

Advances in Biology Teaching Objectives in China

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Abstract: From "Two Basics" education to the three-dimensional teaching objectives, and to the teaching objectives under the background of key competence, the paper summarized the advances in biology teaching objectives in China since 1949. At the same time, the matters need attention of objective instruction design and goal attainments during the teaching process were also discussed in the paper, which can provide reference and guidance for teachers in lesson preparation and instructional designs.

Keywords: Biology teaching; Three-dimensional teaching objectives; Key competence; Instruction design.

1. Introduction

The curriculum objectives, subject to the national education policy in China, and in accordance with the law of students' physical and mental development, are the training objectives for students to achieve through the completion of the prescribed educational tasks and subject content. Curriculum objectives are criteria and guidelines for curriculum development, curriculum implementation and curriculum evaluation. The curriculum objectives dominate the whole process of teaching, and stipulate the direction of teaching and learning, so they are macroscopic objectives. At the same time, the curriculum objectives are embodied in classroom instruction as teaching objectives, namely three-dimensional objectives, are microscopic objectives.

The new biology curriculum in middle school is to meet the needs of students' personality development, aiming at improving students' scientific literacy. In fact, during the class instruction or instructional design, some teachers show up the superficial understanding for the three-dimensional teaching objectives. Their comprehension for the concept of new curriculum still remains on the perceptual understanding level. Therefore, on the basis of the comparison of the biology teaching objectives at home and abroad, this paper discusses the forming background, connotation of the three-dimensional objectives for the new biology curriculum and the advances in the teaching objectives under key competence background, so as to provide guidance for biology teaching and instructional design in middle school.

1.1 The formation background of three-dimensional objectives

With the development of society and the progress of science, biology curriculum objectives change constantly, so the teaching objectives change accordingly in the past 7th education reform. In 1950s, the teaching objectives in China mainly learned from the Soviet Union's, which advocated

the "Two Basics" education, mainly focusing on basic knowledge and basic skills education. In 60s, in order to meet the needs of the rapid development of science and technology, the training requirements of "developing intelligence and cultivating ability" were put forward. Since 70s, the rapid development of the industry has brought some questions on population, environment, energy, resources and others, which make people realize that the biology teaching in middle school must reflect its social values, and help people realize how to use biology to improve their lives. In 80s, "science, technology and society" (then to science, technology, society and environment education) movement reform was originated. In 90s of 20th century, as knowledge economy began to emerge, the information-based society came quickly, which made people think about how to serve the development of human beings, so the quality-oriented education was put forward. After entering the 2000 years, in the face of the international competition of comprehensive national strength, in order to cultivate innovative talents, at the third National Education Conference, China put forward that education reform should carry on the quality-oriented education in an all-round way, aiming at improving the people's quality, focusing on the cultivation of students' innovative spirit and practical ability, and bringing up a new generation in the 21st Century to meet the needs of the development of new era. Therefore, in the experimental stage of the 8th curriculum reform, the Biology Curriculum Standard (Grade 7-9) in 2001, and Biology Curriculum Standard (Grade 10-12) in 2003 issued in China both divided curriculum objectives into three dimensions: knowledge, ability and emotion, attitude and values. Soon after another new three-dimensional objectives were put forward: knowledge and skills, process and method, emotion, attitude and values, which lead to two formulations of three-dimensional objectives. Li and Zhu (2010) constructed the KAPO model (Fig. 1) according to Gagne's instructional events (1977) and their initials O (Occurrence) and the first three latitudes of K (Knowledge and skills), A (Attitude, emotion and values) and P (Process and methods).

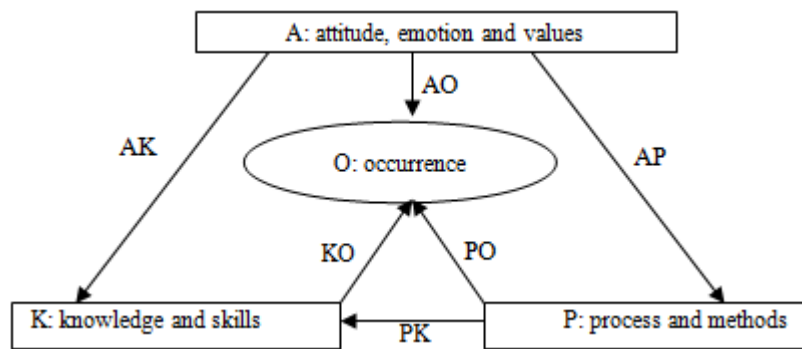


Figure 1: KAPO model

High school biology curriculum standard (2017 version) was issued in 2017, what change most is that three compulsory modules (molecule and cell; heredity and variation; the steady state and the environment) changed into two modules, and the last module changed into elective module. "Life idea, science thinking, scientific research, and social responsibility" was first put forward in the new curriculum standard. Because it is difficult to differ knowledge and skills from process and method objective, knowledge, ability and emotion, attitude and values were at last unified to be adopted in China.

Although the objectives of biology curriculum in different countries are not the same, they have the same development trend in general. The most famous and influential educational objectives taxonomy method is put forward by the American psychologist and educator Bloom (1956) who divided the educational objectives into three domains: the cognitive domain composed by the mastery of knowledge, understanding and intellectual development; The psychomotor domain consisting of various skills and physical skills; the affective domain composed of objectives of interest, attitudes, values and correct judgment, and adaptive development. Each domain is divided into several levels. For the cognitive domain, it can be divided into six levels such as knowledge, comprehension, application, analysis, synthesis, and evaluation from the simple to the highest order (Fig. 2).

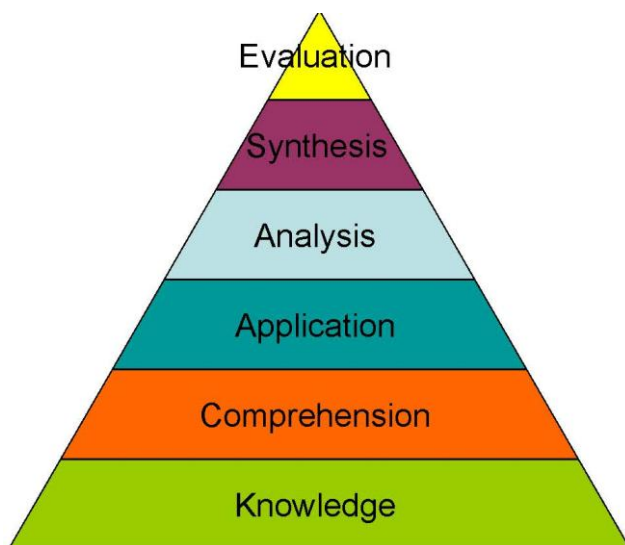


Figure 2: Bloom's six level

At present, in Project 2061-Science for All Americans provide a coherent picture of science literacy that can help in interpreting the grade-specific learning goals in Project 2061's Benchmarks for Science Literacy.

The great attention has been given to the objectives of the affective domain abroad, for example, Valette and Disick (1972) had divided teaching objectives into the subject and affective objectives, among which the subject objectives are divided into five levels in behavioral processes from simple to complex: skills, knowledge, transfer, communication, and criticism. From the perspective of linguistics, the affective objectives are divided into five stages: acceptance, response, appreciation, internalization and integration.

In addition, although Taylor's teaching objectives were put forward earlier, it is still of significant reference value (1949). This model reflects that teaching objectives should be dynamic rather than static, that is, some of the objectives proposed are intended to meet the student's immediate needs, while other objectives will be altered as the teaching situation changes, that is, starting from the objectives that have been planned, to teach and evaluation, then reconsider objectives planned, thus the objective system is gradually improved. This is consistent with the idea of hierarchical teaching for "geared to the needs of all students" under the new curriculum reform.

2. The connotation of the three-dimensional objectives under new curriculum

2.1 The level of curriculum objectives

According to different standards, the curriculum objectives can be divided into the following three levels: Educational "aims", refer to the overall objectives for the basic education set by the ministry of education, which is of the highest level. For example, the training of qualified citizens, the cultivation of responsible members of the community and so on. The second level, corresponding to the word "goals", is the reflection of overall goal in the specific curriculum domains. For example, biology curriculum objectives in high school are as follows: through the study of high school biology courses, the students can obtain the basic knowledge of biological science and technology, understand and pay attention to the application of these knowledge in life, production and social development; arouse interest in

science and exploration of the unknown; develop scientific attitude and scientific spirit, establish a sense of innovation, and strengthen patriotism feelings and social responsibility; understand the essence of science, the interrelationship among science, technology and society, and the mutual relationship between man and nature, gradually form a scientific world outlook and values. The third level, corresponding to the word "objectives", are more specific, and the most direct and close objectives relative to the course, namely teaching objectives, which is reflected in three dimensions, including the cognitive domain, psychomotor domain and affective domain. The objectives at this level are implemented in specific curriculum domains.

2.2 The relationship among three dimensions of teaching objectives

In the face of two presentations of three-dimensional objectives: the first, knowledge, ability and emotion, attitude and values; the second, knowledge and skills, processes and methods, emotion, attitude and values. Many teachers are in a dilemma in the daily teaching or instructional design. In fact, although the two presentations are different, they are essentially the same. Whichever presentation is also allowed here. The former may be easier to prepare, while the latter is often not easy to grasp the definition of knowledge and skills, and process and methods. What is the difference between knowledge and skills and process and methods? This is a difficult problem for many teachers. In fact, the relationship between the two sets of objectives is the relation between "conclusion" and "process". The requirements for the former have three levels: learning, understanding, and applying, while the latter emphasizes on three processes: learning-by-doing, doing-by-learning, and reflecting at last. Skills in former focus on explicit capabilities, such as the operation of microscopes. The ability in processes and methods puts more emphasis on implicit abilities, such as the ability of thinking and operating. There are three levels for emotion, attitude and value objectives: acknowledge, experience, and internalization. In a word, knowledge is the foundation for the realization of three-dimensional objectives, and it is the knowledge carrier to realize the cultivation of ability and the promotion of emotion, attitude and values. Ability cultivation and method guidance are the key to three-dimensional objectives; while the new curriculum reform focuses on the integrity of subject knowledge, it is necessary to focus on cultivating and improving students' abilities. Until 2017, knowledge, ability and emotion, attitude and values was only presentation in instruction and research by the overwhelming scholars in China.

2.3 Attention for the design of three-dimensional objectives

2.3.1 Stick to the collective preparation for lessons

Under the guidance of the new curriculum concept, the preparation contents of the lessons should be from textbooks, but also surpass the textbooks. Some biology teachers do not

understand the importance of design teaching objectives. They focus only on "textbook teaching". They believe that after completing the prescribed teaching material, the teaching task is completed, then the teaching objectives are achieved. In fact, teachers with different educational backgrounds, educational experience and ages may have some deviations in understanding and grasping the teaching objectives, and collective lesson preparation can reduce this deviation. In the concept of new curriculum reform, we should fully excavate how to "teach with textbooks", analyze students' "zone of proximal development", give full play to the advantages of "brainstorming", and finally design the most optimized teaching objectives and achieve the most satisfactory teaching result. Such as in the "Cell Energy Provision --ATP" section, for the knowledge objective mutual transformation between the ATP and ADP, what objective verb to be select? And what examples or exercises to support this objective? The mission and the realization of the teaching objectives cannot leave without the collective wisdom.

2.3.2 Attention to the verbs description of three-dimensional objectives

Some teachers are still using the previous expressing method in the 20th century when preparing lessons or instructional design and the teaching objectives they formulate are vague and ambiguous. It is not easy to test students' learning effects. Therefore, there is no certainty in the teacher's mind whether the teaching objective is achieved in classroom teaching. The design of teaching objectives under the new curriculum reform should embody the idea of "three-centers education", that is, "student-oriented, teacher-led, training as the mainline". It is reflected in the "four elements", namely ABCD expression method. "A" refers to "behavior subject", meaning "Audience", which is the subject of the objective sentence. So the objectives used to use previously, such as "to make students ...", "to train students ...", "to improve students ..." are obviously expressing the teacher's teaching procedure or activity arrangement while not audience's. To make it clear that the students are behavior subject of the teaching objective, the expression can be "can take an example for...", "can construct...", "can design ..." etc. "B" refers to "Behavior", that is, what learners should do. It is the predicate and object in the statement of the objective. In the traditional teaching plan, the teaching objective is almost the same as three levels: "understanding", "comprehending", "mastering". Although these words express different requirements, these general, vague expression of psychological process verbs, are difficult to be measured and tested in reality. Therefore, *Biology Curriculum Standards* has listed the knowledge, skills, emotional objective verbs, such as "depict", "imitate", "pay attention to" and so on, which can be used as a reference for biological teacher to prepare lessons or make instructional design. "C" refers to "Conditions", which means the above behaviors can generate under what conditions. "D" refers to "Degree", namely the standard of above behaviors. The above three-dimensional target verb expression is developed in the method of "target object", "behavior" and "condition", which was put forward by Mager. For example: "After trying to

make a three-dimensional structural model of eukaryotic cells, students can skillfully and accurately use the objects or supplies around them to make a three-dimensional structural model of eukaryotic cells". Among them, the behavior subject is "student", the behavior is "making model", the condition is "using the objects or supplies around them", and the criterion is "skillfully, accurately".

2.4 Effective integration of three-dimensional objectives

The teaching objective is the standard for the positive activity of both sides in teaching, which is also the standard for testing teaching quality, and the top priority when making instructional design. The three-dimensional objective advocated by the new curriculum reform is actually the three dimensions of a goal. It can be disassembled at the research level, but must be integrated at the practice level. Knowledge and skills are still the top objectives of the new curriculum. They are main lines through the lesson, and also the carriers. The implementation of three-dimensional objectives means not weakening the subject knowledge and skills teaching, but reflects the construction and understanding of subject knowledge and skills, and integration of multidimensional cognition. The formation of students' thinking and problem-solving ability and cultivation of emotion, attitude and values are all formed and developed in the process of knowledge exploring. Knowledge and skills, emotions, attitudes and values must be based on the process of teaching activities. There is no experience and perception if without the process, and also no skills can be formed. Emotions, attitudes and values are driving force of classroom teaching. It penetrates into the first two objectives, and only when this objective can be realized, then the whole teaching objectives would promoted better. The realization of the three-dimensional objectives should be based on knowledge and ability. In the process and methods of study, and on the influence of emotion, realize "intelligence, ability and personality factors" harmony, and achieve the three-dimensional objectives of new curriculum classroom teaching, and reflect the value of modern education.

2.5 Focus not only on highlighting key objectives, but also on flexibility

Knowledge and skills are explicit, short-term objectives, while processes and methods, emotions, attitudes and values are implicit, long-term objectives. Emotions, attitudes and values are overall objectives, not partial objectives. In the practical teaching, we should not mechanically divide the dimensions of the three-dimensional objectives, reflect on average, and implement step by step. There can be difference in emphasis, according to different teaching content, but teacher shall keep three-dimensional objectives consciousness in mind during the whole teaching process, and reflect the entire three-dimensional objectives in a certain period of time.

According to the theory of constructivism, Taylor's teaching objective model and the curriculum concept of "For All The

Students", we should pay attention to the flexibility when designing teaching objectives. First, we should treat students of different levels and various interests differently. The unified objective is made to stipulate the minimum standards for all the students, but for students with different characteristics, there shall be difference in emphasis. Second, there are implicit or expected objectives, such as, "willing to... ", " happy to... ", "can insist on... ", etc. Those are obvious the implicit objectives. Another example, the objective of "to experience the process of seed germination and make detailed observations records" can not be accomplished in class, which is the expected objective.

3. The teaching objectives under key Competence Background

With the continuous advancement of secondary school biology curriculum reform key competence was proposed in the new curriculum standards (2017 version). key competence is a kind of idea and general capability which is based on the individual's adaptation to the development of life and society and can only be observed and measured directly by the performance observed under certain circumstances. The key competence includes life idea, scientific thinking, scientific inquiry and social responsibility. And the teaching objectives should be presented based on the four curriculum idea. Take a chapter of "understanding biodiversity" as example, the teaching objectives can be designed as follows:

- 1) The view of intercoordination and mutual restriction will be formed through learning biodiversity in three levels (life idea; scientific thinking).
- 2) The abilities of collecting informations and cooperation and exchange will be improved by collecting landscape pictures, investigating local rare and endangered animals and plants (scientific inquiry).
- 3) Identification and establishment the consciousness of "care for the environment, protect biology and protect ecological balance" (social responsibility).

In conclusion, during the 8th curriculum reform in China, "for all-round development of students" will be still the education reform topics. The design of objective teaching is the starting point and destination of teaching activities, and effective dispersion and integration of three-dimensional teaching objectives or the teaching objectives under key competence background are an important measure to improve the effectiveness of biology teaching. To make "teaching" has basis and "learning" has the direction, and finally achieve the goals of enhancing the students' biology literacy.

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