%, they learn the relevant content mainly through teachers' demonstrations, playing videos and reading experiments in teaching materials,even the teacher did not explain it [7].

3. The future prospect of biology experiment teaching in junior middle school

3.1. Change the concept and Cognition of Experiment teaching

It needs to fully aware of the advantages of experiment teaching, experiment teaching is not to do experiments. Fully realize the autonomy of students in the process of experiment eaching, and carry out experiment eaching by means of cooperation and inquiry. Pay attention to the direction of curriculum reform, in-depth study of teaching materials, combined with the content to choose a practical and effective teaching model,integrate into teaching philosophy.

In recent years, the hot topics of experiment teaching research are: project-based teaching,deep learning,STEM model, large unit teaching, multi-disciplinary integration teaching and so on. For example, multi-disciplinary integration is mostly problem-oriented, creating situations for open exploration, and some even want to integrate with STEM mode,combining multi-disciplinary knowledge such as chemistry, physics, mathematics, multimedia technology, etc.,so as to train students' thinking,cultivate students' innovative ability,practical ability, and the ability to discover and solve problems.

3.2. Improve teachers' experiment teaching ability

According to the current problems of teachers, the training programs, establish a teacher training system, and strengthen the pre-employment training of relevant personnel should be formulated. Local educational administrative departments,institutions of higher learning and scientific research institutions work together to set up experiment eaching and training bases for teachers in primary and secondary schools with conditions, so as to strengthen the combination of professional learning and on-the-job practice. All localities should incorporate experiment eaching ability into the qualification examination of teachers in related disciplines and the necessary quality examination of teacher recruitment [8].At the same time, the relevant educational administrative departments and school personnel departments should reasonably plan the construction of the contingent of teachers, improve the professional counterpart rate of subject teachers, and strengthen the experiment eaching training for in-service personnel who are not related to their majors. Teachers' experimental courses, teaching performance and work performance should be included in the performance assessment; the development of relevant teaching and research activities should be strengthened in schools, districts, cities and other areas. The educational administrative department carries out special supervision and inspection on the standardization and normalization of experiment eaching in schools.

For teachers themselves,seriously study the relevant training contents of teachers' experiment teaching ability, and actively participate in relevant teaching ability competitions, such as experiment teaching competitions,experimental operation competitions, experimental innovation competitions, experimental design competitions, etc.and laboratory administrator professional skills training, pre-

job training. Make rational use of resources and learn excellent experiment teaching examples both inside and outside the school.

3.3. Give full play to students' initiative through diversification of experimental design

3.3.1 Selection of experimental materials

Selecting suitable experimental materials can make the experimental progress smoothly and obtain obvious experimental phenomena or reliable experimental data. some of them can even shorten the experimental time and give full play to students' autonomy in the acquisition of materials according to local conditions. stimulate students' interest in learning, at the same time avoid buying a large number of experimental materials, saving costs to a certain extent.

When selecting experimental materials,make full use of local resources and adjust measures to local conditions so as to promote the development of experiment teaching. For example, in the experiments related to respiration, BTB solution or phenolphthalein solution was used, when carbon dioxide was injected, the color of the solution changed from blue to yellowish green,which was easy to observe, and the tedious operation of testing carbon dioxide was avoided to some extent; When observing the seed structure, fresh or cooked corn seeds were used as experimental materials, and the structure of corn seeds could be observed more clearly. In the experiment of exploring the influence of abiotic factors on certain animals, the coastal cities can choose sand silkworms instead of female rat, and use waste cardboard and cardboard to make self-made experimental devices, and Chinese cabbage can be used instead of geraniums in photosynthesis experiments.

In order to make up for the problem that geraniums are not easily available in Guangdong. In the experiment of “exploring the factors affecting the rate of photosynthesis”, spinach or hydrilla verticillata is often used as the experimental material, and Chlorella, which has a higher rate of photosynthesis and can move, can be used as the experimental material, so that Chlorella can be dispersed in the culture medium. it is easy to control a single variable and shorten the experimental time. In order to explore the way of yeast respiration, the yeast suspension was changed into highly active yeast powder to shorten the reaction time from 38min to 8min [8-12].

3.3.2 Improve the experimental equipment

In the immobilization of yeast cells,the conical bottle fermentation device was improved to a "syringe + infusion" device, which reduced the fermentation time from 24 hours to 15min.In the experiments related to plant respiration,the three experiments of green plant respiration,which release heat, exhale carbon dioxide and consume oxygen, are integrated into an inquiry experiment, and the experimental equipment is improved. The experimental rolling device is made by using infusion device, syringe, empty bottle of hand sanitizer with pressing head, hanging bottle for infusion, transparent thermos cup, mineral water bottle, latex tube, plastic foam board, transparent tape and so on.

After improving the experimental device, it is simple and easy to operate, and at the same time, whether it is the demonstration experiment or the students conducting the experiment themselves, it greatly saves the experimental time and helps to ensure the development of the experiment under the present situation of less class hours. Compared with glass instruments, the above materials are also safer, materials are easy to be available and can be reused at the same time, saving the cost of the experiment. At the same time, the device can be used to verify a variety of plant organs, which is beneficial for students to truly experience the respiration of plants through experiments.

3.3.3 Carry on the experiment development reasonably

“algae, bryophytes and ferns” for algae,the teaching materials of the People's Education Edition set up relevant pictures for convenience,observation and thinking, bryophytes arranged observation and measurement experiments, and ferns provided relevant reading materials. Although the three types of plants are common, students do not know about them, so just with pictures or magnifying glasses, it is difficult for students to really understand the relevant knowledge of organ differentiation, living environment and evolution trend of the three kinds of plants. We can observe and record the

living environment of related plants in the campus, and provide some spore plants and seed plants, which is convenient for students to compare. The root differentiation can be understood by putting the "root" of moss and fern into water and observing the effect of water absorption. At the same time, the leaf cells of bryophytes are observed by microscope, which is easy to realize that the leaf is composed of only one layer of cells. At the same time, it is helpful to give full play to students' initiative and stimulate students' interest [13-14].

3.3.4 Attach importance to quantitative experiments and avoid using qualitative experiments alone

In the experiment to explore the effect of temperature on enzyme activity, teachers determined the reducing sugar by using DNS reagent,and quantitatively detected the content of reducing sugar by spectrophotometer and standard curve.Through such quantitative experiments, students can use the measured experimental data to make curves and form mathematical models, which is conducive to the promotion of scientific thinking and lay a good foundation for follow-up learning [15].

To explore the effect of inorganic salt on plant growth, three plants were put into the same amount of soil extract, soilless culture medium and distilled water respectively, the growth was observed one week later, and the plants were weighed before and after the experiment.In the experiment of observing the effect of solution concentration on plant water absorption,fresh radish was selected and cut into cuboid radish strips with equal width and height, respectively,and the volume of radish strips was calculated after the experiment. In the experiment of observing root hairs,the mature area of root tip was taken as a cylinder, the time and height were measured, and then the surface area was calculated, and finally combined with the number of root hairs per square millimeter surface area [16].

3.3.5 Integrate with information technology

With the gradual development and progress of modern society and the continuous upgrading of advanced technology, multimedia information technology has gradually entered the current social classroom, bringing more opportunities for the improvement of the quality and level of classroom education, especially during the epidemic spread, it can better reflect its advantages.It not only brings more paths for the resource-based equipment and information-based teaching methods of education, but also brings more favorable conditions for the development and progress of the educational classroom. Modern educational technology will not only promote the informationization of biological experiment courses, but also help students better understand biological experimental skills under the trend of information technology.For example, by recording experimental videos and videos of students' pre-class activities, and then showing the experimental results in the form of PPT, using "Internet +", the combination of online and offline, and the integration of pre-class, classroom and after-class to carry out experiment teaching, so that long-time experiments can be completed.

Whether the traditional teaching or the new experiment teaching, experimental safety issues are put in the first place,carry out all kinds of experiment teaching on the premise of ensuring the safety of students.

4. Conclusions

Experiment teaching is to cultivate students' innovative ability,the ability to discover and solve problems, and to improve students' self-confidence and interest in learning by experiencing the experimental process and trying to design experiments.In the face of the problem of insufficient experimental conditions,it is necessary for educational administrative departments and schools to attach importance to experiment teaching and increase experimental investment. As far as teachers are concerned, it is necessary for teachers to change their understanding of experiment teaching, fully realize the importance of experiment teaching to students, and create opportunities for students to operate and experience the complete process. To avoid simply carrying out the experiment according to the experimental steps in the textbook, innovate the experimental design according to the needs, try to transform the qualitative experiment in the textbook into a quantitative experiment and help

students to analyze the data. Expand the experiment as an extracurricular assignment to reduce students' burden and help students try to solve the problems found through experiments. For the problems such as the lack of class hours, the time-consuming and consumable materials for the pre-experiment preparation, try to improve the experimental materials and devices.At the same time,through the overall experimental project design on the project, not only the materials can be saved, but also make students have a complete construction of relevant knowledge through the related activity design.

In order to improve the effect of experiment teaching, pay attention to the experimental process design, also the teaching evaluation,which is beneficial to the experimental report as the material of process evaluation, combined with information technology and artificial intelligence to realize accurate evaluation. Big data technology is used to quantitatively analyze the experimental evaluation. At the same time, the information technology and experiment teaching are deeply integrated to form a mixed teaching mode online and offline, which makes experiment eaching rich and interesting, and can make up for the problems of less class hours to a certain extent. for example, the use of virtual experiments can reduce the security problems in the experimental process to a certain extent.

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