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Methods To Increase The Efficiency Of Learning Through The Use Of Concepts And Terms In Biology Lessons

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Abstract: This article examines effective methods for increasing the efficiency of learning biology through the purposeful use of concepts and scientific terms in classroom instruction. Biology, as a concept-rich discipline, requires students to clearly understand and correctly apply key terms to grasp complex biological processes and systems. The study highlights pedagogical strategies, including concept mapping, terminology-based discussions, visual aids, and contextual learning, to enhance students' cognitive engagement and comprehension. Special attention is given to the role of systematically explaining biological terms, their repeated use in various learning situations, and the integration of real-life examples. The findings suggest that organizing biology lessons around core concepts and terms not only improves students' academic performance but also develops their scientific thinking, vocabulary, and ability to apply knowledge in practice. The article concludes that the effective use of concepts and terminology is a crucial factor in improving the quality and sustainability of biology education.

Keywords: Biology education, learning efficiency, biological concepts, scientific terminology, concept mapping, active learning methods, student comprehension, teaching strategies.

Introduction: In modern education systems, improving the efficiency of learning has become a priority, especially in science subjects such as biology, where understanding is largely based on mastering concepts and scientific terminology. The effective use of biological concepts and terms plays a crucial role in developing students' scientific literacy, critical thinking, and ability to apply knowledge in real-life contexts. Therefore, teaching strategies that focus on meaningful concept formation are widely studied and implemented in many foreign countries.

In developed educational systems such as those of the United States, the United Kingdom, Finland, and Japan, biology instruction emphasizes concept-based learning rather than rote memorization. International studies show that the use of concept maps, inquiry-based learning, interactive discussions, and interdisciplinary approaches helps students better understand complex biological phenomena. The consistent and systematic use of biological terms in different learning situations allows learners to build strong conceptual frameworks and improves long-term knowledge retention. As a result, students demonstrate higher academic achievement and deeper scientific understanding.

In Uzbekistan, significant reforms have been carried out in recent years to modernize the education system and improve the quality of teaching natural sciences. Special attention is given to the introduction of competency-based education, updated curricula, and modern pedagogical technologies in biology lessons. However, challenges remain in ensuring students' correct understanding and practical use of biological concepts and terminology. Traditional teaching methods often focus on memorization, which limits students' analytical thinking and independent learning skills. Therefore, studying and adapting effective foreign experiences while considering national educational standards is highly relevant.

One of the subjects taught at school is biology. This science studies all living organisms on Earth. Biology (from the Greek biología, from bios — life and logos — science) is a systematic science whose object of study

is living organisms, their relationships with each other, and with the environment.

Through this science, we can learn many new and amazing things about plants, fungi, animals, and even about our own bodies. However, mastering this knowledge is not easy. A large number of tasks and examples require much time and effort to learn (1).

Teaching biology involves the use of certain concepts and terms.

The set of concepts in each discipline defines its conceptual system, and the set of terms that belong to it forms its terminological system. When students fully understand the meanings of the concepts and terms, they can better grasp the theoretical foundations of the subject, acquire practical skills and abilities relatively quickly, efficiently, and—most importantly—consciously.

Therefore, terms and concepts play an important role in the development and specificity of any subject, as well as in the effectiveness of the learning process (2).

In the explanatory dictionary of the Uzbek language, the word term (from the Latin terminus — limit, boundary) is defined as a word or phrase that serves as a precise and stable expression of a particular concept characteristic of a specific field of science, technology, or profession.

A concept is a general representation that summarizes logically distinguished essential features and individual connections of objects and phenomena.

The study of any subject begins with the acquisition of basic concepts. Along with the word concept, the word name is often used.

A name and a term are often considered as a single whole. Despite their closeness and similarity, it is clear that in some cases the word name does not always express the same meaning as the word term. The definition expresses a narrower notion than the word term.

METHODS

Jerome Bruner's theory of concept-based learning emphasizes the importance of structuring instruction around fundamental ideas rather than isolated facts. According to Bruner (1960), effective learning occurs when students actively discover relationships among concepts through guided exploration, a process known as discovery learning. This approach encourages learners to engage cognitively with subject matter, leading to deeper understanding and long-term retention.

A key element of Bruner's theory is the spiral curriculum, which proposes that core concepts should be introduced at an early stage of education and revisited repeatedly over time, each time at a higher level of complexity. In biology education, this principle is particularly relevant, as foundational concepts such as the cell, metabolism, heredity, and adaptation can be progressively expanded from basic definitions to complex biochemical and ecological processes. Through this repeated and structured exposure, students develop a coherent conceptual framework that allows them to integrate new biological terms meaningfully.

Bruner's approach supports the idea that scientific terminology should not be memorized in isolation but learned through conceptual understanding. When biological terms are embedded within broader conceptual structures, students are better able to apply their knowledge to problem-solving and scientific reasoning.

David Ausubel's theory of meaningful learning provides a cognitive explanation for how new information is acquired and retained. Ausubel (1968) distinguished between rote learning, in which information is memorized without understanding, and meaningful learning, in which new knowledge is consciously related to existing cognitive structures. He argued that learning is most efficient when new concepts and terms are anchored to relevant prior knowledge.

In the context of biology education, Ausubel's theory highlights the importance of systematically introducing biological terminology using advance organizers. These organizers may include concept outlines, diagrams, summaries, or introductory explanations that prepare learners for new content. By activating students' prior knowledge about biological phenomena, teachers can facilitate the meaningful assimilation of new terms and concepts.

Furthermore, Ausubel emphasized the use of concept hierarchies, where general biological concepts are presented before more specific details. For example, understanding the general concept of "cellular organization" enables students to more effectively learn specific terms such as mitochondria, ribosomes, or endoplasmic reticulum. This hierarchical organization reduces cognitive overload and improves comprehension, making Ausubel's theory particularly valuable for teaching complex biological content.

Recent research in Uzbekistan has explored various pedagogical approaches aimed at increasing the efficiency of learning biology, particularly through the structured use of concepts, terms, and interactive technologies. These studies highlight experimental and applied strategies implemented in secondary schools and higher education institutions, focusing on

improving student cognitive activity and concept acquisition.

In her study, Sadokat Abduakhadovna Abidova emphasizes that in the context of digitalization of education, an effective tool for mastering the terminology of the course "Invertebrate Zoology" is the use of digital educational resources, particularly the Quizlet application. This free platform allows the creation of study flashcards aimed at memorizing biological terms, Latin names, and other theoretical material that can be represented in a card-based format.

The author highlights that students can either use ready-made courses available in the service's database or create their own sets of flashcards tailored to the content of the studied topics. The created flashcards can include interactive materials such as text, audio files, and images, which enhances the visual clarity of the learning process and facilitates the correct pronunciation of Latin names of invertebrate animals.

Furthermore, using Quizlet provides convenience in organizing learning activities, as the flashcards can be used for exercises, educational games, and both formative and self-assessment of knowledge. Thus, the integration of this digital tool into the teaching of the "Invertebrate Zoology" course contributes to improving the efficiency of concept and term acquisition, activating students' cognitive activity, and enhancing teaching methodology in pedagogical higher education institutions.

RESULTS AND DISCUSSION

In the system of biological sciences, terminology is relatively unified. However, there are differences in the definition of some terms used in the study of the native language. This is confirmed by state educational standards, curricula of schools, academic lyceums, and vocational colleges, as well as university textbooks and scientific–methodological manuals at different stages of the continuous education system.

In all works devoted to terminology, terms are considered as units that denote specific concepts within a given field, have a definition, and primarily perform a nominative function (3).

Work with terms and concepts in biology lessons is carried out using various methods and techniques, such as:

- identifying terms and concepts highlighted in italics in the text;
- explaining the meaning and content of each term;
- using a list or index of key terms;
- presenting learning material through logical diagrams and structured exposition;
- writing terms with explanations in notebooks, etc.

The nature of assignments becomes more complex with each school year.

In secondary school, students are asked to find the definition of a concept, identify the described word, and use it to determine the general and then the specific characteristics of the described phenomenon or process.

Such exercises help students consciously understand the term and its definition, grasp the logic of its structure, and later independently characterize the term.

Since many terms have foreign origins, students should be introduced to the semantic meaning of the term and its translation into their native language. This contributes to deeper understanding and better memorization of terms.

When working with terms and concepts, in addition to memorizing and understanding them, it is important to be able to define them correctly.

The ability to give definitions of terms is an essential skill in any lesson and is part of the cognitive learning tools of general education.

The semantics of terms and concepts involves the correct and logical definition of concepts expressed through terms. This is an essential condition for scientific discourse, since the incorrect use or misunderstanding of a term can provide readers with inaccurate information.

The logical operation of definition, which reveals the content of a concept, forms the essence of the process of semanticization.

The term is closely related to the concept. A "concept" is a form of thinking that reflects important properties, connections, and relationships of objects and phenomena in their opposition and development — a thought or system of thoughts that generalizes or distinguishes objects of a certain class according to their general and specific characteristics.

The formation of a concept follows a certain pattern: Perception → Representation → Understanding.

There are specific correlative relationships between terms and concepts:

a term is included in the definition of a concept, however, the definition of a concept cannot be reduced to a term alone.

Since many terms have foreign origins, it is necessary to become familiar with the semantic meaning of the term and its translation into the native language. This

helps to achieve a deeper understanding of concepts and better memorization of terminology.

The concepts that make up the content of biology (and ecology) courses are very diverse and constantly evolving. In each studied section, the teacher must:

- identify the key concepts;
- ensure the development of concepts;
- establish interdisciplinary and intersubject connections.

Therefore, purposeful work on understanding, forming, and defining each term, as well as proper comprehension of the essence of concepts, leads to a deeper and more lasting acquisition of educational material.

Assignments designed to organize work with terminology in sections such as "The Human Being" and "General Biology," when transitioning from thought to concept, can be incorporated by teachers into the process of concept formation, which proceeds according to the scheme: Sensation → Representation →Concept (4).

After analyzing a term and identifying its constituent words, it is necessary to synthesize the semantic meanings of the words that make up the term.

This way, the conceptual meaning of the term is determined.

When organizing work with terms, it is necessary to use the textbook and additional literary sources containing the following types of assignments:

• "Using the index of terms, find on the corresponding pages the conceptual meaning of the given term."

• "To find the definition of a term, use the index. Based on the semantic meaning of the term, determine the essence of the described phenomenon."

The comprehensive development of students' personal qualities is inseparably connected with the formation of solid and meaningful biological knowledge and the study of concepts expressed verbally through terms.

A concept, as the unity and form of thought, is always realized through a word or phrase (term). However, not every word expresses a logical concept.

The semantic and expressive components of a concept play an important role in the formation of a term.

This means that the interpretation of any term should be supported by additional contextual information (5

Compiling a glossary of terms and concepts for each topic by the biology teacher and using it during lessons increases students' interest in the subject.

For example, the set of terms and concepts for the first topic of the 7th-grade biology course looks as follows:

Topic: 1.1 BIOLOGY — THE SCIENCE OF LIFE

№	Term	Origin of the Term	Meaning of the Term
1	Agronomy	Greek *agrós* — field, *nómos* — law	The science that studies the characteristics of growing plants and fungi in agriculture.
2	Atmosphere	Greek *atmós* — vapor, *sfaíra* — sphere	The gaseous envelope of the Earth.
3	Bacteriology	Latin *bacteria*, Greek *vaktírion* — rod	A branch of microbiology that studies bacteria.
4	Bioengineering	Greek *bios* — life, *ingeniare* — to invent, to know, to be skilled	A field of science and technology applying engineering principles to biology and medicine.
5	Biology	Greek *bios* — life, *lógos* — science	The science of life, studying structure, functioning, growth, origin, evolution, and distribution of living organisms on Earth.
6	Biosphere	Greek *bios* — life, *sfaíra* — sphere	The part of the Earth's surface where living organisms exist.

7	Biotechnology	Greek *bios* — life, *téchni* — art, skill, *logos* — science	The discipline that studies the use of living organisms or their systems to solve technological problems and create new organisms through genetic engineering.
8	Biophysics	Greek *bios* — life, *fýsis* — nature	A branch of biology that studies the physical aspects of life at all levels, from molecules and cells to the biosphere.
9	Botany	Greek *botanikós* — related to plants, *botánē* — plant	The biological science that studies plants.
10	Veterinary Science	Latin *veterinarius* — caring for cattle	The science of diagnosing, treating, and preventing diseases in animals and ensuring food safety for humans.

Thus, during the research, we have analyzed and used several methods to increase the efficiency of learning through the use of concepts and terms in biology lessons. Below are some examples:

In this “Concept Mapping” method, students create visual diagrams that show relationships between biological concepts (e.g., classification of invertebrates, organ systems). It helps organize information, shows connections between terms, and improves long-term retention.

In the lesson, after introducing a new topic, ask students to draw a concept map connecting key terms. Can be done individually or in groups.

Digital platforms such as Quizlet, Anki, and Cram allow students to create flashcards containing biological terms, definitions, images, and audio files for pronunciation practice, particularly useful for Latin names. These tools also offer pre-made courses and interactive features that can be adapted to the teacher’s curriculum. Flashcards support active recall, spaced repetition, and self-testing, which are well-established strategies for long-term retention of knowledge. The interactive features enhance engagement and allow students to learn independently or collaboratively. They also help students learn the correct pronunciation of scientific terms, which is essential in biology education. Students can use flashcards for independent practice at home or during class activities. Teachers can incorporate flashcard-based games, quizzes, or matching exercises to make learning interactive. For example, students might compete to correctly match Latin names with organism images in a timed challenge, reinforcing both terminology and concept understanding.

The “PBL” method involves presenting students with real-world problems or scenarios that require the application of biological concepts and terms to solve. This method encourages students to explore, analyze, and integrate information rather than passively receiving knowledge. This approach develops critical thinking, problem-solving skills, and a deeper understanding of terminology. It encourages students to connect concepts across topics and apply them in practical situations, enhancing both conceptual knowledge and scientific reasoning. For instance, students may be presented with a scenario: “A local pond exhibits unusual invertebrate species. Classify them using the correct taxonomic terms and describe their ecological roles.” Students work individually or in groups to research, analyze, and present their solutions, actively using the learned terms in context.

The “Conceptual Discussions and Peer Teaching” method involves students explaining newly learned concepts and terms to their peers in their own words. Peer teaching encourages articulation and clarification of knowledge. Verbalizing concepts enhances memory retention, deepens understanding, and develops communication skills. It also promotes active engagement, critical thinking, and collaboration among students.After a lesson, each student can be assigned a concept or term to teach the group for 2–3 minutes. For example, a student might explain the life cycle of a mollusk, using correct terminology, while classmates ask questions or provide examples.

These methods, when integrated into biology instruction, promote active learning, engagement, and retention of terms and concepts. Combining digital tools (e.g., Quizlet), interactive games, PBL, peer teaching, and multimedia visualizations creates a rich learning environment that accommodates diverse learning styles and enhances long-term mastery of

biological knowledge.

CONCLUSION

The effective use of concepts and terms in biology lessons significantly enhances students' understanding, retention, and application of scientific knowledge. By integrating strategies such as concept mapping, active vocabulary exercises, contextual learning, and interactive discussions, teachers can foster deeper cognitive engagement and critical thinking. Emphasizing precise terminology not only improves scientific literacy but also enables students to connect biological concepts across different topics. Ultimately, the thoughtful incorporation of concepts and terms into teaching methods creates a more efficient, structured, and meaningful learning experience, preparing students to confidently apply their knowledge in both academic and real-world contexts.

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