Construction and utilization of primary school science resource base under the concept of differential education

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Abstract: This study is based on the realistic needs of the differentiated development of science teaching in primary school students, according to the personalized characteristics of students, relying on the support of modern science and technology, collecting student learning data, taking the construction of question bank, evaluation model construction and learning resources construction as the starting point, the construction of school-based primary school science resource bank is carried out to help empower students to improve science literacy.

Key words: primary school science; Resource base construction

I. Introduction

The scientific resource library based on "Everlasting Brain" can support teachers' classroom evaluation, improve teaching efficiency, and support students to obtain personalized chemical materials. It includes pre - and post-test and experimental micro-lessons to support classroom teaching; To meet the learning needs of the question bank and the later generation of personalized homework; Auxiliary micro-lessons for students with different academic abilities and interests; A menu of resources to support teachers in project-based learning; And data models to assist teachers in comprehensive evaluation. This is a growing database that we hope will provide different pathways for students to develop science literacy.

II. The background of the construction of primary school science resource database under the concept of differential education

1. Realistic requirements of scientific literacy cultivation

Under the guidance of the thoughts of the powerful country in science and technology, science education has made great progress. However, the science education in the basic education stage has been questioned by experts, scholars and society. For example, it is widely believed that students have a solid grasp of basic knowledge, but lack creativity and innovation spirit; Students are good at answering questions in books, but unable to solve practical problems in life; Students are good at following teachers to carry out learning, and lack of motivation and methods for active learning.

The construction of teaching resource base originates from many difficulties encountered in science teaching. For example, the influence of pre-concepts in teaching, the disconnection between scientific concepts and practical problems, the comprehensive evaluation of inquiry activities, and the differentiation of learning ability.

We hope to provide students with learning resources that fit in with the teaching materials and conform to the current cognition to support their active learning; Provide students with research scenarios, and guide them to carry out scientific research in real situations through project-based learning.

2.The objective existence of students' learning differences

Each child is a unique existence, and they have differences in cognitive ability, learning style, psychological traits, family learning environment and so on. In teaching, we can easily find that some children are suitable for inquiry practice learning, some are good at reading learning, and some are more suitable for listening learning... Their learning style, attention level, home learning environment are very different.

Tianchang Primary School began research on differential education in the 1990s, advocating student-centered and respecting students' individuality. Difference education is easier said than done. We hope to provide students with different learning abilities with learning resources that fit the textbooks and meet their cognitive levels to support their active learning.

III. The construction and utilization of primary school science resource base under the concept of differential education

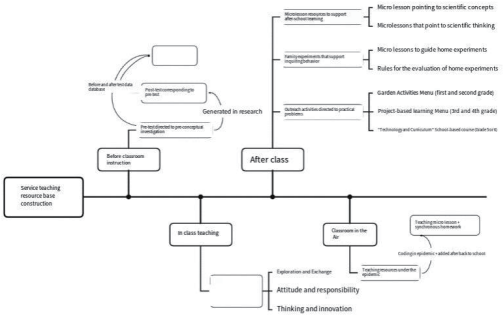

FIG. 1 Model of teaching resource library

In view of the above background, we started the "family laboratory" research in 2008, the "Primary school Science micro-class assisted teaching" in 2015, the "Practice research of pre and post measurement in classroom teaching" (the application of hiteach in primary school science classroom) in 2016, and the "evaluation model based on school brain" in 2018. In the research, we have obtained a lot of feedback on the use, deposited a lot of data resources, and obtained opinions and suggestions from peers and experts. And on this basis, we have modified and iterated. In 2019, after the "School Brain" was officially launched, the teaching resource library (FIG. 1) was sorted out and relocated as a whole, and it was constantly updated according to the revision of the teaching materials.

IV. The construction and utilization of primary school science resource bank under the concept of differential education

1.From "pre-concept investigation" to "personalized homework" question bank construction

(1) Support data monitoring, improve the classroom efficiency of the shared question bank construction

In science teaching, the pre-concept in the cognitive structure of students has a strong stubbornness. They may even recover their original false concepts some time after learning them. Therefore, the concept of conceptual transformation learning holds that learning is the process of transforming students' pre-concepts into scientific concepts. It is very important to understand students' pre-concepts before class to improve the teaching effect. After using IRS real-time feedback tool in Hiteach teaching system to carry out teaching research, we completed the construction of pre-class test bank for grade three to grade six. The pre-class concept survey was completed in the lead-up part of the class, and the data generated in real time helped teachers adjust the classroom teaching strategy and content.

At the same time, in order to better monitor the teaching effect, understand the learning increment and master the difficulties of the course, the post-test matching with the pre-test was written and carried out in the last 2 minutes of each class.

(2) To support data analysis, and to respect the differences of individual question bank construction

In 2019, when building the school brain resource bank, the question bank was further improved. According to the 2017 version of the curriculum standard, the three-level target classification was carried out, and the corresponding target number was given. The existing pre-test questions were combined with the corresponding target numbers and put into the school brain question bank. At the same time, according to the actual learning situation, independently created and adapted exercises of different difficulty and different educational goals, and put them into the school brain question bank.

After learning in a stage or a unit, "Everlasting Brain" will automatically generate corresponding numbers of other science learning resources for students according to the pre-test and post-test data, such as consolidation exercises, scientific knowledge expansion, etc. Each student will receive personalized science homework that meets their own learning needs. After completing the corresponding exercises, students can also complete the homework correction and watch the analysis of wrong questions by scanning the two-dimensional code. The "brain" will also collect the complete information of students' homework, and continue to provide a basis for students to assign homework in the next stage.

The data collected by the school brain will also be sent to the corresponding teachers to help them analyze students' learning situation and test the effect of classroom teaching, so that teachers can adjust teaching strategies in a targeted way, prepare micro-lessons with clear directions, and conduct personalized one-to-one tutoring for students, so as to effectively improve the quality of science teaching and students' learning effect in primary schools.

2. Construction of evaluation model from "subjective judgment" to "objective stereogram"

(1) Evaluation modeling, enabling the new ecology of classroom teaching

Cultivating students' ability of inquiry has always been an important and difficult point in primary school science teaching. Inquiry itself is a practical and personalized teaching process, which requires teachers to change the teaching concept, regard students as the main body of teaching, and build a scientific and diversified evaluation system to achieve the cultivation of students' inquiry ability. Under the guidance of subject experts, by collecting literature, reading course standards and analyzing and sorting out relevant information, we designed a scientific comprehensive evaluation model that conforms to the actual learning situation of our school. Taking the cultivation of core science literacy as the leading factor, we comprehensively evaluate the cultivation effect of four core science literacy of primary school students, namely, science concept and application, scientific inquiry and communication, scientific attitude and responsibility, scientific thinking and innovation, through the evaluation of students' learning habits, scientific knowledge and inquiry learning. The specific evaluation label items can be classroom inquiry, group cooperation, homework completion, etc.

(2) The evaluation can be visible, enabling students to grow in a new way

The four aspects of students' science literacy are graded and summarized with descriptive evaluations, and the suggestions of experts, parents and students are integrated. In the academic report, the content of students' science learning is presented, and the final evaluation results are weakened. Instead, more space is used to reflect students' learning status in daily classroom learning and homework, as well as students' individual performance such as group exploration, communication and innovation ability. Finally, it is presented in the form of personalized academic reports, which makes the evaluation visual. Make each student understand their own advantages and disadvantages, enhance students' interest and enthusiasm in science learning.

3. Construction of learning resources from "helping students with difficulties" to "project-based research"

(1) Micro-lesson resources to assist teaching and improve the quality and efficiency

To really improve the teaching quality, we must discuss the problem of "students with weak academic ability". Weak academic ability

is not necessarily weak learning ability, but also may be the result of students lack of good learning interest, learning habits, attention and family education and other multiple factors. In the completion of the 2015 provincial teaching and research planning project "Primary School science micro-class assisted teaching research", we sorted out the difficulties in science teaching, wrote the script of micro-class, recorded the topic class micro-class, and produced the matching exercises. In order to better promote the formation of students' scientific literacy and cultivate students' ability of independent thinking and hands-on inquiry, we also recorded micro-lessons of inquiry practice, including experimental micro-lessons, material preparation, research reports, evaluation standards, etc. These resources are also in the "everlasting brain" to create related learning resource interfaces. Students can break the limitation of time and space in traditional science learning, and in a more diversified and creative learning atmosphere, they can change from basic imitation inquiry to improved creative experiment. At the same time, students can learn and evaluate each other with classmates. When they encounter problems and new discoveries in the process of scientific experiments, they can also communicate with teachers through online platforms in time.

(2) Project-based learning resources in real situations

Science courses have always included things that are difficult to learn in a regular classroom. Due to the lack of time and space, these contents, which are associated with higher-order thinking such as reasoning, deduction, induction and innovation, have lost the opportunity to develop students' scientific thinking.

In order to drive learning with real problems and emphasize the application of knowledge, we use project-based learning as support. We have compiled project-based learning resources with "technology and engineering" as the main direction, including instructional design, instructional courseware, evaluation scale, communication mode, etc. Through a long class of 80 minutes once a week and independent learning after class supported by "Everlasting Brain", the time and space of project-based learning are guaranteed, the development of scientific literacy is promoted, and interdisciplinary abilities such as the exchange and expression of views, information retrieval and reorganization, data measurement and calculation are developed based on real scenarios.

V. Effectiveness of the construction and utilization of primary school science resource base under the concept of differential education

From 2019, we began to build "Everlasting Brain", and gradually enrich the capacity with the goal of "enabling every student to find suitable learning resources for themselves". To provide students with different ability levels of error guidance micro-lessons, summary of each lesson, routine experiment videos, creative experiment micro-lessons; Provide individualized homework according to students' learning situation; And drawing multi-dimensional digital portraits of students based on big data recorded by the school's brain.

Through the background data, it was found that the utilization rate of science learning resources accounted for more than 50% of the learning space of "Everlasting Brain". At the same time, through the sharing of students' experiment videos, mind maps, survey reports, opinion sharing, etc., students can get the motivation and help from their peers. Technology can be used to better empower differential education, help teachers obtain various data in students' learning, and find the weak links in teaching from it, so as to provide possibilities for differential teaching.

VI. Challenges in the construction and utilization of science resource base in primary schools under the concept of differential education

Most of our science teaching resource banks come from first-line teaching, and are limited by the theoretical vision and technical level of the editors, so the construction of resource banks lacks of constructiveness. There are more contents related to primary learning, and the contents of guidance and inspiration in advanced learning stage are lacking. There are content to stimulate the interest in learning, but lack of resources to form learning motivation; There are knowledge points that are compatible with teaching, but the correlation between old and new knowledge points is not enough.

At the same time, the intelligence and correlation between each module of the resource base are not enough. In addition, the revision of curriculum standards and the change of teaching materials have also brought us a lot of troubles. The 2022 edition of compulsory education science curriculum standards has been released, and the original three-level target classification faces great adjustment; In the autumn semester of 2024, the new version of primary school science textbooks will be used, and the micro-class resources classified according to grade will face great adjustment and adaptation.

The construction of the teaching resource library originates from the difficulties in teaching, serves the reform of teaching mode, and is committed to the different development of students and the high quality and light burden of teachers. We firmly believe that the accumulation and filling of every point now will reduce the burden for the future.

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