Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 2, 2021, Pages. 633 - 642
Received 20 January 2021; Accepted 08 February 2021.

The Role of "Imagination" in the Process of "Creative Thinking" Developing Students' "Imagination" and "Creative Thinking" Skills in Teaching Physics

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Abstract: The article discusses the necessity of professionals with "creative thinking" skills and the dependence of "imagination" and "creative thinking. The role of "Imagination" in psychology, its mechanism of formation in the human brain and its scientific perception of food are discussed.

The possibilities of developing "imagination" were explored. Students are recommended to use the Mind Map as a productive way to develop their "imagination" and therefore "creative thinking" skills. For this purpose, "the mind map of the imagination" was given. The importance of the role of "imagination" in the study of natural sciences, especially physics, and the use of mind maps in the study of these sciences can be an effective way to develop students' "imagination" and "creative thinking" skills is shown.

The article discusses the "Mind Map of the First Law of Thermodynamics" and its role in the study of physical processes, as well as in the formation of "creative thinking" skills in students. This is the first time that Mind Maps have been published.

Key words: Imagination, creative thinking, mind, developing, sensor channels, mind map, natural sciences, physics, thermodynamics, quantity of energy, internal energy, work, pressure, size, mass.

Introduction

The rapid development of science and technology requires new areas of production, and educational institutions need training qualified specialists in these areas. These specialists:

- Being able to define the most important information through the huge data flow and gain the relevant knowledge;
- Being able to use existing knowledge in new situations;

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- They should be able to find solutions of problems and implement them in production.

Those who meet such requirements are called “creative thinkers”. [1]
Creative thinking is taught in educational process. [2]

Teaching “creative thinking” to students begins with developing their “imagination”. LS Vygotsky said that no creative product can be without imagination. [3]
It begs the question of what the imagination is and how to develop it.

Concepts about the imagination

Imagination is a special form of the human psyche that is in a state between perception, thinking, and memory, and which is different from other mental processes.

It is a special feature that belongs to only humanity that until now there are no clear points about in which part of the brain it is. In spite of these facts with the help of it people can create, compose, plan their acts and control it. It gives the opportunity of leaving current state and travel to history or future. Imagination is the basis of figurative thinking, which allows a person to solve a problem without practical action. Its difference from perception is that the images under consideration are not always compatible with real images, but also with elements of fantasy [4]. As A. Einstein's said, logic can take us from point A to point But imagination can take us anywhere.

Imagination is proof that the human brain is the most advanced computer. And the computer brain has "electronic literature" about a lot of things. No wonder these "e-books" are written in our computer brains by genes. Our life experiences and knowledge awaken and activate these "dormant" e-books. When we call this "electronic data", the events pass by our eyes. An inner voice describes events, and only we can record on paper what we hear and see. Every artist describes a scene in its own way. Because the scene affects them differently. Similarly, the “electronic details” in the brain of different individuals of the same process is also different. Thinking hard about a problem, looking for something new, can activate new "information" that was previously unknown to anyone. This is called "creative thinking." These data can be proven in experiments and turned into "scientific discoveries". The famous intellectual experiments of Einstein and Bohr are a good example of this. These experiments were performed "in the computer brain", their "electronic versions" were activated and only then tested in practice. The brain can think more about the information that is activated, draw conclusions, and then it goes into long-term memory and becomes "knowledge." As a result, this information creates a template in the brain. Subsequent information is compared with this template, and similarities and differences are noted and converted into new knowledge. The imagination divides and

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reconstructs the object until it finds the necessary "electronic information", which predicts the result of creation. In other words, it supports creating things and events that did not exist before [5].

Methods of developing imagination.

Imagination not only helps a person to acquire new knowledge using existing knowledge, but also to transfer knowledge from one field to another and use its conclusions to solve new problems. Elements of thinking in the imagination and imagination in thinking complete each other [6].

According to A. Einstein imagination is more important than knowledge. Knowledge is limited, and ‘imagination’ encompasses the whole universe, creating development.

There is a strong connection between 'creative thinking' and imagination. Therefore, to improve "creative thinking", it is recommended to engage in painting, for example, to imagine and draw the following processes:

- Imagine the water in the pot and how it boils;
- Imagine an airplane flying;
- Imagine an elderly person turning into young;
- Imagine a moving car turning into a ball and vice versa and so on;

You can make the child draw a picture to determine the nature and imagination of the child, and look at the picture to assess how the child perceives the environment.

V.A. Sukhomlinsky said, "Children must live in a world of beauty, construction, fairy tales, music, painting, fantasy, and creativity." [7].

Dreams also develop imagination and thinking skills. If a person is thinking about a problem at night, the "subconscious" can show the solution to the problem. There have been cases of "sudden birth" of such ideas for creative people. For example, the explanation of Brownian motion, Mendeleev's discovery of the periodic table of elements, is an example of this.

"Fantasy" plays an important role in the development of imagination. In general, "fantasy" is an indicator of the high level of development of the imagination.

There is a watermelon in front of you. Imagine it as a huge planet. Tell us about life and what is going on in it. Draw a picture.

There are many ways to stimulate and develop the ability to "imagine". For example, Robert McKim, a professor at Stanford University, invites students to the Imaginarium to develop their imagination [8]. This room is like a Planitarium. The bodies are arranged like the wheels of a big wheel, and the heads are placed on one large pillow. Close your eyes, listen to light music and dream. A fantastic journey towards the sky, the moon and the stars. The travel theme can be

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chosen differently. A trip to Venus, a - a trip to the centaur, a trip to an unknown planet, and so on. Students can then be asked to tell a story about their journey or to write an essay or draw a picture of what they have “imagined”. In this way, students can develop their "imagination" and "creative thinking" skills. Being in this room makes students feel free to dream and they live a "creative life". They are empowered to the fullest. As a result, in a typical education system, students with limited "imagination" are more likely to gain confidence and "permission" to "create" once they are in the "imagination room." That is, "free dreams" inspire them. In educational institutions, it is advisable to create such a "room of imagination." It is also possible to use the method of training the sensory channels to develop "imagination". Because it gives perception to the imagination.

- Seeing” - look at something in the room." Take a fresh look at it. Pay attention to the shape and parts. Find something new in it. Tell about it. Draw a picture.
- Hearing - hear a sound. Imagine where it is coming from. Tell about it. Draw a picture of the sound source.
- Smell - there is a smell in the room. Imagine the source of the smell and draw a picture of it. Smell has the ability to enliven the imagination. This is due to the fact that olfactory signals are analyzed in the part of the brain that forms emotions and motivations.
- Taste - determine the taste of candy in your mouth. What's in it. Imagine the sources and draw a picture.
- Feeling - close your eyes and put your finger on your other hand. Tell us what you are feeling and draw a picture. Also, try putting your finger on your friend's hand.

Results and discussion.

Mind maps are one of the most productive ways to develop students' imagination and creative thinking skills [9-11]. Creating a mind map allows students to develop "creative thinking" skills, to come up with new ideas, to concentrate, to identify the essence of the problem and to express verbal information visually. The result is a generalization of the processes of "logical" and "creative thinking", that is, the process of "complete thinking". In other words, there is a joint activation of the left hemisphere of the brain responsible for “logical thinking” and the right hemisphere of the brain responsible for “magical thinking” [10]. The result is a generalization of the processes of "logical" and "creative thinking", that is, the process of "complete thinking". In other words, there is a joint activation of the left hemisphere of the brain responsible for “logical thinking” and the right hemisphere of the brain responsible for “creative thinking” [10]. This ability of the mind map has led to increased attention to it in the 21st century

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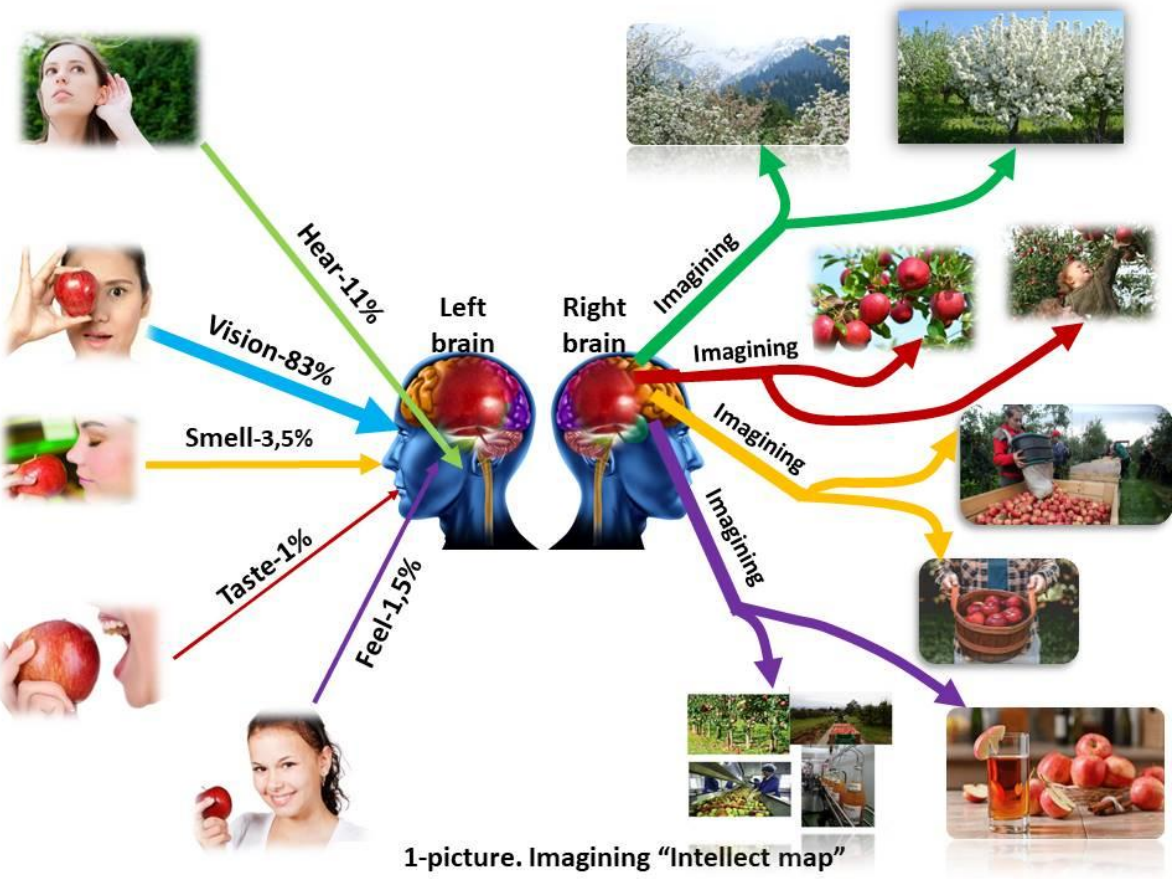
of globalization and making it an ideal method of teaching "creative thinking" [13-14].

Mind map:

- Clarifies the problem;
- Organizes the information needed to solve the problem;
- Helps imagine fully and describe the situation;
- Becomes a means of storing all the necessary information;
- Encourages unusual solutions.



1-picture. Imagining "Intellect map"

As mentioned, the "imagination" perceives information. Based on the information received about the apple through the sensory channels, an image of an "apple" is formed in the brain. As a result, in the right hemisphere of the brain can be formed different perceptions of apples:

- Flowering apple trees;
- Red, pink and blue apples in baskets. These are apple orchards;
- Plates of red, pink and blue apples on decorated tables;
- Different apple juices and children drinking them.

This mind map captures information from sensory channels and then generates various images in the right hemisphere of the brain.

On the one hand, it reflects the mechanism of imagination, and on the other hand, it describes the

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birth of "imagination". Asking students to continue to “imagine” and draw a picture will help them develop their “imagination” and “creative thinking” skills.

These skills give rise to similar "imaginations". Students may be asked to create an imaginative "intelligence map" of "roses," "tulips," "watermelons," and other topics. If the topics are related to folk games, folk tales, sports games, the result will be more productive. The relevance of topics to modern science and technology: airplanes, spaceships, robots, etc., can lead to students combining “creative thinking” with “fantasy” and perhaps even the formation of elements of real practical “creation”.

The ability to “imagine” is important in understanding physical processes. The study of the natural sciences is unimaginable. This is especially important for processes that cannot be seen with the naked eye, that is, "indirectly" studied. At the same time, the study of such processes allows students to develop the skills of "imagination" and, consequently, "creative thinking". This includes textbooks for students of 10th, 11th grades of secondary education and secondary special, vocational education institutions - "Thermodynamics", "Electrodynamics", "Atomic and Nuclear Physics". The physical processes studied in the sciences are a good example [15,16]. So far, mind maps have not been widely used to study these topics. Although the "radioactivity" mind map has been developed, it is not enough for physics [17].

Below we analyze the topic "I-law of thermodynamics" using the "mind map". This law represents the "law of conservation and circulation of energy" in thermodynamic processes:

The first law of thermodynamics states: In a process without transfer of matter, the change in internal energy, ΔU, of a thermodynamic system is equal to the energy gained as heat, Q, less the thermodynamic work, W, done by the system on its surroundings.

$$Q = \Delta \cup + A.$$

Q denotes the quantity of energy supplied to the system as heat. The quantity of heat and work is not a manifestation of energy, but a form of its transmission, which is manifested only in the processes of energy transfer. Therefore, in order to fully represent the thermodynamic processes that take place, it is expedient to take the change in "internal energy" as the central image of the mind map.

Q is positive if heat is supplied to the system, and Q is negative if heat is supplied to the system. Also, work A is positive if the system is working against external forces, and work A is negative if external forces are working on the system.

Let's imagine a heated kettle to imagine what's going on. In this case, we assume that the kettle does not exchange heat with the environment and that the quantity of heat Q given is given only to the water in the kettle.

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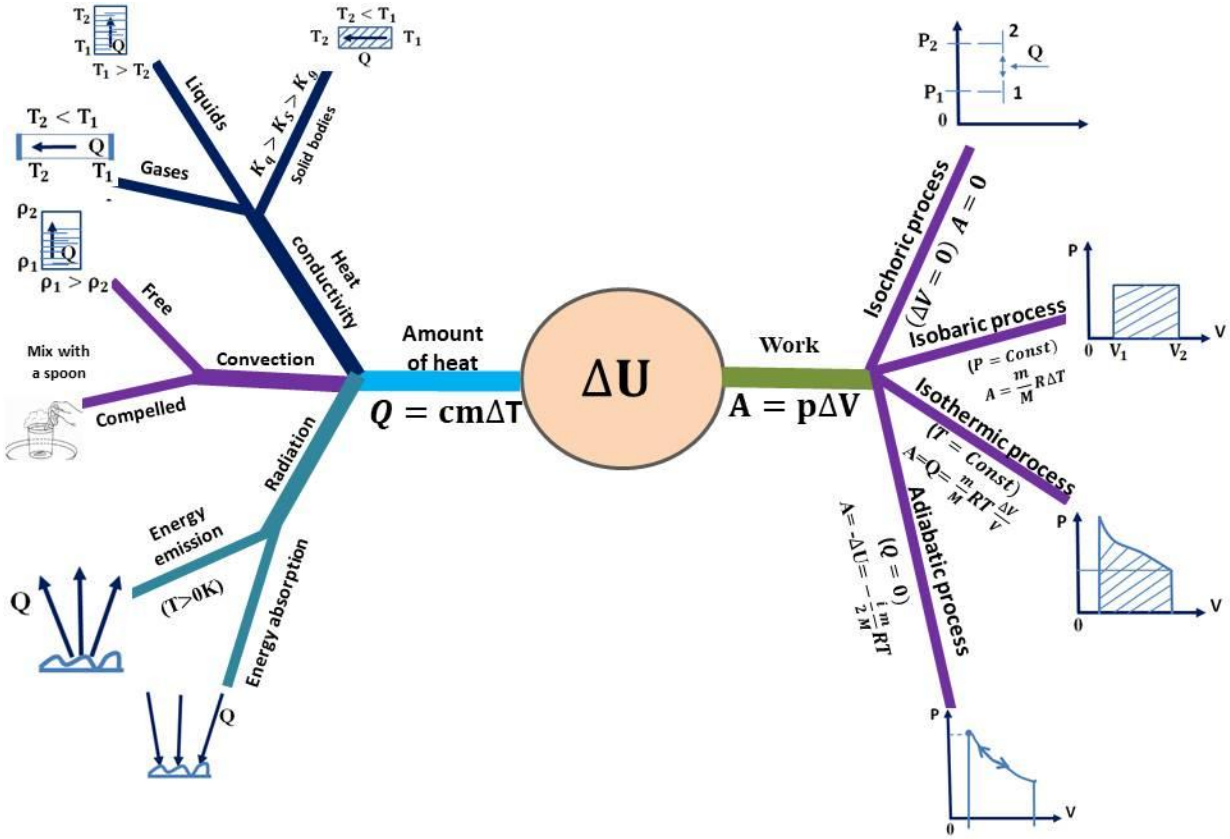
This means that the quantity of heat transferred Q is the change in the internal energy of the water ΔU and the water vapor is used for work A against the external forces (weight of the lid) when the kettle lid is lifted.



2-picture. The first law of Thermodynamics "Mind map"

Intellect map: T-temperature, p-pressure, v-volume, m-mass, M-molar mass, c-specific heat capacity, R-universal gas constant, k-thermal conductivity, i-molecule freedom shows.

The mind map contains the following information: the internal energy of a system can change as a result of giving (or receiving) heat to it and acting against external forces (or acting on external forces).

Give (or take) the amount of heat Q = cmΔT in the system:

- Thermal conductivity (Kq> Ks> Kq) is good in solids, bad in gases;
- Convection (free or forced);
- Light exchange occurs through energy radiated (T> OK) or absorbed;
- A = PΔV operation of the system (or vice versa);
- In the isochoric process (V = const) A = 0;
- In the isobaric process (P = const): A = m / M RΔT;
- In an isothermal process (T = const): A = Q = m / M RT ΔV / V;
- In the adiabatic process (Q = 0) A = -ΔU = -1 / 2 m / M RT can occur;

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This mind map allows you to clearly visualize the problem under consideration in the first law of thermodynamics, to place and visualize the processes necessary to explain it, and to store all the information in order. The mind map not only helps students visualize the processes involved in the law, but it also helps them develop their imaginative skills.

In turn this helps them to create "mind maps" for similar problems and, consequently, to develop "creative thinking skills" with the help of the ideas formed in them.

In addition, the mind can ask many questions that encourage students to visualize the processes shown on the map: - How do you explain that the thermal conductivity of solids is better than that of liquids and gases?

- Give examples of free and forced convections.
- When does the system radiate heat, when does it absorb?
- Give examples of isothermal processes and so on.

The best solution is to break your fears or problems into a series of smaller steps that you can work on. But to do this, we recommend that you learn how to solve the problem in a simpler way, that is, using "mind maps" to solve problems that are considered in special cases. For example, how much work does 1 kg of nitrogen do when heated to 1 K isobaric? [18]

This approach will also help them develop the skills to apply their knowledge in practice in the future. Achieving computer-generated "mind maps" not only develops students' "creative thinking" skills, but also increases their knowledge in the field of information technology.

Teaching physical processes using "animated mind maps" would greatly contribute to the development of students' "imagination" and therefore "creative thinking" skills. Undoubtedly, "Animated Mind Maps" will soon become the most productive method of teaching science.

Conclusion

- The rapid development of science and technology requires the training of "creative thinkers". The teaching of creative thinking takes place in the process of education and begins with the development of "imagination"
- There are many "electronic books" that lie dormant in the computer brain, and life experiences and knowledge activate them. As a result, they are recorded on white paper with only the inner voice we hear. Activating new information that is not known to anyone is called "creative thinking."
- Imagination not only helps a person to acquire new knowledge using existing knowledge, but also to transfer knowledge from one field to another and use its conclusions to solve new problems.

- Intellect gives food to the imagination. It is on the basis of the perceived information that the "image" of the image and the events connected with it is formed.
- The use of the Mind Map is recommended as a productive way to develop students' 'imagination' and 'creative thinking' skills.
- For the first time, the article presents an “Image of Imagination” and explains its importance in understanding the process of imagination and in developing students ’“ imagination ”and“ creative thinking ”skills. Students are also given tasks to create an "imaginary mind map" independently.
- The difficulty of understanding the processes studied indirectly in the natural sciences, especially physics, without the "imagination" has been shown to be important in the development of students' "imagination" and hence "creative thinking" skills in the teaching of these sciences.
- The article first published the "Intelligence Map of the First Law of Thermodynamics" and showed how to "form an idea" about the physical processes that take place. To develop this understanding, it is recommended to analyze the processes using different questions.
- It is recommended to create "Mind maps" for issues related to thermodynamic processes to develop students' "creative thinking" skills.
- Creating "Mind Maps" with the help of computer programs will allow students not only to develop "creative thinking" skills, but also to master programming.
- "We are confident that the upcoming Animation Mind Maps will be the most productive way to study the natural sciences."

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