



THE ROLE OF STEAM APPROACH AND MIND MAPPING METHOD IN TEACHING NATURAL SCIENCES

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Abstract

This article explores the role, advantages, and practical application of the widely implemented STEAM approach and mind mapping methodology in modern education, particularly in teaching natural sciences such as biology. The mind mapping technique enhances students' abilities to visualize information, develop branched thinking, creative reasoning, and logical associations. The STEAM approach (Science, Technology, Engineering, Arts, Mathematics) facilitates the effective acquisition of theoretical knowledge through interactive, practical, and creative activities. The article analyzes how complex biological concepts like cell structure, photosynthesis, and DNA replication can be simplified through mind mapping, and provides examples of teaching methods integrating 3D modeling, AR/VR technologies, and artistic tools. Ultimately, the approach fosters deeper student engagement with science, improves understanding, and promotes independent thinking.

Keywords: STEAM, mind mapping, natural sciences, biology, visual learning, 3D modeling, AR/VR technologies, interactive methods, creative thinking, learning process.

Introduction

As part of innovation, everything today is becoming increasingly oriented toward technology, including the organization of thoughts, brainstorming, and problem-solving. In the past, idea sharing was typically done by quickly jotting down notes



on paper or writing in notebooks. Over the years, these methods have evolved into a digital format of mind mapping, which has proven to be an effective way to generate and develop collaborative ideas through visual maps.

Moreover, this method is also considered an excellent technique for quickly storing or memorizing information. After all, our brain possesses a form of photographic memory, which is why the concept of a mind map was developed. However, many people still wonder: how does a mind map actually work? How does it help people grasp complex concepts? Let us discuss what a mind map is, its deeper meaning, and the advantages and limitations of this mapping technique.

Mind mapping is a method of visually representing concepts, ideas, and facts in the form of a diagram, where the central idea is placed at the center and related sub-concepts branch outwards.

A mind map is essentially an illustration of collected information. In other words, it is a structured arrangement of relevant topics or ideas gathered during the conceptualization of a subject. Furthermore, the benefits of using mind maps are increasingly recognized among students and professionals alike, as it allows them to develop a topic comprehensively before diving into large volumes of data and details through the use of diagrams.

We are confident that you may already have some understanding of this, but let us explain in more detail. Undoubtedly, the term "map" has long been used to refer to visual diagrams, in which authors could manually sketch out their notes as a form of mapping. Additionally, the mind map is an excellent technique for memorizing information networks while solving problems and gaining a holistic understanding of a topic. The following diagram offers insight into when and how to use a mind map effectively.

Mind mapping is a technique for organizing information visually and illustrating the relationships between concepts. In this method, the central idea or theme is placed at the center, with associated sub-concepts branching outwards. This method helps learners effectively structure their thought processes, understand logical connections, and develop creative thinking.

Key Advantages of the Mind Mapping Method:

Quick and easy understanding of information – Since a mind map is visual in nature, it simplifies complex information.



Demonstration of logical relationships – It allows for the visual expression of connections between various topics.

Development of creative thinking – Students can represent a topic in a way that suits their individual imagination.

Faster memorization – With the use of images, colors, and graphical elements, information is retained in the brain for a longer period.

Support for independent learning – Students can study independently using a well-structured mind map.

Application of Mind Mapping in Education

Mind mapping can be used across various disciplines, including natural sciences such as biology, chemistry, and physics.

In biology: Visualizing cell structure, branching out genetic principles, and representing ecosystem components in diagram form.

In chemistry: Classifying types of substances, schematizing chemical reactions, grouping elements in the periodic table.

In physics: Demonstrating energy types and their interrelationships, schematic explanation of mechanics laws, and mapping properties of electromagnetic waves.

Rules for Constructing a Mind Map:

Identify the central topic – The main concept being studied is placed at the center of the map.

Create branches – Various sections are branched out from the core idea.

Use images and colors – Visual elements help reinforce the learning process.

Use keywords and short phrases – Instead of long texts, concise words that reflect key concepts should be used.

Draw interconnections – Links between ideas and sections should be indicated with connecting lines.

Advantages of Mind Mapping in Teaching Natural Sciences:

Simplifies complex concepts

Optimizes students' thought processes

Visualizes connections between topics

Enhances creative and critical thinking

Facilitates easier memorization of material



Application of Mind Mapping in Biology:

Cell structure – Showing the relationship between organelles and their functions

Genetics – Visualizing processes like DNA replication, heredity, and mutation

Ecology – Illustrating food chains and energy cycles within ecosystems

Physiology – Mapping interactions among human organ systems

Organizing Natural Science Lessons Using Mind Mapping:

Lesson stages:

Identify the central topic

Select the main concepts

Reflect the connections between them on the map

Visualize clearly using graphic elements and colors

Facilitate discussion with students and draw conclusions

Experiments and Practical Examples

At the end of the lesson, students are instructed to create a mind map based on the topics covered.

Interactive maps are created using digital mind mapping tools such as XMind, Mind Meister, and Coggle.

Biological models and experiments are visually presented in connection with the STEAM approach.

The STEAM approach (Science, Technology, Engineering, Arts, Mathematics) is considered an effective method not only for delivering theoretical knowledge in biology but also for fostering students' scientific and creative thinking. This approach enables students to visualize biological processes, helping them internalize complex concepts more deeply.

Advantages of Teaching Biology through the STEAM Approach

Interactive learning – Students are not just passive listeners but active participants.

Visualization of complex concepts – Biological processes become easier to understand through simple graphics, models, and experiments.

Development of creative thinking – Biology is explained through drawing, 3D modeling, and the creation of physical models.

Practical orientation – Real-life biological problems are explored through hands-on experiments.



Creation of Biological Models and Visual Presentations Based on STEAM

A) Science – Studying Biological Processes

Use of 3D models to study cell structures

Explaining the photosynthesis process in plants using mind maps and infographics

Illustrating evolutionary processes using visual diagrams and schemes

B) Technology – Digital Models and Virtual Laboratories

Using AR/VR Technologies:

Students can explore cells, organs, and ecosystems through virtual reality (VR).

Biological processes are demonstrated in real-time using Augmented Reality (AR) applications.

Digital presentations and animations:

Biological processes are presented visually using tools like PowerPoint, Prezi, and Canva.

Interactive biological simulations are created using programming languages such as Scratch or Python.

C) Engineering – Modeling Biological Systems

Modeling cell structure through 3D printing:

Students can print biological cells using a 3D printer to study their structure in detail.

Creating miniature ecosystems that simulate ecological dynamics:

For example, studying the dynamics of closed ecosystems using terrariums.

D) Arts – Visual Interpretation of Biological Processes

Drawing infographics and diagrams for biological sciences:

For example, illustrating the circulatory system or DNA replication through artwork.

STEAM creative projects:

Reconstructing ancient animals

Depicting the morphological structure of plants through artistic tools

E) Mathematics – Analyzing Biological Processes

Genetic calculations and statistical analysis:



Studying Mendel’s laws using mathematical models

Modeling population dynamics and ecological environments:

For example, analyzing changes in organism populations in forest or river ecosystems

STEAM-Based Experiments in Biology Lessons

Experiment Title	Objective of the Experiment	STEAM Component	Tools and Resources Used
Modeling the Process of Photosynthesis	To explain how plants absorb light energy	Science + Technology	Smartphone applications, sensors
Creating a 3D Model of a Cell	To study the structure and function of cell organelles	Engineering + Arts	3D printer, clay or plasticine
DNA Extraction	To obtain and visualize DNA in physical form	Science	Chemical reagents, laboratory equipment
Building a Mini-Ecosystem (Terrarium)	To understand the stability and function of ecosystems	Engineering + Science	Glass container, soil, plants
Creating a Food Chain Mind Map	To visualize food relationships among organisms	Arts + Mathematics	Canva, MindMeister

Visual Presentation of the STEAM Approach Through Digital Mind Mapping Applications

XMind, MindMeister, Coggle – Used for visual mapping of biological processes

Google Jamboard, Miro – Online platforms for interactive presentations and discussions

Sketchbook, Procreate – Tools for creating biological structures through digital art

Conclusion The STEAM educational approach enhances students’ engagement in biology lessons by facilitating visualization of concepts and improving knowledge acquisition through hands-on activities. By integrating mind mapping, 3D modeling, AR/VR technologies, and interactive experiments, the effectiveness of teaching natural sciences can be significantly increased.

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