Integration of Information Technology into Biology Teaching in China Rural Junior Schools: Practice and Reflections*

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Abstract - Through more than ten years' construction, China rural areas gradually step towards the Information Age, and some rural junior schools are provided with the fundamental conditions of informatization education. In the form of case study, the practices of integrating biology teaching with common hardware, software and basic information technology in a Southwestern rural junior school are presented and analyzed. Furthermore, the common mistakes and countermeasures during the integration practices are discussed.

Index Terms – Integration, Biology, Information Technology, Rural Junior School.

1. Introduction

Since the entry into the 21st century, the informatization level in rural China has improved a lot; many people in rural areas, including teachers and more and more students, can lead a simple network life with the terminals such as personal computers and smart phones [1, 2]. Correspondent with this trend, the China Ministry of Education and the Bureau of Finance from the central to the local governments have increased the investment on popularizing information technology education in junior and elementary schools. Through projects such as the "Rural Distance Education" "School Passes", they step by step promote the process of campus-networking in China rural areas [3]. Today, although the rural informatization level is still lower than that of the city, and there are also huge regional differences, some middle schools in richer rural areas have partially equipped with the hardware for informatization education. With the rapid development and popularization, IT, an important means of improving teaching and learning quality, has been widely used in education practice and provides us a multi-sensory and multi-informative way. It riches the education resources, breaks the traditional teaching pattern depending on textbooks and explanation, and it is now even more tightly integrated into the teaching practice of biology. As a Grade 7 biology teacher in a rural middle school in Southwestern China, the author practiced with the IT integrated biology teaching.

2. Case Study I. Scientific Skills Development: Observing Living things in Nature

A. Questions

How to grasp the connotation and denotation of "observation"? Observation is traditionally defined as a kind of visual activity, ignoring the cognition with cooperation of the other four senses, i.e. audition, olfaction, gustation, and tactus [4]. However, these four senses are irreplaceable by vision. During the process of scientific observation, people expand and strengthen all five senses by using a variety of instruments, such as microscope, video camera, tape recorder, sensors, analysis and measurement instruments, etc. Thus, if teachers can help students access to various information via all the senses and timely introduce advanced technologies for observation, there is no doubt that it will lead rural students to a better understanding of biology.

B. Design and Preparation

In addition to textbook content, we added two modules, namely "the singing of birds" and "observe corals", respectively corresponding to a hearing training and a comprehensive five senses training. Record 7 species of birds tweet in the countryside and seek 5 species of birds' recordings on the Internet. Save mixdown as the "singing of birds" audio file (Fig. 1). Prepare several coral skeletons.

C. Practice and Note

1) Pose the questions: what kind of living things are there in the campus? How to determine whether an object is alive? According to the life experience, students actively give their own understanding. Based on this, ask the students to watch the textbook illustrations, and sum up the basic characteristics of life by comparison and discussion.

2) Extend the denotation of "observation". Ask the question "As the characteristics of life were figured out by observing, who can tell what observation is?" Some students answered "look" or "see" and most classmates agreed with them. Further question: "Since people have 'five senses', why not we include looking, hearing, smelling, tasting and feeling all into the observation category?" Awhile a student shouted

"there is the sixth sense!" The author encouraged the students and gave a brief introduction of the sixth sense.

3) The singing of birds. Question: "If you are an ornithologist and stay in the primitive forest, the dense shade blocks your sight and you can't see a bird, how can you continue your study at this moment?" Students answer "to hear the voices", "to listen to the bird sound"; the author confirmed and broadcasted the audio of "the singing of birds" and asked the students to identify how many different birds are there. After identification, some students can figure out seven kinds of birds out of a total of 12 kinds in the record at most. Teacher praised on students' excellent listening ability, and pointed out that in order to get higher identification ability; it requires more advanced instruments such as recording equipment, audio analysis equipment and so on. Students showed a longing look towards those hi-techs.

4) Observing the corals. Ask five students to act people's five facial features and describe a piece of "strange stone" (coral) respectively by "eyes" to see the shape and color, "ears" to listen to the knocking sounds, "nose" to smell the odor, "tongue" to taste voluntarily and "skin" to feel the quality, weight, temperature and so on. After the game, tell them that the "stone" is the coral skeleton and pass it around for a look, which stimulated the students' interest. Furthermore, lead the students to discuss about the coral and determine whether the coral is a living creature.
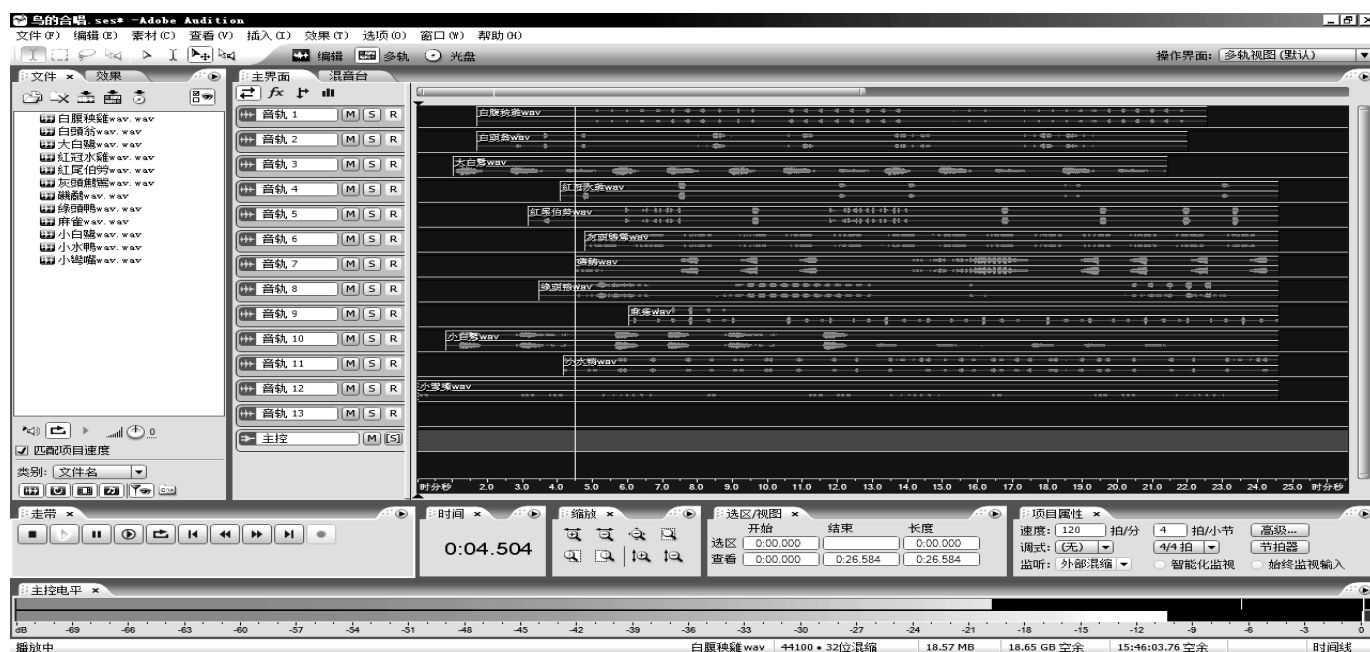

Fig. 1   Using Adobe Audition® v1.5 software to produce the audio "Singing of Bird".

3. Case Study II: To Know the Microscope

A. What is Recommended in Syllabus?

Each student should independently operate microscope and find out the imaging characteristics under microscope.

B. Actual Condition

Because of lack of microscopes in the biological lab, six students shared one microscope. Except the microscope used for teacher's demonstration, all others are old-fashioned, student-use microscopes, which is uneasy to get started as the structure is different from the demonstrations in the currently used textbooks. There are 60-70 students in class on average, which generally exceeds the standard capacity; students sitting in the back have poor visions at the lectern. It was also found out that the use of microscope which should comply at the 6th grade was neglected in local elementary schools due to the limited conditions. All these difficulties made the subject "to know the structure of microscope" hard to implement.

C. Thinking and Design

If teachers blindly follow the teaching strategy in the syllabus to adopt the hands-on model, it is hard to get the ideal effect. When students get a microscope, they want to know "what can be seen in the microscope" and "how to see the wonderful sight", and then they would like to have a try. Compared with the texts and illustrations in books, it is a desirable method to guide the students with multimedia and help them to use it through the whole process.

D. Course Preparation

At first, teachers search for standard microscope-operation videos on the Internet. Because most videos are for professional use, teachers should re-edit them to suit for the junior students. Download relevant teaching videos with good-quality and edit them with editorial software e.g. Windows Movie Maker ® [5] or Adobe Premiere ® [6]. Teachers can do audio processing, such as noise reduction,

reverberation, volume gains, etc. in the help of Adobe Audition ® [7] to have a better sound effect. Teachers also can remove the original sound track and record voice or directly give explanation in the class. In this way can reprocess the Internet resources into suitable multimedia files for the teaching purpose. As shown in Fig. 2, construct the combination of microscope, webcam and PC and get used to the disassembling and commissioning of these facilities.

E. Practice and Note

1) Picture show. Project pictures of microorganisms and show the extraordinary beauty of the microscopic world. Students were deeply impressed.

2) Magnifiers. Discuss with students on what kind of objects and instruments can enlarge images. Students actively participated in and enumerated glass beads, reading glasses, water droplets, telescopes and microscope, etc. Show the students a set of microscope and tell them that it is commonly used to magnify tiny creatures in biology.

3) Introduce the structure and standard operation of microscope. The author tried two different teaching methods: a. project the edited videos from Internet; b. capture videos of different parts of a microscope and project them on the screen with the teacher explaining. These projections are large and clear enough for students in every corner of the classroom to accurately know the structure of a microscope. Method b has a stronger on-site operability. It can emphasize details according to the actual class demands and achieve better teaching effects. Meanwhile, since light may cause adverse effects on webcam such as backlight, glare or overexposure, teachers should have knowledge in optics and well prepared.

4) Experience microscope imaging characteristics. Quickly assembled the equipment and projected microscope images on the screen. A tiny letter "b" written on slides under the microscope presented as "q" on the screen (Fig. 2). Students reached the conclusion that microscopes "reverse" the image (in a centrosymmetric manner) from the real.
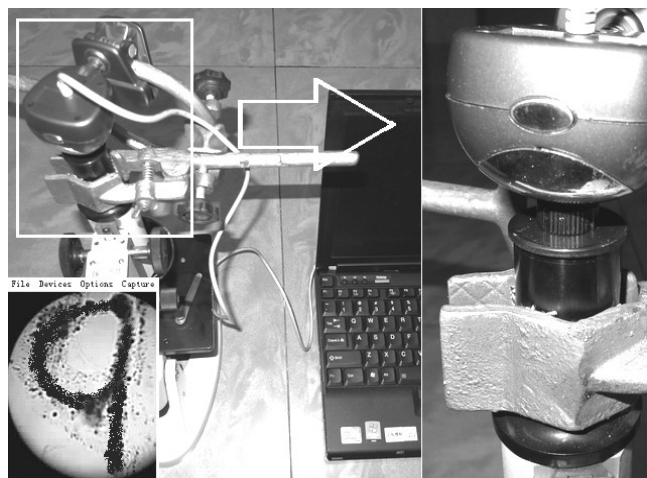

Fig. 2 Microscope and Digital Camera System. The reversed image of "b" observed from microscope is shown at the bottom left.

5) Observe Slides. At the end, teacher can continue to display a variety of permanent slides of cells and tissues specimen with projections. This can satisfy the curiosity of students and lay the foundation for their "microscope observation" experiment.

4. Discussion

Modern IT represented by multimedia and Internet is amazingly changing people's ways of life and learning. As it is developing, multimedia technology in modern education gradually shows the incomparable superiority than those traditional teaching methods. This advantage is particularly prominent in biology teaching as biological science study includes macroscopic and microscopic, static and dynamic, physiological structure and situational process content. The above two successful cases are the representation of feasibility and advancement to integrate informatization into biology teaching revolution in the rural areas. However, after discussing with the headmasters and the biological teaching and research group of that school, we found that some educators obviously made mistakes on how to treat the information technology and how to fuse IT into biology classroom, especially adapting to the software and hardware foundations and regional characteristics of rural middle schools in China. These disorders may due to the teachers' obsolete teaching ideas, and rejection to, dependence on or improper use of IT, and misunderstanding of informatization teaching resources, and so forth.

A. Typical Misunderstandings

1) Rejection of Technology. Some teachers think that as a result of China's current education system and the economy in rural areas, information technology and courses cannot be integrated at all. Computers, multimedia classrooms or campus networks are merely to put on air, follow the fashion or cope with evaluation of higher authorities [8]. However, they are unfavorable from the point of view as "to be responsible for the students" and "to guarantee the teaching schedule". A few teachers think that only IT professionals can perform informatization education, and they can hardly use the complicated multimedia courseware like Authorware, Flash or Geometric Sketchpad."

2) New "Cramming Education" under the Information Technology Environment. In the new curriculum standard, students are the main body of information processing and the initiative builder of knowledge meaning, while teachers are just helpers and promoters for students' learning activities. Under the guidance of the new teaching methods, teachers should take brand new teaching modes in the process of teaching. However, as taking advantage of new technology, some teachers send too much information to their students and spend the whole class displaying and explaining; multimedia courseware has become the dominant, while teachers transform into projectionist and commentator and students are still the passive receivers [9]. It still remains the "cramming education" mode for exam-oriented education.

3) Overdependence on Internet Information Resources and Ignore Other Teaching Resources. There never exists a universal media or the only source of information, so does the Internet. Despite of its obvious advantages, its massive information still cannot cover every corner in the world. In fact, diverse ecological environment in China's rural areas and abundant species are irreplaceable local resources in terms of biology. During the one-year teaching, the author, however, found that the local teachers never utilize these precious resources. On the contrary, they are always tired of searching for the suitable Internet resources.

B. Countermeasures and Suggestions

Based on personal teaching practices and the analyses of the misunderstandings, we put forward the following countermeasures and suggestions on information technology integration in biology teaching in China's rural junior middle schools:

1) As for the Human Resources. Strengthen the teachers' training to form a high-qualified team. Rather than applying information technology simply to teaching practices, to integrate information technology into courses is a high-rank and active adaptation [10]. Teachers should change the teaching and learning view and create a digital learning environment with vigorous attitude. In terms of the limitations of rural teachers' information technology capability, they should be encouraged to learn basic and widely-used techniques, software and hardwire to gradually cultivate their IT ability. In fact, access to net resources and integrating them into the class is available through a variety of channels, e.g. all sorts of searching engines, scientific and educational videos on YouTube, IM tools and webcams, and computerized Karaoke TV recording software. Even for the rural high school teachers, they also can find and edit information with these tools. They not only provide students with vivid, interesting and advanced biological knowledge, but also cultivate students' multi-sensory development. They guide students to cultivate simple feelings of life value and life aesthetics and simultaneously improve the rural biology teachers' information technology accomplishment.

2) As for the Teaching Methods. Develop effective teaching methods suitable to the new curriculum standard and avoid teaching misunderstandings under the information technology environment. Make a change on the fact that "the traditional blackboard writing" is replaced with advanced "electronic blackboard writing". Make a change on the fact that visual effect is deliberately pursued when using the multimedia courseware and only form rather than the actual effect is paid attention to. Make a change on the fact that student practical operations are replaced with large number of demonstration experiments. Make a change on the fact that the "man-machine dialogue" replaces "interpersonal conversation". Make a change on the fact that the class is crammed with informatization materials. For middle high

schools in the rural areas, biology teaching should combine local environment and their abundant biological resources with information technology, thus create a biological teaching mode with local characteristics. As a Taiwan scholar Prof. Xinyi Xu once said "the information technology can be a tool or an assistant, but it cannot replace teachers as the whole of teaching. As long as teachers can grasp focus of the course and guide students in the most appropriate and most effective way, Word and PowerPoint files can also achieve the required learning effects. Everyone can do tricks, but each has his own cleverness. With different backgrounds and characteristics of teachers and students, the same material can be learned from different angles, which bring about different vitalities and perform different learning effects. This is also the charming part that education can be regarded as a creative art."

5. Conclusion

As an increasingly-common and life-oriented means, information technology can bring rich and colorful life for the large rural areas and integrate into biological teaching to create vivid and effective classes. With the development of information technology, the integration process of biology teaching with information technology must be organic and dynamic. Only when we arm ourselves with modern education theories, try to explore the teaching methods of the information age which adapt to the biology class in rural middle school and actively carry out information technology integration, can we arouse students' initiative and improve teaching quality and efficiency.

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