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INFLUENCE OF RESEARCH-BASED TEACHING MODEL ON THE TEACHING OF "INTRODUCTION TO LIFE SCIENCE"

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ABSTRACT

Introduction to Life Sciences is a general education program for non-biological majors in many colleges and universities. However, in the long-term traditional teaching model, many problems have emerged, hindering the improvement of students' comprehensive ability. This paper focuses on the analysis of the causes of these problems, introduces the impact of the three new teaching models on the teaching of the course and the shortcomings that still exist, and puts forward corresponding suggestions for the teaching methods and reforms of the introduction to life sciences in the future.

KEYWORDS: Introduction to Life Science; Research-based Teaching; Teaching Models

1. INTRODUCTION

Life science is a broad and interdisciplinary subject and is a significant part of the life education system in Chinese universities. In recent years, with the rapid development of biological applications and research techniques at home and abroad, as well as humankind's deepening understanding of life phenomena, the focus on interdisciplinary research in biology has also become a focal point of scientific development. Cross-scientific research in the field of life sciences and other disciplines is also a hot subject of concern to scientists, including biophysics, biomathematical inquiry, marine biochemical inquiry, etc. (Qin et al., 2018). Therefore, studying life science courses to adapt to the international development trend of interdisciplinary research and all-around development of biology, as well as the cultivation of integrated, innovative, broad disciplinary backgrounds of biological personnel has essential significance.

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Furthermore, "Introduction to Life Sciences" is an essential course for university students to learn the life sciences, as its content is simple, informative and widely applicable, it is loved and respected by students. Its main research content includes the origin of life sciences, the basis of life and the structure of life, life sciences and agriculture, life sciences and industry, life sciences and medicine and life sciences and health in many aspects, see Table 1. this makes students have a certain understanding of the knowledge and technology of life sciences, on the one hand, to train students to follow the development of science and technology awareness, on the other hand, also allows students to recognize the discipline of biology potential for future development (Zhou et al., 2011). In addition, the teaching mode of the subject can also enhance students' understanding of interdisciplinarity, permeability and integration. It can stimulate enthusiasm for inquiry and creativity, enhance scientific and technological literacy, promote knowledge transfer, actively respond to professional needs, and strengthen social practice and social responsibility.

Table 1 Introduction to Life Sciences Course Content and Chapter Teaching Requirements

	Chapter	Content and requirement	Cred it hours	Remarks
Main teaching content	Chapter 1 Introduction	An understanding of the development and study methods of Introduction to Life Sciences, how the course is assessed, how it is conducted and the main bibliography; An understanding of the links and differences between this course and related courses, and their application in practice;	2	
	Chapter 2 A rich and varied world of life - biodiversity	Knowledge of biological diversity, classification of organisms, familiarity with the basic concepts of biodiversity, characteristics and composition of micro-organisms; Understand the relevance of microorganisms as emerging infectious diseases in humans to viral or bacterial properties;	6	Video: 1 hours

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	Chapter 3 The nature of life	An understanding of the material composition of life and an understanding of the macronutrients and trace elements that make up life and their roles; Knowledge of the relationship between sugars, lipids, proteins and nucleic acids and the function of organisms;	4	
	Chapter 4 Ecological civilization, beautiful life	Understanding the effects of environmental factors on individual organisms, on changes in the population size of organisms, and on the spatial distribution of biomes and ecosystems; Knowledge of the basic concepts and characteristics of ecology:	6	Video: 1 hours
	Chapter 5 Rapidly changing biotechnology	Basic theoretical knowledge of genetic engineering, cell engineering, enzyme engineering and microbial engineering; An understanding of the application and characteristics of the four major projects and an understanding of the trends in the four major projects;	6	
	Chapter 6 Thematic applications of life sciences and technology	To understand the application of life science and technology in neighbouring areas such as new energy, environment, food and medicine, and to understand the current status and trends in related fields; a) Precision therapy and medicine; b) High-throughput sequencing and bioinformatics; c)Genetically modified foods and human health; d)Stem cell technology and biological evolution;	8	Seminar: 1-2 hours
Other teaching content	A colourful world of creatures (Biodiversity)	Classroom video	(1)	
	Humans and Ecology	Classroom video	(1)	

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	Discuss applications and trends in the life sciences in relation to your interests(profession)	Classroom Workshops	(1)	
Total			32	

2. Problems in the teaching of introduction to life sciences

Today, a few universities have made outstanding achievements in constructing Introduction to Life Sciences courses, and some national quality courses have emerged. However, some universities still offer this course with unsatisfactory teaching results. After communication and communication between teachers and postgraduate students and years of teaching research, it is found that there are two general reasons for this:

(1) High repetition rate between introduction to life science and high school biology knowledge

As the aim of Introduction to the Life Sciences is to give students an initial understanding of the life sciences, covering a wider and more extensive range of aspects, the book is based on basic knowledge. Certain key knowledge of high school biology therefore coincides with the key points that are required to be memorized. So, although students express a strong enthusiasm for learning new achievements and technologies in the life sciences, they neglect to receive key information about the underlying theories and technical theories, which often results in their psychological paralysis of learning the course. In addition to this, a significant proportion of students believe that the course has little relevance to their professional skills, leading to a low level of interest in the subject. A questionnaire survey of teachers revealed that most of the students did not pre-study before class, did not revise after class and did their homework just perfunctorily. Only 60% of the students listened attentively in class and actively cooperated with the teacher, while the rest were either reading books on other subjects or completing tasks outside of class. As a result, it is difficult for teachers to mobilize the initiative of their students in the classroom, making students less interested in learning and lowering the quality of teaching.

(2) Single assessment method

The current Introduction to Life Sciences is mainly a single final examination, mainly through a written test to assess, which is a relatively single, rigid assessment mode. It is difficult to understand students' comprehensive quality and ability to carry out a comprehensive assessment. At the same time, this teaching assessment and assessment time are relatively fixed and used less often, making it difficult to stimulate students' learning enthusiasm. Hence, students' participation in the daily learning process is low, primarily for temporary surprise study before the examination, making it impossible for students to achieve the absorption and mastery of knowledge truly (Ma et al., 2021).

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(3) Limitations of the traditional teaching model

As a crucial general education course, the contradiction between the richness of the content and the limited class time is also an important issue that should be considered in the teaching process. The traditional teaching mode often consists only of the teacher directly teaching the content, while some complex abstract content such as cell division embryonic development of organisms, genetic engineering operations, and other processes are difficult to explain clearly only through language. In addition, some of the content, such as the observation of biodiversity, is taught in the departmental herbarium or on campus, using a combination of dipped and peeled specimens and natural objects. However, due to the limited time available, these teaching methods cannot be completed in class. Although the current teaching mode allows students to learn a great deal quickly, it does not allow them to establish a clear concept in their minds, making them uninterested in learning and not understanding the knowledge.

3. The impact of new teaching models on educational practice

Educational reform for students in higher education has long been a focus of attention in our country. In order to motivate students to study and improve the general environment of learning style, the Ministry of Education has put great efforts and efforts. However, it has yet to show a qualitative leap and improvement. The author believes that the main reason is that today's universities focus more on their form of teaching contents and teaching methods, such as writing new teaching materials and acquiring new teaching facilities, while neglecting the fundamental reform: the reform of the teaching model (Zhou et al., 2012). The so-called teaching method refers to a certain way of structuring classroom teaching based on certain teaching theories, educational methods and teaching techniques, i.e., the way in which teaching activities are organized. In the traditional teaching model, the teacher is the master of the whole teaching process, which makes students too passive in receiving knowledge from the teacher and lacking the sense of independent learning, often with a negative attitude. It is therefore easy to imagine that achieving the desired educational effect is very difficult.

Since Humboldt founded the University of Berlin, the university's mission has been to combine teaching and research; university education should not be about the existing theoretical knowledge, as in high school education, but they must do their own "research". The teacher's task is to motivate them to do " research". This is a way of bringing research into teaching, which needs to be added to the traditional education model. In recent years, the concept of optimizing the teaching mode of introductory life science courses to allow students to take the lead in the teaching process, and in this way, cultivate students' research and innovation skills, has been increasingly favored by universities and research-based teaching methods have been increasingly emphasized. Some standard research-based teaching models such as flipped classrooms, case study teaching and problem-based learning have been carried out in university education practice.

(1) Transforming the role of students through the flipped classroom

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The traditional teaching model is divided into two parts: the teacher teaches the students in class, and they learn by themselves through homework and practice after class. The flipped classroom reverses this format, allowing students to absorb knowledge in class through teacher guidance, explanation, peer interaction, and practice while teaching the basics independently through pre-reading or reading after class (Zhang et al., 2012). This model was first proposed in 2000 and is now being used successfully in countries such as the USA and Australia. This form of teaching allows the teacher to become a facilitator and promoter of learning by imparting knowledge, as shown in Figure 1. In turn, students are transformed from passive recipients of learning to active participants. The flipped classroom model gives students sufficient time to preview their knowledge before class. In the classroom, teachers can reduce teaching time and adopt new teaching strategies to facilitate students' learning without interfering with their choices, leaving enough time to communicate and complete tasks independently to promote better growth and development (Zhang, 2019). It is also possible to use the method of students completing learning tasks in the classroom to increase their interactivity and motivation by minimizing the amount of knowledge presented.

Fig. 1. Teaching form of flipped classroom

For example, before class, students are asked questions about the growth process of microbial cells and the morphology of colonies, and students are randomly divided into groups to obtain information and materials from various sources to create a PowerPoint presentation and to present their collection in class and discuss with the teacher any difficulties that arise in the design and revision of the course. Each group of student's debates based on what they already know and the information they have gathered. After the discussion, the leader of each group has to explain the results of the group discussion and the situations in which disagreements arise (Wang et al., 2018). The teacher summarizes the student discussion results and the body of knowledge. Details are given on which issues the students differ significantly, leaving it to the students to explore and resolve after class, but giving relevant hints and guidance in order to ensure that the students are genuinely conversant with their knowledge.

(2) Case-based Inspired Teaching Model

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Case teaching, where a specific illustration of a specific scenario or event by the teacher allows the teacher to introduce the topic and actively discuss the various aspects of case teaching with the students, thus using the acquired theoretical knowledge to guide them in solving the problem. The teaching method was first developed at Harvard Business School in the USA. In 2010, Professor Copeland first introduced the group discussion approach to business administration at Harvard Business School in the USA. At that time, many managers from companies came out of the classroom to present to the school different problems faced by their employees in management, with case studies and many solutions. In 1921, with the advice and encouragement of then-President Dorham, Copeland published a casebook that promoted the adoption of the case-based teaching method in the classroom by the school's faculty (Zhao, 2006).

In this new teaching model, students will act as active participants. Students are expected to read carefully the case studies given by the teacher, analyze and reflect carefully and draw their own conclusions. Students should maintain their initiative throughout the teaching activities, actively participate in all aspects of the case study and share their ideas and judgments in the discussions. It is only through independent analysis, discussion and exchange that students can gain 'first-hand' knowledge. For example, the teacher shows the specific metabolic processes of the tricarboxylic acid cycle in aerobic organisms on a multi-media screen and prepares props to enhance the students' memory and asks them to explore how the interconversion of the three major nutrients is linked through the tricarboxylic acid cycle. This mode of teaching allows students to acquire theoretical knowledge and grow in competence through experience and activity and improve their expressive skills through discussion and analysis of the case study. The process of implementing case study teaching is shown in Figure 2.

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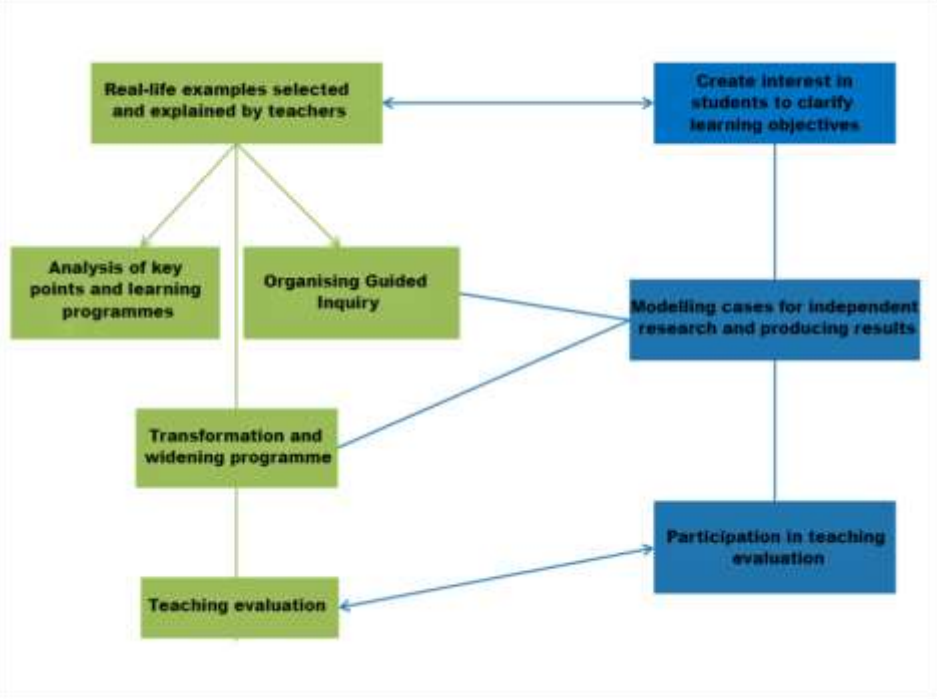

Fig. 2. The specific operational steps of the case teaching method

This teaching method often involves the selection of real-life cases for study and discussion, requiring the teacher to select and organize the material to be discussed in advance and to choose appropriate cases. This reduces the distance between the learning environment and the real-life scenario, allowing the learners to put themselves in the shoes of the students, think about possible problems, and develop the ability to propose solutions to various problems. The teacher points out the target solution and guides us to apply our existing knowledge, analyze the problem in depth with our peers and design a solution (Xu et al., 2021). This greatly enhances students' creativity and practical problem-solving skills and allows thinking to be more than just acquiring fixed formulas and principles in books.

(3) PBL teaching method to develop independent learning skills

PBL, which stands for Problem-Based learning, is an active teaching model of "question-based learning" that advocates putting complex and meaningful questions into context at the beginning of the course, where learners must engage in cognitive actions such as questi0ning, judging, comparing, sifting and classifying, summarizing and inscribing knowledge, as well as using various cognitive means of thinking in order to master the processing of questions.

It is the process of learning that is implicit in the learning context and the process by which the learner must gradually acquire integrated thinking and solve it. McMaster University Medical School developed this approach in the UK in the 1970s and has been used in recent years in medical schools and vocational and technical colleges. The traditional fill-in-the-blank classroom approach of 'teacher talk, student listen' is often teacher-centered and student-centered. Students are often passive because

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their knowledge is based on the teacher's ideas and mastery of the subject matter without engaging their exploration and initiative (Yang, 2005). Students are in a passive position, and their learning is only based on the teacher's ideas for the sake of learning knowledge, which does not bring into play the students' exploratory and active nature. In contrast, the PBL approach is learner-centered and scenario-based. It requires the researcher to teach through a combination of scenarios and problems so that the problems become the primary material for students to develop their creative skills and improve their comprehensive thinking skills. At the same time, the researcher can not only consolidate new knowledge through the investigation and solution of a phenomenon but also provide students with new research ideas by investigating scenarios. This approach helps to improve students' independent learning skills. This approach helps to improve students' ability to learn independently; on the other hand, it develops students' awareness of lifelong learning, improves their overall thinking skills, and is more conducive to their future understanding and mastery of professional knowledge and multi-faceted abilities. The teaching design of Introduction to Life Sciences based on the PBL teaching mode is shown in Figure 3.

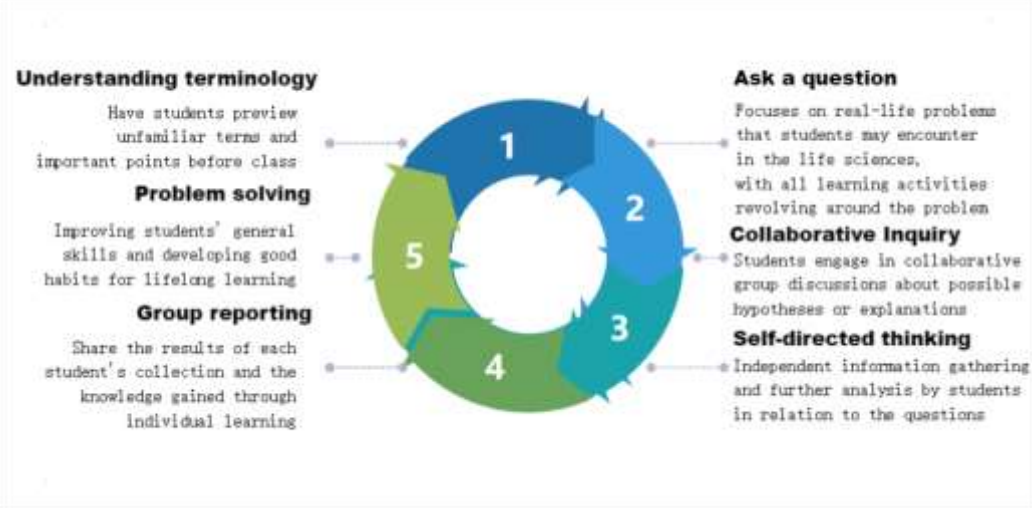

Fig. 3. The teaching design of Introduction to Life Sciences based on the PBL teaching model

These three approaches are designed to stimulate and develop students' interest in learning and their ability to adapt to work by creating realistic teaching situations. Joyce, an American scholar, argues that the core of the exploratory teaching process is creating an environment, i.e., a teaching method is a learning environment. When learners can observe the environment from various perspectives, problem situations stimulate interest and help students find solutions to problems independently. This provides a good foundation for learners to move into society and adapt to work more quickly in the future. At the same time, the students organize meetings and write and present reports in advance during the problem-solving process, which allows them to improve their organizational, communication, and teamwork skills in a more realistic working environment early on, thus laying a good foundation for them to adapt to the working environment more quickly when they enter society.

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4. Limitations of research-based teaching methods

(1) Difficulties in case and subject selection

Should the basis for research-based teaching be case-based or problem-based? Moreover, how to select typical, representative cases or problems? The author believes this can be considered from the following three aspects: 1. To ensure that the teaching content meets the requirements of research-based teaching. The first is to choose appropriate cases or problems. Here, both the case and the problem need a factual background. In turn, the questions must be moderately complex, manageable and manageable; otherwise, it will be difficult to follow the required time frame, and not too small and challenging; It will be difficult to stimulate the students' interest in learning. At the same time, they should also facilitate the study and accumulation of knowledge. For example, in the simulation experiments, students can select the proteins, nucleic acids, and other biological macromolecules that they understand in high school as the object of study and further extend them on this basis so that students can learn new knowledge in a few minutes while not being too obscure and difficult to understand and prematurely discouraged.

Currently, research-based teaching reform experiments are generally carried out in Chinese universities and have achieved specific results; however, from an overall perspective, the results still need improvement. The reasons for this are insufficient theoretical research, difficulties in practice, and lack of practical experience. The difficulties we face are the limited number of real-life problems and cases accumulated by the teachers themselves. It is difficult for teachers to engage in quality projects and accumulate research topics in practice. Therefore, effective research education requires, firstly, raising the standard of teachers' academic research and, secondly, requiring teachers to be more involved in practical research and to accumulate more cases and problems. The emphasis on teachers teaching and researching together helps to develop quality research-based teaching.

(2) Difficult to control both the educational process and classroom assessment

The establishment of the research-based teaching model has created a new opportunity for exploration and innovation in our educational reform. However, it is still a challenge to grasp the effectiveness of the classroom process, especially in the course of seminars. How can these difficulties be resolved? This can be done in the following ways: a. Improving one's practical skills and increasing confidence in the subject research. b. Adopting a variety of teaching methods and encouraging students to participate in classroom discussions. c. Establishing a platform for teacher-student interaction.

The teacher's role in guiding the course discussions can affect the teaching process's quality and efficiency, especially as students often need to be more experienced when using this method at the beginning. In university classes, the lack of communication between the students and the teacher leads to various problems in implementing this teaching model, such as poor motivation and reluctance to cooperate with the teacher's requests. Also, as work is usually done in small groups, assessing the talents and contributions of each group member is a complicated issue. The teacher's role at this point should be one of guidance rather than domination. It is also difficult to devise assessment systems and

methods for this class, especially for teachers who are used to letting students work independently. In addition, the openness of the answers to the questions is a crucial concern for teachers. As Introduction to Life Sciences involves a wide and shallow range of knowledge, there often needs to be standard answers. The questions asked may go beyond the teacher's expertise, so the evaluation of the students' work is more demanding than traditional teaching methods in terms of the teacher's knowledge structure, job experience and working ability.

(3) Increased time spent and difficult transition of teacher and student roles

In the PBL model, teachers are expected to avoid traditional lecture-based teaching. They have to learn to construct appropriate questions to assist students in mastering content and developing competencies. This is why teachers spend a lot of time writing lesson plans or asking questions. For example, it takes much time to explain to students some of the more difficult points in Introduction to Life Sciences that are difficult to understand and master, and it takes considerable effort to do so for those points that are closely linked to real-life situations (Tang et al., 2005). On top of this, if the group is used as a learning unit, the time spent by the teacher on group instruction is several times more than that spent on the course lecture.

In group discussions, therefore, the teacher's focus is not only on whether the students can grasp the basics, but should concentrate on whether the students are logically correct, correcting their mistakes and providing guiding cues, providing resources for their research, and monitoring their completion of tasks. As this shift in role and delivery is new to some teachers, it can be difficult for them to change their old habits. Not only is this transition difficult for teachers, it is equally as big a change for students (Liu et al., 2002). Most students see the teacher as a transmitter of knowledge and they only need to memorize boring mechanics, which makes many students seem to lose their curiosity about things. learners in the PBL model need to spend more time on open-ended topics for students, which is the only way to fully understand and master what they are learning and to become independent learners.

(4) Not conducive to systematic learning of knowledge

This mode of learning knowledge is centered on a problem scenario, but as all knowledge points are centered on this problem, it often leads to poor overall knowledge. Therefore, basic subjects with a high degree of originality are not suitable for research-based teaching because, in these contents, there are often a large number of concepts, theorems, laws, and other highly abstract knowledge points (Cui et al., 2009). If traditional teaching methods are used, it is easier for students to grasp the basic knowledge embedded in them. Therefore, "Introduction to Life Sciences", a comprehensive course designed as a research-based teaching, makes better use of the strengths of such courses. Using cases or questions can place specific, overly abstract, theoretical lessons in concrete, practical situations, giving learners a deeper understanding of their specific meanings and implications.

5. CONCLUSION

In conclusion, although curriculum reform has begun to bear fruit, it is also clear that reforming the curriculum, teaching content, and other aspects of the curriculum to achieve the desired results will require a long period of sustained effort and exploration. In order to achieve this purpose, all workers must also carry out long-term unremitting struggle and exploration. Only in this way can we realize the concept of "people-oriented" schooling under the requirements of the new era of talent training objectives and ultimately form a new talent model with contemporary characteristics (Chen et al., 2021). Therefore, in the future teaching reform, it is necessary to constantly change the concept of education and teaching, correct the educational ideology and guide the teaching reform practice. At the same time, in the future education and teaching reform, it is also necessary to further reform the traditional education and teaching concept, correct the teaching ideas and guide the implementation of education and teaching reform (Du et al., 2006). In order to achieve the goal of improving students' knowledge structure, training students' scientific thinking skills, enabling students to identify cross-cutting hotspots of related majors, laying the foundation for students' future interdisciplinary studies and in-depth research, thus prompting better and faster progress of students' scientific research work.

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