Scientific and Social Research, 2024, Volume 6, Issue 12
https://ojs.bbwpublisher.com/index.php/SSR
Online ISSN: 2981-9946
Print ISSN: 2661-4332

Exploration of "Evidence-Based" Learning Model in Large-Unit Primary School Science

Liu Yang*, Wenfeng Tang, Nana Chen, Qimiao Hou

Primary School of Chengdu Jinpingguo Jincheng First Middle School, Chengdu 610213, Sichuan Province, China

***Corresponding author:** Liu Yang, 41959694@qq.com

Abstract: In order to better cultivate students' innovative abilities to meet future challenges and promote teachers to continuously advance curriculum and teaching method reforms, this paper proposes a new model of "evidence-based" learning in large-unit primary school science, which encourages students to think and explore like scientists. This model includes "puzzle-based" evidence collection to map the biological comprehensive spectrum, observe and discover biological characteristics, and strengthen inductive and deductive thinking, "ladder-based" evidence collection to explore the laws of the material world and develop abstract logical thinking, and "spiral-based" evidence collection to create universe simulation models and explore the mysteries of the unknown world, enhancing innovative transfer thinking. Such learning is conducive to forming preliminary philosophical concepts in primary school students and fundamentally promoting the development of students' scientific inquiry and practical abilities, thereby implementing core literacy.

Keywords: Core literacy; Primary school science; Large-unit learning; Evidence-based

Online publication: January 3, 2025

1. Problem statement

With the development of technologies such as artificial intelligence, big data, and the Internet of Things, there is an increasing emphasis on providing momentum for the development of a "future world," especially through education and skill training to "cultivate innovative abilities to meet future challenges." Consequently, there is an urgent need to continuously advance curriculum and teaching method reforms, focusing on enhancing students' creative thinking abilities, modern information technology application abilities, proactive learning abilities, and teachers' training abilities to promote and guide systemic educational changes. The report of the 20th National Congress of the Communist Party of China states: "Education, science and technology, and talent are the foundational and strategic supports for the comprehensive construction of a modern socialist country." The Ministry of Education and other eighteen departments' "Opinions on Strengthening Science Education in Primary and Secondary Schools in the New Era" also point out that primary school science curriculums need to do addition under the "double reduction" background, highlight the cultivation of students' core literacy, strengthen the organic connection between grades and sections, reflect the practicality and comprehensiveness of activities, implement heuristic and inquiry-based teaching, and cultivate students' deep thinking to adapt to future development [1]. However, there are indeed some problems in the current primary school science teaching activities, which may affect students' future development and interest in science.

1.1 "Low-order" learning dependency: lack of literacy implementation

In classroom learning, students mostly stay at a shallow level of learning, accumulating knowledge mainly through memory, resulting in a low-order learning dependency, lacking high-order thinking participation and emotional investment. The core literacy of the science discipline is the essential character and key abilities that students gradually form through science education, adapting to personal lifelong development and social development needs. The implementation of core literacy depends on curriculum teaching and evaluation, and on the development of students' key abilities during the learning process. Therefore, teachers should focus on cultivating students' observation and experimental abilities, scientific reasoning and problem-solving abilities, scientific communication and cooperation abilities, and the like [1]. Only through the cultivation of key abilities can students truly master scientific knowledge and methods, improve scientific literacy, and lay the foundation for future development.

1.2. "Island" teaching model: lack of teaching change

In the teaching process, there is a lack of overall thinking between units within the discipline, without considering the internal connections and laws of knowledge, and designing holistic learning based on students' cognitive development characteristics and learning cognitive foundations. There is a lack of communication and connection between disciplines, with teaching content being isolated and segmented, leading students to often learn on their respective "islands" of disciplines, lacking interdisciplinary knowledge integration and application. Therefore, teaching should, under the joint action of external and internal conditions, take educational goals as the core, overall coordinate teaching goals, content structure, learning methods, resource systems, homework systems, and evaluation methods, advocate student active inquiry, and promote high-quality transfer and improvement of students' high-order thinking and comprehensive abilities during the inquiry process.

1.3. "Treetop" learning concept: lack of empirical inquiry

In the learning process, teachers and students often only focus on scores, just like "eyes habitually cast towards the lush shade," neglecting the growth force of the roots. Such a "treetop" learning method neglects the cultivation of learning ability and cannot go far. Therefore, it is necessary to integrate the cultivation of empirical consciousness in scientific inquiry practice, using "evidence-based" learning as a handle, not only focusing on the acquisition of scientific knowledge, the improvement of scientific methods, and the cultivation of scientific spirit, but also paying attention to exercising students' innovative and practical abilities.

2. Design framework of primary school science large-unit "evidence-based" learning model

To promote the cultivation of students' scientific core literacy and develop students' scientific thinking and inquiry practice abilities, this paper proposes a learning advancement process based on the evidence perspective, taking "large-unit learning" as the main carrier. Based on the core concepts of the discipline, teaching resources are integrated, and students' learning power is improved through active participation and positive experience. Based on the educational concept of curriculum standards, teaching methods are changed, and large-unit teaching is promoted to promote literacy implementation through overall design. Based on core literacy, new paths for advanced learning are explored, with hands-on and brain-engaging activities to cultivate students to think like scientists and experience the process of scientific inquiry like scientists.

3. Implementation process

3.1. Puzzle-based" evidence collection: drawing a comprehensive spectrum of life science

Primary school science includes a vast array of biological observation, planting, and breeding inquiry activities. These activities are crucial for students to understand the life cycle of organisms, enhance observational skills, foster a love for nature, strengthen willpower, and develop inductive and deductive thinking. The biological world is a significant domain in primary school science learning. The following "puzzle-based" evidence collection life science large-unit learning model is designed around the "biological world" to achieve student cognitive advancement and meet curriculum standards. The specific implementation process is as follows:

(1) Extracting essential questions, big concepts lead unit goals: Students encounter organisms frequently in daily life, forming certain life experiences. However, these pre-existing concepts are often fragmented and discontinuous. Using the large-unit teaching model, teachers effectively integrate biological knowledge across the curriculum, extracting core concepts in the field of biology based on the continuity and breadth of life, and setting unit essence questions to stimulate students' interest in exploration.

(2) Acquiring growth evidence, structural design of unit content: Based on the biological concept foundation from initial surveys, teachers deeply analyze biological teaching content, fully grasp the life cycle of organisms, integrate the knowledge structure of biological units, and guide students to gradually master the growth of each stage of the biological cycle through initial classroom inquiries, preparing for continuous growth inquiry activities.

(3) Using long-term picture books, puzzle-style linking unit inquiry: Depending on different observation objects, long-term picture books are roughly divided into three themes: animals, plants, and microorganisms. Each theme has different focuses in the information recorded within the picture books to help students find commonalities through observation. The picture book content we attempt to design mainly includes observation guidance on the shape, size, color, and the like, of organisms, allowing students to record through text, charts, and other forms. Then, along the various stages of biological growth, students are guided to observe and record the growth changes of organisms, using tables, drawings, and other methods to document the changes. The picture book guides students to further observe and discover along each stage of the organism, ultimately promoting students to complete long-term observation inquiry activities.

(4) Creating a comprehensive spectrum of life, displaying diversified transfer outcomes: Through the construction of long-term picture books, students gain a comprehensive understanding of biological growth and a deep perception of biological characteristics. Combined with cultivating and other activities, students organize and improve long-term picture books, induce the characteristics and growth patterns of the observed objects. Through display and exchange, students review their observations,

forming a high-level development of big concepts. As students accumulate certain experiences, teachers design new inquiry themes, guide students to review new life situations, explore the growth of other organisms, and gradually improve the cognitive development of the ecosystem.

3.2. Ladder-based" evidence collection: displaying material project groups

The study of the material world spans the inquiry process of primary school science for six years, including sound, light, electricity, water, air, and others. The following "ladder-based" evidence collection material science large-unit learning design allows students to understand the material world around them, find its laws, enhance inquiry abilities, and develop students' abstract logical thinking by exploring material science. By designing large units as large projects and linking them with tasks, students can better carry out extracurricular inquiry activities, use multimedia technology to record the changes of materials, and explore material laws. The specific implementation process is as follows:

(1) Publishing project tasks, interview survey to set unit base points: The primary school science material unit teaching field involves many areas. Based on the learning advancement theory and considering the unit textbook content and students' actual situations, surveys are conducted to understand students' knowledge of material-related information. A macro-level planning and integration of the large-unit system are combined with students' cognitive levels and teaching content to extract the big concepts in the material field.

(2) Relying on project activities, cooperative inquiry to find evidence of change: Based on the concept hierarchy of the material unit, considering students' knowledge structure and cognitive characteristics, and thinking from the perspective of learning advancement theory, a material unit learning advancement table is designed. Combining practical exploration micro-project design, students are guided to associate various phenomena during experimental exploration, delving into the learning of core subject concepts. Through group project implementation and optimization, students' multi-level and multi-dimensional concept enhancement is promoted, and through various small projects, students' innovative thinking abilities are cultivated.

(3) Reviewing project history, deepening material concepts layer by layer: Students combine the content of the project book, organize the evidence collected throughout the project activities, and discuss and exchange in groups to form the most effective information to continuously enrich the material big concepts. Students review their participation in the entire project activity, analyze their strengths and weaknesses, and comprehensively improve their personal abilities.

(4) Displaying engineering project groups, autonomously perfecting material knowledge networks: Based on previous inquiry activities, students carry out a series of practical interactions as carriers of various micro-projects, continuously improving the big concepts related to material disciplines. Using the cross-unit big concepts already mastered, students extend their learning to extracurricular inquiry and in-depth practical operation of engineering project groups, innovating inquiry forms, further observing the subsequent changes of materials, and perfecting and transferring the original cognition to improve the material knowledge network.

3.3. Spiral-based" evidence collection: creating universe simulation models

The universe and celestial bodies are another important area of inquiry in primary school science, characterized by abstraction and long observation cycles. Therefore, in the exploration of celestial motion, model construction can be used for inquiry activities. The "spiral-based" evidence collection constructs a large-unit learning model of Earth and universe science, enabling students to observe celestial motion phenomena, raise questions to stimulate students' thinking, design and make models to explain the causes of phenomena, and promote model iteration and upgrading through group reasoning and argumentation, constantly reconstructing and perfecting concepts related to celestial bodies. The specific implementation process is as follows:

(1) Triggering cognitive conflicts, explicit defects in original models: Learning about the universe and celestial bodies is abstract, and students often do not understand it in daily life, leading to lost concepts. Using question-and-answer surveys to understand students' knowledge of the universe, students' understanding is often incomplete, even producing many incorrect or lost concepts. By question-and-answer format, the deficiencies in students' original cognition are fully exposed, forming cognitive conflicts and stimulating students' desire to learn actively.

(2) Searching for inquiry information, model development integrating virtual technology: For some experiments limited by weather or time, students often cannot complete the recording of long-term changes in celestial bodies. Virtual experiments replace physical inquiry activities, and through virtual experiments, the observation of phenomena is further improved.

(3) Integrating virtual and physical evidence, spiral iteration of simulation models: In regular classrooms, even in single activity inquiries, students use simulation inquiry forms, using a single material to answer questions about the universe, thus understanding the basic and essential concepts of the universe, allowing students to remember single-point information. By cleverly using virtual experiments to improve celestial phenomena and iterate models, students clarify the causes of phenomena through model design and making, and continuously refine and improve cognitive models.

(4) Skillfully using central museum virtual technology, perfecting universe concepts: Through modality research, single-item inquiry, central museum virtual technology, project development research, construction (correction) of model tools, and the like, students' learning of "universe" knowledge is advanced through evidence-based processes. Using the large-unit teaching model, extracting the big concepts of the universe field, and effectively integrating textbook knowledge of the universe unit with the systematic and completeness of knowledge, a more holistic cognitive learning system of celestial bodies is gradually formed.

4. Conclusion

American scientist and astronomer, Carl Sagan once said: "Every person is a scientist when they are young, because every child, like a scientist, is full of curiosity and awe for the wonders of nature." Through the "evidence-based" learning of primary school science large-units, a "new door of learning" has been opened, leading students to approach science, love science, and truly let them explore and practice a variety of learning methods [1]. It seeks deep-level understanding and transfer support for core concept construction, allowing them to learn for interest, for the unknown, and for the future, striving to think and explore like scientists.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Eighteen Departments Including the Ministry of Education, 2023, Opinions on Strengthening Science Education in Primary and Secondary Schools in the New Era, published May 26, 2023. http://www.moe.gov.cn/srcsite/A29/202305/t20230529_1061838.html

[2] Developed by the Ministry of Education of the People's Republic of China, 2022, Curriculum Standards for Primary School Science in Compulsory Education. Beijing Normal University Publishing Group, Beijing.

[3] Wang Z, 2020, An Empirical Study on the Improvement of Primary School Students' Observation Ability Through Nature Notes, thesis, Central China Normal University.