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Review Strategies of Junior High School Physics from the Perspective of Big-unit Theory

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Abstract: Under the new wave of curriculum reform, junior high school physics education not only aims to help students grasp basic physical concepts and laws but also emphasizes guiding them to construct a systematic knowledge framework, develop scientific thinking skills, and foster practical inquiry and innovation. However, the current review of junior high school physics often suffers from fragmentation and utilitarianism, overemphasizing problem-solving techniques and test scores while neglecting the logical connections between concepts and their practical applications. This approach hinders students from forming a structured knowledge framework and applying physics knowledge to solve real-world problems, which contradicts the goals of cultivating core competencies. This article, guided by the concept of core competencies, proposes strategies for review, including setting tiered objectives, reconstructing the knowledge system, creating real-life scenarios, focusing on practical applications, and adopting diversified evaluation methods. These strategies aim to provide teachers with concrete and effective measures to break away from traditional review models and achieve an integrated "teaching—learning—evaluation" process, thereby helping students transition from rote memorization to the development of practical skills.

Keywords: Big unit theory; Junior high school physics; Review strategy

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1. Introduction

The theory of large units, with its systematic and integrative advantages, has gradually become a key direction in educational reform. Review, a crucial step for consolidating knowledge and enhancing skills, urgently requires the introduction of the concept of large units to innovate. By integrating large units, students can move beyond rote memorization of isolated knowledge points and gain a deeper understanding of the essence and principles of physics. Additionally, by setting tiered goals, creating real-life scenarios, and adopting diverse evaluation methods, students' initiative and creativity can be effectively stimulated, thereby promoting the development of their core competencies in physics.

2. Overview of the theory of large units

2.1. The connotation of the theory of big units

The compulsory education physics curriculum standards (2022 edition) emphasize the exploration of large unit teaching, actively promoting thematic and project-based learning activities... to strengthen the intrinsic connections between knowledge and promote its structured organization [1]. The theory of large unit teaching was introduced by the renowned domestic scholar Professor Cui Yunhong in 2016, aiming to enhance teachers' instructional positioning, focusing on units that connect with core subject competencies and knowledge point requirements [2]. Large unit teaching typically involves systematically planning and considering the integration of fragmented knowledge from a specific field. Specifically in school teaching, it refers to the overall planning and curriculum design at the level of learning stages, subjects, or textbook units [3].

In summary, the theory of large units emphasizes the central role of big concepts, which serve as the foundation for organizing and structuring teaching content. By integrating knowledge and fostering a coherent and systematic learning process, this approach enhances students' ability to apply their knowledge in real-world contexts. Through the design of meaningful tasks and real-life scenarios, students are encouraged to engage in problem-solving, thereby deepening their understanding and internalizing the knowledge as part of their cognitive framework. This method significantly supports the development of critical thinking and creative thinking skills, as it promotes inquiry, analysis, and innovation. Most importantly, the theory of large units emphasizes the importance of the entire learning process, from the establishment of unit objectives, the design of learning activities, to the implementation and feedback of assessments. This requires teachers to adopt a holistic perspective in order to promote the comprehensive development of students.

2.2. The advantages of the large-unit theory in junior high school physics review

The advantages of the large-unit theory in junior high school physics review for the middle school entrance examination are particularly evident, as the subject is composed of several major modules such as sound, light, heat (phase change), force, and electricity (electricity and magnetism). First, the large-unit theory provides a strong conceptual framework by integrating fragmented knowledge under broader concepts like mechanics and electricity, helping students build a systematic understanding of physics and avoiding the fragmentation of knowledge. Second, it encourages students to apply their knowledge in real and complex situations through thematic tasks and problem-based learning, such as investigating the physical principles behind the structural design of bridges, which enhances their ability to transfer knowledge and develop innovative thinking. Third, the theory supports the use of diverse learning activities, such as project-based learning and practical investigations, such as troubleshooting household electrical circuits, to stimulate student engagement and interest. Finally, it aligns closely with the core goals of physics education by fostering students' scientific literacy through comprehensive problem-solving activities, ensuring that the cultivation of core competencies is embedded throughout the entire review process.

3. Analysis of the current status of physics review lessons in junior high school

3.1. From the perspective of students

On one hand, students begin to study physics in the eighth grade, and their exposure to the subject is relatively limited. However, the content they encounter spans nearly all the core modules of physics, which is characterized by its breadth and complexity, posing significant challenges in mastering the material within a constrained timeframe. Furthermore, students' cognitive development is still in the process of transitioning from concrete thinking to abstract reasoning, which results in a superficial understanding of physics concepts and a lack of deep analytical engagement.

In addition, the influence of traditional educational perceptions often leads students to perceive physics as an inherently difficult subject, thereby fostering a psychological aversion and reducing their motivation and confidence. This mindset can give rise to anxiety and resistance during the learning process, which in turn hinders effective learning outcomes. Moreover, the fragmented nature of physics knowledge makes it difficult for students to consolidate and internalize the information, thereby complicating the application and understanding of physical principles. As a result, this situation may further diminish students' interest and intrinsic motivation in the study of physics.

3.2. From the perspective of teachers

There are several critical issues that hinder the effective teaching of physics in the current educational context. On one hand, many teachers still rely heavily on traditional methods such as knowledge review, practice exercises, and detailed explanations of key and difficult question types during revision. While these methods may yield short-term success in improving students' performance in standardized tests, they fail to cultivate students' ability to integrate knowledge and develop abstract thinking skills. This approach is fundamentally at odds with the long-term goals of education, which emphasize the cultivation of core competencies and critical thinking abilities.

On the other hand, the teaching objectives set by many teachers tend to be overly narrow, focusing primarily on rote memorization and passive reception of information. In such a scenario, students are often left without the opportunity to engage in active thinking and exploration. This passive learning environment not only fails to stimulate students' interest but also neglects the development of their problem-solving and analytical skills. As a result, students may develop a superficial understanding of physics and struggle to apply their knowledge in real-world contexts.

Moreover, the teaching of abstract concepts, such as magnetic fields and electric currents, requires the use of modern educational technologies such as virtual laboratories to provide students with visual and interactive experiences. However, many teachers still rely heavily on pre-prepared review materials and do not adequately incorporate these emerging technologies into their teaching. This limitation restricts the ability of students to grasp complex physical principles and hinders the development of deeper conceptual understanding.

Finally, the uneven proficiency levels among students pose a significant challenge for teachers in implementing differentiated instruction. Without proper strategies to address the varying needs of students, those who struggle with the subject may continue to fall behind, while high-achieving students may not receive sufficient challenges to further their abilities. This lack of tailored instruction can lead to a widening achievement gap and hinder the overall development of students' physical learning outcomes.

3.3. From the perspective of schools

The current implementation of junior high school physics education faces several significant challenges, which can be summarized as follows.

First, many schools still lack adequate hardware facilities, such as fully equipped laboratories and sufficient experimental equipment. In some cases, laboratories are outdated, equipment is insufficient, and digital teaching resources are underdeveloped, making it difficult for teachers to recreate authentic experimental scenarios during review classes. This limitation hinders students' ability to grasp abstract physical concepts and develop practical skills through hands-on experimentation. Additionally, due to financial constraints and limited educational investment, some schools have not adequately updated their experimental equipment or expanded their digital resources, further constraining the quality and effectiveness of physics instruction.

Second, in remote or rural areas, there is a shortage of qualified physics teachers, and many educators are often required to teach across multiple grades and subjects. This situation limits the ability to design and implement highly specialized and differentiated teaching plans for junior high physics. As a result, students may not receive the tailored instruction they need to address their individual learning needs, which exacerbates the imbalance in educational quality between urban and rural regions and hinders the overall improvement of students' physics learning outcomes.

Third, although the new curriculum reform has strongly emphasized the development of core competencies in physics education, in some regions, the middle school entrance examination system still primarily evaluates students based on their scores. Under the pressure of college entrance examination performance, schools and teachers tend to prioritize exam-oriented instruction, even during the review phase, which often neglects the cultivation of students' innovative thinking, problem-solving abilities, and scientific inquiry skills. This exam-centric approach not only restricts the diversity of teaching methods but also diminishes students' intrinsic motivation and interest in physics learning.

Finally, driven by the demands of standardized testing and the pursuit of higher enrollment rates, many schools have increasingly focused on reinforcing test-taking strategies and have reduced their support for innovative teaching models and project-based learning. As a result, teachers in review classes often adopt a rigid approach characterized by rapid coverage of key concepts and an overemphasis on extensive practice exercises. This long-standing and repetitive teaching model has led to a decline in students' interest and enthusiasm for classroom activities, ultimately limiting the effectiveness of review lessons. Such a one-dimensional instructional approach not only fails to stimulate students' learning motivation but also hinders the development of their critical thinking and scientific reasoning abilities.

4. Review strategies for junior high school physics under the theory of large units

Under the guidance of the big-unit teaching theory, the optimization and innovation of review strategies for junior high school physics have emerged as a critical direction in the current education reform. Big-unit teaching underscores the integration of teaching content through big concepts, overarching themes, and major tasks, guiding students to transcend fragmented learning and grasp the internal logic and disciplinary essence of physics knowledge from a higher-dimensional perspective. For the review phase, it is essential to connect scattered knowledge points into systematic frameworks, create authentic problem scenarios rooted in real-life contexts, activate knowledge foundations by solving comprehensive problems, and cultivate students' transferable application capabilities and scientific thinking. Therefore, teachers are required to break away from traditional review models, explore more holistic, practice-oriented, and developmental teaching strategies, and facilitate students' transition from knowledge acquisition to literacy enhancement.

4.1. Extracting core competencies and formulating hierarchical objectives

The Compulsory Education Physics Curriculum Standard (2022 Edition) clearly states that physics teaching should be oriented toward core competencies, emphasizing the cultivation of four major core competencies: "physical concepts", "scientific thinking", "scientific inquiry", and "scientific attitude and responsibility” [4]. As an integrated teaching model, big-unit teaching can systematize and structure fragmented knowledge points, better serving the cultivation of core competencies. However, when there are differences in students’ cognitive levels, intelligence, and abilities, formulating hierarchical objectives is an important means to achieve teaching according to aptitude. By setting teaching objectives of different difficulty levels and arranging corresponding teaching tasks and activities based on students’ cognitive abilities, every student can gain a sense of accomplishment through review. This not only enhances the pertinence of the review but also boosts the confidence and review interest of students at different levels, maximizing review efficiency. For example, in the review of electricity, students with weaker foundations are only required to understand basic concepts and formulas and perform simple circuit calculations; average-level students should be able to understand electrical laws, analyze circuit faults, and calculate energy conversion; while top-level students with strong foundations and abilities are expected to design open-ended experiments or solve innovative problems, such as creating an energy-saving circuit system.

4.2. Implementing diversified evaluation to promote sustained development

Big-unit teaching design should adopt backward design and planning from the perspective of expected outcomes, emphasizing the learning stance, attaching importance to disciplinary practices, and running through the alignment of teaching, learning, and assessment. This design not only helps students understand the essence of knowledge but also enhances their ability to comprehensively apply knowledge to solve problems in real-world contexts [5]. The core of big-unit teaching lies in fully considering the goal orientation of physics core competencies. Through systematic sorting and structured integration of fragmented knowledge, it connects knowledge points to form a coherent knowledge network. For example, in the review of “mechanics”, relevant knowledge such as force, pressure, and buoyancy can be integrated around the central concept of “force.” The concept of force extends to gravity, elastic force, and frictional force; the concept of pressure is derived from the magnitude of pressure on a unit area, followed by analyzing related concepts of solid pressure, liquid pressure, and gas pressure; based on the difference in pressure (force) on the upper and lower surfaces of an object immersed in a gas or liquid, the concept of buoyancy and related laws are introduced, forming the mechanical knowledge framework as shown in **Figure 1**.

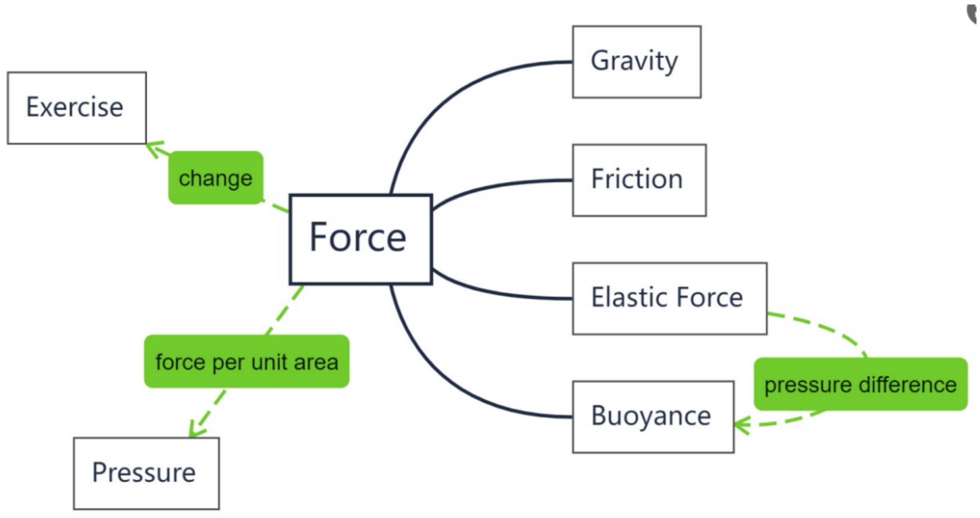

Figure 1. A knowledge framework centered on the concept of force

4.3. Creating authentic contexts and driving inquiry through problems

Context-based teaching review classes play a positive role in efficiently constructing students' knowledge systems, promoting the development of skills, process experience, and emotional cultivation, and correspondingly enhancing students' core competencies in physics [6]. For example, in the sound review class, teachers can take familiar campus sounds as a clue to create authentic teaching contexts: record a video of campus life and play it before class to guide students in reviewing knowledge points related to the generation and propagation of sound; set Task 1—decoding the "personality" of campus sounds, where students record sounds in different campus scenarios in groups and analyze sound characteristics; set Task 2—campus "noise reduction engineers", proposing solutions to campus noise problems, corresponding to knowledge points about noise classification and control; finally, expand the context to the "superpower" applications of sound, demonstrating sound technology applications on campus, such as voice-controlled streetlights, ultrasonic mosquito repellers, and security voiceprint recognition systems, guiding students to explain relevant principles and attempt to list more applications of sound in daily life. This strategy not only helps students systematize knowledge but also strengthens the connection between knowledge and real life, ultimately achieving the goal of improving students' core physics competencies.

4.4. Focusing on real-life practices to promote knowledge transfer

Big-unit teaching serves as a crucial pathway for teachers to shift from a "teaching-centered" to a "learning-centered" approach, and from "imparting knowledge" to "cultivating morality." The lesson planning for review classes should also prioritize students, design teaching content, and promote the implementation of "cultivating morality and fostering virtue" through practical activities [7]. In junior high school physics review classes, enabling students to apply knowledge to explain real-life phenomena and problems is an effective way to enhance their review interest. For example, after reviewing the pressure topic, teachers can pose questions like, "Why is sitting on a sofa more comfortable than on a bench?" or "How do airplane wings lift hundreds of tons of fuselage into the sky?" to help students appreciate the power of technology. After reviewing thermodynamics, questions such as "Why are gaps left between railway tracks?" or "Why is the freezer compartment of a refrigerator on the top and the chiller compartment at the bottom?" can be raised, allowing students to explain seemingly ordinary but overlooked phenomena through their learning, thus building confidence and a sense of pride in studying. After reviewing electricity and thermodynamics, the "magic" of how a microwave oven heats food can be presented, prompting students to think and discuss, and revealing the connection between electromagnetic waves and molecular motion.

4.5. Implementing diversified evaluation to promote sustained development

From the perspective of big-unit teaching, constructing an integrated, precise, and diversified unit evaluation system is crucial to guarantee the quality of unit teaching. Through diversified evaluation, teachers can comprehensively understand students' performance in knowledge mastery, thinking development, ability cultivation, and social-emotional aspects, thus providing a basis for adjusting teaching models [8]. The implementation of diversified evaluation can start from three aspects: process-oriented evaluation, outcome-oriented evaluation, and reflective evaluation.

Process-oriented evaluation: Teachers can focus on students' thinking development and cooperative abilities by observing their classroom performance (question answering, focus level, etc.), the completion and participation in group cooperative activities, and the detail of records in experimental operations. Specifically, scores can be assigned to each student during activities, or timely verbal encouragement or material rewards (such as small cards or stamps for exchanging gifts, etc.) can be provided.

Outcome-oriented evaluation: Focusing on phased learning achievements like unit tests, project reports, and innovative experimental designs, it aims to detect students' ability to apply knowledge and solve problems.

Reflective evaluation: Guiding students to summarize knowledge gaps and learning methods, draw mind maps, and clarify improvement directions, which echoes the ancient wisdom "Examine oneself three times a day."

Diversified evaluation enables students to gain a sense of accomplishment at various stages, stimulating their learning interest and initiative in review. It also promotes the integrated construction of "teaching-learning-evaluation."

5. Conclusion

In summary, the review strategies for junior high school physics under the theory of large-unit teaching should be guided by the core competencies of the subject, emphasizing the integrality, systematicness, and structurality of knowledge. By formulating differentiated objectives, reconstructing the knowledge system, creating real-life contexts, focusing on practical applications, and employing diversified evaluation methods, these strategies aim to comprehensively enhance students' core competencies in physics. Such approaches not only improve the efficiency of review but also promote students' all-around development, laying a solid foundation for them to become future talents required by society. In the formulation of teaching objectives, teachers should focus on the integration and restructuring of knowledge, breaking away from traditional, fragmented teaching models, and constructing a systematic knowledge framework centered on core physics concepts. This enables students to understand physical laws within an integrated cognitive framework, thereby fostering their scientific thinking abilities. Furthermore, during the teaching process, attention should be paid to the creation of realistic and contextually relevant scenarios, linking physics knowledge with real-world problems to stimulate students' interest in exploration and their desire to learn, thus enhancing their problem-solving capabilities. Additionally, the mode of teaching evaluation should be diversified, not only paying attention to students' mastery of knowledge but also emphasizing their learning processes, cognitive development, and practical abilities. Through process-oriented and formative assessments, students can establish scientific self-awareness and learning strategies, transitioning from passive reception of knowledge to active exploration. As a result, students' core competencies and overall capabilities in physics will be comprehensively enhanced, providing a solid foundation for their future studies and lives.

Disclosure statement

The author declares no conflict of interest.

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