

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE

HOW TO STUDY AND NOT FORGET PRINCIPLES OF BRAIN-COMPATIBLE LEARNING

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HOW TO STUDY AND NOT FORGET - Principles of brain-compatible learning

University textbook

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PREFACE

Do the best students devote most of their time to studying? Do the best students have a talent for studying? Or do the best students know how to study effectively, how to make the best use of their brains and memory? It is also good to have instructions, theoretical background, and practical preparation for studying. The title of the book "How to study and not forget" is intended to catch your attention and entice you to learn how to make studying easier and how to study better with the help of simple tips and methods. After an introductory theoretical background, you will learn how to approach studying so that you study effectively, learn more, understand the study material and at the same time do not waste too much time studying. You will learn how to study in college, respective techniques that will speed up and make the whole learning process faster. Mastering these methods will cost you a certain amount of time, but it will pay off many times over in the form of saved time, which you would otherwise have to spend studying. Studying a lot and studying hard is not the same as studying effectively. The goal of effective studying is to study less, but to learn more.

This short book will reveal to you the principles of effective studying that are scientifically proven, it will teach you how to absorb a lot of information, understand and remember complex contexts, how to retain knowledge, how to concentrate, how not to waste time, but also how not to stress before a test or an exam and many other practical tips. Each of us is different, so it makes sense to try out for yourself and find out what is right for you. The book alone cannot change your study habits, you have to find a suitable study approach by yourself. It will take a lot of patience, but the results will pay off. By mastering the simple principles of brain-compatible learning, you will be able to study effectively. You will learn as much as possible with maximum retention and minimum likelihood of forgetting in the shortest possible time. You will learn how memory works and what is natural for the brain. You will learn to use Pareto principle, discover your creativity, imagination, sense of humour, and the power of concentration.

The book can also serve as a theoretical basis, but mainly as a practical tool for mastering university studies. Our goal was to create a well-balanced book designed especially for first-year university students, which will help them to overcome the sometimes difficult transition from high school to university system of study. The book can be an interesting and useful resource for senior students as well as for everyone in need of lifelong learning.

Authors

Note: For the sake of simplicity and better understanding, we state in the book that the brain is learning in you or that you use the brain for learning. We accept the possibility that the brain may have different attitudes to learning and it may want or may not want to learn, or that it may think of something.

1. JOHN AMOS COMENIUS

John Amos Comenius (Iohannes Amos Comenius, 1592 – 1670) is a significant figure in the field of pedagogy, education, and philosophy. This creator of new pedagogy, writer, theologian, and philosopher is known for his statements: Repetition is the mother of education and Learning through play.

Comenius's basic pedagogical views:

- the need to get to know the world, science, technology, crafts,
- the need to know oneself,
- the need to know God and God's principles,
- the need for demonstration - direct experience enables better memorization of the study material,
- the need for systematicity and consistency - the content of a course needs to be consistent as well as it needs to be consistent with the contents of the other courses.
- the need for activity - application of acquired knowledge in practice,
- the need for permanence - continuous repetition of the study material,
- the need for adequacy - the teacher must take into consideration the age and individual abilities of the children.

Comenius rejected corporal punishment for not being prepared for the class but expressed his possible acceptance of it for breaking the discipline rules that came first. The children's attention should have been enhanced by more varied teaching styles and an interesting approach to the interpretation of the study material.

He highly appreciated the importance of a child's upbringing. The teacher was supposed to help children to acquire:

- sciences education, arts education, craft education and thereby learn to know themselves and the world around them,
- moral education that enables development of self-discipline and self-control,
- religious education that leads them to the personal knowledge of God.

Comenius also preached revolutionary changes in the school organization. He defined the concept of school week, school year and school holidays. He believed that parents should be committed to the upbringing of children up to 6 years of age and set good examples for their children. In **elementary school**, children between the ages 6 and 12 learn to read, write, count, sing, they learn religion, handicraft and realities of nature and society. Boys and girls up to the age of twelve attend the school that is common for both. The first two-hour set of classes takes place in the morning and the second in the afternoon. Young people between the ages of 12 and 18 attend **gymnasia**, the Latin school that complements education by pursuing seven liberal arts (grammar, rhetoric, dialectics, arithmetic, geometry, astronomy and music) and by pursuing natural sciences, geography, history, mathematics and languages. Young people from the age of 18 to 24 study at the **academy**, a university where they learn catechism, law, and medicine. After completing the education, one should travel - **apodemia**.

At the same time, Comenius emphasized that education never ends, and it is necessary to continue learning throughout one's entire life.

Thoughts of John Amos Comenius:

- he rejected the old methods of learning by memorization,
- schools should be transformed into workshops of wisdom and humanity,
- students and teachers should enjoy going to school,
- a school should be accessible to all (the poor and women) and it should be for free,
- reduction of the number of pupils in the classrooms (it used to be from 80 to 100 pupils per classroom),
- there should be educational and training classes,
- a student has to gain a lot of knowledge within a number of different disciplines,
- he emphasized the necessity to develop sensory abilities,
- when studying, use demonstrations, start with simple and continue with more complex matters,
- use pictures for demonstration purposes,
- teach in the mother tongue,
- know universal languages - Latin and German,
- take age into consideration when educating children,
- the importance of preschool education,
- education is the gateway to knowledge and knowledge should be a means of correcting the world,
- the total correction of the world must be based on the correction of the individual,
- the improvement of humanity starts with investment in education from the youngest age,
- applying educational activity can help to confront ignorance and the evil that stems from it,
- he placed emphasis on the individual's freedom,
- pedagogy and didactics are the ways of getting to know the world,
- the basic didactic requirement is that education should follow children's natural rate of mental development,
- let all things flow freely, let violence in all things be absent,
- the basis of education is religious teaching - the Bible is the source of wisdom,
- God is love; He is not: you can do this, and you cannot do that
- he believed in respect for the individual, in their good and educable character, in reason and philosophy,
- his philosophy is **pansophia** - universal wisdom, a comprehensive system of knowledge, harmony of all things,
- he proposed the establishment of an international academy to disseminate new knowledge.

Comenius described all his pedagogical and didactic views and teaching methods in his most important work **Didactica magna** (didactica - the art of teaching). He wrote it in Czech, it was published in Latin and it sets out the teaching principles:

- one has to learn from an early age,
- compulsory school attendance and free of charge,
- demonstration teaching,
- the need to achieve a certain level of education,
- the study material needs to be appropriate to a student's age,

- put everything learned into practice,
- teach from simple to complex wholes,
- the need for constant repetition,
- a student should also be a teacher,
- teaching should be fun.

These principles were revolutionary at the time. Nearly all the current principles of BCL are in accordance with the teachings of John Amos Comenius. He rightly deserves to be called the teacher of nations. Comenius is a revolutionary figure in pedagogy. He has not been forgotten even today. **Comeniology** deals with systematic research on the contribution of Comenius to world culture by conducting a scientific study of Comenius's life, activities, works and his life's work. He tested practically all his projects. [His principles of teaching are followed to this day.](#) Sometimes it seems that pedagogy has not discovered anything as revolutionary as Comenius.

If Comenius were alive today, he would certainly have noticed the paradox of universities: the most important figures in education have obtained academic degrees for scientific work and usually have no pedagogical education. Every graduate of the faculty of medicine is required to write a diploma thesis while only a fraction of the graduates will be devoted to science or research in their career.

John Amos Comenius - quotes:

- Becoming a human is fundamentally influenced by upbringing.
- If one is to become a human, one has to acquire education.
- A school without discipline is like a mill without water.
- Not only children of the rich or powerful should be sent to school, but all children, boys and girls, highborn and lowborn, rich and poor in all towns and villages.
- [Repetition of significant things is the key to memory and its storage.](#)
- The school of life does not know the holidays.
- [Let us search for a way for teachers to teach less and pupils to understand more.](#)
- The only teacher worthy of the name is the one who awakens the spirit of free thought and helps to develop a sense of personal responsibility.
- [Do not believe everything that is presented to you. Explore and see for yourself.](#)
- [What was good yesterday is no longer enough today and what meets our demands today will not be sufficient tomorrow.](#)
- Good books, if they are really well written and wise, cultivate the spirit and refine judgment. They are the ointment for the eyes, the funnel of wisdom, the mirror of other people's thoughts and deeds that then become our own guide.
- Not loving books means not loving wisdom. However, not loving wisdom means becoming a fool.
- Whoever wants to become educated must value books above gold.
- With the help of books, many become learned outside of school. Without books, no one becomes learned even if they attend school.
- The wise have always considered forgetting the wrongs they have suffered to be the safest path.
- The truth has an invincible power if it is armed with the light of knowledge.

- The wise man is the one who possess not only knowledge but also moral values, the one who can live properly.
- The art of ruling is not based on strength or caution but on wisdom.
- Only the one who has experienced servitude can rule well.
- **The basis of health and happiness is moderation in all things:** in food, drinking and other bodily pleasures. This is the secret of longevity.
- **It all depends on a good start.**
- What the eye does not see, the heart does not grieve over.
- Man plans, and God changes.
- Every job requires a whole person.
- The one who is satisfied with what they have will never be poor; but the one who has never enough of what they have will never be rich.
- There is nothing more important in life than time. Time wasted is life wasted.
- Lend your money and lose your friend.
- No one is born for himself. Everyone is born for human society and those who do not contribute to the society according to their strength, turn out to be unworthy of being helped by others. The principle of all principles is human nature. Everything that contradicts human nature is unhealthy.
- The first and foremost goal of all of us should be the happiness of the human race.
- All people should be educated to cultivate humanity.
- What can we do better than seek peace, truth, and life!
- Let all things flow freely, let violence in all things be absent.
- We are all citizens of one world, we are all of one blood. To hate a man because he was born in another country, because he speaks a different language, or because he takes a different view on this subject or that, is a great folly.

2. EFFECTIVE LEARNING

Learning, studying can be defined as an effort to improve the current level of knowledge. Successful learning depends on its effectiveness and intensity of concentration, not on the amount of time spent studying. Effective studying synthesizes the latest knowledge about brain activity into simple ways of learning. It is based on strengthening the ability to remember and building long-term knowledge. It is also called brain-compatible learning (BCL) and it uses the principles of brain function to demonstrate [how to learn more quickly while making the studying process more interesting](#). The goal is that the information gained through studying would not be forgotten easily, If you know how to store knowledge correctly and repeat it at the right time, you can remember it throughout your whole life. The process of storing information in memory is an integral part of life and it is also a prerequisite for any kind of learning. After all, our whole life is based on memory and on memories, because the present moment passes quickly and only memories remain.

If you do not know how to study, it makes your student life very difficult. In some cases, a person spends 20 years of his life studying. Mastering the methods of effective and fast learning will save you a lot of time and effort. [These methods can be learned by almost everyone](#). You should not waste time on learning techniques that do not work. Many students even study a few hours in the row, but they still remember little. The mistake is in the way of learning. If you are smarter than your friend, but if he knows how to learn, he will achieve better results. Conversely, if you are less smart than he is, applying the right learning methods will give you better results.

Sadly, at schools, students have almost never (or never) been taught what is the proper approach to learning. The learning practices that are used are deeply rooted, but inefficient. Often, they do not bring the expected results and on the top of that they make the learning process boring; if you apply wrong learning techniques, you waste a lot of time on studying. Basically, all you have to do is learn effective principles which will enable you to concentrate better. The actual studying process will take you less time, which you can then use to do whatever else you wish. You can learn up to 4 times faster. Effective learning is for those who want to work on themselves, because it will not happen immediately. Try new methods, follow them a few times and only then can you see real results. [Effective learning is not only about techniques that facilitate learning, but it also includes everything that helps to make studying successful - plan your study time, divide the study material into individual portions, know how to motivate yourself to study, concentrate well, attend lectures and seminars, take notes, repeat, avoid stress, have enough sleep and exercise](#).

BCL methods combine the latest knowledge about brain activity with the learning process. BCL is a new approach to teaching and learning. It is slowly becoming more widely known among students and teachers of non-pedagogical specialization at the universities. It is successfully applied in many countries. Singapore is currently the absolute top in education. The country has no natural resources and quality people are the only thing the country can thrive on. Education has therefore become a national priority and 5 times more funds are allocated per capita in comparison with our country. Since 1991, Singapore has changed its curriculum for all subjects, the focus is on the thinking development and on the

ability to solve problems and make the right decisions. They study less, but thoroughly. It is not considered very important to master the school subjects on theoretical level, but more important it is to be able to implement theory into practice in everyday life. Bachelor's degree graduates of any university can become teachers if they were among the students with the best academic results. They become qualified teachers after receiving specialized pedagogical education through one to two-year program. However, teachers without any pedagogical education still teach courses of non-pedagogical specialization at our universities.

BCL is successfully applied in Switzerland, Finland, Germany, Canadian province of Quebec and France. In 2012, the approach flourished especially in France where its application was extended to high schools and it had an impact on the studies of 82% of students. In 2013, the pilot project was successfully applied in universities and it is spontaneously implemented in all study programs. These relatively simple means or forms of learning are not known among our teachers and therefore they are not known among the students either. What is it about? It is about teaching and learning methods that are suitable for all teachers and students who want to learn how to teach/study to maximize knowledge acquisition and knowledge retention rates. The goal is to enable students to draw on the knowledge throughout the studies and subsequent practice.

The expected consequence of the application of these methods is increasing the students' knowledge retention level, e.g. at the Faculty of Medicine, knowledge of anatomy is a prerequisite for the successful completion of the anatomy exam. Knowledge of anatomy is essential for the study of clinical subjects. Knowledge of clinical subjects leads to successful completion of the university study and it is important for future employment in clinical field. BCL methods can be used by students throughout their studies, and in postgraduate and lifelong learning.

BCL is an interdisciplinary approach based on the knowledge of many disciplines: pedagogy, neurophysiology, psychology, and social sciences. It studies how to use the brain in the pedagogical process to make learning the most effective. BCL does not belong to the medical field, but to pedagogical-didactic field. Its main disciplines are neuropedagogy and neurodidactics. Effective learning is closely linked to traditional teaching methods, which are (up to 90%) still valid and applicable. **BCL strengthens the ability to retain and to store knowledge in long term memory. Moreover, it reduces stress levels.** BCL focuses on the brain activity in the learning process, emphasizes individual differences of the students and thus the development of an individual as well as the importance of motivation and self-improvement.

In BCL, an important role is played by regular and diverse brain stimulation that keeps it on constant alert. Repetition of the study material stimulates the activity of neurons and if the repetition takes place within 24 hours after learning the study material, it leaves a significant mark in the memory. Changes in the way of learning change the physical structure of the brain. These changes in the structure result in changes in the functional organization of the brain. Learning has therefore the ability to reorganize the brain. Learning can be defined as the formation of synapses, and thus the formation of new neural networks or alteration of original neural networks **by the active learning activity of the student**, not by passive listening, rote learning, or memorization. The goal of BCL is to form as many new

connections as possible in the brains of students and at the same time strengthen existing neural networks. The student can progress much more easily and save time by adopting new learning methods.

The basic questions of the cognitive sciences were already explored by ancient philosophers. The main subject in scientific research was the mind. However, at the scientific level, the processes of learning and memory began to be studied by experts only in the last century. At present, it is common to use instrumental examination methods, such as electroencephalography and magnetic resonance imaging, even with the administration of a contrast agent that can reach various parts of the brain. The applied questionnaire demonstrates correlations between an individual's activities and an image of the brain and thereby thought processes are monitored in real time. The image of the brain displays which part of it is activated e.g. at the time when certain thoughts occur. It is possible to determine what is the individual's colour or music preference and it is even possible to measure dopamine levels in the brain. Although the use of brain imaging methods makes it possible to identify the neural correlates of cognitive functions more and more accurately, the old problem still remains. The study of the mind is complicated by the fact that cognition involves subjective experience and therefore the required condition of the individual being an independent observer is not fulfilled.

Attention is the focus and concentration of mental activity on a particular object, or action. The experiences that capture attention are memorized, the others are forgotten. Attention is extremely important for quick learning. The more you can concentrate, the more you can retain. Due to the quantity and complexity of the study material, the university is more demanding than the high school. However, a major difference lies in the approach to learning. It is important to attend lectures and seminars on a regular basis. Revisit your notes and material from the day, edit the notes and try to recall its content without looking at the notes or material. At university, a lot depends on the exam period and the effort invested by the individual. Make sure you begin to prepare for exams well in advance. The worst thing is if you stay up the whole night studying before an exam and then go to take an exam. You do not have to have above-average intelligence to be able to learn successfully. The brain has enormous potential. It contains more than 100 billion neurons. There has not yet been produced a large-capacity computer that has the capacity of the human brain.

- When you enjoy the process of studying, you study more effectively. The brain stores positive experiences and tries to repeat them. You absorb information better when you feel fine.
- There are many types of learning that work for everyone, regardless of age. Once the solid foundation is laid, everyone can personalize their learning strategy.
- It is difficult to cope with the fear of exams. It makes you nervous, deprives you of sleep and limits your ability to think. As uncertainty is a major cause of the fear, it needs to be removed. Relaxation techniques will not be of much help.
- Old habits hold you back. You need to build useful learning habits.
- Never say to yourself: "I cannot do this" or "I will never learn it". Communicate positively with yourself because it affects your mood and therefore your results. Develop a positive mindset. It requires discipline, but it pays off! Never give up. Look at

difficulties as challenges that can be overcome. Everything can be learned. The number of students who have experienced it before you prove it.

- A person learns best from mistakes. It is linked to how the brain learns. The brain learns by making comparisons. **The smartest brain is the one that has processed a lot of experiences and made many mistakes.** Making mistakes should not be a reason for punishment in schools. It should rather be used constructively to help the brain to learn from mistakes.

Example of effective learning:

Memorizing anatomical terms is like learning a foreign language. Both can be done in a fun way. It is effective to engage the imagination and create a mental image when memorizing abstract terms. Every unfamiliar word is initially just a random group of sounds for you. Try to find another word, a similar familiar word, that will serve as a key to unlock the meaning of the new word. Engage creativity, imagination and link the keyword with the new one. The resulting memory image can be remembered easily. The described method is called **the keyword method**. Your keyword means something different than the word you want to remember. It only serves as a temporary memory aid. Once you have remembered a foreign word, you will not need this aid and you will gradually forget about it. Mnemonics is based on this principle. E.g. the word acetabulum (hip socket): imagine how vinegar is being poured over a board, imagine how it looks and smells; and then imagine pouring the vinegar into the hip joint. The more bizarre it is, the better you remember. The keyword method is very effective. It enables a threefold increase in the ability to learn abstract words and remember them even 6 weeks after learning them. It involves creative logic, creating your own images, deceiving the brain, and inventing several crazy absurdities. Engaging your senses has a major impact on learning.

Neuropedagogy and neurodidactics

Neuropedagogy and neurodidactics represent highly topical approaches to the teaching process in the world of education and can be characterized as a new scientific area of pedagogy (science of upbringing and education) and didactics (science of teaching) focused on brain activity. They have already been established and have been receiving due attention for a long period of time in many developed countries of the world and especially in the countries of the European Union. Both approaches are based on the latest knowledge gained in brain research, its ability to learn, in relation to the connection of three basic attributes:

teaching - brain - student

They try to contribute to increasing the efficiency of the educational process at all its levels. They provide a scientific explanation of learning and teaching based on brain function. They aim to gain a deeper understanding of the basic mechanisms of learning as a higher-level biological phenomenon and, on this basis, to propose appropriate teaching methods used by teachers that are in line with the concept of modern education and the learning brain. They increasingly emphasize the importance of the active use of brain activity in teaching, but also in the individual learning as well as in the process of lifelong learning.

Neuropedagogy

Neuropedagogy in Slovakia is currently included in the pedagogy framework as a new developing interdisciplinary field that integrates not only pedagogical but also neuroscientific and psychological knowledge. It takes into consideration the brain in the process of complex education. The theory of the field thus draws on the knowledge of pedagogy, neuroscience, and psychology, which it connects in a coordinated and integrated way and subsequently uses for its established specific cognitive objectives. Individual's cognitive processes are strongly connected with emotional or, in other words, affective processes.

Neuropedagogy has two main objectives, cognitive and practical.

A/ **The cognitive objective** of neuropedagogy is to understand the connections between:

- properties, processes, or laws existing at the level of neural systems or at the level of their individual parts, and
- properties, processes or, more precisely, laws at the level of learners or social groups who are in the process of receiving education.

Neuropedagogy also deals with possible problems of human learning and cognition, looking for suitable mechanisms of certain cognitive, behavioural, or emotional disorders in children and adolescents and the possibility of their compensation. Many disorders of school skills development, such as dyslexia, dysgraphia, dyscalculia, but especially behavioural disorders, mental development disorders (autism) and attention disorders associated with hyperactivity make education, communication, social interaction, and imagination very complicated and difficult. It is therefore important to recognize these disorders in their early stages and to pay due attention to them. Another group of intense interest in neuropedagogy includes the problems of recognizing mechanisms leading to excessive or even pathological creativity of various kinds associated with a higher degree of intelligence, musical or even artistic talent.

B/ **The practical objective** of neuropedagogy is to involve all the senses in the cognitive and learning processes, increase interest in self-education, perform brain exercise by applying more information, sensory preferences and implementation of acquired knowledge in the process of active education. Neuropedagogy represents a progressive path from passive education to its active form and uses knowledge about the structure, function, and integrity of the brain. Its theory is based on the principle of brain activity. The most important role is played by regular and diverse brain stimulation, which keeps it on constant alert. The repetition of the subject matter stimulates the activity of neurons and if it takes place within a few hours up to one day, it leaves a significant memory trace.

Even weaker individuals can make obvious progress in learning as soon as they identify with the idea that their brain is no worse than the brain and perception of their classmates while following the above-mentioned principle of repetition. This theory and form of learning also helps low-performing individuals to effectively overcome the difficulty of learning the subject matter. *If a student wants to be successful, he or she has to properly learn the material in class, focus on its content, think hard and review the study material.*

Biology or, more precisely, neurobiology, evolutionary biology, anatomy, and physiology are the basis for understanding brain activity and the principle of short-term and long-term memory. The cerebral cortex is best stimulated by specific examples. Therefore, it is recommended for the teacher to start every presentation of the topic with specific examples. With respect to brain activity, it is also important for students to know that **it is more advantageous to do homework on the same day it was given to them**. It has long been verified that it is not appropriate or beneficial to start learning the day or rather in the afternoon or evening before the next seminar or, more precisely, practical exercises. Learning to sketch a mind (mental) map and scheme of the subject matter together with concrete examples is a great benefit. It will enable students to learn to synthesize knowledge and learn it more easily. The mind map has its advantages as it contains combinations of the main ideas, keywords and a black and white or colour composition of the image.

Despite many common prejudices from the past saying that human intelligence does not change, current research in neuroscience suggests that although intelligence is genetically determined, we can influence it and thus develop in some way. The brain can learn indefinitely and throughout life thanks to its plasticity. Plasticity is a unique ability of the brain based on the constant creation of new connections between neurons as a result of a living organism's response to new stimuli, discoveries, experiences and the processing of those experiences in order to learn something new and enriching. Newly acquired knowledge is incorporated into long-term memory and the brain changes not only structurally but also biochemically, and intelligence thus grows through learning.

Neuropedagogy seeks to eliminate many stereotypes in our thinking and thereby contribute to effective learning. It combines several fields of study and their specializations such as: neurobiology, neuropsychology, neuroesthetics, neuroethics, neurophilosophy, neurolinguistics, neuromarketing, neurosociology and others. These fields contribute their knowledge to the improvement of the active pedagogical process. What the student remembers from the previous class after a day, week or month is also important. It is especially important to apply neuropedagogy to the teaching of young people at secondary and tertiary education - in gymnasiums and universities. If the teacher has acquired the basic knowledge of the functioning of the human brain, he or she can support the development of intelligence of all students - even those who are described as problematic, less intelligent, and even stupid.

Neurodidactics

The term neurodidactics has been known since the 1980s and represents an interdisciplinary field combining and interconnecting various aspects of the traditional form of teaching from the viewpoint of new perspectives. It uses the related links between knowledge from neurosciences and didactics, as well as the links between psychology and pedagogy in general. The term didactics comes from the ancient Greek word didasko - I teach and represents pedagogical science that deals with teaching and the related areas, the content and scope of education and training, methods, forms and principles of the teaching process and, last but not least, the interaction between teacher and student.

One of the basic objectives of neurodidactics is to define the principles that govern learning based on knowledge of the neural functions of the brain. According to many

authors, neurodidactics is the art of organizing and improving education based on acquired knowledge about the structure and function of the brain, sensory preferences, differences in the cerebral hemispheres, learning style, appropriate response in stressful situations and different types of memory. Neurodidactics has a practical purpose in learning about the truths and learning about the secrets of brain function, leading to the application of this knowledge in education. Looking at the many recommendations based on the theory of brain-compatible learning, it can be stated that neurodidactics is shifting towards autodidacticism (theory of self-education). However, it is a long-term and demanding process which requires organizing the didactic side of the educational process.

Neurodidactics deals with various types of intelligence:

- verbal-linguistic,
- logical-mathematical,
- visual-spatial,
- musical,
- naturalistic,
- interpersonal,
- emotional (intrapersonal),
- social (interpersonal),
- and kinesthetic intelligence.

Each person has a different combination of strengths and weaknesses of intelligence. Therefore, neurodidactics attaches importance to the knowledge of the brain, so that one knows how to properly use it and improve its efficiency, but also so that the teacher knows how to improve students' strengths during teaching - involve all sensory activities in cognitive and learning processes, increase interest in self-education, train the brain e.g. working with more information. Neurodidactics also emphasizes the need for emotionality in teaching, focusing on basal tendencies in brain activity, which can also be described as the interests of the brain or the passions of the brain. The involvement of the body and emotions in learning is also aided by expressive (aesthetic-educational) fields or movement-oriented courses. It is considered desirable to choose a subject matter that the student has a chance to understand: it is interesting, meaningful, encourages curiosity, creative, but also practical and especially motivating, leading to clarification of the meaning of the content.

In the learning process, it is important to ensure the motivational, exposure, fixation and diagnostic role of the educational process as follows:

- motivate, engage, and involve the student in the current course of learning activities in an informal, fun, and enjoyable way,
- to support creation, discovery, and curiosity of the student,
- provide the study material from current and latest study sources,
- consolidate learned knowledge and find out what the student has learned
- eliminate distractions.

To achieve optimal conditions in the teaching process, it is necessary to:

A/ plan and maintain the relationships between the subject matter taught within the grades and the relevant grade:

- vertically - continuity of the subject matter of one specific course in the years of study,
- horizontally - continuity of the subject matter of individual courses in one year of study.

B/ solve common problems of didactics:

- persistence of the traditional transmissive form of teaching,
- information-receptive and reproductive teaching methods,
- excessive amounts of the subject matter,
- predominance of passive memory learning and mechanical reproduction,
- stagnant critical and creative thinking,
- inadequate and often subjective evaluation of students,
- insufficient material equipment such as teaching aids,
- disrespect for relations among courses and their continuity,

In the educational process, it is necessary to focus on the relationship between emotions and stress, on reducing stress by appreciating the positive activities of the student, on the cognitive abilities of the student, on clarifying key and relevant concepts in brain maturation with regard to speech development at various stages of development. It is a new and slowly establishing pedagogical-didactic area and therefore its development and exploration still require further years of research.

Prerequisites for effective learning

Being successful in the studies is the wish of every student. Even if students enter a university with the knowledge that the studies will be difficult, in addition to the amount of course materials and the demands for being an independent learner, they are still surprised by differences in the way of teaching as well as differences in continuous learning. A structure of the timetable has different characteristics - it is less regular, there are gaps in it and as a result, the time spent at university seems to be longer. Although, it might concern only some days and others can be completely free in terms of study obligations. Another difference is the way in which students are tested and ongoingly assessed. Tests or exams take place within larger time intervals, so the student has a feeling of freedom - "I still have time, I will catch up, I still study more effectively when there is an approaching deadline" (in modern terms, the student procrastinates). Ongoing assessment often affects the exam performance and there are criteria (usually a percentage) that must be met; and there is not as much room for retaking exams as in high school. Therefore, not only the exam itself, but the ongoing tests cause significant stress, too.

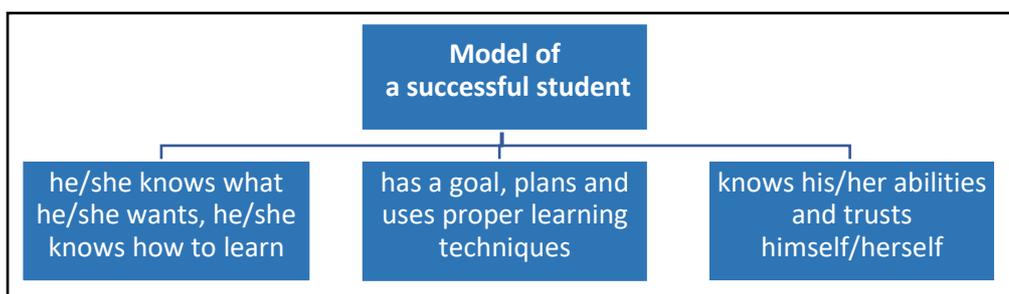


Fig. 1 Model of a successful student

Successful student:

- he/she knows what he/she wants, he/she knows how to learn
- focuses on the learning process and techniques, has a goal and plans,

- he/she trusts himself/herself, he/she knows his/her abilities.

The way of learning is a completely different chapter. There are several elaborated methods and it pays to familiarize yourself with them. For example, one of them is called PQRS Method: P - Preview, Q - Question, R - Read, S - Summarize and T - Test.

Proper learning, optimal learning, the right mental techniques, and effective learning mean discovering the learning style that suits you the best. There is no universal guide, but there are some rules to consider if you start noticing a problem.

You are learning	you actively receive information, you think, you try to understand (active learning)
You are not learning	you are learning by rote, you are listening passively to the presentation of the course material, you are not trying to understand, only to memorize (passive learning)

Tab. 1 Active and passive learning

If you learn without understanding you will forget 60% of the learned information within 2 hours, but if you learn with understanding, you will remember 60% of the learned information for up to 100 days.

Useful information for effective learning

- **When is the best time to learn?**

Mental performance fluctuates during the day. Usually (although it is very individual) the performance curve reaches optimum performance point in the morning around 10:00 am and in the afternoon around 05:00 pm. It is necessary to determine the time that can be dedicated to learning each day. [Learning at the same time each day or at the same time on certain days creates a useful habit.](#)

- **The arrangement of course materials when studying:**

Start studying course material of medium difficulty, continue with a difficult one and end with the easiest one. When you are in the middle of studying process, always focus on the most demanding courses. Do not study course materials of similar nature in a row, because the information you acquire often blend and get mixed up. The brain cannot separate them properly due to their similarity. The course materials that you study as the second in the row while its content is like the content of the first ones, are therefore usually learned much more slowly. It is advisable to alternate written assignments with oral preparation for courses. The principles cannot always be applied in the same way, sometimes timetables of courses do not allow it. Try to follow at least some to avoid the difficulties that come from arranging course materials incorrectly when studying.

- **Knowing your individual personal style**

The way a person learns is called a learning style. These are innate learning practices that are used according to what kind of perception, abilities, and memory a person has. If you know yours learning style, you know which learning methods are most effective for you. This will make it easier to absorb and retain information, and the way of learning will be adjusted to your needs (p. 40).

- **Learning technique**

Consistent learning (learning with understanding) leads to the strongest retention of learned information!
Rote learning (memorizing, learning without understanding) leads to the fastest forgetting.

Scientific findings show that students retain more information by studying the course material that is divided into parts (paragraphs) than by studying the whole content of course material at once. The steepest part of the forgetting curve occurs right after course material is learned. Therefore, after acquiring new information, the repetition must occur immediately. Additional repetitions are most effective after a break. Newly learned information needs a certain settling and laying down in the brain, that is to say, it needs more time for being consolidated and becoming a part of long-term memory (that is why it is important to perform short systematic repetitions). **Extensive forgetting of learned information always occurs after course material is learned but not repeated properly.** It is proven that if you do not repeat the study material, you will forget about 56% of the learned information within one hour. After two hours you will forget about 60% of the learned information. In one day, you will forget almost 70% of the learned information (p. 36).

Forgetting can be prevented by repeating the learned information right after it is learned. The first two repetitions are the most effective, most of which you will retain - but they must be thorough and extensive enough. The third repetition consists in asking questions based on the content of the study material and its individual parts - the aim is to learn to answer questions quickly and to create an overview of the study material. The fourth repetition is effective after a minimum of one hour break because after one hour we forget the most of the learned information; by asking questions we find out what we have retained and what we have forgotten - the repetition is shorter, e.g. 10 minutes. The fifth repetition is the last in the row and serves as a consolidation of previously learned information, which is suitable to do right before going to bed, when the acquired knowledge is stored in the memory system and relevant connections are created within it. Sleep and rest help the brain consolidate learned information.

- **Study breaks**

Breaks are needed when studying. Without them performance slowly declines. As you study, your brain is in an excitement stage (activity), allowing you to focus. If you can no longer stay focused while studying, the brain is in a decline stage (fatigue, overload). An excitement stage constantly alternates with a decline stage. In the decline stage, there is no point continuing to study, because you will learn much less and especially very slowly. At that moment, you need a rest break. After finishing up to a one-hour study session, a break should last from 2 to 5 minutes., after finishing a one-hour study session - from 5 to 10 minutes and after finishing a two-hour study session or a longer one - from 20 to 30 minutes. During the break, the activities you do should be simple. It is optimal to change a position, move, stand up, walk around the room, open the window and air the room for a while - breathing fresh air is refreshing, drink something or eat fruit, do a few back exercises, stretch, listen to a favourite song, talk to loved ones for a while. What not to do during a short from 2 to 10-minute break? It is not recommended to sit at your computer, play computer games, use social media, watch TV, play games on your phone, make phone calls, and send text messages, or go to bed (p. 99).

3. MEMORY, BRAIN, AND LEARNING

Memory is a mental process, the intellectual ability of an organism to receive, store and recapture previous information and experience so that it can be used as needed. Memory is the basis for the thought and conceptual world; it plays an important regulatory function in learning and behaviour. You use memory in everyday situations and work with it throughout your whole life. It is inseparably linked to learning, thinking and it is a basic condition for one's mental development. Philosophers have been dealing with memory for a long time; today it is an interdisciplinary topic. It was Aristotle who found out that memory is based on associations. Ebbinghaus was one of the first to study human memory and forgetfulness.

Brain-compatible learning is not seen as a storehouse of knowledge, but as an intense and constant reconstruction in a mass of information that is stored in various places in the brain and is connected through a neural network. The brain forgets everything that it does not consider necessary and that is not constantly updated. Therefore, it is necessary to systematically revisit the acquired knowledge, work with it and repeat it continuously. When you focus on an object, information about it is processed in the brain. The brain uses memory to find out if it is something new or if it has experienced it before.

Memory is an inevitable condition for learning. It is necessary to know how to retain knowledge in memory and remember it when you need it.

In the process of remembering, the following shall apply:

- the more you focus on what you do not remember, the lower chance of remembering it you have (concentrating on the forgotten things is concentrating on emptiness),
- to remember, it is necessary to give the brain clues,
- peace, quiet and relaxation are very helpful in providing conditions under which your subconscious can help you to remember.

Memory

Memory retention is a complex process that battles with our tendency to forget. The aim of learning is to prevent or slow down forgetting of learned knowledge. Information enters the brain through the senses and settles into a certain type of memory. Every single type of memory serves a particular purpose. You mainly remember what is essential for life.

- **Logical memory:** the brain processes information intended to be learned based on thought operations, logical division and processing takes the form of remembrance. This type of memory is enhanced by sensory perception and experience.
- **Mechanical memory:** connections are formed between elements without a mutual relationship. Information is being retained in memory through multiple repetitions and processing takes the form of reproduction.

Neuroscience distinguishes three types of memory:

- A/ **Ultra-short-term (instantaneous, sensory) memory:** is the fastest memory, it responds to sensory stimuli. The centre is in the hippocampus. The information retained in this type of memory are fleeting, they only last for a few seconds. It processes several visual,

auditory, and emotional stimuli at any given time, but only some of them enter explicit memory.

B/ Short-term (working, operative) memory: The information retained in this type of memory are stored in the hippocampus. It is used for everyday needs to deal with various situations and tasks. You can quickly recall information retained in it, but you will also quickly forget it. The information is kept in it for a maximum of half a minute, then disappears or is transferred to the long-term memory. The capacity of short-term memory is limited because it is constantly necessary to free up space for new perceptions.

C/ Long-term memory: The information retained in this type of memory are stored all over the surface of the cerebral cortex during repetitions, sometimes permanently. If we have something stored in long-term memory, every small impulse can trigger the mechanism that leads to recall of the relevant information. Information is stored in long-term memory gradually, more slowly, but they remain stored for a long time to be used in future; it is good to repeat them at intervals. Long-term memory stores stimuli that the brain evaluates as significant, interesting or with a certain emotional charge, unusual phenomena associated with thoughts and ideas. Paying attention through multiple senses and unusualness are the gates of memory.

In short-term memory, it is possible to store an average of 7 different items at any given time and perceive them as a whole, because explicit memory has a capacity of about 7 memory units that can be memorized at once. If you want to memorize more things or, for example, longer numbers, it is advisable to divide them into smaller groups of numbers (be careful, if you do not repeat it within 30 seconds, you will forget it, but if you retell it out loud, then you will remember it longer). One remembers numbers poorly because the brain does not have a centre for remembering numbers. What one remembers a lot better are pictures, visual perceptions, and vivid images. During the learning process, it is appropriate to divide complex information into simple memorable images and repeat them in a targeted manner.

The names of the people from the vacation are stored in a short-term memory and you will soon forget them. Long-term memory stores the names of classmates that you remember for a lifetime. For the learning process, it is necessary that the information from the short-term memory is transferred to the long-term memory, which occurs especially during sleep. Repetition shifts information from short-term to long-term memory through consolidation processes. The information is stored in the form of a code - visual, auditory, olfactory; acoustic encoding is also important for short-term memory, as the information that was encoded visually is more fleeting. In long-term memory, information is better stored semantically, based on the meaning of words.

Long-term memory includes:

A/ declarative (verbal, conscious, explicit) memory: previously stored information can be intentionally recollected and expressed in words, it stores information in the form in which they were instilled, it can be

- semantic: in the form of verbal encoding, allows you to remember facts and knowledge that are not drawn from personal experience, or

- episodic: in the form of remembering events including their location and time while placing an emphasis on the specifics that are very individual, it allows you to remember past events and stories, it is individually specific.

B/ **non-declarative (non-verbal, unconscious, implicit) memory:** previously stored information cannot be intentionally recollected and expressed in words, it is

- procedural: automatic abilities and skills (cycling, piano),
- emotional: allows you to remember emotional experiences.

Memory and thinking are key prerequisites for one's mental development, personal development and performing purposeful activities. Memory is formed by associations, memories can be evoked, for example, by scents. The part of the brain responsible for spatial orientation and imagination is also involved in the process of remembering. The brain cannot recognize whether it is a fact or just an idea. The ability to ask questions, asking each other questions regarding learned knowledge and discussion help to remember. It is necessary to enhance memories with senses, emotions, and logic so that they are well anchored in memory.

The following factors are involved in the process of using memory:

- associations: connecting new knowledge to the previously acquired knowledge,
- perception by several senses at the same time,
- fantasy and imagination: finding resemblance to something else,
- visualization: formation of a mental image,
- transformation: turning abstract information into something specific,
- logic: looking for logical connections when learning,
- intellectual curiosity: the more knowledge you have, the easier it is to learn new ones,
- concentration: the more focused you are, the better you can remember,
- repetition in a controlled manner,
- selection: do not burden your memory with unnecessary thoughts and information,
- comparison,
- elimination of disturbing influences,
- the importance of positive thinking.

Positive emotions such as joy and curiosity have a positive effect on memory retention. Negative emotions work the other way around, for example, [the fear of forgetting will cause forgetting](#). Psychohygiene and positive autosuggestion are important, in addition to studying, students should also have some interests, hobbies or sports and must not forget to set aside time for them.

Every person is born with an amazing ability to know the world around them. Every child has a great memory until about the first to second grade of elementary school. If the teacher is unable to motivate the pupil, then the pupil will discover that:

- he/she learns unnecessary things
- learning is boring
- he/she does not understand the study material because it was not explained properly,
- he/she does not know how to learn.

He/she loses interest in learning, he/she struggles with learning and forgetting. They learn only to satisfy their parents or teachers, but the real motivation for learning out of curiosity

is lost somewhere. It often reappears at university or not at all (of course, this does not apply to everyone). If people stop learning after they finished their studies and their brains are not regularly stretched, the memory will weaken with age. The capacity of memory and the ability to learn new things decreases. The very process of learning and training one's memory is absent.

Students must know where and how to regain forgotten knowledge, they must take into consideration a necessary factor, such as forgetfulness, when learning. [Information on effective learning and memory should be obtained at the beginning of university studies at the latest.](#) You put great effort into learning, but it is often inefficient and irrational. You forget because you do not repeat what you have learned. The process of remembering, that is, the recall process is more important than learning itself. If you cannot recall the knowledge stored in memory and use it, it is unused, dead.

According to Tepperwein (1992), all people have a universal memory that can be revived using hypnosis. [None of you have a bad memory, you just do not know how to use it properly.](#) "Bad memory" is only the result of insufficient attention, a consequence of incompetence or reluctance to think. Memory and imagination have no boundaries, they work on the principle of associations. Since the language of the subconscious is image, try to imagine everything you learn and combine it with creativity and experience. This will form more association links, which will ensure better and faster future recall. It is advisable to form connections with the previously learned information. Memory recall is best if the learning conditions are the same as the memories (preparation for oral examination needs to be done the same way as the oral examination itself - studying the information out loud). You have to understand what you are learning, otherwise it is almost impossible to remember. Since you all have a good memory, you ONLY need to learn based on the principles of memory and to use all its possibilities and keep your brain in good shape. Memory deteriorates with age only when people do not take care of it or train it.

Tips for a better memory:

- [affirmations](#): say out loud: "I have a fantastic memory, I can remember everything"; it does not matter that you do not believe it, by repeating it your subconscious will consider it as the truth (p. 103),
- [rest and regular sleep schedule](#): necessary for storing information in long-term memory, fatigue reduces the ability to concentrate, so you must not forget to relax (p. 47),
- [memory training](#): watching knowledge competitions, puzzlers, riddles, crossword puzzles, sudoku, pexeso or pairs, chess, and others (p. 76),
- [learning foreign languages](#): one of the best and useful ways to improve memory in the long run (p. 77),
- [positive thinking](#), optimism, and emotions: information associated with strong emotions is better remembered; stress and fear block remembering and retrieving information (p. 106),
- [maintaining a healthy diet](#): not only when studying, you will have not only good physical health but also a good memory (p. 80),
- [exercising](#): physical activity increases blood flow to the brain, memory retention is improved (p. 71),
- [repetition](#) in a controlled manner (p. 37),

- **diaries, reminders:** relieving yourself of things you would otherwise have to think about (p. 93),
- **recalling memories:** from childhood, dreams, activities you have done during the day before you go to bed (p. 78).

Memory processes

- A/ reception of information by receptors,
- B/ information processing, information encoding (instillment),
- C/ storage of information (retention, storage),
- D/ retrieval of information (reproduction) or reconnaissance (recognition),
- E/ forgetting

A/ Receipt of information

Not all the information you perceive are processed. The brain works with the information it considers important.

B/ Encoding

The basis of encoding is the formation of temporary neural connections that last a few seconds but can be restored later.

Encoding can be:

- **unintentional** - without intention, often under the influence of emotions, the memory trace has an unimportant or accidental character, you remember it as an event,
- **intentional** - with intention, memorizing while studying, the memory trace has the character of purposeful work.

Types of encoding:

- **mechanical** - without logical connection awareness, training movements,
- **verbal-logical** - associated with thinking and speech; logical, is more effective than mechanical,
- **demonstrative** - associated with real perceptions and ideas,
- **emotional** - associated with feelings and emotions.

In memory encoding, new neural connections are formed, or the old ones are restored.

C/ Memory storage

Memory storage is a complex process of acquiring and reprocessing memory material. For a long time, one only remembers what is personally important to him or her, connected with his or her needs, interests, goals, and emotions. Memory storage indicator is the ability to recall content that you have memorized. Penfield's permanent memory hypothesis (1958) states that every piece of information is stored in the brain, some of which are inaccessible because they cannot be recalled. One can realize only that information, that are important to him or her.

D/ Memory retrieval

Memory retrieval is the process of accessing information that has already been stored in memory. The more information you need to recall at the same time, the slower your recall.

Information can be retrieved:

- **in parallel** - the required information are recalled simultaneously,
- **in series** - the required information are recalled one after the other.

Types of retrieval:

- **reproduction** - active retrieval, literal repetition, requires wilful effort; for example, you will use reproduction for open-ended questions (test without options, requires a full answer, using one's own knowledge),
- **recognition** - reconnaissance, re-perception of what a person has previously learned, what he or she has perceived, done or experienced; for example, you will use recognition for closed-ended questions (test with options, questions are answered by selecting the correct option).

The physiological basis of memory retrieval is the restoration of previously formed temporary neural connections. Reminiscence is an involuntary, often surprising, emergence of a memory or a conscious process of recalling memories. It has therapeutic benefits especially for seniors.

E/ Forgetting

Forgetting can be:

- **temporary**, for a certain time under specific conditions,
- **permanent**, definitive, there is no possibility of recalling or recognizing.

Forgetting is the opposite of storing information. One forgets the most within 1 hour after the information enters memory (for example, after studying). Then one remembers about 44% of the originally learned information.

However, forgetting is not only negative; it is also beneficial when it comes to forgetting unpleasant or tragic events. Forgetting is even necessary to maintain healthy mental regulation. When forgetting, memory traces disappear or are blocked. This may be due to the replacement of old information with new information or the disappearance of unused information over time.

The brain

From a physiological point of view, complex biochemical processes take place in the brain at the level of nerve cells (neurons) and their contact points (synapses). The more synapses, the better the memory, thinking and brain function. The capacity of the brain is very large, one can remember an enormous amount of information. New connections between neurons emerge in the brain in response to one's studying, experiencing, or learning new things, curiosity, and active approach to life. An important role of the brain is estimation and prediction, the so-called key survival skills for the human organism. The brain engages both hemispheres, experiences emotions, imagines and comprehensively deals with tasks. Brain activity during life cannot be stopped, only directed. Each person's brain is unique, and the structure of the brain varies due to the environment, learning, and heredity. Women have 10% more fibres in the brain that connect the two halves of the brain than men, these fibres are called commissural fibres.

The limbic system is a functional system of cortical and subcortical structures connected by neural pathways. The limbic system influences the functions associated with self-preservation and species preservation. It is essential for learning and memory, for orientation in space, for emotions and behaviour and it also controls sexual functions. Women typically have a larger limbic system that controls and processes emotion. These brain's features make women more emotional and men are more rational. The hippocampus and cerebral cortex, and to a lesser extent the amygdala, are largely responsible for memory and learning. The hippocampus and amygdala are structures of the limbic system.

The cerebral cortex

The brain is the most complicated system for transmitting information. It sends electrical impulses along fibres hundreds of kilometres long. The information coming into the brain immediately breaks down into fragments that are sent to different areas of the cerebral cortex. Each brain stores information in a different place and in a different way. Memories are not stored in just one part of the brain but are widely distributed throughout the cerebral cortex. It is a process called distributed processing, in which several areas play a role, interacting with each other.

Most information received from the environment reach the sensitive/sensory areas of the cerebral cortex (visual cortex and others) and then they are transferred into the short-term memory (hippocampus). During sleep, information that is suitable for being stored is transferred from the hippocampus back to the cerebral cortex to the same part where specific fragments were formed. If they are consolidated, they can remain in the cerebral cortex for years or even permanently (long-term memory), if not, they remain in the hippocampus.

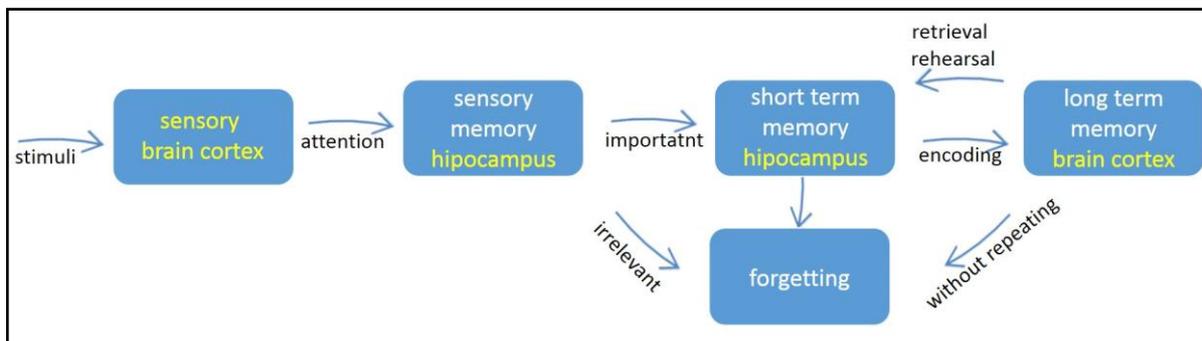


Fig. 2 Diagram of storing information in memory

During sleep, information is sorted into important and unimportant, memories are stored, and insignificant things are forgotten. The hippocampus converts information into memories. The natural disintegration of memory traces protects the brain from being overwhelmed by information. Only the essential information remains in the memory, the details fade over time. At the level of long-term memory, purposeful forgetting and restoration of memory connections take place. Memory is fleeting, adaptive and therefore needs to be constantly active as it strengthens synaptic connections between neurons. The cerebral cortex is the site of the most complex performance of the brain. It is richly

furrowed, which has enlarged the surface of the brain several times. The cerebral cortex resembles a walnut. As the forebrain grew, the hippocampus was in the temporal lobe of the cerebrum during intrauterine development. It lies in the lateral ventricle and is bathed by cerebrospinal fluid. The amygdala is located within the temporal lobe and is adjacent to the hippocampus and the lateral ventricle. Both the hippocampus and the amygdala are paired structures. Hippocampus has the shape of a curved tube, which has been compared to a seahorse, hence its name. The term amygdala translates to almond because it has an almond-like shape.

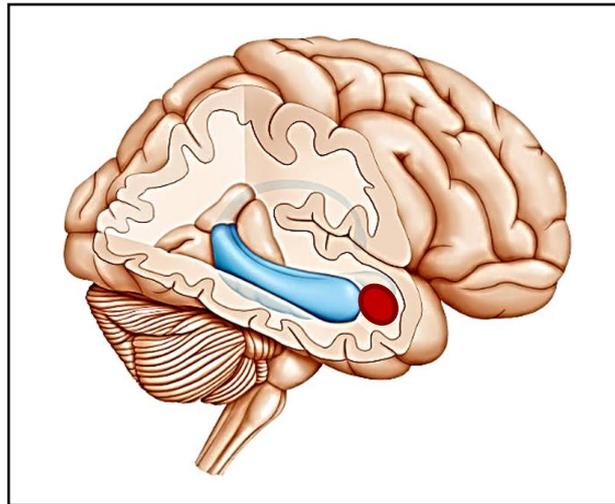


Fig. 3 Location of the hippocampus and amygdala in the human brain
the hippocampus - blue, the amygdala - red (adapted from <https://www.gettyimages.com/>)

The hippocampus

The hippocampus plays a role in the mechanism of learning and memory, in the storage and retrieval of memories. It is involved in spatial orientation and in the regulation of the stress response of the individual and it is manifested through emotions and sexual behaviour. The hippocampus makes key decisions about which of the fleeting information will be remembered and transfers it to the cerebral cortex which is responsible for long-term memory. The left hippocampus, dominant in most people, is mainly involved in verbal learning and memory. The right hippocampus, mostly non-dominant, predominantly associates with nonverbal memory. The hippocampus has connections to the olfactory bulb, thereby it aids in olfactory memory. The hippocampus provides temporary storage for the information kept in short-term memory while it plays a big role in the formation of new memories and updating the old ones. Hippocampal activity is the highest at the beginning of each learning session. It slows down movements and enables focused attention.

The hippocampus activates neurons whenever one wants to recall a memory. The stronger the emotional background, the stronger and more durable knowledge retention. The hippocampus participates in maintaining attention, in the formation and retrieval of engrams (memory traces) and in the formation of declarative memory (facts, pictures, names, experiences). It creates associative and logical relationships between experiences and transforms experiences into memories.

However, the hippocampus does not participate in the formation of working and procedural memory, which includes habits, learned abilities and skills, so patients with damaged hippocampus have these abilities preserved and do not forget to play tennis, play musical instruments or solve puzzles. The hippocampus is important in the formation of conditioned reflexes and purposeful behaviour; it has a close connection to the hypothalamus that is located at the base of the brain. Excitations from the cerebral cortex are first processed in the hippocampus and then transferred to the hypothalamus. In the somatic sensory area, the hippocampus is involved in motor and sensitivity functions.

The hippocampus is one of the few areas of the brain in which neurogenesis continues throughout life. Progenitor cells can generate new neurons and glia. Thus, even in adulthood, the hippocampus plays an important role in the brain plasticity mechanism not only under physiological conditions, but also in the brain regeneration after injury.

Hippocampal damage

Hippocampal damage is related to the development of neurological and psychiatric diseases. When it is damaged, one cannot store new memories. The content of the memory, which was stored in the cerebral cortex before the damage occurred, usually remains available. Amnesia is a deficit in memory. Amnesias often occur because of injuries, but also occur due to other reasons. Damages to many different parts of the brain can cause amnesia, too.

- Retrograde amnesia is a form of amnesia where one is unable to recall events that occurred before the development of the amnesia. It affects the posterior hippocampus.
- Anterograde amnesia is a loss of the ability to create new memories after the event that caused amnesia. Damages to the anterior hippocampus result in this type of amnesic syndrome.
- Sometimes amnesia manifests as an impaired ability to remember new information. Patients understand but do not have the ability to remember. The condition can be triggered by an intense emotional experience.
- Even small abnormalities of the hippocampal structure can cause relatively severe clinical symptoms. The stronger the emotional background during perception, the greater the intensity of short-term memory impairment.
- Bilateral hippocampal damage causes short-term memory loss and associative memory impairment. The patient does not remember new facts, does not recognize new people, and forgets what he or she said.
- Function of the hippocampus in memory formation is also affected by stress that drives changes in blood flow and oxygenation. Hippocampal neurons are extremely vulnerable to hypoxia and to the activity of various toxins.
- Hippocampal damage leads to the impaired formation of conditioned reflexes based on spatial orientation.
- Impaired hippocampal function due to metabolic, organic, neurological, or others is a symptom that occurs in many neurodegenerative and psychiatric diseases, such as Alzheimer's disease and other dementias, Korsakoff syndrome, types of depression, schizophrenia. Alzheimer's disease is associated with progressive memory loss.
- During aging, hippocampal volume decreases by 1,6 - 1,7% per year, but in people with Alzheimer's disease up to 3,5 - 4% per year.

The amygdala

The amygdala (amygdaloid body) comprises clusters of neurons at the subcortical level, functionally belonging to the limbic system, but not developmentally. It plays a major role in forming and preserving memory traces associated with emotional events. It significantly affects one's behaviour when experiencing fear and it is responsible for negative emotions such as aggression, anger, anxiety. The amygdala is involved in the development of fear responses, such as immobility, rapid heartbeat, faster breathing, anxious stomach, and the secretion of stress hormones. Appetite is also associated with the amygdala.

The role of the amygdala is to constantly provide the limbic system with information about the state of the environment in which the human organism finds itself and to ensure that an appropriate behaviour pattern is selected in accordance with the situation. The amygdala is part of a defence mechanism that monitors the environment for potential danger, its responses to stimuli associated with unpleasant events are very prompt and faster than the rational responses of the cerebral cortex.

The amygdala retains memory from early childhood until the hippocampus is fully developed. It allows us to recognize a person's face and understand the facial expressions associated with emotional states. Damage to the amygdala impairs emotional functioning and leads to greed and loss of fear.

Neuroplasticity

The brain constantly receives and processes various information, stimuli and adapts to new situations and the environment in which it finds itself. Every activity a person performs (physical and sensory activities, learning, thinking, and imagination) leaves traces in the brain and changes it. Changes take place not only within our conscious awareness (actively learning to play a musical instrument, foreign language, cycling), but also outside of our conscious awareness (the influence of the environment in which one learns). Thanks to these activities, the brain is constantly shaped, adapted and evolving. It is essential and important that the brain changes through use and training, and these changes can occur throughout life.

The most intense changes in cognitive function and intelligence occur during childhood, adolescence, and young adulthood. However, in a large study (almost 50 000 respondents), neurologists Hartshorne and Germine (2015) concluded that different cognitive abilities of the brain peak at different times in life. So, at any age, you can improve or get worse or stagnate. The brain's ability to process facts without combining them with other information peaks at the age of 18 - 19 and the speed of processing and recalling information peaks around the age of 20. Short-term memory improves until the age of 25, maintains its state until the age of 35 and then begins to decline linearly with age. Fluid intelligence (the capacity to think logically and solve problems in novel situations, independent of acquired knowledge or experience) peaks at the age of 20. A few components of fluid intelligence, as well as crystallized intelligence (influenced by education, upbringing, environment, based on facts and knowledge), peak at the age of 40; emotional intelligence peaks at the age of 40 - 50. The ability to think strategically peaks at the age of 50 and stays at the same level until the age of 70.

Neuroplasticity refers to the brain's ability to modify, change, and adapt both structure and function throughout life. Rakús (2009) defines brain plasticity as "the sum of all functional and structural changes in the building blocks of the nervous system and their clusters, which occur as a result of various activities of the nervous system and which ensure more effective and/or adaptive provision of these activities". Neuroplastic changes take place within individual neurons (neuronal plasticity) as well as within complex structures (plasticity of certain anatomical regions of the brain).

Plastic changes in the brain include the formation of new neurons and glial cells (neurogenesis) and their integration into functional neural networks, branching of axons and dendrites and the formation of synapses between neurons (synaptogenesis), strengthening existing networks, the process of synapse elimination (pruning) and also the formation of new blood vessels (angiogenesis). According to Hulín et al. (2009) a key role in brain plasticity is played by the efficiency of signal transduction at synapses, which can change throughout life as a result of individual experience (learning).

Neuroplastic changes in the brain persist into adulthood, even into old age. In the brain, they are strengthened by new intensive stimulations or form new synapses that condense neural networks. It is the density of these networks that appears to be an important factor in maintaining mental performance. Connections change throughout life thanks to various impulses, experiences, and thoughts. The brain determines which connections and networks it strengthens and which it weakens, for example, it preserves memories, improves memory, learning, and adapts to the environment. Functional neural connections are the result of a longer-lasting change in thinking, behaviour, action and to remain functional, they must be used and trained. Without forming active connections, every learning process is dysfunctional, the effect quickly disappears, it fades away. Such connections and neural networks are purposefully developed by performing activities repeatedly. On the contrary, unused, inactive connections deteriorate, disappear (use it or lose it).

By increasing neurotrophic, neuroprotective and growth factors, certain biochemical changes in the brain can be actively influenced. These factors promote neurogenesis and angiogenesis and help more new neurons survive and engage in an existing functional neural network. They also support the formation of new ones, thus they strengthen the neural connections between different parts of the brain. Many scientific studies point to factors that increase the level of neurotrophic factors in a natural way, such as voluntary physical activity, stimulation of the intellect and limited calorie intake. For example, brain-derived neurotrophic factor (BDNF) regulates synaptic plasticity, axonal growth, dendritic proliferation, and neuronal differentiation. It plays an important role in protecting vulnerable neurons in the short-term decline in cerebral blood flow, low blood sugar and against the effects of certain neurotoxins. It is an important factor in the process of learning and memory formation. It also affects cognition, behaviour, and the stress response.

Applying knowledge about the functioning of parts of the brain leads to an enhancement of the learning process and the use of memory as efficiently as possible, and thus to the effective use of the time needed for learning.

4. LEARNING THEORY

Learning is a process of modification of behavioural and mental functions, the result of which is the acquisition of life experiences and the formation of a person throughout his or her life. Learning, inherent only in human being, arises based on speech. It is a deliberate and systematic acquisition of knowledge, skills, habits, personality traits and types of behaviour. Knowledge is a set of ideas and concepts that the learner has adopted. They are the result of learning. Knowledge includes visual ideas as well as non-visual concepts that are closely related to each other.

In terms of the durability of knowledge, one is able to remember 5% of what one has heard; 10% of what one has read; 20% of what one has seen; 30% of what was demonstrated to him or her; 50% of what one has heard and seen at the same time; 75% of what one has tried to do practically. The most, **90%, is learned by those who teach others**. They actively repeat knowledge and thus consolidate their learning, they practice deep learning and retain knowledge.

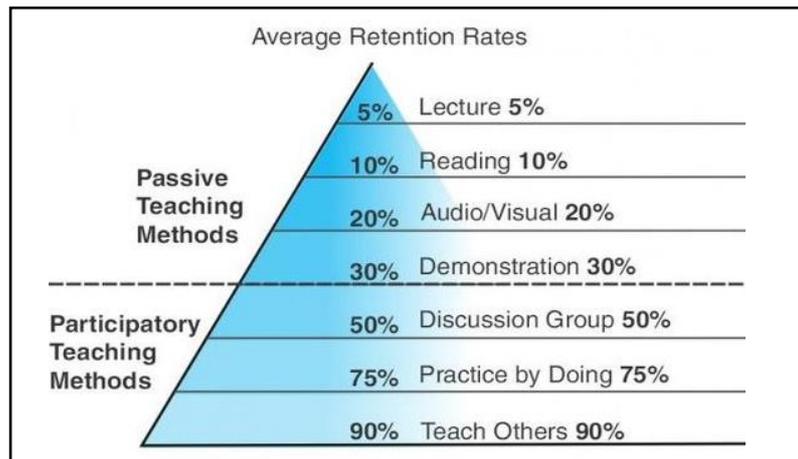


Fig. 4 The learning pyramid (adapted from National Training Laboratories, Bethel, Maine)

The four phases of learning:

- **The motivation phase:** the student begins to realize the internal or external factors that should prepare him or her for learning. If the motivation to learn is low, there is a tendency to avoid it.
- **The cognitive phase:** the student begins to understand the course material, tasks, problems and compares them with previously acquired experiences and searches for other resources or means to solve them, creates, and examines possible solutions. This phase is associated with searching and being uncertain.
- **The performance phase:** the student understood and solved the problem, mastered the course material, and adds it to previously acquired knowledge. Learning often ends at this phase.
- **The validation or verification phase:** occurs when the solution to a problem or what has been learned through reproduction of the course material is being verified by applying the adopted formulas, definitions and rules. This phase is important for permanent retention of information in memory.

Learning includes conscious (intentional) and unconscious (unintentional, subliminal) processes. It requires sufficient time to process them. It is good for the brain to be given time to reflect on what is being learned and how it is being learned. Learning is influenced not only by direct learning activities, but also by the environment in which one learns a particular course material and by social and emotional awareness.

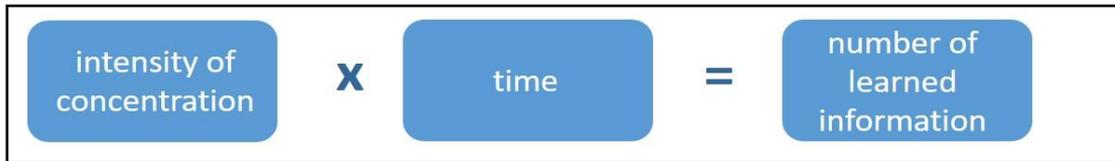


Fig. 5 The amount of learned information expressed by the equation.

The more intensely you can concentrate, the less time you spend learning. Learning means acquiring skills and information that are transferred from short-term memory into long-term memory, thus reducing forgetfulness.

In a 2008 survey conducted in Czech schools, pupils and students were asked: Do they teach you how to learn at school? The results were surprising: 94.3% of elementary schools, 85.5% of high schools and 73.4% of universities do not deal with this topic at all. Universities achieved the best results thanks to universities with a pedagogical specialization. However, the active effort to facilitate learning and make it more effective in terms of brain function has lasted for more than 40 years in the world.

Two thought structures are used in learning:

- **epistemic**, from the Greek epistémé - knowledge; it deals with facts and reproduction,
- **heuristic**, from Greek heuriskó - trial and error; it is about creativity in practice.

The terms task and problem are often confused:

- **task**: one wants to achieve a certain goal that he or she does not know, he or she only knows the ways and methods to achieve it; **reproductive thinking** is applied to solve the problem,
- **problem**: one knows the goal that he or she wants to achieve, but he or she does not know the ways and methods to achieve it; **productive thinking** is applied to solve the problem.

Weaker students aim to get a grade, take an exam/midterm exam. The best students aim to acquire information, they want to know a lot and they do not care so much about grades.

In the traditional way of learning, students learn the way that is against the nature of the brain. They learn in the belief that learning is effortful, school is a necessary evil, they hate learning through memorization and sitting motionless at a desk. While in active learning, the brain learns through play, involving visual, auditory, and motor stimuli, ideas, new facts, memory, logic, concentration, speech, and spatial orientation.

The brain thinks in pictures (visual memory is the most powerful, one knows pictures since the beginning of ages), not in the alphabetic characters but in written texts (they have only been known for 6000 years). Therefore, it is a mistake to learn ONLY from books and university textbooks as it is perception without experiences. It is necessary to actively

involve the primary senses and imagination in learning. Explore the idea with all your senses. [The more senses you engage, the better the information will be etched in your memory.](#)

Perceptions can be:

- visual (80% of perceptions),
- auditory,
- olfactory,
- gustatory,
- kinesthetic.

Engage as many senses as possible because using only one of them robs you of the benefits of using several senses, and thus you use your abilities only partially. There is a great power in using multiple senses that help you to remember. [Draw \(also in the text\) while learning, thereby involving not only sight but also motor skills and spatial relations. Read the study material aloud, so you can see it, hear it and retell it at the same time.](#) You do not have to read everything aloud, just what you should pay the most attention to (drink water regularly so you do not lose your voice). Do not slavishly learn using just one preferred learning style but adapt your learning style to the nature of the study material you are learning. Some people learn visually, others have to listen to the study material and others have to experience it (emotions). What works for one may not work for another. Everyone has to find their own learning style that suits them.

Information is stored in the brain in two forms:

- information that is familiar to you later after reading it or hearing it is known in a **recognizable form**; you know that you have learned it, but you have difficulty recalling it (the essence of passive learning),
- information that can be recalled is stored in an **accessible form**. By asking yourself questions regarding the learned information and testing yourself, you recall and reaccess the information from your memory, so you can learn it perfectly. By recalling information, they are transferred into long-term memory. [Learning through recalling is the most effective method of learning and the essence of active learning.](#)

Passive learning

In passive learning, one does not actively participate in the learning process, he or she just reads the text, just listens to the lecture. It is a way of learning through memorization, ineffective highlighting texts with colour or rewriting. If you learn through reading the text repeatedly, it is not mentally demanding or unpleasant. The use of repeated reading brings more familiarity to study materials, but it leads to the occurrence of an illusion of learning and a false feeling that you know something. However, you do not remember the study material well and you cannot even recall it. This way of learning is very monotonous, after a few minutes you will stop having fun. After many hours of such study, you feel tired and bored while you have learned almost nothing. In passive learning, you only look at the text, but you do not work with it. You learn slowly, you forget, and you are stressed. And after the exam is over, you will forget all the information that you have learned. In passive learning, you are not involved in learning, you do not even store the information in your memory. Repetition in the same way (through reading) is not the basis of education, but in fact, it is

very inefficient, boring, and often the cause of failure, dysfunction, and weakness of will. This kind of repetition does not ensure that you will remember what you have learned. **The text you are learning from is still in front of you, so there is no reason for the brain to try to engage the memory.** Such learning through thoughtless repetition and memorization is shallow, you do not think about the information you are learning at all and you are just trying to remember it.

Active learning

To store the information in your memory, it is necessary to work actively with the study material. Reading and subsequent retrieval of information from memory is very efficient. However, learning through retrieval is unpleasant and difficult, in addition, you feel that you do not know anything well enough. To store the information in the long-term memory, it is necessary to review the study material again, i.e. read a few pages and retell it aloud 2 - 3 times. It does not make sense to read the text more than twice because afterwards, the brain cannot remember more information.

Active learning is one of the effective ways of learning, in which one looks at the study material from several perspectives, **firmly connects it with prior knowledge** and uses information from other sources, which **make him or her think more.**

Ask yourself questions:

- How does it build on the previously studied material?
- What is it related to?
- What does it look like?
- How do I understand it?
- How can it be used?
- What can I connect it to?
- What questions could be on the test?

The basis of active learning is to get information out of your head, i.e., to retrieve it from memory, which increases understanding and remembering. Only when you recall something, you can say that you really remember it. It will be difficult in the beginning as the mind is not trained for it. You will remember less, but through training you will improve your memory. The brain gets used to recalling information. Maybe for the fourth time it will work, do not give up. When you study, keep recalling information from memory. When you search for the information you have stored in your memory, you remember it better than. Active learning is much more mentally challenging, and you will initially think of going back to an undemanding passive way of learning. It is important to resist and develop a habit of active learning. There is a huge difference between learning something passively for an hour or actively for an hour. **The quality of learning does not depend on how much time you spend learning, but how you learn.**

In deep processing, the student tries to understand the study material, thinks about it, asks himself or herself various questions regarding the study material, and thus remembers it much faster and better. By actively retrieving the learned information from the memory, the information is stored again, more strongly, and the memory trace is fixed. **The harder it is to recall the information, the stronger it is then stored in memory.** When actively recalling

information from memory, an illusion of learning (that you know something, even if you do not remember it) has never a potential to arise. Active learning will validate and consolidate your knowledge. **Try to explain the study material aloud, you will remember it better. The exam should never be the first time you try to recall previously learned information.** If one learns actively, he or she is motivated, focused, and can understand the study material.

Example of active learning:

Read a new study material, that you are not familiar with, slowly, preferably out loud and **think about it**. Underline the most important part in the paragraph. Ask yourself how you understand it, what it is connected to and what it reminds you of. Read the paragraph, then cover it and retell what you remember. Learn the information that you could not recall. Read the study material twice this way and you will learn it successfully. Do not forget to take short breaks. Review the learned information the next days in a guided manner and then before the exam. If you are learning a large amount of study material, use this method for entire chapters. It is the way you learn the most. The basis of the long-term storage of information in the brain lies in repetition conducted in a guided manner (p. 37).

Forgetting curve

Several experiments were performed regarding remembering and forgetting. The pioneer of experimental psychology, Hermann Ebbinghaus (1850 - 1909), dealt with how quickly people forget what they learned if they learned it only ONCE. In 1885 he came up with a discovery that changed how thinking and memory were perceived at the time. He created the forgetting curve. He found out that the perfect retrieval of stored information is possible only if the knowledge is stored in long-term memory.

The Ebbinghaus forgetting curve depicts how more and more learned information is forgotten at specific intervals over time. Most of the information that was received only once, was forgotten, and lost during the first hour. In 2013 Ebbinghaus's experiments were repeated and it turned out that they are still valid, but it only concerns a mechanical memorization of abstract words without meaning.

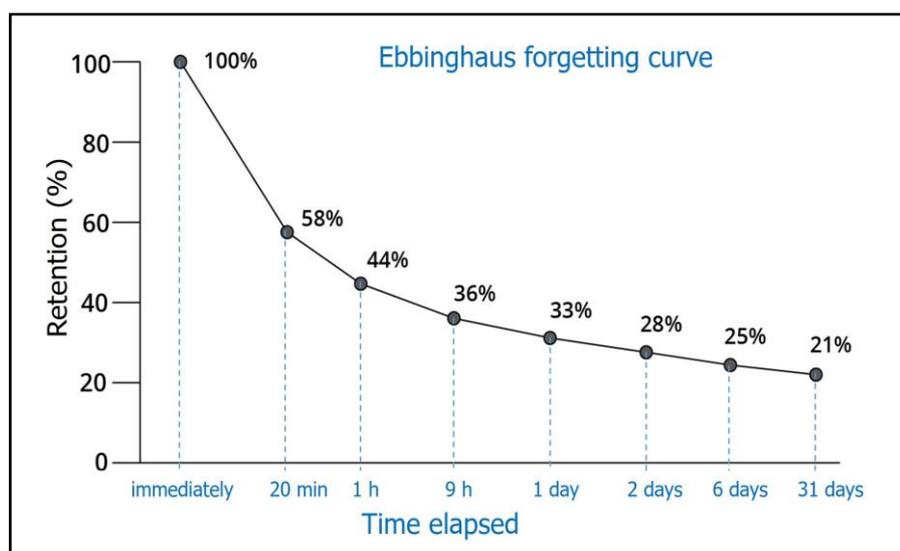


Fig. 6 The Ebbinghaus forgetting curve (adapted from: <https://bearinmind-logbooks.com/mission/>)

The process of forgetting:

- after 20 minutes, people can recall about 58% of what they once learned,
- after one hour it is about 44%,
- after 9 hours it is about 36%,
- after one day it is about 33%,
- after two days it is about 28%,
- after 6 days it is about 25%,
- after a month, you can only recall about 21% of what you once learned.

Guided repetition

Guided repetition (distributed learning) is the correct distribution of learning time and subsequent repetition. It is a very important element of effective learning. It is the prevention of forgetting. **You have to review it so that you do not forget it quickly.** Theoretically, when the learned information is almost forgotten. This time can only be estimated, you have to keep an eye on it. The use of guided repetition enables you to store information in long-term memory. It is not enough to hear and see information once. If you review the study material at certain intervals, you will remember it better and forget it more slowly. By investing an extra 20% of your time in repetition now, you will save 80% of your time later. **Repetition stops forgetting.**

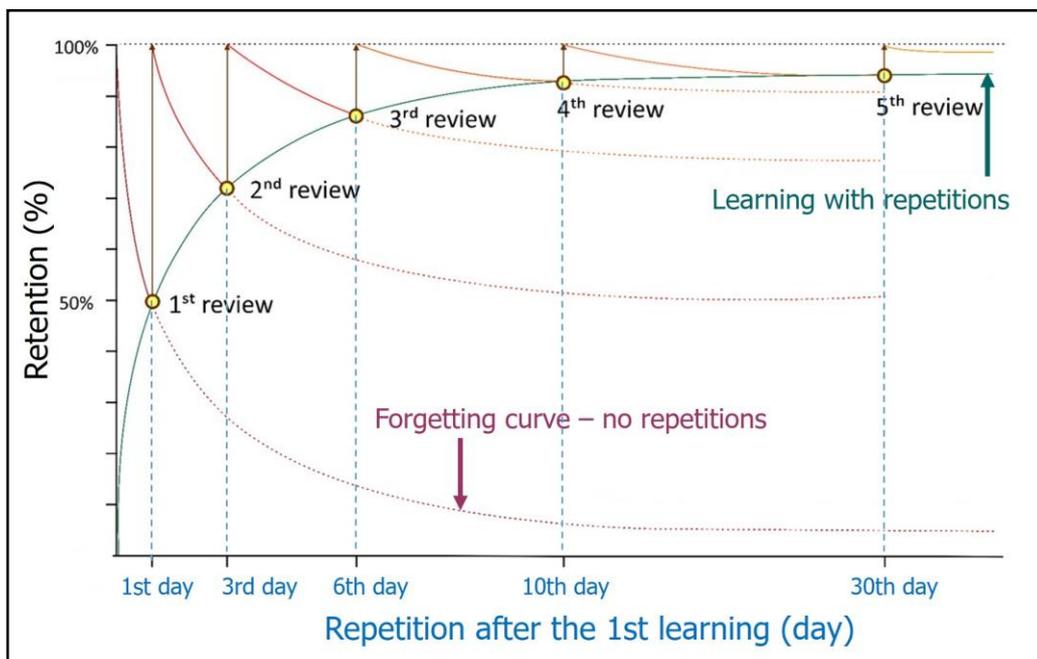


Fig. 7 The Ebbinghaus curve of guided repetition (adapted from: <https://www.learnthat.org/>)

The brain is unable to remember everything. It only remembers things that are important for some reason. When you study the material through a system of guided repetition over and over, you get to the point where your brain thinks that since **you have repeated something so many times, this information must be important for some reason, therefore you will remember it.** The procedure is simple, precisely planned repetitions need

to be involved in the learning process. Repeat not when you think about it, you have time or you just want to, but at precise time intervals. There should not be too much information to study. Repetition should be more intense and thorough at first. Once you learn the material better, it is sufficient to perform the next repetition only briefly.

Ebbinghaus's experiments required memorizing lists of short abstract words (nonsense syllables composed of letters and numbers) without any meaning. The memorizations were repeated the 1st, 3rd, 6th, 10th, 30th and 90th day after the first learning session. It is important to realize that you really need to learn completely different sets of information from the sets of information he learned in his experiments, so the real forgetting curve is flattened in comparison to Ebbinghaus's. The intervals of actual repetition depend on many interacting factors, such as the meaningfulness of the study material, the continuity of the study material, prior knowledge, emotional significance, interest, rest, stress, and others. It is true that the more abstract the information is, the more often it should be reviewed.

Based on the foregoing paragraph, the repetition days set by Ebbinghaus cannot be regarded as unchangeable instructions. Quite the contrary, try and find out which repetition intervals will suit you (for example the 1st, 2nd, 7th and 12th day or the 1st, 7th and 30th day).

Repetition	Repetition intervals after the first learning session			
1st repetition	1 day	1 day	1 day	1 day
2nd repetition	3 days	2 days	3 days	7 days
3rd repetition	6 days	7 days	7 days	30 days
4th repetition	10 days	12 days	15 days	1/2 year
5th repetition	30 days	30 days	30 days	3 years
6th repetition	90 days	90 days	90 days	

Tab. 2 Recommended intervals of guided repetition according to the difficulty of the study material

If you are applying effective learning techniques in the learning process, looking for context, studying actively, using associations and mnemonics, then you only need to review the learned information twice: the day after the first learning session and just before the exam. Do not be afraid of repetitions, it does not have to take long. If you study for an hour, it will take a maximum of 10 minutes to repeat.

Thinking and understanding

Thinking takes place in two ways, both of which are equally important:

- A/ **Associative (concentric) thinking:** occurs through intense, strenuous study, goes deep, requires complete concentration and involvement in learning. The student makes full use of the corresponding part of the brain. You can think concentrically for a maximum of 40 minutes, then the brain gets tired, it does not remember and does not understand. A break is required.
- B/ **Dissociative (scattered) thinking:** occurs during a break, gains perspective and distance from memories, the brain works in the background. If you come across something

complicated while studying that you do not understand, do not worry about it. During the break, when dissociative thinking prevails, the solution often appears. It was stored in another part of the brain that you had not focused on before because your thinking was concentric. Do not think consciously about what you did not understand, do something else, and suddenly the solution comes to mind - this is called **the AHA effect**, in which several interconnected areas are activated. Rest and breaks are extremely important in learning. They will increase your success rate by tens of percent.

Tips for active learning and good memory retention

- **Memory techniques** (p. 132)

Memory techniques (mnemonics) are mostly involved with associations. Things that are interesting, crazy, controversial, or emotionally charged are remembered well. Engage in black humour, something spicy, unusual, or funny. When speaking, change the pace of speech, gestures, or movements.

- **Speed reading** (p. 136)

Even after a short training, you can read twice as fast. After a few hours of training, you can read five times as fast. You will save a lot of time, especially when reviewing a large amount of study material.

- **Highlight key information**

The importance of highlighting key information in colour has been confirmed in the past by research where students were presented with three different edited versions of the same text. The first version was plain text, in the second version the key information was highlighted in bold and in the third version the key information was highlighted in colour. As a result, students remembered 32% of the information from plain text, 45% of the information from text highlighted in bold, and 60% of the information from text highlighted in red and purple. Useful connections were made in the brain based on color-coded words, and students remembered almost twice as much in comparison to plain texts. Use coloured highlighters, but wisely (p. 124).

- **Effective repetition**

After reading the study material, ask yourself: What was in the introduction? What information was discussed first? How did it continue? What followed afterwards? What else was mentioned? And then what? Repeat, ask yourself questions and only then, when you are sure that you will not get more out of your head, look at the text. **You need to think about what you are learning, which is the basis of effective learning** (p. 36).

- **Long-term memory retention: rule 10 - 20**

If you want to retain the information you are learning for 100 days, repeat it once every 10 - 20 days. **The longer you want to retain the information, the longer the intervals should be between repetitions.** Too frequent repetitions are unnecessary because you still remember everything well. Advice for long-term memory retention, for example for state examinations: if those will take place in 2 years, review the study material once every 4 months. Then you do not have to study too much for state examinations, you will retain the learned information.

Learning styles

Probably everyone who went to school had the opportunity to notice the different learning habits of their classmates. Some like to study quietly at home, others like music, prefer to learn outside or walk around while studying. Such a set of practices that people prefer to apply when learning at a given time is called a **learning style**. People perceive these practices as normal and natural. Students are rarely aware of them and adjust them to make their learning more effective. From the viewpoint of scientific research, this is a new and insufficiently researched phenomenon and therefore opinions on it are divided. In this chapter, the learning styles are explained briefly and properly so that you can apply the knowledge to your study. Each student has individual perception abilities, memory abilities and uses several senses - sight, hearing, sometimes smell and often movement. There are opinions that the main learning style is innate. However, one can also adopt another, less preferred style and combine them. [A student who can listen, take notes and at the same time think about the course content that is being presented, has excellent preconditions for successful studies.](#)

Surface and deep learning style

The traditional view of learning was mainly defined by a quantitative approach. We can learn little or a lot of information. Marton and Säljö were among the first to become interested in qualitative differences in approaches to learning. So not only how much, but also what and how you can learn. They carried out a series of experiments in which they had a selected group of students read a text that was difficult to understand and then asked about the main idea of the text. They then analysed the responses and created categories. They found out that while some students understood the idea comprehensively and could analyse it in depth, others understood the issue only partially or did not understand it, and their responses were at odds with the author's idea or they only memorized general definitions.

Based on such experiments, the authors theorized the existence of two learning styles: surface and deep learning styles.

- **Surface learning style** consists in the mechanical reproduction of study material without emphasis on the perception of deeper meanings and contexts, which results in the acquisition of only formal knowledge that is quickly forgotten.
- **Deep learning style** consists in trying to understand study material, searching for its deeper meaning, and realizing the wider context. The result is not only a memorization of study material, but also comprehension of study material and ability to apply the learned knowledge.

Learning styles according to sensory preferences

Neil Fleming created a concept of learning styles based on sensory preference. The theory and the questionnaire created on its basis are known under the acronym VARK (visual, aural, read/write, kinesthetic). This acronym represents 4 learning styles:

- **Visual** (visual, visual-verbal) - represents the preference for visual materials in learning; when learning, it is appropriate to highlight important words in different colours and write a brief outline.

- **Auditory** (aural) - represents the preference for audio materials in learning; when learning, it is advisable to invent rhymes or logical ways of memorizing technical terms.
- **Reading/writing** (read/write, visual-pictorial) - represents the preference for written study materials; when learning, it is appropriate to develop signs and symbols that would represent specific terms.
- **Movement** (kinesthetic) - represents the preference for study materials one can manipulate; when learning, it is appropriate to create a graphic concept of the text using words, symbols, arrows, and bullet points.

Fleming also identified mixed learning styles in which the preferences of two or all four types of study materials were mixed. He considers the use of styles that correspond to personal preference to be the most effective (like the other theorists of learning styles).

Learning styles according to Kolb

Representative of experiential psychology David Kolb created a **typology of learning styles** based on his experiential learning theory. This theory says that learning is a process of transforming experience into knowledge in a repetitive cycle that has 4 stages:

- **Concrete experience** - one is confronted with a new experience or reinterprets previous experiences.
- **Reflective observation** - one looks for important characteristics and compares experience with one's present understanding.
- **Abstract conceptualization** - through reflection, one forms a new idea or modifies an existing abstract understanding
- **Active experimentation** - one applies new or modified knowledge to the world around them.

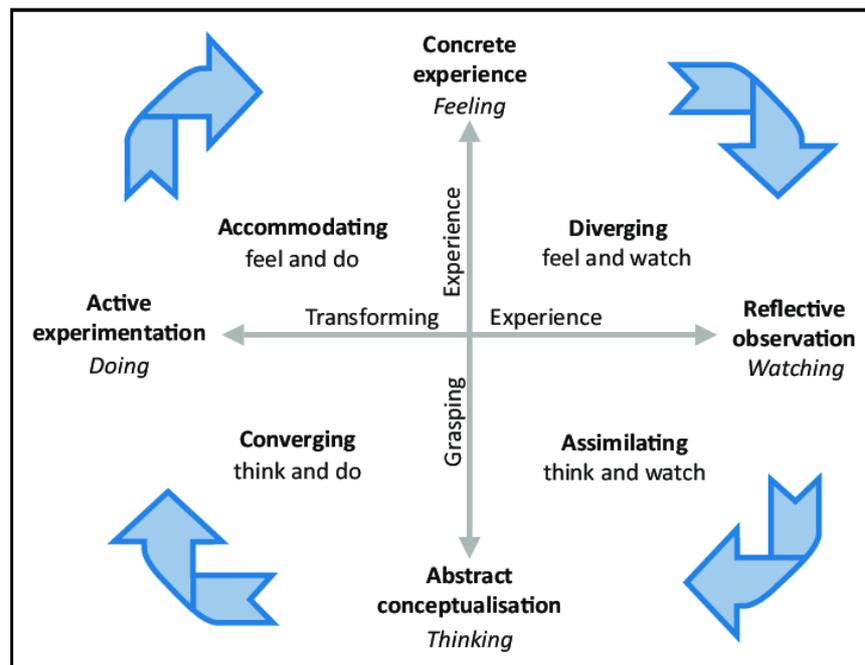


Fig. 8 Diagram of experiential learning
(adapted from <https://www.simplypsychology.org/learning-kolb.html>)

By introducing the dimensions of receiving and processing information into the experiential learning cycle, 4 learning styles are obtained according to Kolb (1984):

- **The diverger** (student innovator) - one prefers to receive specific information and processes it through reflective observation.
- **The assimilator** (student analyst) - one prefers to receive abstract information, which he processes through reflective observation.
- **The converger** (practical student) - one prefers to receive abstract information, which he processes through active experimentation.
- **The accommodator** (dynamic student) - prefers to receive specific information, which he processes through active experimentation.

Theory of learning styles

Theory of learning styles dates to the 1980s. In recent years, there have also been opinions that call it into question. One of the most important points of criticism of learning styles is the weak experimental verification of the theory of learning styles. The claim that learning in accordance with the preferred learning style should improve academic performance has not been confirmed at all in several studies. The dimensions of learning styles do not correlate with preferred study material or academic success. An example is the study by Husmann and O'Loughlin. The results of the study showed that most students do not use strategies in accordance with the measured learning style. The dimensions of learning styles are not related to academic performance, even if the specific strategies that were used match the preferred learning style.

Authors often develop their theories in a vacuum, so to speak, without a causal or empirical basis. An example is the often-used concept of auditory and visual learning style. However, research in cognitive psychology shows that both styles are available to everybody and optimal results are achieved when both styles are used at the same time, not just one preferred style. Kolb's theory has also been criticized for failing to demonstrate sufficient links with existing and validated theories in the field of cognitive psychology and personality psychology. Despite criticism, knowing one's own learning style is a prerequisite for mastering effective learning methods.

The use of a deep learning style leads to understanding and the ability to apply knowledge, which is ultimately the real goal of learning, not just the mechanical reproduction of study material in the exam. Knowing sensory preferences in learning can help you identify shortcomings and engage multiple senses in learning. Understanding learning as a constantly recurring process that takes place on an abstract and specific level can also be used to create a strategic plan to become a doctor.

What does this mean in practice, for example in the study of anatomy?

- By listening carefully during lectures and asking questions, you engage your hearing and process information on an abstract level.
- By using an anatomy atlas, you engage your sight and process information on an abstract level.
- By participating in practical classes, you engage other senses and receive information on a specific level.

Typology of language learning

Two types of students are distinguished based on the typology division below, logo cognitive and audiomatic types.

A/ **Logo cognitive type** of person needs to rewrite words, pays extreme attention to detail and insists on being organized when studying. They are good at taking tests and reading books in a foreign language. They need to use logic to acquire new knowledge. Once they learned the material, they need more time to recall what they learned. This type of person tends to learn to write before they learn to speak in a foreign language. When learning, they need conscious understanding and comprehension, logic, learning goals, translations, and repetition to be involved. Grammar and text analysis are very important.

B/ **Audiomatic type** of person needs to repeat the study material aloud and, ideally, repeat a word or phrase, that is currently being learned, several times in a row. It is more natural for them to listen to the interpretation of the study material. Audio books can serve as a suitable learning aid. In this way, they can practice the correct pronunciation and accent of the language. This type of person will find attending a course where communication is conducted within groups very effective. They learn a lot by listening. This type of person absorbs information through hearing and automatically. They learn through listening to something repeatedly, just like young children. They remember song lyrics, local dialects, rhymes, and slogans well. They learn unconsciously, automatically, through repetition and they can learn whole sentences without translating them. This type of person often listens and repeats aloud, reads, speaks, and has a good pronunciation.

By answering these 5 questions you can find out which type you are:

- Can you remember the lyrics of your favourite songs?
- Do you also speak a dialect?
- Does an advertising slogan come to your mind out of nowhere?
- Do you pick up a few words while being on vacation in a foreign country?
- Do you remember rhymes from childhood?

If you have mostly answered no, you are a logo cognitive type; if you answer has been yes most of the times, you are the audiomatic type. Find a learning style that suits you the most. That way, you will learn naturally, and it will make the learning process less strenuous. If you are not specifically one type or the other, use all available methods that work for both types. A high IQ does not mean that you will learn languages quickly. Even Einstein never learned English properly, despite the fact he lived in the USA for a long time. IQ scores have stopped rising in society for some time now. Whether this is directly linked to the use of social media is not entirely certain, but it is certain that [the use of social media is directly linked to the brain's ability to think and solve problems as well as to the increase in depression and anxiety.](#)

5. SLEEP, MEMORY, AND LEARNING

Sleep is still shrouded in secrecy because, despite many existing electrophysiological findings capable of defining good quality sleep or impaired sleep, it is not possible to describe in detail all its physiological functions. From the viewpoint of evolution, the limited reactivity of an individual to external stimuli during sleep is associated with a threat to survival, but nevertheless almost all animals sleep. This fact suggests that sleep has an important function in increasing the overall body condition: it saves energy, contributes to the renewal of energy sources and cell renewal, thermoregulation, regulation of metabolism and affects immune functions.

Sleeping takes up a third of our lives. The waking state or the state of being asleep depend on the level of neuronal activation in the cerebral cortex. Neurons in the brain are interconnected by excitatory and inhibitory synapses, which are activated or deactivated by impulses. In the waking state, the human brain responds dynamically to contact with the external environment. A reversible interruption of dynamic contact with the environment occurs in sleep.

Sleep is usually defined as the opposite of a waking state when there is a decrease in the excitability of cortical neurons, but they are not generally attenuated. Simply put, the brain is not asleep during sleep, it only modifies its activity. Dreaming is proof that thinking takes place even during sleep and sometimes memories are formed, albeit differently than in the waking state. Sleep is essential for mental and physical regeneration of the body. Important [metabolic and regenerative processes take place during sleep](#). The influence of sleep on the optimal [functioning of the human immune system](#) is also unquestionable.

Sleep is a physiological process, immediately reversible. The sleep duration changes in different periods of one's life. Sleep duration recommendations in different periods of life according to Hirshkowitz are depicted in table 3.

Age	0-3 months	4-11 months	1-2 years	3-5 years	6-13 years	14-17 years	18-25 years	26-64 years	65+ years
Recommended sleep duration	14-17 hours	12-15 hours	11-14 hours	10-13 hours	9-11 hours	8-10 hours	7-9 hours	7-9 hours	7-8 hours

Tab. 3 Recommended sleep duration (according to Hirshkowitz et al., 2015)

Importance of sleep

Sleep can significantly affect not only physical health, but also the psyche, cognitive functions, and thus, of course, learning outcomes. Several specific functions of sleep affect the metabolism of the brain and body. A decrease in metabolism and body temperature during sleep helps to restore energy loss during wakefulness, especially during slow-wave sleep (delta sleep), where slow waves could reduce the need for glucose. The reduction in energy demand may not only be specific to the brain, but also to the whole body. The reduced energy requirement is also due to gross muscle hypotonia or atonia (decrease in

muscle tone or loss of muscle tone) during sleep, as opposed to wakefulness, when active muscles consume large amounts of energy.

The relationship between sleep and the immune system has been the subject of research for a long time. Its validity is confirmed, for example, by the findings in the study of antibody titres after immunization, depending on the quality of sleep. Sleep contributes to overall physical well-being. It is known that the expression of thousands of genes in the brain is changed after sleep deprivation, most of which are involved in the synthesis of cholesterol and proteins important for lipid transport. It is therefore not surprising that lack of sleep can lead to anatomical and structural changes.

Traditionally, the function of sleep is associated with the storage and consolidation (more lasting storage) of the memory trace. One example could be the impact of sleep on declarative memory. It was confirmed that a good night's sleep facilitated and improved immediate facial recognition but did not help with long-term memory consolidation. Research on sleep, memory, and learning encounters many methodological problems, such as influencing performance in previous sleep deprivation testing, the presence of a sleep disorder that was not revealed in anamnestic analysis, and others. The result is sometimes conflicting findings and the questionable role of sleep in memory consolidation. However, most studies agree that [sleep plays the greatest role in memory of healthy young adults](#). The exact role of sleep in memory impairment associated with aging and neurodegeneration remains unclear.

Normal sleep

Wakefulness and sleep are the essential functional states of the human body. Sleep is repeated at regular intervals because of circadian rhythms and homeostatic mechanisms (internal need of the human organism). As early as the 1930s, Loomis, Harvey, and Hobart (1937) began to study sleep, its depth, and stages. Based on the monitoring of electrical activity of the brain and eye movements during sleep, they defined two stages of sleep, REM sleep and NREM sleep.

REM sleep (rapid eye movements sleep) is characterized by rapid eye movements from side to side beneath closed eyelids. It is deeper than NREM sleep and a stronger stimulus is needed to wake up from this stage.

NREM sleep (non-rapid eye movement sleep) is shallower than REM sleep and the breathing and heart rate are slower than during REM sleep. This type of sleep is divided into stages 1, 2, 3, and 4 according to the depth of sleep. Stage 1 is a time of drowsiness or transition from being awake to falling asleep, stage 2 is a period of light sleep. Stage 3 is a period of deep sleep characterized by the presence of slow brain waves.

Both REM sleep and NREM sleep stages are cyclically repeated. The sleep cycle is a regular alternation of light and deep stages of sleep. A healthy young person's sleep is organized in about 5 sleep cycles. The average length of the sleep cycle in an adult is 60 - 90 minutes, while 15 - 20% represents REM sleep and 80 - 85% represents NREM sleep. Interestingly, new-borns typically spend about twice as much time as adults in REM sleep.

As we begin to fall asleep, we enter light **NREM1 sleep**, during which brain activity slows down in the polysomnographic record and typical sleep patterns appear as vertex sharp waves located at the vertex of the head. Subsequently, sleep deepens, and K-complexes and sleep spindles start to appear as part of **NREM2 sleep**. As sleep deepens further, brain activity slows down, and its frequency becomes 0,5 - 2 Hz. This so-called slow-wave **NREM3 sleep** is a deep sleep stage from which it is no longer easy to wake a person up. It is important in a period of growth, as it is essential to produce growth hormone. Slow-wave sleep occurs mainly in the first half of the night. The amount of slow-wave sleep begins to decline with age and can be completely absent in older adults. At the end of **NREM3 sleep**, one usually wakes up for a few seconds, falls asleep again during light stages of sleep and switches into REM sleep.

REM sleep is associated with abundant dream activity, changes in breathing rate and cardiovascular activity. REM sleep dominates the second half of the night, especially during the final hours of sleep in the early morning. The sleep cycle is completed after REM sleep ends. Fig. 9 shows typical electrophysiological and clinical characteristics of individual stages of sleep.

Stage of sleep	NREM1	NREM2	NREM3	REM
Brain activity electroencephalogram	Breakdown of basic activity	Sleep spindle	Delta waves	Sawtooth waves
Eye movements	Slow Movements			Rapid movements
Chin muscle activity				Atonia
Breathing	Regular			Irregular
Heart rate	Regular			Irregular
Dreams			+	+++

Fig. 9 Electrophysiological and clinical characteristics of individual stages of sleep

Note: polysomnographic examination is an examination performed in a sleep laboratory, during which the characteristics of individual stages of sleep, electrophysiological features such as bioelectrical brain activity, eye movements, muscular activity of mimic muscles and limbs and clinical features: breathing, cardiovascular activity, blood oxygen saturation level, dreaming and more as needed are recorded throughout the night.

The individual stages of sleep are accompanied by characteristic neurochemical processes. In orthodox sleep, or NREM sleep, cholinergic, serotonergic, noradrenergic activity decreases in some regions of the brain. In REM sleep, serotonergic and noradrenergic activity are reduced even more markedly, but cholinergic systems are

activated and reach levels as in the waking state or higher. Serotonergic and noradrenergic activity increase sharply after awakening.

Sleep characteristics change with age. The most significant change is the reduction in the duration of NREM sleep. The higher the age, the shorter the NREM sleep. The alternation of the stages of sleep and wakefulness during the night is depicted in the hypnogram.

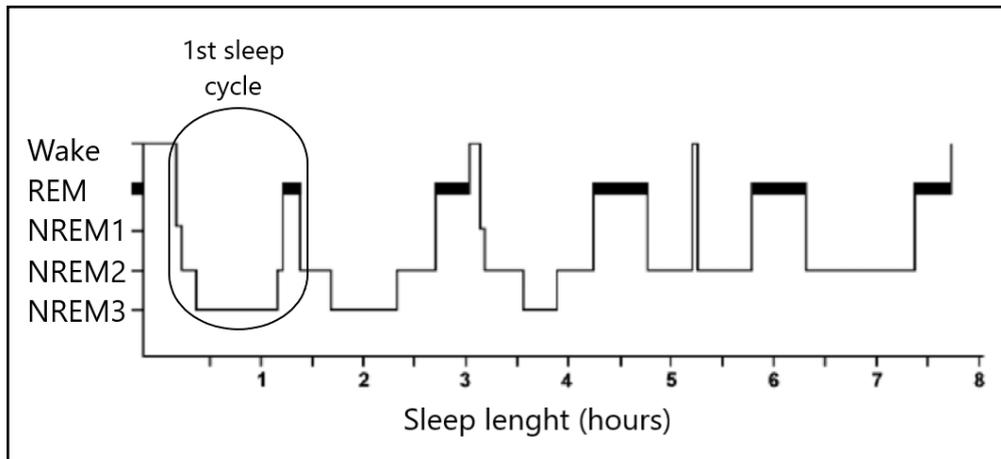


Fig. 10 Hypnogram of a healthy adult (source: Peigneux and Leproult, 2014)

The relationship between sleep, memory, and learning

At present, a two-stage memory system is generally accepted. It is assumed that the memory is first stored in the so-called interim repository, which is the hippocampus, and subsequently it is consolidated and transferred to the so-called long-term repository, which is the cerebral cortex (the neocortex). Mc Gaugh (2000) characterizes memory consolidation as a slow process by which labile, unstable memory traces (engrams) are transformed into more permanent and stronger memory traces, which occurs by creating new connections, especially between the hippocampus and the cerebral cortex (p. 26).

At the beginning of the 20th century, sleep was assumed to play an important role in consolidating the memory trace. The first evidence proving the fact was provided by Jenkins and Dallenbach in 1924. In examining the memory processes, they focused mainly on the causes of forgetting. They also incorporated the impact of sleep into many of them. The assumed key role of sleep in memory processes was confirmed. The results showed that participants, who went to sleep shortly after learning, had a higher retention of learned information, remembered more than participants who remained awake for several hours after learning and then went to sleep. The authors explained this finding by stating that during sleep the possibility of interference, mutual interference or rewriting of memory traces is significantly reduced as during sleep the encoding of new information and perceptions is considerably reduced.

On the contrary, in the waking state, the brain is constantly attacked by new perceptions and by the encoding of new memories that leads to mutual interference and erased or mixed up memories. The storage of information depends on the nature of the stored information and the time that has elapsed since it was acquired. The information is

not immediately stored in its final form and it is subject to changes that lead to forgetting the information or, conversely, to memory consolidation. Sleep and the associated brain activity that leads to the formation of connections between neurons play an important role in this process. NREM2, NREM3 and REM sleep are important from a memory viewpoint. Animal studies using positron emission tomography have shown that regions of the brain activated throughout the learning process are selectively reactivated in the subsequent night's sleep (REM and NREM).

The first sleep after the information was acquired is crucial for memory consolidation. However, sleep is not the only condition for memory consolidation and in case of sleep insufficiency; it can be compensated by other mechanisms. Even the suppression of REM sleep, for example, by the administration of antidepressants may not be a major problem from a memory viewpoint.

It has long been assumed that only REM sleep stage is associated with the memory consolidation process. However, in recent years, the concept of memory consolidation has evolved rapidly, and new information and theories have emerged. According to the dual process theory, which is based on the study of human memory, NREM sleep as well as REM sleep are important for memory consolidation. According to this theory, declarative memory consolidation takes place during NREM sleep, which is predominant during the first half of night's sleep. Non-declarative memory consolidation occurs during REM sleep and predominates in the second half of night's sleep.

The authors, who relied mainly on experimental studies conducted on animals, created the so-called sequential or two-step consolidation. According to this theory, in the first step, during NREM-sleep, unnecessary memories are weakened and, conversely, important memories are consolidated. Subsequently, in the second step, during REM-sleep, the integration of important memories into the already existing memory network takes place.

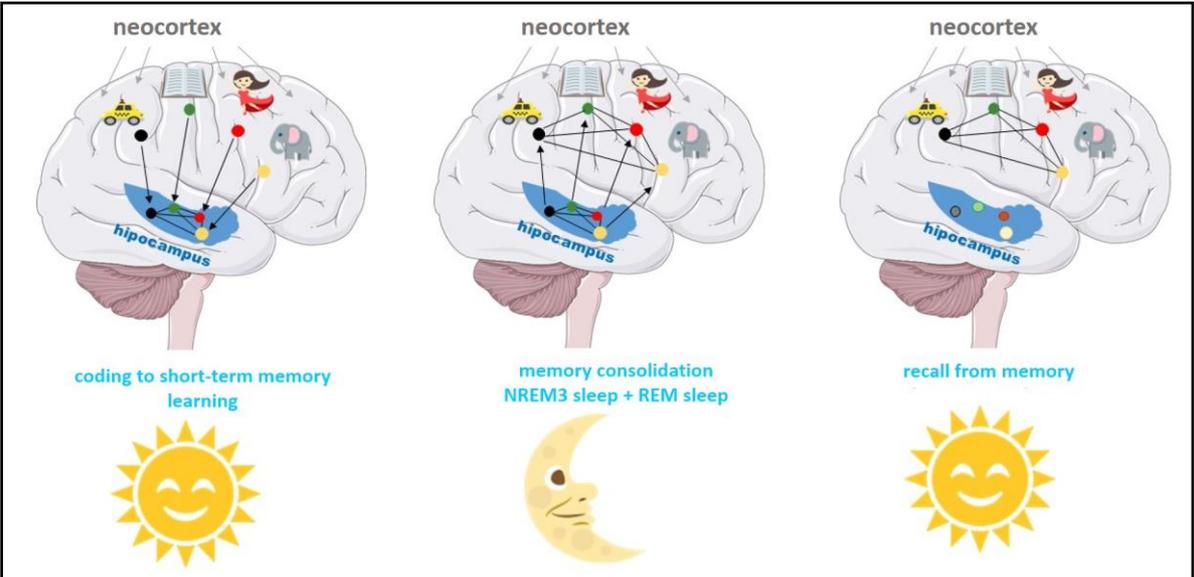


Fig. 11 Active system consolidation of memory (adapted from Feld and Born, 2020, redrawn using Smart Servier Medical Art and Emoji Keyboard)

The concept of active system consolidation summarizes the latest knowledge in this field. It is believed that during NREM sleep, reactivation of memory traces is repeated, and memories are subsequently transferred from the hippocampus to the cerebral cortex. In other words, memories are being integrated into long-term memory. The next stage of REM sleep is accompanied by a qualitative reorganization and transformation of the memory that is stabilized in the process of synaptic remodelling of the cerebral cortex.

The increase in the amount of new information in the field of neuropsychology was made possible mainly by modern imaging methods. Functional brain imaging such as functional magnetic resonance imaging (fMRI) has provided a unique view and possibility to monitor the activity of anatomical structures in the brain during various states of consciousness, as well as during individual stages of sleep, or in performing certain tasks and engaging various cognitive functions. Experimental studies conducted on animals represent another important benefit, which provides information on neurochemical processes in anatomical structures responsible for memory (especially the hippocampus, the cerebral cortex, and the amygdala). Based on their conclusions, memory consolidation is closely related to brain plasticity. Brain plasticity is usually characterized as the brain's ability to undergo synaptic remodelling. Synaptic remodelling during memory consolidation is triggered by molecules that are formed mainly during sleep, but some also in the waking state. The excitatory neurotransmitter glutamate plays a prominent role in inducing synaptic consolidation. At the same time, the results of experimental studies also confirmed that sleep deprivation (lack of sleep) clearly leads to reduced synthesis of molecules inducing synaptic consolidation in the brain.

Declarative (explicit) memory is divided into semantic memory (which stores facts and knowledge) and episodic memory (which stores abilities and skills), (p. 22). NREM3 sleep seems to be the most important for the consolidation of semantic memory and NREM2 sleep plays the most important role in the consolidation of episodic memory. Episodic memory is affected by sleep quality and sleep duration most clearly in young people, for whom the extent of stored information positively correlates with the sleep duration and, conversely, negatively with the extent of disruption of natural sleep continuity. Physiological deterioration of sleep with aging is likely to cause deterioration of declarative memory with aging. It has been proven that sleep spindles in NREM2 sleep decline not only with aging but also in people with schizophrenia, neurodegenerative diseases, sleep fragmentation or shortening of sleep. Episodic memory is also impaired in all these situations. Information stored in episodic memory with an emotional charge is less dependent on sleep than the one without an emotional charge. Non-declarative (implicit) memory is mainly, related to REM sleep and NREM2 sleep.

Sleep deprivation

Sleep deprivation because of work and social responsibilities has been a trend in recent years. It is estimated that in this artificial way the sleep of an adult (7 - 9 hours) was shortened by 1 - 2 hours. If sleep lasts less than 7 hours, the need to sleep during the day increases. Epidemiological studies point to a significant association between many diseases and chronic sleep deprivation. In this regard, the American Academy of Sleep Medicine issued a recommendation in 2015 that adults should obtain seven or more hours of sleep

per night. Obtaining less than 7 hours of sleep on a regular basis is associated with weight gain, obesity, arterial hypertension, the risk of heart disease and stroke, the development of diabetes and glucose intolerance, but also with an increased risk of death. In addition, short sleep is associated with impaired immune function, increased pain perception, poorer performance, increased error-proneness, and a higher risk of accidents.

Obtaining more than 9 hours of sleep on a regular basis is suitable for young adults, sleep-deprived people, and sick people. In other cases, longer sleep could be associated with an increased health risk.

People who are exposed to sleep deprivation usually experience a decline in performance, concerning promptness more than accuracy, but also a decline in the ability to think structurally, verbal, and spatial memory and the ability to learn. There is also a decline in stress resistance and emotional responses to stress stimuli increase. Thinking and dealing with complex cognitive tasks are not affected. Acute sleep deprivation resulted in the same psychomotor performance deterioration as alcohol consumption with a blood alcohol level of 0,05 %. Some components of reduced psychomotor performance can be compensated by higher motivation (exam, test), but only in sleep deprivation shorter than 24 hours. Prolonged sleep deprivation causes problems in retrieval of memory traces, changes in mood and its stability, and even behavioural disorders, sleep drunkenness, shaky hands and more. Evidence of increased brain sensitivity after sleep deprivation is also an increase in the frequency of epileptic seizures in epileptics without adherence to regimen measures.

Short-term sleep deprivation is compensated the next night by deep NREM3 sleep and partially REM sleep at the expense of light sleep stages. Overall physical condition and cardiovascular response to normal physical activity only slightly decline in acute sleep deprivation. Acute sleep deprivation probably affects brain function. One night without sleep causes a 30% loss of cognitive abilities and loss of performance the next day. Recovery of psychomotor functions after complete sleep deprivation lasting 24 hours requires one night of prolonged sleep. If sleep deprivation lasts for two nights, there will be a 60% decline in performance the next day; such a person does not return to his standard psychomotor performance until after five days of prolonged sleep. If acute sleep deprivation is followed by an appropriately long but not prolonged night's sleep, one night of sleep deprivation is compensated by more than 5 nights of normal sleep duration. If sleep is reduced to 4 hours per night 6 days in the row, the chemical processes in the student's body will drop to the level of a 60-year-old person. [Long-term shortening of sleep time leads to problems with concentration, mental inefficiency including memory disorders and daytime sleepiness.](#) Daily problems lead to a threat to work ability and the risk of accidents on the road. A long-term consciously shortened sleep duration results in a sleep disorder referred to as insufficient sleep syndrome.

Sleep fragmentation

Sleep deprivation leads to cognitive impairment and a greater tendency to sleep and fall asleep. Sleep fragmentation has a similar negative impact on the brain, memory, and learning. Sleep fragmentation is a disruption of the natural sleep continuity because of external factors - noise, a small child or as the result of a sleep disorder.

Insomnia is the most common sleep disorder associated with shortening of night-time sleep and/or concomitant sleep fragmentation and daily difficulties affecting memory and the ability to learn. In its acute form, insomnia is the body's response to a stressful somatic or psychological event, and after it goes away, sleep normalization and the disappearance of daily difficulties occur. Chronic insomnia is a complex and broad problem beyond the scope of this publication. From the viewpoint of learning disabilities, it is important to mention the most common form of chronic insomnia and sleep disorders in young adults, which arises as a result of poor sleep hygiene and wakefulness, together with a shift in circadian rhythm.

A circadian rhythm is an endogenous biological rhythm that is a part of the biological clock that regulates the sleep-wake cycle and repeats roughly every 24 hours. The circadian cycle is controlled by a region of the brain known as the hypothalamus (part of the diencephalon), where external stimuli are analysed, especially information about exposure and internal stimuli in the form of neurotransmitters and metabolic products.

The molecular basis of circadian rhythm is represented by **clock genes**, which can regulate the production of other genes. These genes are also responsible for the ability to work and perform tasks at different times of the day. Evening-type individuals (so-called owls) are active in the evening, tend to fall asleep later, have a hard time getting up in the morning. On the contrary, morning-type individuals (so-called larks) can achieve full cognitive performance early in the day, get up early, tend to retire early in the evening. During adolescence, because of endogenous and exogenous factors, there is a tendency to shift the biological clock towards the evening type.

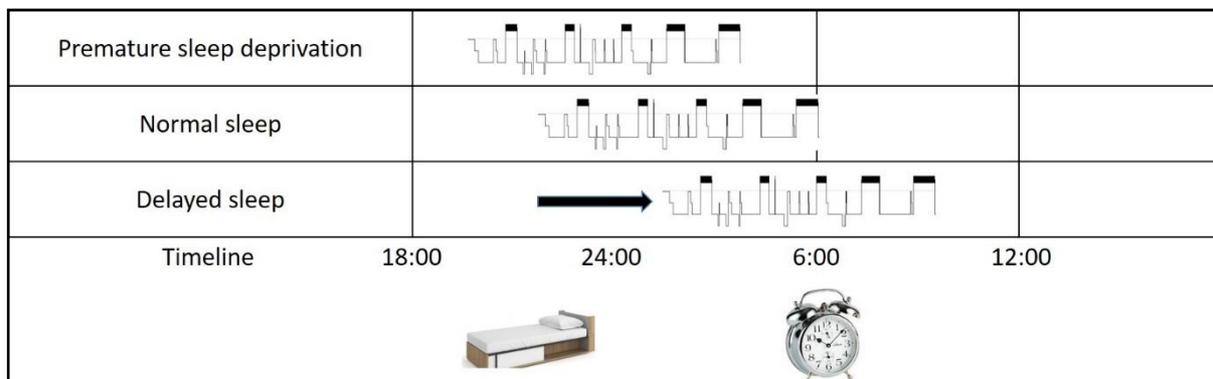


Fig. 12 A phase shift in a circadian rhythm determining sleep patterns in the adolescent period depicting delayed sleep and waking up

According to epidemiological surveys, this shift - a delay in circadian rhythms, will grow into a sleep disorder in 7 - 16% of adolescents and young adults. Such people shorten their sleep duration when they need to get up in the morning, which results in the occurrence of chronic sleep deprivation. Getting up is very difficult while it also has symptoms of sleep drunkenness. To get up in the morning, one has to set several alarm clocks, then take a cold shower and drink coffee to be able to communicate meaningfully, leave home and do other things at all. The resulting chronic sleep deprivation continues to worsen daily symptoms and drowsiness. Drowsiness results in a longer nap in the afternoon and a longer sleep, which further supports delayed sleep. Affected individuals seek professional help in the

treatment of insomnia or seek prescription stimulants to improve cognitive performance, concentration, and eliminate daytime sleepiness.

The causes of sleep disorders related to the delayed circadian phase are both internal and external. Adolescents experience a sleep phase delay because of hormonal and metabolic changes, with a share of genetic predisposition in the form of inheritance of clock genes (40% of the population). Equally important in this period are the external influences and dependence of adolescents on information technology, which is a source of blue light that can shift the processes of melatonin production (a hormone that promotes healthy sleep and synchronizes the biological clock) and the onset of sleep. If social activities or learning are scheduled in the late evening, it can also significantly delay the sleep onset.

Even when adolescents understand the nature of the problem, they do not always show interest in resetting their sleep-wake cycle. Such behaviour may be amplified by mood disorders, hyperactivity, obsessive-compulsive disorder, low level of family support or chronic condition.

Obstructive sleep apnoe (OSA) is a classic model of the disease with impaired sleep continuity that leads to daily insufficiency with memory and learning problems. Repeated awakenings and responses to awakening that terminate nocturnal breathing cessations, do not allow physiological deepening of sleep. As a result, despite spending enough time in bed, people are chronically sleep deprived with an almost complete absence of deep sleep stages. OSA is highly prevalent in the population, clinically severe forms are associated with loud snoring and nocturnal breathing cessations. The disorder can be treated. In addition to the elimination of nocturnal breathing cessations, the treatment also eliminates daily difficulties, improves concentration and memory.

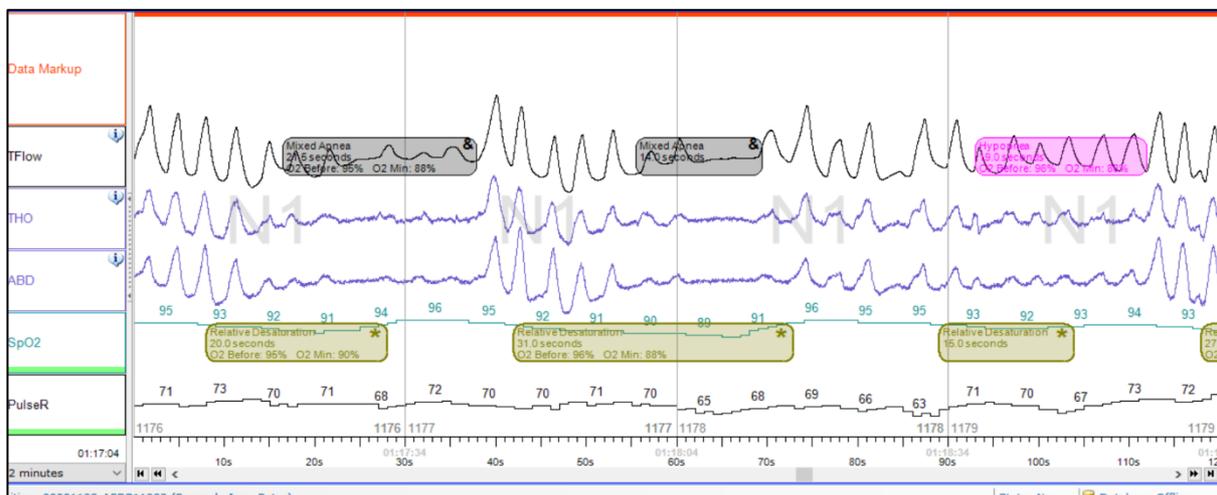


Fig. 13 Polygraphic recording showing cessations of breathing

2 minutes epoch of sleep (apnoe - gray rectangle, hypopnoe - pink rectangle, accompanied by desaturation - beige rectangle). Cessation of breathing is followed by compensatory hyperpnoe with an increase in breathing rate and amplitude (between breathing events). In the overnight recording session of a 47-year-old man, cessations of breathing occurred on average 52 times per hour of sleep (source: Department of Neurology Archive, Faculty of Medicine, Pavol Jozef Šafárik University and Louis Pasteur University Hospital in Košice)

Note: apnoe - complete cessation of breathing, hypopnea - reduction but not a complete cessation of breathing, desaturation - decline in blood oxygen saturation level.

Neurodegenerative diseases (Alzheimer's disease, dementia, Parkinson's disease) are also inextricably linked to memory and sleep disorders. Sleep disorders in these cases are the result of a neurodegenerative process as well as memory disorders. Sleep disorders are not the cause of cognitive impairment, but a part of the clinical picture. However, sleep disorder treatment can significantly improve quality of life.

Sleep and students

University students often experience time stress, not only throughout the examination period, but also throughout the semester. An interesting finding was made in the work by Wen-Wang Rao et al. (2020). Sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI). The results showed that students in Europe had the worst sleep quality, followed by students in America and Africa while students in Asia and Oceania had the best sleep quality. They also confirmed that medical students had a significantly poorer sleep quality than students of different disciplines, and also than the general elderly population, which may be related to higher study demands.

Studies that investigated the basic sleep characteristics of university students showed significant differences from the general population. The results showed that compared to the recommended values and the general population, students sleep less, while 35 - 77% of students (depending on the conducted study) experience a lack of sleep. They often report difficulty falling asleep, drowsiness during the day, and many of them have a markedly disturbed circadian rhythm. Up to 30% of students reported more severe sleep disorders.

Many studies examining a relationship between sleep deprivation and learning outcomes of university students have found that sleep deprivation and sleep disorders negatively affect student outcomes. They usually assessed the duration of the night's sleep before the exam/test and the subsequent exam/test results. Cognitive studies have confirmed that students with a sleep deficit performed worse in dealing with more difficult and complex tasks but were equally successful in dealing with simple tasks compared to students without sleep deficits. Questionnaire studies have confirmed that students with poor sleep or poor sleep quality have higher levels of psychological stress.

The National Sleep Foundation advises that the optimal duration of sleep for young adults (aged 18 - 25; age range of university students) should be 7-9 hours per night. **During time periods that demand increased effort and energy, the need for sleep also increases.** In the age range of adolescents and young adults, sleep onset is very often delayed until late at night. The examination period often contributes to sleep disturbance, especially if the student postpones learning until night hours. Sleep subsequently lasts until the late morning and early afternoon hours which gradually disrupts the circadian rhythm. It results in difficulty falling asleep, inability to fall asleep, difficulty waking up in the morning, fatigue during the day, impaired concentration, and irritability.

Another form of sleep disorder during adolescence is insomnia without a circadian rhythm shift. In the beginning, difficulties that the student experiences are a stress response associated with final exams and the like. The student to prevent cognitive problems and failure because of poor sleep, goes to bed 1 - 2 hours earlier. However, prolonging the time in bed cannot consolidate and deepen sleep, on the contrary, it leads to further sleep

fragmentation and worsening of insomnia with an increase in anxiety and fear of another night. Such a health problem during the examination period or after starting a job attracts a quick and affordable solution, such as alcohol. It will serve as an excellent means of falling asleep, but it is not good as a sleeping medication. In addition to the risk of addiction, it will cause frequent awakenings and vivid dreams in the second half of sleep, creating a vicious circle of sleep disorders. The most ideal preventive measure is awareness of this matter and adherence to proper sleep and wakefulness hygiene. In the case of already developed insomnia, the treatment is based on psychological guidance on the principles of the so-called cognitive behavioural therapy, which aims to apply the sleep hygiene principles in real life. At first glance, medication treatment has a faster and more pronounced effect, but it is associated with a high risk of addiction. Scientific papers clearly prefer psychotherapy to pharmacological treatment in the long term.

Not only the sleep duration, but also its quality is important for physical and mental health. [Lack of sleep and poor sleep quality have a significant negative impact on memory and learning processes.](#) Therefore, it is appropriate to master the basics of sleep hygiene and adhere to them during university years, and in adulthood. Sleep hygiene includes several recommendations on how to improve the quality of night's sleep.

- Keep a regular sleep-wake schedule on weekdays as well as weekends.
- Create a relaxation ritual that you will do before you go to bed.
- Create an optimal sleep environment: suitable temperature, dim lighting, silence, comfortable bed. Remove clocks, electrical appliances, and electronics from around the bed.
- Avoid alcoholic, energy and caffeinated drinks and nicotine. The effect of these substances can last for several hours and thus affect the sleep quality.
- Be active, exercise regularly during the day, but not immediately before bedtime. 10 minutes of aerobic exercise during the day improves the quality of night's sleep.
- Do not eat heavy foods, large portions of food or drink plenty of fluids before bedtime.
- Do not use devices that produce blue light, such as a computer, tablet, or mobile phone, at least 30 minutes before bedtime. If possible, use screen protectors and yellow glasses in the evening.
- Do not sleep during the day. If you have to, then for a maximum of 30 minutes, never later than 03:00 p.m. (so that you do not fall asleep, do not lie down on bed, just sit comfortably in a chair).
- When you are in pain, do not avoid use of analgesics. It will help you sleep at night.
- If you are taking medications, make sure they do not cause insomnia (such as beta-blockers or some antiepileptics). Check over-the-counter medicines for caffeine, ephedrine and more.

Sleep has many positive effects. Its importance is clearly manifested in sleep deprivation, but its effects cannot be enhanced by more sleep. The effect on memory consolidation and the ability to learn has only been scientifically confirmed in a group of young people. A very good example of the beneficial effect of sleep in learning can be the AHA effect, when solving a problem or understanding the study material seems impossible in the evening. However, [after a good night's sleep, the solution seems to emerge, the problem is solved, and the study material is understood.](#)

6. STRESS AND LEARNING

Throughout life, one normally encounters problems and difficult situations that pose a burden to him or her. One usually manages them using conventional adaptation mechanisms and adapts to new conditions. Sometimes, however, a stress response is activated, which significantly disturbs the balance of the body on the psychological and biological level. According to a Dictionary of Psychology by Hartl and Hartlová (2010), stress is "a physiological response of the human organism to an excessive psychological load that cannot be avoided which leads to a stress response".

At the beginning of the study of stress, scientists have defined stress as a negative emotional response of an individual to a changed situation that represents a potential threat and requires adaptation to new conditions. The stress response is accompanied by characteristic neurophysiological and biochemical changes in the human organism. For a situation to be described as stressful, the conditions of the changed situation should exceed one's ability to cope with the situation. Stress causes a disparity between the exposure factors of a stressful situation and the dispositional factors of a person. Situations or events that because stress, are called **stressors**. These are traumatic, uncontrollable, and unpredictable events representing a fundamental change in living conditions but also intrapsychic conflicts. Stress can also be caused by long-term accumulated, not very strong, but annoying impulses.

Biological stress

Walter Cannon was one of the first scientists to study stress in terms of biology. As early as 1915, he described the now well-known response to the stressful event called **fight or flight**. According to his theory, compensatory mechanisms are triggered in the body by which the body prepares either for a fight (solving a situation) or a flight, that is, escape from a difficult situation. Cannon monitored changes in the adrenergic system when animals were being exposed to stress.

Hans Selye (1966) first studied stress responses of laboratory animals, later focused on the study of stress in humans and began to develop the theory of psychosocial stress. He emphasized the fact that a socio-psychological problem can also be a stressor for a person. Selye considered stress to be **the mechanism by which the body adapts to the demand for change**. According to his definition, "stress is a condition manifesting itself as a specific syndrome the causes of which are non-specific". He coined the concept of General Adaptation Syndrome (GAS), otherwise known as the stress response. It involves three phases: alarm reaction stage, resistance stage and exhaustion stage.

During **the alarm reaction stage**, the amygdala evaluates whether the situation is dangerous or not. If so, the information passes into the hypothalamus (part of the diencephalon) and the production of monoamines (adrenaline, noradrenaline, serotonin, dopamine) is increased. These cause the heart rate to speed up, breathing to speed up and blood vessels in the brain, heart, and muscles to dilate. The production of neuropeptides (corticoliberin) in the hypophysis (the pituitary gland) and corticosteroids in the adrenal glands, which mobilize energy from energy store, is increased. Thanks to these mechanisms,

the body prepares itself for physical activity such as fight or flight. In **the resistance stage**, the body calms down and mobilizes other energy sources. It adapts to a stressful event and suppresses stress response mechanisms. By the third stage, **the exhaustion stage**, the body's energy stores are depleted. This stage is rare. Heart attack, infectious or other serious diseases can occur at this stage.

It is important to realize that stress mechanisms are to some extent motivating, in danger they even provide rescue. In the distant past, these patterns of behaviour were necessary for human survival in nature when faced with danger. The immediate consequences of stress are both somatic and psychological. The most common somatic symptoms are fatigue, headache, abdominal pain, changes in heart rate. Psychological manifestations are decline in performance, loss of motivation, memory, and concentration impairment. It is not uncommon for stress to cause lasting consequences in the form of mental health disorders (such as post-traumatic stress disorder) or to lead to psychosomatic disorders, especially cardiovascular diseases (ischemic heart disease, hypertension) and digestive diseases (peptic ulcer disease).

Eustress and distress

Physiologists distinguish between two types of stress: eustress and distress.

- A/ **Distress** is excessive, disproportionately high level of stress associated with negative emotions. It is usually accompanied by anxiety, anger, but also aggression. It is very traumatic, destructive and results in reduced performance as stress hormones block processes in the brain and reduce the effectiveness of learning.
- B/ **Eustress** or positive stress has a positive effect on the student. It is to some extent encouraging and motivating, and sometimes even accompanied by positive emotions, such as joy. It creates an optimal stimulation level, improves concentration, memory, and performance, increases perception, and enhances learning. This reasonable fear arises when the student feels slightly threatened but knows that he or she can handle the situation.

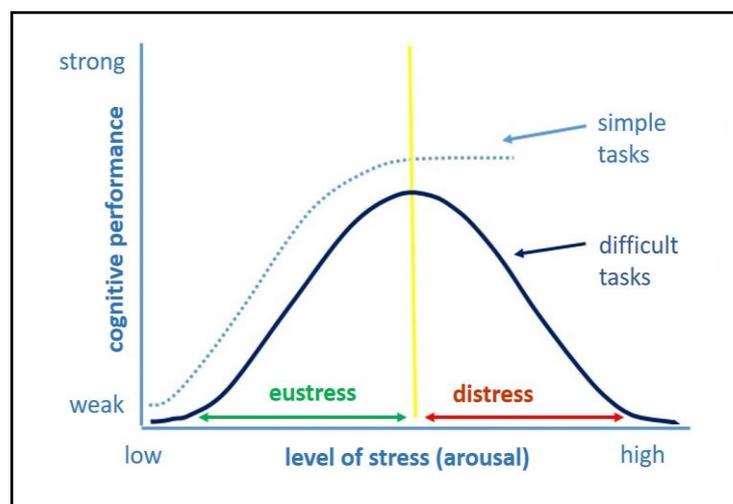


Fig. 14 The Yerkes-Dodson law (redrawn and adapted from Diamond et al., 2007)

Influence of stimulation or, more precisely, stress on performance is explained by The Yerkes-Dodson law. According to this law, appropriate level of stress during difficult and complex tasks increases attention, interest in the problem and thus improves performance. However, if the level of stress increases above the tolerable level, the performance decreases because of impaired attention and memory and errors in decision-making. According to this law, deterioration of performance does not occur during simple tasks.

Stress and memory

Stress can improve or worsen memory. The resulting effect depends on the degree of stress and the timing of its occurrence. Stress tolerance is individual. What causes a high level of stress in one person's life, can cause little or no stress in another person's life. Neurotransmitters, hormones (noradrenaline and corticoliberin) and corticosteroids (especially cortisol) are released during the body's stress response. Neurotransmitter receptors and hormone receptors are found in the hippocampus and amygdala, the structures responsible for memory. These substances play a role in the memory trace formation, its consolidation and transition to long-term memory. However, their level and timing are important. For example, too low or too high levels of glucocorticoids impair memory, especially declarative memory. Adequate glucocorticoid levels improve memory encoding and memory consolidation but impair memory retrieval.

It has been confirmed that exposure to mild stress before learning can improve the process of encoding memory traces, especially in terms of better memorization of details. Exposure to high-intensity stress, by contrast, exacerbates memory encoding and memories tend to be less accurate. Adequate stress shortly after learning (within 1 hour) enhances the process of memory consolidation. However, this is not the case if the level of stress is high, then the process of memory consolidation is impaired.

Memory retrieval is negatively affected by both mild stress and high-intensity stress, especially when it comes to episodic memory retrieval, which is dependent on the hippocampus. This is because cortisol is released during a stress response which improves the encoding of a new memory trace but suppresses the retrieval of older memories via the hippocampus.

While retrieval of information from episodic memory requires the support of the hippocampus, retrieval of information from semantic memory can be realized via the cerebral cortex. Adequate acute stress can improve the retrieval of information from semantic memory. However, memories should be strong (well-learned) so that the retrieval of these memories is independent of the hippocampus and can be realized via the cerebral cortex, which shows increased activity during stress. From a neuroanatomical point of view, stress affects memory processes at the level of the hippocampus, amygdala, cerebral cortex and has an impact on interactions between memory systems.

Schwabe and Wolf (2010) confirmed that stress affects not only the quantitative characteristics of memory (how long it is necessary to study in order for a person to learn it and how long it will be remembered), but also the qualitative characteristics of memory (how a person learns and what he or she remembers).

As for the duration of stress the results of the studies are unambiguous. Short-term stress to an appropriate extent can have a positive effect on learning and memory, long-term stress has negative effects not only on memory, but on the whole human organism. Long-term exposure to stress and stress hormones significantly affects brain structures and often results in cognitive impairment and memory impairment. Distress experienced by the mother during the prenatal development of the fetal brain causes the impairment of cell proliferation in the fetal hippocampus, thereby affects fetal cognitive functions and memory later in life.

Medical students, especially in the first year, are exposed to a higher level of stress than the general population. Similarly, anxiety and depressive symptoms are more common in first-year medical students. The major stressors are credit tests and then exams. Other stress-inducing factors include lack of time and poor time management, lack of sleep, large amount of study material, lack of systematic preparation, high expectations and fear of failure.

Stress management strategies

A stress response is characterized by defensive and coping responses, the task of which is to influence emotions and reduce stress levels. Defensive responses are automatic, instinctive, and unconscious. Coping responses are based on thought-out action and cognitive processes. Both types of responses are influenced by a person's personality traits. An active and conscious way of coping with stress is called coping strategy or **coping**. These strategies can be focused on problem solving or influencing an emotional state. Both types are usually used to manage stress.

A/ **Strategies focused on the problem** include, for example, analysis and assessment of the situation, evaluation of the positives and negatives of possible solutions and subsequent decisions. Evaluation and improvement of one's abilities, new personal goal setting or alternative satisfaction in other positive activities or events also help to solve the problem. Another cognitive strategy can be a temporary break from the problem or its underestimation, reducing its importance and thus reducing the level of stress.

B/ **Strategies focused on the emotions** are divided into behavioural and cognitive. Behavioural strategies are, for example, taking exercise or doing physical activity that relieves stress and seeking emotional support from the close ones. Understanding and support from your close ones and friends is a very important factor in managing stress. Negative stress management strategies include, for example, trying to avoid stressful situations, self-blame, perseverance, or resignation.

What does theory and scientific knowledge about stress imply?

University studies are accompanied by many stressful situations, especially during examination periods, but often also during semesters. High intensity stress negatively affects memory processes and learning, and thus your cognitive performance and your learning outcomes. However, mild stress increases your performance as it improves concentration, memory and learning processes.

It is important not to give in, not to be controlled by stress and emotions, but to try to take control of the situation and yourself. Positive strategies are a condition for coping with stress:

- Seek support from your friends and close ones, talk to them about stress. Social support is a very effective stress management strategy.
- Take exercise. Every physical activity is good. Endurance sports especially because they teach you to go beyond your limits.
- Remember to get enough sleep. Lack of sleep results in impaired management of stress responses.
- Work on your time management skills. Time management is important.
- Separate responsibilities (learning) from your free time.
- Gain real perspective on your skills. Do not overestimate yourself, improve your skills if necessary.
- Set realistic goals. Divide one big goal into smaller ones and fulfil them gradually.
- Reward yourself for success, learn from failures.
- Practice suitable relaxation techniques such as deep breathing, autogenic training, yoga, aromatherapy, or music therapy.
- In case of problems with stress management, do not hesitate to find a specialist.

7. STUDIES AND MENTAL FUNCTIONS

University life tends to be a very sudden and extreme transition for many students coming from high schools because of many situations that lead to stress, such as overlapping exams, submission deadlines for papers, social needs, or part-time job. It is not easy for a student to deal with several complex tasks, and therefore it is not surprising that there is a relatively large proportion of emotional fluctuations of various kinds.

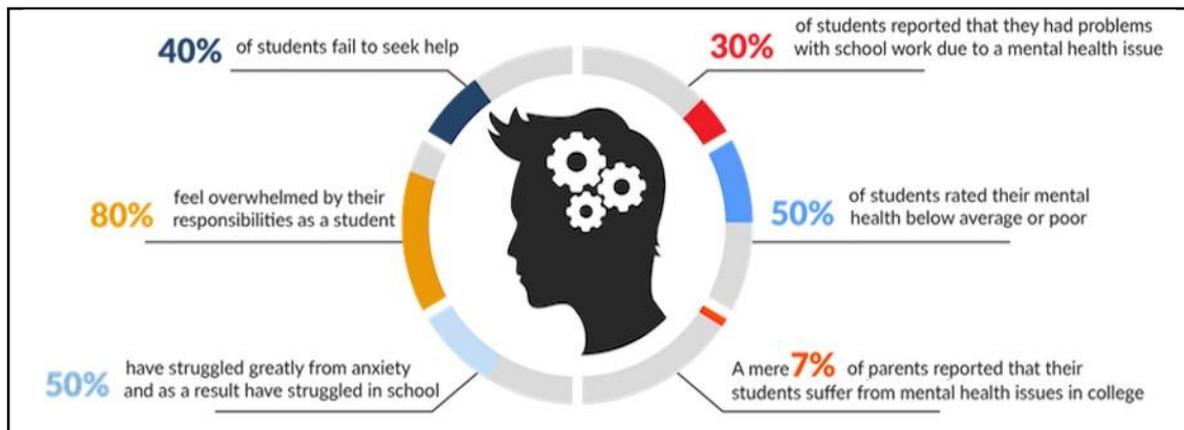


Fig. 15 Mental health problems of today's students

(adapted from: <https://collegestats.org/resources/mental-health-guide/>)

Depressive and anxious states are among the most common mental health difficulties that occur during periods of increased study load. These are characterized as follows:

A typical **depressive episode** is manifested by a period of at least two weeks, more often several weeks, when a person feels very depressed, "down in the dumps", dejected and despite various distracting stimuli, this mood persists or worsens. The most obvious symptom is a reduced ability to experience satisfaction and joy even from the small things. These manifestations can lead to a significantly worsened quality of life and performance at school. Typical manifestations of depression are associated with many symptoms, such as sleep disorders, impaired ability to concentrate and think, feelings of worthlessness, guilt, or shame, slowing down and fatigue, or suicidal thoughts or actions.

Anxiety is an unpleasant emotional state accompanied by physical symptoms, the causes of which cannot be defined more precisely. The intensity varies, from a mild feeling of restlessness to a state of panic. Anxiety can also manifest itself in the form of excessive worries, which can also occur in a completely healthy person if he or she is going through a period of increased load (unpleasant events, hormonal fluctuations, and others). After the situation calms down, the worries usually disappear. It is only reactive anxiety (occurs in response to something). Anxiety is a common symptom of several disorders, but while people with depressive disorder, for example, feel anxious occasionally and people with phobia fear one particular thing, a typical anxiety disorder such as Generalized Anxiety Disorder involves several different tension for at least six months or even a longer period of time, without the person concerned being able to explain the cause of the situation. From the point of view of diagnosis, the doctor follows the criteria of the International

Classification of Diseases (ICD, currently in its 10th revision), and the extent to which these symptoms interfere with the patient's normal functioning in life is also important.

- Typical **psychological** symptoms (signs) of anxiety include insecurity, tension, worries, expectation of evil, distraction, inadequate reactions, upsetness the need to constantly do something and the feelings of fatigue afterwards, a significantly emotional reaction, fear of death, fear of illness, sleeping difficulty, especially difficulty falling asleep, excessive reactions to unexpected situations or interruptions (a person is easily frightened), difficulty concentrating, or "emptiness in the head"; constant irritation.
- **Physiological** manifestations of anxiety are characterized by instability while walking, chills or feeling hot, numbness or tingling in different parts of the body, heart rhythm disturbances, pricking sensation and pressure in the chest and abdomen, breathing problems, spinning sensation in your head or dizziness (these difficulties are not physiological in nature; from the point of view of internal medicine, a person is healthy), loss of interest in sex, shaking and tremors, tics and visual and hearing impairment.

Psychological changes such as mood swings or increased anxiety do not necessarily mean the presence of a mental health disorder, but on the other hand, it is not good to downplay them or be ashamed of them. Finding a specialist who will provide a student with the necessary information regarding a topic can be very beneficial for the student's future. University years represent a breakthrough that will mark the next chapters of one's life in many ways. Up to 75% of serious mental disorders start before the age of 24.

Other significant mental health problems the students may struggle with are:

- A/ problems with identity formation,
- B/ self-harm,
- C/ extreme mood swings/bipolar affective disorder,
- D/ use of psychoactive substances.

A / **The struggle for identity** is accompanied by a period of transition to adulthood. It is not an easy period even under normal conditions, and with an increased emotional and psychological load, self-esteem is often exposed to many doubts. The result is resignation, apathy, a sense of nonsense and accompanying signs of anxiety, inner distress, contradiction, and depression, as well as unbalanced and conflicting relationships.

B / **Self-harm** often occurs in connection with an identity crisis and is an expression of an extremely intense internal tension, which self-harm releases and brings momentary relief. Self-harm is the act of purposely hurting oneself without the intent to commit suicide. These people usually choose to hurt those parts of the body that are not visible. It is always a very serious signal of internal struggle and tension and requires consultation from specialists.

C/ **Extreme mood swings.** Moody "ups - downs" are a natural part of life. If longer periods of depression and inefficiency alternate with periods of excessive activity and it is difficult and to explain them in terms of external factors and more serious psychological changes occur in a person, it is appropriate that a specialist assesses psychological state of the person and determines a diagnosis if necessary, such as bipolar affective disorder.

D/ **Psychoactive substances.** Their use often appears as doing something mature and independent to a student. Unfortunately, the opposite is true. A common consequence is

represented by a poor daily routine, failing to complete tasks and increased stress levels. According to survey data, 32.4% of students get drunk once in two weeks and 40.8% of students have at least one episode of intoxication in one month. Data on mental health problems of university students are not the most optimistic. They show that in the last twelve months, more than 40% of university students have experienced higher than the average stress level and almost 80% of university students have felt overwhelmed by the amount of responsibilities and 45% have felt hopeless. Almost 73% of students went through a mental health crisis during their studies, while 34% of them report that they did not share it with anyone (these data come from the National Alliance on Mental Health statistics, 2016). It is a sad fact that 7% of students have seriously considered suicide. In addition, 40% of students with pathological changes in their psychological state did not seek professional help. The main reason is the fear of stigma.

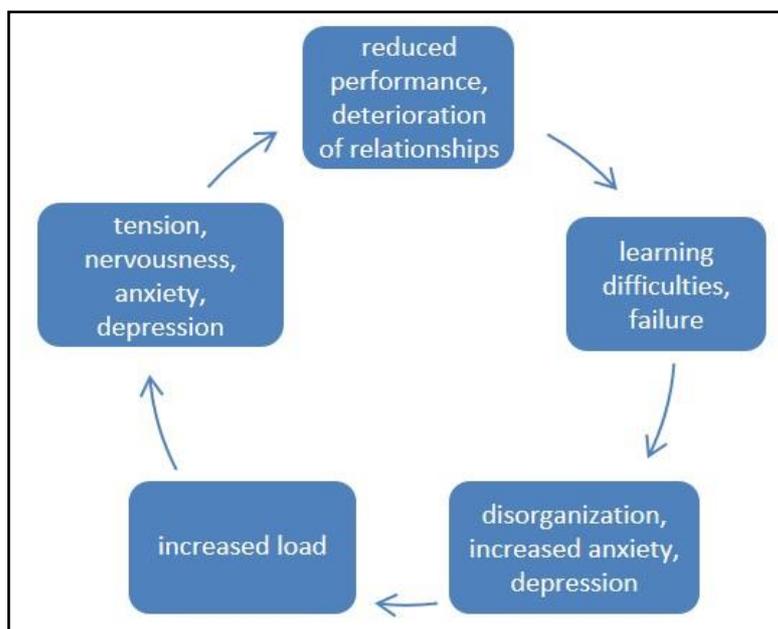


Fig. 16 The vicious circle of causes of mental health disorders

If sufficient attention is not paid to such stressors, their influence will manifest itself in unhealthy, self-destructive, and ultimately dangerous behaviour. Behaviour commonly described as student lifestyle, such as poor diet, excessive alcohol abuse, drug use or chaotic sleep are directly linked to mental health stability and overall mental health.

Dynamics of development of mental changes, especially the most common ones, that is, anxiety and depression in university students is difficult. Several factors contribute to their development, such as new adaptation requirements (new teaching methods, new social groups, etc.), exceeding the individual capacity to cope with psychological load, and finally wrong or ineffective methods of learning.

Three levels of context need to be considered:

- increased load as such → genetically predisposed human organism → anxiety, depression,
- increased load + poor management (for example, ineffective learning) → anxiety, depression,

- anxious, depressed individual + increased load as such → deepening of basal symptoms to the clinical level.

These levels are not always distinguishable, certainly the unifying element in the background is unproductive studying, which again can be the cause or consequence of psychological changes.

Low learning efficiency also includes factors outside of learning itself:

- Social aspects of the pedagogical process: fear of the teacher, devaluation of the student → reduced motivation, poor planning, busy exam schedules, poor relationships in student groups, and the like.
- Social aspects of an individual: problematic situations in the family, problems in intimate or friendly relationships, bad financial situation, and others.
- Performance style based on an individual's personality: procrastination, tendency towards helplessness, giving up after failure, excessive perfectionism, focusing on unimportant details (does not allow to understand the whole concept), poor time management and others.

There are many kinds of student stories... Difficulties appear most often after the second year of university studies.

Student V. describes the problem of her not knowing how to study even though she studies often and tries hard. She repeatedly fails midterm tests, studies more and more, anxious feelings emerge, which gradually escalates to such a level that she experiences terrible tension when she thinks of studying. She subsequently cannot focus on studying at all, she does not enjoy anything, and she does not believe in herself. The problem has two connections: one is learning by memorization which is a wrong learning method, and the other is not feeling appreciated and being considered a slacker.

Student I. is very motivated to study, studying is her life's dream. After failing an exam for the first time, a block occurs. She starts to doubt herself and her abilities. She thinks about quitting because she "does not have it" and compares herself with a successful sister. At her own request, her intellectual abilities were assessed, and they were above average. It brought her a sense of relief and improved her quality of life overall. After two years, the depressive states re-emerged, again because of failing an exam. At that time, the depression seemed autonomous and she was referred to a psychiatrist. The necessary time was set for psychopharmacological treatment and the result - she is happy.

Student A. failed an important exam (she has to retake the exam the following year) which left her feeling sad for a long time while she also experienced suicidal thoughts. She is excessively conscientious and needs to learn everything in detail. Her self-esteem depends on being appreciated by others. Especially she feels unspoken pressure from the family, then she compares herself with fellow students. She gradually reevaluates the need to get an "A", she learns to appreciate her achievements - "learns how to brag". After overcoming the crisis, her study results are excellent.

Student A. comes with the problem of excessive anxiety. He is in a very difficult situation because if he fails the exam (a big one), his studies will be terminated. The problem is in the way he organizes his work - he studies with the feeling that a lot of information is useless,

and he will never need them anyway. He also admits to playing computer games and having two computers on the table. One for studying, the other for playing games. He was surprised that the main recommendation was that he had no psychological tricks in his methods of studying and that he had to study (we assumed that until now he had always made it thanks to luck or cheat sheets...)

And a sad example at the end: a successful student, extremely intelligent, motivated, who had no problem with exams, was affected by a serious mental health disorder – schizophrenia. Gradually she was becoming more and more closed but continued to study. Her interests changed, slowly she was becoming increasingly autistic, uncritical, but she handled school demands.

If a student finds himself or herself in a difficult situation, the most important thing is to be able to look at himself or herself from a detached point of view and to have an independent mind to assess the core of the problem: "Do I have it? Am I studying enough? Am I being bothered by other problems?".

It is sensible to ask an expert about his or her opinion. [The most appropriate person to go to is a counselling psychologist from the University Counselling Centre \(UNIPOC\)](#) – it is always good to navigate the problem, listen to the opinion of others, and understand the core of the problem.

Studying with special educational needs

For many years, the prevailing view was that the characteristics and symptoms of Attention Deficit Hyperactivity Disorder (ADHD), Attention Disorder (AD), specific learning disabilities (especially dyslexia and dysgraphia) noticed during childhood disappear as the child is getting older. But these are lifelong conditions, they do not disappear, they only develop as a person ages.

[The most common educational complication is ADHD](#), which is a disorder marked by an ongoing pattern of inattention and/or hyperactivity/impulsivity that interferes with daily functioning or development. **Inattention** represents one of the symptoms of ADHD. It means a person wanders off task, lacks persistence, has difficulty sustaining focus, and is disorganized. These difficulties are not due to defiance or lack of comprehension. **Hyperactivity** means a person seems to move about constantly, including in situations in which it is not appropriate; or excessively fidgets, taps, or talks. **Impulsivity** means a person makes hasty actions that occur in the moment without first thinking about them, or a desire for immediate rewards or inability to delay gratification. Impulsivity has a high potential for harm. Impulsive people may be socially intrusive and excessively interrupt others. Typically, they make important decisions without considering the long-term consequences. In adolescence and adulthood, hyperactivity falls out of this well-known triad and inattention is accentuated. ADHD and ADD are medically classified as mental health disorders. The criteria for ADHD and ADD are precisely defined by the classification systems of the International Classification of Diseases (ICD-10) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).

General practitioners and pediatricians are increasingly confronted with adults who show signs of performance-limiting inattention but are not hyperactive. ADHD is a disorder

that affects individuals differently, but consistently, throughout their lives. ADHD in adulthood may also be a hidden disorder. Although many cases have been diagnosed correctly, it is likely that there is many those whose attention problems and their consequences have remained underestimated and unresolved. The importance of listening to students at more advanced levels of education is made known. Indeed, the disorder may go unnoticed until adulthood in case their upbringing may have been liberal, or it may be a mild degree of the disorder until the demands of adulthood arise. Students who have undiagnosed ADHD or related disorders are confronted with academic problems because of the demands for intensive concentration that is required at higher education levels. It has been found that students with specific disorders usually begin to fail and eventually drop out of university by the second year of university studies. An undetected, and therefore untreated, disorder may lead not only to significant problems in education, but also to a disruption of the social and family situation and personal relationships and a disruption of self-confidence and emotional balance. Proper management of this disorder may help improve the lives of many with these disorders and their families.

People with attention deficit have an inability to pay enough attention to details in everyday life, make negligent mistakes at work, but also during other activities. It is difficult for them to pay attention to the task they are dealing with, for example, in lectures or when the reading is long. They do not seem to listen when somebody speaks directly to them. They do not follow instructions and cannot complete normal tasks and duties. They have trouble organizing tasks and activities - for example, they are chaotic and have poor time management. They are reluctant to take part in tasks that require more sustained mental effort and try to avoid them. They tend to lose things even when they need them to function in everyday life, such as keys, wallets, cell phones. They can be easily disturbed by irrelevant stimuli and thoughts and are forgetful in everyday life. They forget to pay bills, to go to arranged meetings or to reply to e-mails.

People with signs of hyperactivity/impulsivity are clearly restless. They will tap their feet or fingers and cannot sit still even in situations where it is expected. They feel tension and cannot keep quiet for a long period of time. They cannot calmly devote themselves to relaxing activities, they talk too much. They spill out an answer before the question is completed. They have trouble waiting for things, for example, waiting in line. They interrupt and jump into other people's speeches.

The individual constellation of these symptoms varies; there are individuals with ADHD who have primary attentional symptoms while other individuals with ADHD have primary symptoms of hyperactivity/impulsivity. There are also those who have symptoms from both categories. Based on observations of students studying with special educational needs (ADHD, AD, dyslexia, dysgraphia, etc.), an understanding approach of the family and a friendly academic environment has proven to be supportive. They especially appreciate the willingness of teachers to have patience with their frequently asked questions about the explained course material, as well as the understanding attitude of fellow students. It helps them if teachers can adapt the instructions to their needs and perceive the teacher's interest in their academic growth in a collaborative environment. Peer relationships, so called peer tutors, where a student teaches a student, may also be a source of support. When the environment does not reflect their problem, they feel unappreciated or underestimated.

They often feel blocked and isolated and it takes away the courage to seek individual consultations.

Obviously, academic performance is the sum of various factors:

- characteristics of neurocognitive operations,
- teaching method,
- learning style,
- social environment factors (family, fellow students, school atmosphere, etc.)
- motivation and its value orientation.

It is important to bear in mind that for students diagnosed with ADHD, the learning process requires more rebuilding for it to be sufficiently effective and successful. The complex set of problems that students face is diverse and often requires specific interventions; this publication focuses only on suggestions for possible useful modifications to the study process.

Modifications to the study process

Experts summarize the guidelines related to education in the following categories:

- A/ study skills,
- B/ organizational skills and structure,
- C/ time management skills,
- D/ skills for the whole semester and individual assignments,
- E/ test/exam preparation strategies,
- F/ structure,
- G/ fight against procrastination.

A/ Study skills

- space out study sessions over a longer time,
- designate one quiet room or area as your study space,
- develop regularity, create a routine,
- take frequent breaks,
- study consistently, not at the last minute,
- ensure sufficient time for the completion of assignments so that the time for editing and correcting the text is considered,
- use individual consultations when necessary,
- underline or highlight important information in the text and add notes in colour,
- rewrite notes,
- test/rehearse the information being studied and create practical questions regarding the topic,
- use active reading techniques - read the headings before delving into the whole chapter, go through the chapter to find out what is first and what will follow, take notes, create questions about the chapter headings, rehearse the main information of the chapters,
- use a laptop to take notes during seminars and lectures,
- introduce one-hour time intervals between study sessions throughout the day instead of a 3 - 4 hours study session in the evening,
- find your optimal time to study, when you are the most attentive and in the best shape,

- choose the most suitable study environment, white noise, or absolute silence (white noise combines all the sound frequencies that humans can hear),
- think about whether it is better for you to study alone or in a group to make study sessions interesting and to help you stay focused longer,
- go through the notes as soon as possible after the seminar/lecture, remind yourself of the material covered, then go through the notes before the next seminar/lecture,
- do activities, such as reading, underlining, writing in the margins, highlighting in colour, reading aloud and repetition, as they often help you stay energetic and focused.

B/ Organizational skills

- keep your desk uncluttered,
- use bookmarks and various paper clips to organize notes from lectures (as well as your own study notes),
- when taking notes, leave enough space in the margins for writing information from study materials,
- keep track of which books and other materials are needed for studying,
- borrow books and other materials from the library before starting the study sessions,
- at the end of each day, clean and organize your desk.

C/ Time management skills

- start each day with a list of what needs to be done and set priorities (for example, going to buy socks is not as important as completing the assignment that is due today),
- do not procrastinate,
- finish your to-do lists every day,
- do not put a lot of commitments, physical exercise, and meetings into your daily agenda,
- set aside enough time for assignments, reading, and studying course materials,
- organize your time so that you can take breaks, rest, and exercise, engage in social activities, and eat food,
- use the daily planning calendar and write down all important tasks/activities for the day,
- stick to the plan and do not be seduced by distractions,
- realistically estimate how much time individual activities require and clearly mark the time for school, seminars, laboratory papers and the time for completing assignments and taking notes in the diary,
- mark also a spare extra window if something lasts longer,
- break down larger tasks into bite-sized tasks and include them in your daily planning calendar; a large task may seem unmanageable, but if it is divided into smaller parts, it is a way more manageable,
- do not use the "It should be done" category in your daily planning calendar - for people with ADHD it will become the "It was never done" category,
- create a general overview of duties for the whole semester, month, and week,
- get used to having a diary with you and writing down even bite-sized tasks - check every morning and then continuously during the day what duties are currently planned and try to fulfil them all.

D/ Skills for the whole semester and individual assignments

- talk openly to your teacher about your needs,

- ask the teacher as soon as something is not understood during the class,
- take a break to eat small snacks between classes, to take a walk or just to relax for a moment,
- plan your seminars and lectures so that there is enough time to move between classrooms,
- alternate easy and difficult classes (if possible) and divide the load into 2 - 3 days (for example, Monday, Wednesday, Friday are difficult days, but Tuesday, Thursday are easier days), so that there is time to study,
- plan writing seminar papers or diploma theses in advance to ensure ample amount of time to meet with the teacher to discuss the topic, search for materials in the library, write and organize the text.

E/ Test/exam preparation strategies

- review often - this is the only way to store information in long-term memory.
- try to understand information, do not just memorize it.

F/ Structure

- use self-instruction lists and notes,
- use coloured highlighters,
- consistently adhere to routines and rituals,
- use reminders and software programs that help organize time,
- use calendars, laptops, phones.

G/ Fight against procrastination

- stick to a daily schedule,
- try to add the things you put off the day before to your daily schedule,
- embark upon difficult assignments as soon as possible,
- choose an interesting topic of assignment to avoid being bored afterwards,
- use the help of university centre counsellors,
- find out, explore what is motivating,
- study first, then have fun,
- learn to reward yourself with little things during the day (for example, a favourite drink, dessert, phone call, visiting a friend, etc.),
- be careful not to extend the 10 minutes break to a 15 minutes break,
- television should be avoided when studying; watching TV should be used rather as a reward after the end of a scheduled activity,
- indulge yourself with a greater reward if a more serious task is fulfilled (for example, a free weekend, sports outside the usual environment, etc.).

These ideas for optimizing study skills are just suggestions. It is up to the student to incorporate what is productive for him or her into his or her learning style.

It is understandable that university studies place an increased demand on students with symptoms of ADHD. The prerequisites for success are realistic self-reflection, adjustment of learning habits (especially getting used to greater demands, independence and self-regulation of learning) and, finally the ability to ask for help.

At present, university counselling centres are available to students, where experts are ready to solve both study and personal problems.

For students diagnosed with special educational needs (this includes not only students with ADHD, but also students with other learning disabilities or other changes in health status), it is possible to apply for the status of a student with special educational needs, on the basis of which it is possible, without changing the demands on the scope of knowledge, to request various changes in the educational process so that the student has as much space as possible to acquire knowledge and also to prove the acquisition of knowledge.

Rules of psychohygiene

Mental health hygiene is based on three pillars:

- A / proper work-rest schedule,
- B / well-balanced diet,
- C / prevention of stress reactions.

A/ **Proper work-rest schedule**

should be set individually according to the needs of each person who needs a certain balanced ratio of workload and rest at any stage of life.

B/ **Diet for effective learning**

The university period brings with it, among other things, a lot of studying and exams. Examination periods are very stressful for many students and a lot of them suffer from insomnia, experience weight fluctuations, stomach problems, and the like. But how to stay in the best possible shape and what can be done to help you study? Sometimes a proper diet, regular exercise and getting enough sleep will help. Properly chosen foods support brain activity. What you eat also has a significant effect on how well you think. So how do you properly feed your mind? Undoubtedly start with the right hydration schedule. In addition to enough pure still water, it is recommended to alternate high-quality coffee with green tea, mint, or other herbal tea. It is also recommended to opt for a diet plan that includes plenty of sea fish (salmon, tuna, halibut, sardines), olive oil, fresh fruit (banana, blueberries, strawberries, avocado, pineapple) and vegetables (carrots, broccoli, cauliflower, cabbage, tomatoes) that are rich in fibres, vitamins and antioxidants, low-fat dairy products, legumes (soybeans, chickpeas), oatmeal, nuts and seeds to support proper brain function when studying. It is necessary to avoid stressors that affect the brain, which include refined sugar, caffeine, alcohol as they may cause problems with concentration. If you want to stay awake, choose high-protein meals. Indulge in carbohydrates for a good night's sleep. It is important to eat smaller portions approximately every three hours so that you do not feel completely full. Recommendations for the optimal number of daily servings to be eaten are taken from the basic food groups in the form of a food pyramid and a healthy eating plate both of which have been put into practice. The food pyramid (the healthy eating pyramid) has been designed to show the recommended balance among different classes of nutrients and to help ensure that the diet is sufficiently varied. The healthy eating plate helps to determine the correct ratio of individual components of food.

The most common diet mistakes include: eating large portions of food, continuous and almost constant eating throughout the day, irregular eating 1 - 2 times a day, shifting the highest energy intake to evening and night, overeating, consumption of sugar-sweetened beverages, alcohol, excessive caffeine intake, insufficient water intake, reading while eating

or watching television, fast and greedy eating, eating to relieve stress, to cope with fear or to relieve tension, food as a form of reward and sticking to senseless diets.

C/ **Stress prevention**

Stressful situations are a natural part of life and cannot always be avoided. In general, extreme situations, long-lasting though mild conflicts, sudden and unpredictable circumstances are stressful. Stress management is individual for each person.

Load management techniques may be divided into two groups:

- problem-oriented techniques (problem solving, reassessment of objectives, change of solution tactics) and
- techniques aimed at dealing with the stress reaction - it includes the most suitable preventive relaxation techniques (autogenic training, progressive muscle relaxation, mindfulness, breathing exercises and many others).

Beware of inappropriate techniques such as escaping into fantasy, alcohol, or other psychoactive substances.

When a student is under stress while studying, he or she loses 60% of his or her ability to solve problems. Stress may deprive you of hours of study sessions. But if you are perfectly prepared, you will not be under such stress. If you do not understand something and you do not find the answer in the textbook or online, do not be afraid to contact your teacher. Each teacher has consultation hours. Properly formulate a question regarding the part of the study material you do not understand or the point at which you are starting to get lost.

A simple guide to **breathing exercises** such as deep breathing, which is extremely important for relieving stress, because it relaxes tense muscles (such as in the throat or abdomen), oxygenates the brain (for better thinking and memory) and has an overall calming effect. So, stand by the window in the hallway, inhale slowly and deeply, exhale slowly, while thinking about how you are blowing the parachute seeds off a dandelion, inhale - exhale, repeat 10 times. Think of dandelion parachutes, inhale - exhale, repeat 10 times.

8. MEANS TO ENHANCE MEMORY AND LEARNING

How one uses and trains his or her brain is unique and variable depending on the person. It is influenced by external factors (family, friends, fellow students, environment, school), but a lot depends on every individual (individual experience and qualities, self-confidence, intellectual involvement, physical activity, nutrition, social interaction). There is no one universal method to enhance brain function, to learn more effectively, to remember more or to improve attention span.

The basic pillars are:

- regular physical activity,
- mental training,
- a proper lifestyle with a balanced diet,
- getting enough sleep,
- mental balance.

Anyone who strives to improve and move forward can choose and try ways, methods and techniques that suit him or her and help him or her realize their plans, achieve their goals, and fulfil their commitments.

Physical activity

Regular and long-term aerobic physical activity is one of the most effective ways to favourably influence and encourage brain plasticity and adaptability. Exercise has an overall positive effect on physical and mental health. Regular physical activity increases the functional capacity of almost all organs and systems. It stimulates the cardiovascular system, strengthens the immune system, improves the functions of the movement apparatus, digestive system and improves physical fitness. It reduces stress, anxiety and has antidepressant effects. It also leads to the release of so-called happiness hormones and has a relaxing effect. Regular exercise brings benefits to the preventive and supportive treatment of metabolic, neurodegenerative, and oncological diseases.

During physical activity, blood flow increases in the brain and supplies it with oxygen and nutrients. Thanks to physical activity, the brain is trained and its executive functions are improved, such as planning, decision-making and willpower, initiation of new tasks and activities, expedient action, problem solving, adaptation, successful performance, as well as cognitive functions such as memory, learning, thinking, attention, verbal proficiency and spatial orientation.

However, this requires our will, our energy, but also our self-discipline, as regularity and perseverance are needed. Of course, time, because the overall positive effects on our body and brain do not appear overnight. However, if you get used to physical activity, which individually lasts 1 - 3 months, the changes will be visible after only half a year of such regular activity. [Long-term physical activities enhance neuroplasticity](#). Thanks to these activities, the neurogenesis of some parts of the brain important for memory, learning and attention occurs as a result and the process of brain aging slows down, or the brain even becomes younger.

To enhance cognitive functions of the brain, physical activity should be carried out over a long period of time, at least 2 - 3 times per week for at least 30 - 40 minutes. Aerobic, endurance exercises that enhance cardiorespiratory fitness are suitable: running, cycling, tennis, swimming. Exercise intensity should be 40 - 70% of your maximum heart rate, so that your heart starts pumping faster and you start sweating. In practice, you can also use the so-called talk test - exercise at a specific pace that you can communicate without problems and you do not gasp.

Exercise = structured movement	over a long-term period consistently = lifestyle
	type: aerobic, endurance activity
	frequency: 2 - 3 times a week
	duration: 30 - 40 min / activity
Strength training	intensity: 40 - 70% of maximum heart rate
	frequency: 2 - 3 times a week a break of at least 48 hours between exercises

Tab. 4 Recommendations for physical activities to enhance cognitive brain functions
(adapted from: Ukropcová and Ukropec, 2016b)

Mild intensity	Moderate intensity	High intensity	Very high intensity
< 40% of maximum pulse rate	40 - 59% of maximum pulse rate	60 - 80% of maximum pulse rate	80 - 100% of maximum pulse rate

Tab. 5 Determination of physical activity intensity (adapted from: Ukropcová and Ukropec, 2016b)

Maximum heart rate HRmax	
men	HRmax = 220 – age
women	HRmax = 226 – age
obese BMI > 30kg.m ²	HRmax = 220 – (0,5 x age)

Tab. 6 Calculation of the maximum heart rate (adapted from: Ukropcová and Ukropec, 2016b)

Charakteristics	Number of steps / 24 h
sedentary individual	< 5 000
an individual with low daily activity	5 000 – 7 499
more active individual	7 500 – 9 999
active individual	10 000 – 12 500
very active individual	> 12 500

Tab. 7 Volume of physical activity defined by the number of steps in 24 hours
(adapted from: Ukropcová and Ukropec, 2016b)

To improve the benefits that aerobic exercise offers, it is recommended to change activities, change the exercise intensity, shorten pauses, speed up the pace or increase the load. An example of a change may be the inclusion of high-intensity interval training. Also, the change of environment during exercise is stimulating (exercise in nature). The brain thus receives more stimuli and new impulses that influence it and enhance its functions.

- **The combination of physical and mental exertion** ensures that newly formed neurons engage in a functional neural network. Research shows that an average of 20% more words can be learned when exercising before or during study sessions.
- **An alternative training method (life kinetics)** combines perception, movement, and cognitive exercises. Its goal is to strengthen physical and mental performance. The point is to change repetitive exercises to avoid movement automation (for example, juggling balls and catching them with the opposite hand or with crossed arms). After four or five successful attempts, it is recommended to change the content or difficulty of the exercise. The brain thus remains on alert.
- **Coordination exercises** such as dance, gymnastics, martial arts, football are among the activities that develop coordination skills, improve flexibility, balance, speed of movement and spatial orientation. They provide cooperation between the brain and the musculoskeletal apparatus and enhance neuromotor abilities at the peripheral and central levels. Such exercise improves cardiovascular fitness and leads to enhanced cognitive performance.
- **A combination of moderate-intensity aerobic exercise and strength training** is beneficial. Weight training should be done with breaks of at least 48 hours between workouts to enable muscle regeneration. It is necessary to follow the correct technique of exercise and breathing. The ability to learn new words is enhanced during aerobic exercise, while strength training helps associative memory (the ability to associate a name with a person's face) but does not improve the learning of new words. This is because different types of movement affect different parts of the brain. This affects different types of memory as memory, learning or the storage of emotion-related memories are provided by different specific areas of the brain.
- The positive effects of physical activity on brain function are manifested even **after a single aerobic exercise**. Better results in memory tests are achieved by those who exercised just before the test, even though they are in worse physical condition, than people in good physical condition who did not exercise before the test. However, the immediate effect of a single aerobic exercise on cognitive functions is short-lived (up to 60 minutes). The brain begins to form the brain-derived neurotrophic factor after the first exercise session, but with long-term repeated activity, its levels increase more, even though the exercise intensity is not increased. The mechanism of the effect of such a short-term activity on our memory is based on the principle of strengthening the connection between the hippocampus and the cortical areas.
- To improve your focus, it **is best to exercise in the morning** to feel the effect during your duties throughout the day, as the immediate effect gradually disappears after a few hours. Every physical activity is better than none. Sports should be relaxed and should bring joy alongside studying. If you are not used to it, it is advisable to start with a small amount of

physical activity and gradually increase the duration, frequency and intensity or start with regular walks in the park, in nature. Activities aimed at maintaining physical and mental balance are also suitable.

Such exercises improve concentration, increase fatigue resistance and mental strength, relieve stress and nervousness, soothe thoughts and emotions. Tai chi, also referred to as meditation in motion, stretching aimed at increasing flexibility and range of motion, yoga and the like are also proven to be effective. Suitable additional physical activities are also hiking, jogging, brisk walking, walking uphill, climbing stairs or so-called Nordic walking, which develops aerobic fitness and improves movement coordination. Team sports such as ball games are also excellent way to improve physical condition and social interaction.

[The hippocampus is one of the parts of the brain that may be most affected by exercise.](#) Exercise will increase your heart rate and improve blood flow to the whole brain, including the hippocampus. In this way, physical activity strengthens the memory mechanism during which information is transferred from short-term to long-term memory. This consolidation of memory traces occurs several hours up to one day after exercise. It may also be used to enhance motor memory. If you are learning to play a musical instrument or practicing a serve in tennis, the practice leads to the formation of new neural connections, which are strengthened by practice and repetition. Movement supports the transfer of this information from short-term memory to long-term memory.

[A more permanent improvement of memory \(and thus improvement of the learning process\) is directly related to the improvement of physical condition,](#) and this depends on the duration and intensity of each exercise, as well as regularity and how long you have been exercising. However, physical activity, in the context of these advantages, should be adequate. It turns out that too intense physical activity, anaerobic exercise achieved by increasing movement speed and/or muscle strength (e.g. sprint, triathlon, marathon) does not lead to improved memory. The brain is more stressed, which impairs memory during such exercises. When moving or doing physical exercise, do not exert yourself and cause yourself pain.

In March 2020, the World Health Organization (WHO) has issued the "Global Recommendations on Physical Activity for Health". The recommendations set out in this document address different age groups. For 18 - 64 years old it recommends 150 - 300 minutes of medium endurance activity or 75 minutes of intense endurance activity per week, or an equivalent combination of these activities. These activities should be supplemented with strength training focused on the major muscle groups at least twice a week. For the health benefits to be complex, it is generally recommended to add approximately 10 000 steps a day to the mentioned training. It is the cumulative data of physical activity throughout the day, which can easily be measured by a pedometer when going to school, work, while performing normal domestic activities. It is also a recommendation on how to limit a sedentary lifestyle, for example during the examination period.

Despite the many well-known health benefits associated with exercise, the physical activity of the population is insufficient. The sedentary lifestyle is becoming more and more popular, the number of obese people is increasing, and the number of people affected by

diseases of civilization is also increasing. According to WHO data from 2016, globally 28% of adults aged 18 and over are physically underactive, i.e. engaged in less than 150 minutes of moderate-intensity or high-intensity physical activity per week. Data collected in Slovakia: 34.9% of the adult population, with 31.1% of men and 38.4% of women have insufficient physical activity.

The risk increases not only with low physical activity, but also with a sedentary lifestyle: long time spent in front of a television screen, computers, electronic devices, but also, for example, a sedentary lifestyle for some students during the examination period. It is characterized by sitting for long periods, limited movement throughout the day (less than 5 steps per day) and low energy expenditure. In two healthy 20-year-olds, after just two weeks of low physical activity (less than 1 500 steps per day), insulin sensitivity, physical fitness, and muscle mass decrease while visceral fat levels and blood pressure levels increase. Health risks will not be reduced even if, for example, you exercise for 1 hour after 9 hours of sitting.

During periods of intensive preparation for exams, sitting for long periods should be avoided and it is advisable to take regular breaks with a short warm-up exercise when studying. One can fully concentrate on one thing for about 30 - 40 minutes. During mental work, the attention span decreases after 15 minutes. After 60 - 120 minutes (this time is unique to everyone) it reaches a minimum. Taking regular shorter breaks will keep the ability to concentrate at a high level. All you have to do is, for example, close your eyes for about 3 minutes, or look into the distance or into the unknown, take a deep breath, drink, air out the room, stretch your arms and legs. At the same time, stretching the body relieves the stiff muscles of the neck and spine and back muscles, which worsens the blood supply to the brain. However, do not extend these short breaks much, because the longer the break, the harder it will be for you to return to your study session.

Pause	after 15 - 30 minutes of studying with high concentration	3 minutes	close your eyes, stretch your arms and legs for a short time, drink, air out the room
Break	after 60 - 90 minutes of studying with high concentration	15 - 30 minutes	walk, short exercise, drink, air out the room, eat fruit, play favourite songs

Tab. 8 Recommendations for maintaining attention when studying and limiting longer sitting time by a short exercise or movement

Mental training

Brain training, brain jogging is a mentally stimulating activity that affects neuroplastic changes both by forming new neural connections, but also by maintaining and strengthening already existing functional synapses. It also leads to increased production of neurotrophic substances. Mental activating activities such as cognitive training enhance memory functions, improve attention span, ability to concentrate, verbal expression, creativity, and coordination of the brain hemispheres. Similarly, as with physical exercise, cognitive training

results will appear, but you have to be patient and work systematically. It is more effective to perform it for a shorter time (10 - 20 minutes a day), but regularly. The more stimuli the brain receives, the more connections are formed and, in terms of their functional connection to the neural network, the overall function of the brain improves accordingly. Regular and long-term mental and physical training, education, social interaction increases brain plasticity and develop, practically throughout the whole life, the so-called **cognitive reserve**. It will enable compensation for possible impairment of cognitive functions during physiological (aging) and pathological processes or post-traumatic conditions.

A long-term research project aptly titled "The Nun Study" by professor of neurology David A. Snowdon, that examined the onset of Alzheimer's disease. For more than 20 years (1986 - 2009), he regularly monitored and controlled the physical and mental condition of 678 nuns who were older than 75 years at the beginning of the research. They all agreed to donate their brains after death. The researchers found that although the autopsy showed typical abnormalities of Alzheimer's disease in the brain, there were no signs of cognitive impairment during life. The explanation is the mentioned cognitive reserve. When some of the connections in the rich neural network deteriorate and disappear due to disease, there are still many other alternative synaptic connections available to effectively compensate for the missing ones.

Mental training is suitable for any age. For students, for example, attention training enhances short-term memory and thus the ability to acquire new information more quickly. Various mnemonic aids are effective in the process of transferring information from short-term to long-term memory. In a healthy population, such training is also an effective form of prevention of neurodegenerative diseases. In patients with early detection of degenerative brain diseases, it may alleviate and slow down the disease progression.

The advantage of mental training is that we can do it practically anywhere and anytime. They are often very simple, natural, and fun activities, while they enhance the cognitive functions of the brain, make them more efficient and do not let the brain become lazy.

There are ways to help develop the neural network, and slow down the brain aging:

- **Logic and memory tasks:** games (cards, memory, chess, scrabble, board games), solving logic puzzles, tests, quizzes, crosswords, painted crosswords, sudoku, assembling puzzles that enhance visual-spatial functions, memory, and logic. Bridge is one of the most challenging and brain-stimulating card games (widespread among people, especially in the investment world). Like chess, it requires concentration, logical thinking, combination skills and, in addition, cooperation with a fellow player.

- **Reading** is one of the best mental exercises, during which the brain is forced to process a large amount of information and stimuli at once. By reading, you gain knowledge and expand your vocabulary, improve concentration as well as abstract and analytical thinking skills. Imagination and fantasy are being developed. If you read aloud or listen to someone who is reading, other neural connections are involved than when you are reading to yourself silently. At the same time, when reading aloud, the information is also stored in the auditory memory. In general, people who read a lot have a better memory.

- **Applying the learned numbers from a multiplication table** when counting or doing a simple math equation without using a calculator. A more complex cognitive activity is, for

example, the serial subtraction of seven beginning with the number 100 or counting fast and aloud from 1 to 120. Always write down how fast it was done and watch the progress.

- **Mastering foreign languages** changes the structure of the brain and its function. Learning a foreign language enhances all types of memory and the ability to pay attention. A foreign language affects thinking. People who actively use a foreign language think in two different ways. It has been found that, for example, a person who thinks in English, the language that involves progressive tenses, tends to focus his attention on the course of events. Progressive tenses are not used in German, thereby German-speaking people tend to focus on the beginnings, midpoints and ends of events. Bilingual people have better vocabulary and the ability to express themselves. They are more flexible in solving tasks, make faster decisions and can separate the essential from the irrelevant. They have a broader perspective and can look at the world and various events in alternative ways. Knowing a foreign language is also a practical thing to use when exploring new countries.

- Opinions on **computer games**, smartphone games and the use of various applications to enhance cognitive brain functions vary. Acquisition of computer skills, improved coordination skills, peripheral vision, reaction time are cited as the reasons why playing video games or using your smartphone may be beneficial. They can also enhance the functions of the brain areas responsible for spatial and visual skills, or strengthen the range of cognitive abilities, such as spatial navigation, attention, reasoning, working memory, perception, concentration, logical thinking. The fact that many children and young people invest a lot of their free time in this activity is not considered positive by many. When you play for 3 or more hours a day, you may already experience symptoms of addictive behaviour. Impaired vision, indigestion, shoulder and spinal pain, headache. "Everything in moderation" applies here.

- **Social interaction:** Personal encounters bring moments and situations that improve situational awareness, attention, the ability to think and remember and trigger emotional responses. Communication with the other person activates the areas that represent a condition for judgment, empathy, understanding and anticipation. Laughter and good mood are also positive signals for the brain, which registers the activation of mimic muscles into a smile and the endorphins are released. For the record: 17 muscles are activated when smiling, while 43 muscles are activated when frowning.

- **Positive attunement** is extremely important as dopamine is released, which helps to store memory traces and memories. If you always think about how bad and difficult it is at school, no learning technique or even a change in education system will help you.

- **Retrieval of memories and reciting things by heart** are effective and easy ways to train memory. It is beneficial when you can retell events and experiences, as well as ideas or plans, and share them in person with someone else. Repeat the things you need to buy without having a shopping list. Remind yourself of the meetings and the agreed dates that await you. Repeat extracts from the poems you learned in high school, recall your classmates from elementary/high school, their names, and the desk they sat at.

- **The ancient Greek technique:** In the evening when lying in bed, try to recall everything that happened that day. You can close your eyes. Try to recall the details of what you had for

breakfast and what you did afterwards. It effectively trains your neural network, memory, attentiveness, and awareness of reality.

- Other stimuli for brain training are **documentaries and knowledge competitions**, but with an active approach, try to respond, get involved and guess the answers. **Listening to music**, which helps to process new information more deeply, has a good effect on improvement of thinking: classical music, jazz, ethnic melodies, sounds of nature; change playlists and genres. And, of course, brain functions are affected by adequate **sleep**.
- **The Stroop test** has been known since 1935. It is about strengthening the connection between the right and left hemispheres, which is an excellent stimulus for the brain. This is a disruptive effect, where the task is to name the colour of the written word, but the word itself indicates a different colour. Try to say the colour of the word as quickly as possible (not what is written). It only takes a few minutes. You will see the difference when you practice it daily.



Fig. 17 Example of the Stroop test

Neurobics

The world-renowned professor of neurobiology Lawrence Katz brought a new perspective and a certain change in brain training. He developed a method called **neurobics**. The same way as aerobics involves different muscle groups and improves physical condition, neurobics stimulates different areas of the brain in an unusual way and improves mental flexibility. Professor Katz based his scientific method on understanding the physiological functions of brain activity and senses (1999). He was inspired by small children who engage all their senses on their journey of exploring and discovering the world.

Neurobics specifically supports the formation of new associations between the various pieces of information that we obtain through our senses and combines them with emotional perception. Each sensory information ends up in a different part of the cerebral cortex. Thanks to the hippocampus, these cortical centres are interconnected by neural networks. If the brain receives information from several sense organs related to one object, event, or a person in a short time, it automatically connects them. **It will create associations that are the basis for memory and play an important role in learning and retrieving information.** If a stimulus later affects only one part of the network, the other areas related to the stimulus are also activated. What information is stored in the hippocampus depends on whether such information is of emotional significance to a person and/or is linked to something he or she already knows. When you try a new meal on vacation, you start paying more attention and engage more senses. If you ever see a travel documentary and the food you tried on

vacation is mentioned, you will remember its taste, smell, colour, but also your vacation memories.

Neurobics uses the senses to stimulate the brain. The more senses you engage, the more effective the training. You can perform such multisensory activities every day without much effort. It is essential to do the usual activities in an unusual way. Involve at least one of the senses differently than usual. When something is unusual, you will remember it faster. **The more the brain is busy with unusual activity, the more the body produces its own neurotrophic substances that support the neuroplasticity of the brain.** The brain needs changes in established activities to break the monotony of everyday rhythm. The brain is negatively affected by passivity.

A few examples of neurobic exercises in practical life:

- change the usual way to school/work or when walking the dog; if you are traveling by bus, close your eyes and imagine the route you are following, the individual bus stops;
- if you are right-handed, use your left hand to brush your teeth, shave, button up a shirt or a different piece of clothing, write, eat, turn on your computer (if you are left-handed, obviously, use your right hand);
- shop in a different store than you are used to; instead of the supermarket, go to the bakery, butcher shop, smell fruits, vegetables, herbs;
- move around the apartment with your eyes closed; wash or shower with your eyes closed in the morning, try to find things or look for the keys in your purse by touch;
- try new tastes, smells, non-traditional exotic foods (for example, with your eyes closed or your nose held); when dining, change the usual seating position;
- play a new melody;
- prepare a new scent on the bedside table and smell it after waking up;
- combine listening to your favourite band with aromatherapy;
- try to distinguish the sounds coming from the street, in nature; identify individual musical instruments when listening to a song;
- learn to type on the keyboard with all fingers, read the text "turned upside down";
- mix up familiar things on your desk, in a drawer, cupboard; rotate your calendar or photos 180 degrees.

Learning new things, new forms of movement is also a challenge for the brain. Try doing completely new, unknown activities to activate new connections and engage different areas of the brain. When you do an activity for the first time, it requires maximum concentration. By repeating, you improve, the activity becomes simpler and gradually becomes automated. This is again the time to come up with something new, unusual. This way you will avoid stereotypical habits, procedures and routines involved in daily activities. Activities that require full concentration are excellent: playing a musical instrument, painting, embroidery, a new sport, dancing, or a foreign language.

Learning, senses, emotions

Sight and hearing are the senses that one uses the most. Most advertisements are also targeted on these sense organs. You usually remember what you see with your eyes more than what you hear. However, it is best to involve as many sensory perceptions

(combination of word, image, sound), emotions and motor memory (allows you to perceive the position of the body and objects in space) in the process of retaining information and creating associations among them. [It is easier for you to retain information through sensory perception that is associated with emotion or an emotional experience.](#) Positive emotions have motivational effects and promote self-confidence. If we learn with joy, enthusiasm, and excitement, it is more beneficial for the brain. Some people find music to be helpful when studying and trying to concentrate. Mozart's music has been found to cause joyous excitement and activate the cognitive functions of the brain. Music has an impact on stimulating the right hemisphere, which is important for learning and creativity development. Smell no longer plays such an important role as it did during evolution, but it is still very important for the function of memory. Associations connected with olfactory perception are created rapidly and persist for a long time. Olfactory information is the only sensory information that has a direct connection to the cerebral cortex, hippocampus, and limbic system. These structures regulate emotions and behaviour and affect the storage of memories. Therefore, a scent can trigger a strong emotional response and help you recall specific information.

Balanced diet

A high-quality, fresh, varied, and balanced diet has beneficial effects on the body as a whole. It affects not only physical health, but also mental activity and mental state. There is growing scientific evidence on how diet can affect brain functions in a good or bad way. People with excessive fat and sugar intake have impaired short-term memory. In obese people, mild impairment of certain cognitive functions, such as attention, decision-making and short-term memory, was more common.

A rational diet should generally meet energy requirements of the body while providing it with all the important nutrients. Recommended dietary allowance should contain **10% of proteins, 26% of fats and 64% of carbohydrates**. Intake of vitamins and minerals also needs to be sufficient as humans either cannot synthesize them or if they can, only in insufficient amounts. Optimal energy intake in the diet is individual. To maintain a balance between total intake and total expenditure, age, gender, and type of job must be taken into consideration. Remember to consume adequate fluids.

- **Proteins** in the brain have a beneficial effect on memory processes. They are involved in the formation and renewal of cell membranes and act as neurotransmitters. Amino acids found in proteins are the basic building blocks of the brain network. It is necessary that protein intake includes enough essential amino acids that the body cannot synthesize, by optimizing the ratio of animal and plant proteins in the diet. **Proteins of animal origin** (fish, meat, eggs, milk, dairy products) are adequate, because they contain amino acids in proportions and quality that is required for the synthesis of new proteins. They supply the body with essential amino acids. The greater part of the **proteins of plant origin** (legumes, soybeans and soybean products, nuts, seeds) is in this respect considered to be inadequate because of a different ratio between the individual amino acids. To ensure sufficient intake of essential amino acids in adolescence, the ratio of proteins of animal and plant origin should be balanced. For these reasons, the predominant intake of plant protein is suitable

only in adulthood. The intake of proteins of animal and plant origin in a ratio of 1 : 1 is generally recommended as optimal.

- **Fats** are the highest energy sources and they enable the absorption of fat-soluble vitamins (A, D, E, K). Brain tissue and the peripheral nervous system have high representation of fats that are necessary for their proper functioning. A balanced diet should contain the correct ratio between the **saturated and unsaturated fats**, while it is recommended to reduce the proportion of saturated fats for prevention of diseases of civilization. Saturated fatty acids (FA) should account for about 10% of fat intake. Consumption of saturated FA (in fried foods, high-fat meats, smoked meats, bacon) increases the levels of "bad" LDL-cholesterol (low-density lipoprotein), the risk of cardiovascular diseases, the emergence of diabetes and other.

The intake of "good" unsaturated FA should be higher. They are found in fish, seeds of oil crops, nuts, vegetable oils and fats produced from them. Some of these unsaturated FA, more specifically, the omega-3 polyunsaturated fatty acids are essential to human health but cannot be manufactured by the body. For this reason, omega-3 polyunsaturated fatty acids must be obtained from food (saltwater fish and seafood).

- **Complex carbohydrates** that contain fibres (legumes, potatoes, whole grain cereals) should prevail in the intake of carbohydrates. **Simple carbohydrates** with rapid absorption (glucose, fructose) should account for less than 10% of daily energy intake. Carbohydrates, especially glucose, provide energy for both the whole body and the brain. If glucose is released during digestion gradually, by decomposing the complex carbohydrates, it gives the brain energy continuously, not all at once.

- The optimal **fluid intake** depends on several factors. Adults should drink about 2 - 3 litres of fluids daily. When doing sports, physically demanding, strenuous work in the heat, fluid intake must be increased. It is important to drink continuously and in smaller quantities so that you do not start feeling thirsty. The bases of the drinking regime are non-caloric beverages, mainly water. The most affordable option for us is high-quality tap water, alternatively spring and mineral waters. Mineral waters are not recommended to be drunk for a long time, since they contain a greater amount of dissolved mineral substances. It is necessary to know their composition and change them regularly. Genuine juices from fruits, which contain, for example, vitamins C, E, carotenes, folic acid, minerals, and nutrients with antioxidant effects are also suitable. Pay attention to their high energy value.

Brain food - foods with nutrients for the brain, smart foods

Regular consumption of certain foods will ensure adequate nutrition of the brain and protect it from diseases of civilization. A balanced ratio of high-quality fats, carbohydrates and proteins will ensure the proper functioning of organs, including the brain. Brain foods keep the brain in good shape, they may even enhance its performance, positively affect brain functions, especially concentration and memory. They also improve mood one feels more fresh and smarter. In addition to the basic nutrients, fats, carbohydrates and proteins, brain food is represented by food with a high content of vitamins (B, C, E, A), minerals (iron, magnesium, selenium), antioxidants and dietary fibres.

- **Omega-3 fatty acids** belong to the group of essential FA, which humans cannot synthesize. They have a significant impact on the healthy structure and function of the brain. They affect neuroplastic brain changes and activate the BDNF factor (brain-derived neurotrophic factor). They regenerate nerve cells and participate in the regulation of cell membranes. They contribute to the proper functioning of memory. They improve the course of mental disorders and they have antidepressant effects. Their anti-inflammatory effect protects the brain during febrile illnesses. They also adjust fat levels and play a positive role in the prevention of cardiovascular diseases. SOURCES: saltwater fish, seafood, and seaweed, especially tuna, salmon, mackerel, sardines, and anchovies. Wild salmon is a preferred option compared with farmed salmon, because it has a lower fat content and hence smaller quantity of any toxins that are piling up in the fats. The sources of these acids are also walnuts, linseeds, pumpkin and chia seeds and olive oil.
- **Carotenoids, vitamin A:** One of the most popular and the most important carotenoid is β -carotene, which is a precursor of vitamin A and a strong antioxidant. It is important for vision, immunity, in the prevention of cancer and cardiovascular diseases. The usability of carotenoids in the human organism is improved by heat treatment. They should be obtained only in the diet and always with at least a small amount of oil or ground nuts or oilseeds. Taking synthetic preparations is not recommended. SOURCES: leafy vegetables, broccoli, parsley, yellow-orange coloured fruits and vegetables (carrots, apricots, tomatoes), fish liver oil and liver.
- **B vitamins**, mainly B1, B2, B6, B9, B12 improve the metabolism of fats, carbohydrates and proteins and the absorption of amino acids. Positively affect the function of the nervous system, enhance concentration and memory. Their sufficient diet intake should be ensured at a time of increased psychological load, when stressed and in people who regularly go running. A lack of these vitamins may be manifested by an overall feeling of tiredness, irritability, insomnia, lack of appetite, muscle aches and a tick in the eye. A lack of vitamin B2 (riboflavin) may manifest itself by inflammation of corners of the mouth. Vitamin B12 deficiency (cobalamin), especially in elderly people, may cause an impairment of the peripheral nervous system, accompanied by pins and needles in the hands or feet and reduced sensitivity. SOURCES: whole grain cereals and sprouted cereals, sunflower seeds, yeast, bananas, avocados, eggs, meat, dairy products, legumes, fish, and liver.
- **Vitamin C** is a water-soluble vitamin, which is essential for the function of the body. It belongs to the essential nutrients that the body cannot synthesize, therefore it is obtained only in diet. Practically we cannot overdose with vitamin C, because with increased intake, its absorption in the intestine does not increase. It is destroyed by being stored and by cooking. Its levels are reduced by smoking, taking contraceptive pills and some other medications. Its sufficient intake is associated with reduced risk of cardiovascular diseases and cancer. Vitamin C is a powerful antioxidant. SOURCES: fresh fruit, especially citruses, apples, strawberries, black currants, rose hips, fresh vegetables, potatoes, peppers, broccoli, leafy green vegetables, and sauerkraut.
- **Natural vitamin E**, unlike synthetic vitamin E, protects the brain, improves microcirculation of brain tissue, and exhibits anti-inflammatory effects. It slows down the aging process and play a significant role in the fight against dementia. Vitamin E is a powerful antioxidant. It belongs to the group of natural nootropics. SOURCES: whole grain

foods, oils from sprouts and vegetable oils, particularly soybean oil, nut kernels (walnuts, cashews, hazelnuts, almonds, peanuts), sunflower and sesame seeds, linseeds, eggs, meat, legumes and avocado.

- **Minerals** are one of the major groups of micronutrients that the human body needs. They enable and control the metabolic processes and they are important for the activity of the enzymes, vitamins, and proteins. Moreover, minerals play an important role in bone health, dental health and they help conduct nerve impulses. Potassium and sodium are essential minerals for the brain as they participate in the transmission of nerve impulses. Iron is essential for normal neurological function because it is a cofactor in the synthesis of neurotransmitters and plays a significant role in brain oxygenation. Vitamin C has been shown to enhance iron absorption. Iodine is essential for growth and development of the brain. Zinc is needed in both, information transfer in the brain and growth of new neurons. Zinc deficiency causes inability to concentrate. Magnesium protects the brain from neurotoxins. Magnesium deficiency may result in symptoms, such as frequent migraine attacks, cramps, or muscle twitches. Magnesium intake should be increased during stress. SOURCES: whole grain products, oatmeal, natural rice, walnuts, various seeds, wheat sprouts, chocolate containing 80% of cocoa or more, potatoes, leafy green vegetables, apples, and fish. Iron in egg yolk, meat, legumes, and apricots.

- **Antioxidants:** The brain is much more sensitive to damage by free oxygen radicals than other organs. Oxidative stress is an imbalance of free radicals and antioxidants in the body. It has a negative impact on the brain as it causes a decrease in the neuronal energy metabolism. The brain becomes more vulnerable and damaged neurons cannot be replaced. This gradually leads to disorders that seriously threaten the body – allergies, infections, atherosclerotic changes in the vessels may cause stroke. The negative impact of oxidative stress can lead to many oncologic or neurodegenerative diseases. Antioxidants protect the brain from activity of free radicals and slow down the production of free radicals. They improve communication between neurons. Thanks to this, they enhance cognitive functions of the brain, such as memory, judgment, deduction, and motor skills. Antioxidants reduce the effects of long-term stress. The effective antioxidants that we obtain from food are vitamin C, vitamin E, flavonoids, and carotenoids. SOURCES: fruits, especially berries (blueberries, raspberries, blackberries, currants, grapes), strawberries, goji berries, citruses, vegetables (tomatoes, garlic, onions, leek, cabbage, celery, spinach, broccoli), legumes, seeds, ginkgo biloba, chocolate containing 80 % of cocoa or more, coffee, green tea, and red wine.

- **Fermented foods** such as kefir, sauerkraut or yogurt have a favourable influence on the intestinal microflora, the immune system, and the function of the brain. Bacteria in the large intestine help not only digestion and immunity, but also enable the fermentation of dietary fibre, help absorb electrolytes, synthesize certain vitamins and psychoactive substances. Up to about 90% of serotonin, responsible for a sense of happiness, is produced precisely by intestinal cells. Large intestine is sometimes referred to as the second brain. It is very sensitive to frequent or long-term stress, which upsets the balance of the intestinal microflora and leads to negative psychological changes. Intestinal bacteria influence how a person feels and how he or she perceives pain.

- **Nootropics, cognitive enhancers** are substances that enhance brain functions, memory, concentration, increase the amount of the processed information, improve the blood circulation in the brain, protect the brain from neurotoxin exposure, renew the energy metabolism of nerve cells. They are known to stabilize emotions and moods and improve the sleep quality. Natural nootropics include omega-3 fatty acids, natural vitamin E, ginkgo biloba, ginseng, and lecithin. **Ginkgo biloba** has antioxidant effects. It improves blood flow to the brain and has a positive effect on memory, thinking, attention and concentration. It also slows down age-related changes in the brain. Its effects are manifested only after it is used over a longer time. However, the effects manifest themselves mainly in people with cognitive deficit. **Ginseng** has proven itself as a substance with an anti-fatigue effect. It improves blood circulation and has antioxidant effects. **Lecithin** is considered an excellent source of choline which plays an important role in the formation of neurotransmitter called acetylcholine that is essential for the proper function and health of the brain. It is found in eggs, milk, saltwater fish (salmon), beef liver, Brussels sprouts, broccoli, legumes, and soybeans.
- **Herbs:** Sage may improve memory and concentration. Rosemary enhances brain functions not only by being eaten, but also by being smelled.
- **Coffee, black and green tea** are among the known stimulants of cerebral activity because of their caffeine content. Caffeine improves attention and concentration, physical and mental endurance, reaction time and memory. It gives energy, removes the feeling of fatigue, and improves mood. Caffeine may not be suitable for everyone since it increases blood pressure and pulse rate. If you obtain caffeine less than 5 - 6 hours before bedtime, it can negatively affect the sleep quality. For a healthy adult, the recommended dose is 350 mg per day, which is about 4 - 5 cups. The effects of caffeine on the body may begin as early as 30 - 45 minutes after being obtained. A cup of coffee contains more caffeine than a cup of tea. Caffeine, which is found in tea, is often referred to as theine. Coffee and tea are powerful antioxidants.

The Mediterranean diet promotes a healthy diet. It favourably affects the overall shape of the brain and enhances cognitive functions. The foundation of the Mediterranean diet is vegetables, fruits, fish, seafood, whole grain foods, pasta, baked goods, bread, and nuts. The Mediterranean diet has a prevailing amount of healthy fats, such as olive oil or fish oil. The dish is seasoned with herbs, for example, rosemary. Poultry, eggs, cheese, and yogurts appear on the menu less often. Red meat and carbohydrates are not included very often either.

It is likely that all the previously mentioned nutrients will not be included in the diet every day. However, it is appropriate to make sure that the healthy food will account for about 80 % of your diet and you can enjoy the rest in a form of the so-called junk food, i.e. sweets, salty or greasy food.

9. MOTIVATION AND METACOGNITION

Motivation is the driving force of a psychic nature, which sets in motion human activity and is also an important factor that affects learning. Motivation is an important aspect of study. The results and achievements of students depend on properly targeted motivation. Motivation plays a significant role in the formation of self-confidence. The most difficult thing is to start studying. Discipline and habits are needed.

The processes of motivation are biochemically associated with:

- Dopamine - affects motivation by facilitating the transfer of information in neural networks of the limbic system and the respective areas of the cerebral cortex. Being a neurotransmitter, it affects the activity of neurons, its deficiency causes a lack of activity of neurons and the consequent low activity of the cerebral cortex; it affects the function of neurons, its deficiency causes their insufficient activity, and thus the subsequent low activity of the cerebral cortex,
- Noradrenaline - regulates cognitive functions, including attention, working memory, impulse control, and behaviour,
- Glucose - provides short-term energy, obtaining low to medium doses of glucose activates memory traces.

In the recent past (perhaps not anymore), negative motivation prevailed in schools. Failing to perform duties, forgetting to carry out tasks or to bring student tools was followed by getting an F. But if the task was carried out or student tools were brought, no positive comment was received. Even though, logically, it should be followed by getting an A.

Procrastination

Perhaps every person, and especially a student, sometimes struggles with procrastination. The term **procrastination** sounds very complex and incomprehensible for those who are not familiar with the topic. It is common that one moves studying or other activities that might be unpleasant forward, yet important in the long term; procrastination is derived from the Latin root pro (meaning forward) and crastinus (meaning of tomorrow). And what does it have to do with the ability to learn and interest in learning? An important exam is coming up, but you still cannot motivate yourself to start studying, you are still moving it forward to the day after and so on. Your brains and subconscious are focused only on the present moment, you want to feel good right here and right now, your mind is not very interested in the future.

The brain is reluctant to start studying because it is afraid of the complexity of the whole process. The brain is just intimidated, horrified. Studying is an unspecific concept under which the brain imagines something overwhelmingly difficult. The brain thinks that you will have to study a few days in a row, which is not desired, therefore, using various excuses, it forces you to procrastinate. But if you divide large tasks into bite-sized tasks, the motivation for studying will increase. The brain does not like to work on tasks that do not have a deadline, that is why it is important to plan your studying for the exact time so that you have to study exactly at that time.

How to motivate yourself to study

The solution is quite simple. It consists in building good habits. Studying certainly belongs to more complex habits than, for example, combing your hair in the morning. Habit formation is directly related to the strong will, which is unique to every individual and largely inherited. However, there is a certain pattern for the habit formation, which will help even weak-willed people motivate themselves to do activities they do not find pleasant or natural. There are three main components to habit formation: trigger, routine, and reward. When studying uninteresting and unimportant course material, the reward is the most motivating and attractive.



Fig. 18 Pattern of habit formation

The trigger may be the knowledge that there will be exams and possible exam fears at the end of the semester. It is necessary to adjust and specify the trigger. Routine is the action you take such as the habit of studying regularly. The reward may be the benefit you gain from maintaining a habit, e.g. small activities that follow immediately after the end of study session, which will make you happy, such as listening to music, eating favourite food, and the like. You have to look forward to the reward and enjoy it. According Dr. Maxwell Maltz (2010), it takes 21 days to form a habit and anchor it in our subconscious. The time of building a habit depends, in fact, on the habit difficulty, and therefore it may also be significantly shorter or longer. When forming a habit, it is important to take into consideration several points.

Have an accurate and clear plan

Plan your study sessions sensibly. The later you start in a day, the less motivation you will have to do it, and maybe you will not even be able to motivate yourself to start studying. First, you need to set expectations, namely what you are going to study and what amount of the study material you want to learn. Write down, write a note, or set a reminder in your cell phone what study materials exactly you want to focus on. From a psychological point of view, it is much more effective if you study smaller portions at one go. **The whole study material needs to be divided into smaller portions** that are easier to learn. The brain is afraid of large tasks, but if you break them into smaller portions, you will start studying much sooner. It is best if you do not postpone difficult tasks but do them right away. It is not good to take on huge portions of study materials. It is worthwhile to establish the exact beginning of the study session, but not the exact end so that you have enough extra time in case you need it. It may happen that the study session will be pleasant for you and you will prefer to continue rather than taking a break. On such a day you will learn more than you originally

planned. Another method is the pomodoro technique, where it is necessary to do everything precisely (p. 97).

If you are ambitious, you may set high goals up to unrealistic ones. If, on the contrary, you do not have that many ambitions, set more modest goals. It is important that you are not disappointed in yourself at the end of your study session, which could happen if we did not even approach the fulfilment of our initial plans. Despite the fact that at the beginning it sometimes seems that what you study is not interesting and necessary, please note that in any material that you study, you may find something interesting or something that you can use later.

Be motivated

Proper motivation is extremely important when forming a habit. Motivation can be divided into two different theories known as internal motivation and external motivation.

A/ **External motivation** is very common, not of great value and non-functional. You do not want to do something, but you must do it because somebody else wants it. Most often it is parents, teachers or a close person, the opinion of whom is important to you. I am studying because XY wants it.

B/ **Internal motivation** is a stronger and more effective degree of motivation. What you do, you do for yourself based on your own conviction. I am studying because I have a goal and I want to achieve something.

Saying you cannot motivate yourself is nonsense. You are always motivated to do something, even to stay in bed all day or to play computer games. You can motivate yourself to study:

- after thinking for a long time,
 - motivation towards: imagine a successful target (strongly overestimate),
 - motivation away from: imagine what will happen if I do not do it (strongly overestimate towards negative scenario),
- do not think too much, have everything necessary prepared in advance, divide the study material into smaller portions, do not let preparation keep you from starting,
- act immediately, sometimes counting down from 10, 9, 8, ... 1 helps to get up and really go to study.

Every person needs to have short-term results to keep his or her enthusiasm and motivation to continue studying. As children, you explored new things for yourselves. At school, you studied because of parents or a teacher. Now it is time to learn for yourself. Learn to understand things and be able to use them. However, if you do not want it, no force will drive you to learn it. Interest cannot be forced it can only be obtained. The student must be interested in learning. Pay attention to what you are good at. [Try to see achievements even through mistakes](#). Permanent motivation in learning may be interest in the field of study, obtaining a degree and having a successful career.

Parkinson's law:

Work expands to fill the time allotted. If you have 3 days to learn something, then you will study for 3 days. It is necessary to designate a time limit for each task, the brain will try to meet the time limit - time pressure leads to motivation.

Deceive your own subconscious or how to motivate yourself to study

Excuses will not help you achieve anything. The student is often afraid to start because he or she thinks that he or she will not be good enough. He or she says to himself or herself: "I cannot learn all this, there is a lot of it, it will take me a lot of time, I cannot do it."

Say to yourself:

- at least I will have a look at the first page,
- I will learn at least a small portion of the study material,
- I will try and see what I can do,
- knowing something is better than knowing nothing,
- I do not have to learn everything to get a good grade,
- I am not going to study, I am just going to read it.

The brain also can reject the tasks that it is presented with. This happens if there are too many tasks and the brain generally evaluates it as an unmanageable situation. **The brain becomes sort of paralyzed.** To prevent this from happening, you need to resort to deceiving your subconscious. For example, you have to learn a whole textbook, what the brain is afraid of and it procrastinates. That is why you should not say to yourself that you have to learn the whole textbook, but rather you should say to yourself that you will only look at the first page and study just a little bit. This will help you start, and you will be able to proceed step by step. **If you set only small goals and break large tasks, you will be able to motivate yourself to study.**

Other examples to deceive the subconscious:

- I will not learn 40 words, I will only look at the first five,
- I will not write a 15-page paper, I will only write an opening,
- I will not learn 30 questions as a part of the exam preparation, I will learn the first part of the first question,
- I am not going to read, I am just going to open a book,
- I am not going to study, I am just going to read one paragraph,
- I am not going to study, I am just going to review one page.

Of course, it is important not to finish after accomplishing a simple task, but to proceed further. **The brain has the biggest problem to get to work, but when it starts to work, it tends to finish it as well.** It arises from the fact that people do not like or tolerate unfinished tasks.

Do not place too high demands on yourself and allow yourself to be imperfect. You do not need to learn everything so that you get an A. The grade itself or other evaluation will not yet guarantee your success in professional life.

Partner up with a friend

Even if you set clear rules, it may happen that you break them anyway. Therefore, it is very reasonable to tell someone else about them - a friend, a roommate, or a sibling. Ask them to look out for you. Let them keep an eye on you, let them warn you, guard you and, possibly, they can also punish you somehow if you will not study. Such a psychological effect has unbelievable power. Bets are also useful. Decide with someone that if you do not follow your rules, then ...

Reward yourself

Positive emotions that arise when one is being rewarded favourably influence formation of study habits. In doing so, dopamine is released, which is associated with faster learning. The reward is something that you love very much, and you are always looking forward to. **The reward must come immediately after the end of study session**, not later, so that the brain connects it with studying, not with another activity. One way to connect studying with positive emotions is to reward yourself even for accomplishing small tasks. The size of the reward always depends on the size of the achieved goal. Having fulfilled a small task, give yourself a small reward, and vice versa. However, if you do not fulfil the task you gave yourself, do not reward yourself. The reward may be, for example: good food, favourite game, going out with friends or playing sports. Most students consider studying to be a necessary duty and few consider it to be a fun activity that makes sense.

Metacognition

Metacognition is the ability to monitor, manage and control one's own learning to improve one's cognitive abilities. It allows students to reveal gaps between what they really know and what they should know. Students with good metacognitive skills are at the helm of their own learning process, through which they can execute a learning task more effectively.

Metacognition refers to the processes used to plan, monitor, and assess one's understanding and performance. Learning requires constant decision making about what you will study, how you will study and whether you have learnt it well enough.

Metacognition **includes a critical awareness of one's thinking and learning**, helps you improve yourself without devoting more time to learning, allows you to stop and challenge established patterns of behaviour. If more students knew about this method, it would be much easier for them to learn. Students learn without thinking. They are not thinking about the causes and ways of learning and tend to engage in cognitive biases. Metacognition is an ability like any other. If you start practicing metacognition, you will not excel in it, but after a while you will get better. **The better your metacognitive skills, the better your ability to learn**. By applying metacognitive strategies, you will not ruin anything. **The more metacognition is utilized, the better**.

In one experiment, university students were divided into two groups. One group of students received an e-mail before the exam, which reminded them about the upcoming exam. The second group received a short metacognition questionnaire. The students were supposed to think about what and how they will learn whether the exam is important to them and what grade they would like to receive. Result: the group that was encouraged to utilize metacognition reported fewer negative emotions in connection with the upcoming test; the students felt more in control of their performance and achieved better exam results than the group that was only reminded about the exam.

Cognitive biases

Dunning-Kruger effect is an example of a cognitive bias. People who are incompetent at something are unable to recognize their own incompetence. People with limited knowledge

or competence greatly overestimate their own knowledge or competence. On the other hand, people with above-average knowledge or competence greatly underestimate their own knowledge or competence. By having limited knowledge in a given domain, they cannot realistically see their shortcomings and assess their respective skills. But experts have enough experience and know what they do not yet know, and thus underestimate themselves.

In a series of experiments, it was demonstrated that students who were incompetent in solving logic puzzles overestimated their abilities, they thought that they solved the puzzles correctly and that they learn in the best way possible. In learning, cognitive bias is characterized by the feeling that the student understands something or remembers something perfectly, but in fact, it is not true. People are confident in the way they learn. Therefore, if you feel that you know something well be more sceptical. The overestimation of the future performance of your memory or the feeling that if you learn something once, you will never forget it again are quite common. Think about how you learn and whether you are not influenced by cognitive biases.

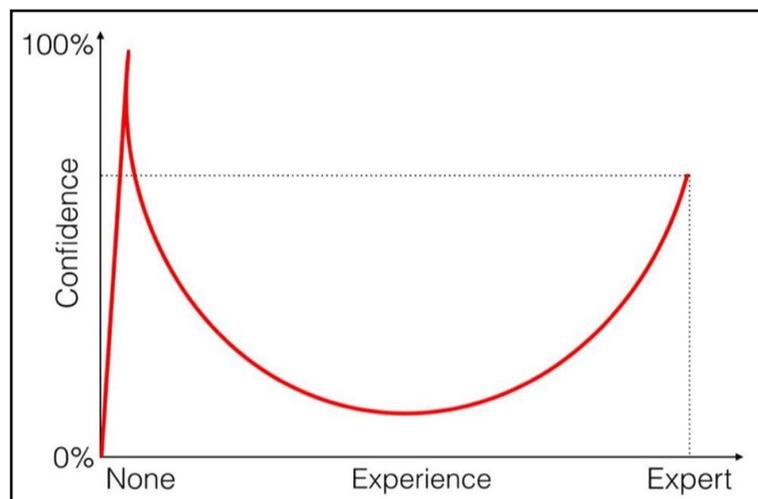


Fig. 19 Dunning-Kruger effect (source: Dunning and Kruger: Unskilled and unaware of it, 1999)

A common cognitive bias that influences students in the process of studying is called the hindsight bias or: **I knew it all along effect**. Example: you actively repeat the learned information but cannot remember anything. When you look at the answer, you suddenly think that you knew it all along and therefore you no longer repeat the information. In doing so, you underestimate the situation and the test results may negatively surprise you. Thinking you know something does not mean you really know it! It is more beneficial to believe objective facts. If you could not recall the information, it means that you do not know it and you should have studied more.

How to utilize metacognition

Before the exam, ask yourself what goal you have and how much you care about it. Then think about what study materials are available to you and how you can learn as effectively as possible. Stop for a moment and think a little strategically.

Metacognition should be practiced not only before the exams, but also during semesters. After you are finished with classes, find 5 minutes to reflect on these questions:

- How did I understand the material that was explained in class today?
- What information should I retain from what I heard today? What were the main points?
- What topic sounded difficult to me today?
- What will I do to understand it?

Only thanks to a few questions you will become more aware of what you are doing and why you are doing it.

Before the exam or even the mid-term exam, do the following metacognitive exercise:

- What is my goal and how much does it matter to me?
- What will be on the exam/test?
- What knowledge gaps do I have?
- How long do I want to study and how do I divide my study time?
- Do I have everything I need for studying?
- What learning methods will I use?
- What grade would I get if the exam/test took place now?

Questions will motivate you and give you suggestions on how to learn better and what to focus on in your study sessions. The prerogative of all successful people is that they can learn from their mistakes.

Ask yourself after the exam/test:

- What did I not know? What mistakes did I make?
- Were there any unexpected questions in the test?
- What could I have done differently?

Next time you will avoid the mistakes and you will be able to learn a little better. The more you know about effective learning, the better metacognitive skills you will have.

10. HOW TO LEARN

It is important to realize that:

- concentration is a condition of learning,
- breaks are as important as learning itself,
- in sleep, knowledge is sorted and stored in long-term memory,
- guided repetition will ensure that you retain the information you learn,
- continuous learning ensures understanding, more permanent knowledge, saves time and prevents stress before the exam,
- without regular and planned study sessions, it will be very difficult,
- you do not study for the sake of your parents, teachers, friends, but for yourself,
- you study so that you understand the course material, know how to use it and achieve satisfactory results,
- the same daily habits are beneficial,
- good results motivate continued learning.

Students like to talk about what is not possible, that the teacher is bad, that the timetable is bad, that the syllabus is bad, the seminars/lectures are long, the study material is difficult and much more. Do not even think about what you cannot change, you waste energy unnecessarily and a negative attitude will not help you either.

You should rather think about what you can influence:

- goal - realize why you are studying, where you are going and what you want to achieve,
- concentration in lectures and seminars,
- note-taking style as you subsequently learn from those notes,
- time spent studying books,
- learning style - learn to study properly,
- behaviour and way of thinking,
- healthy lifestyle.

Use and work with effective learning methods. Once you have mastered one learning method, move on to the next one. Do not try all methods at once. In the beginning it will be difficult, you have to learn to concentrate intensively and learn effectively.

Concentration

Concentration refers to the mental effort you direct towards whatever you are working on or learning now. The ability to pay attention significantly affects the effectiveness of learning. The better you can concentrate, the more effective your learning becomes. What affects concentration? Why is it not still the same? There are several factors that affect the concentration itself.

Goal

You must have a goal so that the mind knows what to retain and why. Before your study session, go through what you have to learn, headings, highlighted parts and **think about it**. **Ask yourself** what you already know about the topic, try to recall at least something because

once it is recalled, it becomes even more engraved in your memory. Retell the recalled information out loud, or at least write it down because only thinking about it silently is not enough. **Say to yourself out loud what you want to retain and what information you will acquire after the study session.** That is enough to turn your attention in the right direction and it will result in your ability to concentrate, and thus you will retain more information.

The learning process is important, but the brain is afraid of complex tasks, that is why you have to deceive your brain: Do not say you are going to learn one chapter (20 pages), but rather say you are going to study for 40 minutes. You know that you have to learn the whole book, but you say out loud that you are just going to read a paragraph. That is manageable. This will motivate you to pick up the book. And when you read one, you can read the other. Set a goal and pretend to do only 1/10 of the task initially. But as you study, you can continue to study. The hardest part is to start studying (p. 88).

Set a clear goal. Realize that you are studying to achieve a certain level of education that is necessary for you to practice medicine. Even if some classes are not your favourite, be aware that if you pass them, you will get closer and closer to your desired goal. If you keep a clear goal in your mind, being properly motivated will not be a problem for you. And if you are properly motivated, concentration will be much easier for you.

Plan

You have enough time, you just cannot use it wisely. Time may be gained through planning. Think about what takes you the most time and how you can organize it better. Include all dates and events in your daily planner, such as tests, mid-term exams, exams and when it is necessary for you to study for them. Divide a large amount of material into smaller portions, learn continuously and review what you have learned, that way you will retain everything that you have learned. Create a study plan, study at about the same time every day. Write only a few tasks for each day in your daily planner so that you will not be annoyed by it. **The brain likes rules, that way it works much more efficiently.** Write the activities that you look forward to in you daily planner. Daily planner should not be full of duties, it should also include the activities which make you happy, hobbies and sports. Do not take on too many activities. Write dates and activities in the daily planner specifically. Writing “I have to study” is not enough.

It is useful to plan your day and divide your time between school, studying and leisure. The study plan during the semester depends to a large extent on the timetable, divide your preparation time for the classes into the individual days of the week. For example, on Saturday and Sunday you will focus on anatomy, on Monday and Tuesday on histology, on Wednesday you will devote your time to studying biophysics, on Thursday you will study for chemistry and on Friday you will decide what to study for according to the current requirements. This division will allow you to focus on the topics covered throughout the classes. **Never compare medical studies with other majors** or with fellow students at other universities. Everyone knows that studying medicine has its specifics. It is not only time consuming but also requires one to study large amounts of the study material and at the same time requires daily preparation so that the time spent in lectures and practical exercises makes sense to him or her.

Once you have divided your time, do not think about it anymore and do not waste time making further decisions and follow the plan. Planning itself is not difficult. It is best to plan your activities for the week, but you can also plan them for the day. The advantage of having the plan is that you do not waste time thinking about what to do as you have it all planned. [Stick to your plan, manage your life](#). The big advantage is forming a study habit that you implement regularly.

Designated place

When concentrating the mind, you must eliminate the disruptive effects of the external and internal environment, which negatively affect the ability to maintain attention that is essential for successful learning. A prerequisite for maintaining attention for a long time must also be a suitable environment in which you are used to studying. It should be a quiet place where you will not be disturbed by daily hustle and bustle, such as traffic, telephone, and movement. You need to feel comfortable and safe while studying.

A separate study room is suitable for study sessions. A great place for studying is also a study room in a scientific or city library. You can also use an abandoned bench for studying in a nearby park or forest. Someone is satisfied with one stable place designated for studying, but if your preparation for exams during the examination period lasts longer, you need to change your place for studying a few times. This change may refresh your ability to concentrate and study again.

It is best to study while sitting at the desk. [A sitting position helps you concentrate your mind on the study material](#) and helps prevent distractions. The desk should not be cluttered with distracting objects. [You cannot concentrate in a messy place](#). The mind works best if the desk you sit at is clean, clutter disturbs it. Leave only the study material you will need during your study session on the table. Put other things away. Just switching your phone to airplane mode (no one will be able to call or text you) will help increase your study productivity.

Textbooks, study materials and atlases should also have a permanent layout in accordance with the location of the computer monitor. Use the computer, for example, to watch a lecture presentation, which is a suitable addition to your study sessions. Not only cell phone, but social media apps must be turned off as well. Being constantly online will divert your attention from studying to something else and you will lose focus, avoid such distractions while studying. You will be surprised how it will increase your interest in the topic you are studying, and it will improve your attention span as well. An unsuitable study location is a bed that is a designated sleep or rest place or the place where you may possibly read fiction, but unacceptable for learning anatomy, for example.

Lack of light and suboptimal temperature affect the speed of thought processes and cause fatigue. The place should have plenty of natural light and a reasonable temperature. If you study in the evening or at night and in the winter months, regulate the optimal need for light and heat. When studying, never listen to music with lyrics, it disrupts concentration, you cannot immerse yourself deeper in the study materials and it has an adverse effect on the quality of your concentration.

Preparation

Before the actual daily study sessions, get ready everything you will need in advance so that you are not disturbed by anything while studying. For example, finding out that you are missing a book or notes from a lecture. Even such a distraction will take you out of your learning state when your effectivity is on the rise. Again, it will take some time to get back into it, then your effort will be better and more meaningful. Therefore, always, before you start any concentrated work, check everything in advance and the results will arrive.

If it is difficult for you to start studying, create a start-up ritual that will become natural to you over time and you will be able to start studying immediately after performing it. It may be anything: 10 squats or drinking a glass of water. At the end of the study session, you will feel good and proud because of what you accomplished.

Train your brain to concentrate

It is possible to build your ability to concentrate and the training itself improves your concentration, but if you do not do anything about it, it gets worse. There are techniques that improve concentration and other techniques that train your ability to ignore disturbing impulses.

The first technique is **active meditation**. When walking, running or swimming by yourself, when you are in your offline mode and nothing disturbs you, you can think and solve a problem, such as figuring out how to prepare a presentation or write a paper. During the walk, you can think about the content of the presentation or paper. What the opening will be about, what headings and subheadings you will use and what you will include in the conclusion of your paper. A walk or swimming can take less than an hour, but when you return home you have an idea how you will do things that await you. You have a clear head and you know how to do it and at home you just type it on the computer.

At first it will seem very difficult for you to devote the whole time of walking or swimming to one problem, but gradually you will learn how to do it. You can use this active meditation to review the material you have learned, and it can also be used to think about the project you are currently working on. At the time, you are completely immersed in your own thoughts or one idea that you are coming up with at a given moment. **Never deal with multiple problems at once**. Complete one task first and then move on to the next one. Again, do not compare yourself to others, do things as best as you can. The results will be excellent.

In the beginning, it will be very difficult for you to deal with one task for a long time without being disturbed. Remember that training and self-discipline will improve it, and you will be able to concentrate for a longer time and your learning outcomes will be much better.

Many studies show that the improvement of concentration can be achieved by **traditional meditation**. Just 5 minutes of meditation a day and you will be happier and calmer. Sit back and set the timer for 5 minutes. Close your eyes and take a deep breath through your nose and then exhale. All the while just focus on your breathing and try to ward off distracting thoughts. Always pay attention only to breathing. After you hear the time signal sound, you will end this traditional meditation.

If you are stressed out during the day, you can just close your eyes and try to **breathe deeply** (inhale and exhale 10 times). You will feel relieved.

Train yourself to be offline. Try to spend time sometimes by being bored. Do not play with a cell phone while traveling or standing in line. Get bored! Simply stay immersed in your own thoughts and do not let technology control your time. Another simple training is a slow response to text messages or phone calls. Do not answer right away, pick up your phone and answer after a short while. The moment someone texts you, but you do not reply right away, you are intensively building your ability to concentrate and resist temptation. Nowadays, we are extremely controlled by social media. Let us not allow them to control us but let us gain proper control over them. Think about what time spent on social media brings you and what it takes from you. It robs you of time you could spend more meaningfully.

Schedule the time you spend on social media, do not open the social media apps outside of this time. Even if it takes you longer, it can be learned. This technique has a similar effect as the cell phone technique, you improve your concentration and resist temptation. You will become independent of the internet and you will have more time to study and more time for your friends. If you can detach yourself from social media by using this method, your ability to concentrate will improve and at the same time you will feel freer and happier. Be careful, **do not spend time on social media in the morning**. This time is very productive, try to use it as much as possible for education and self-realization.

Exercises to improve concentration

Successful learning depends on the use of both hemispheres and their proper interaction. Exercises may stimulate harmonious coordination between hemispheres and create optimal conditions for studying. If both hemispheres work well together, the exercises will be easy for you and the learning process will be effective.

Exercises to strengthen the connection between hemispheres:

- Slowly walk on the spot. Touch the left elbow with your right knee, then the right elbow with your left knee. Repeat several times.
- Sit on a chair. With your right foot raised, make circles in a clockwise direction, and write the number 6 in the air with your right hand.
- Take two pens. Write numbers 8 in a row on the paper with a dominant hand. Then three times with the other hand, again three times with the dominant hand and finally three times simultaneously with both hands.

By focusing fully on something else for a moment, you can completely detach yourself from the problem and then regain full attention.

Exercises to improve concentration:

- Breathing. Sit comfortably, close your eyes. Breathe through your nose, focus your perception only on how you are inhaling and exhaling slowly. Try not to think about anything. Hold on 1 - 3 minutes, if you repeat the exercise regularly, increase its duration.

- Counting. Sit comfortably. Imagine an object, such as a blank whiteboard. Focus only on that board. If any thought comes to your mind, count it and focus your attention on the board again. Count all thoughts that have occurred to you within an interval of 2 minutes (there can be 100 of them or more). The more often you repeat this exercise, the more you will be able to concentrate while studying.
- Energy between the palms of your hands. Close your eyes and press the palms of your hands together. Then move them 10 cm apart and imagine the hot energy between them that prevents the hands from getting closer to each other. Now imagine that you are trying to distance your hands from each other even more, again the energy between them will not let them get closer to each other. Again, imagine that you are trying to press the palms of your hands together, the energy will not let you do so. Finally, slowly place the palms of your hands on your stomach and imagine that this energy is flowing into you and charging you.

The Pomodoro technique

The Pomodoro technique is simple and requires no training. It uses the principle of dividing the study material into smaller portions. This technique works in accordance with the principles of memory and promotes concentration. The technique uses a timer. You will constantly be under time pressure, which will force you to learn quickly and effectively. In this case, it is a positive stress. The brain realizes that it does not have much time left, so it activates centres that you do not normally use. There is a sense of urgency in the brain that forces information to be retained.

The Pomodoro technique will make you feel energized and ready to start studying. Turn on the timer and you will feel a little adrenaline. The time limit calms the brain as the brain realizes that study session will not last forever, and therefore it can be motivated to concentrate on studying. Start using the Pomodoro technique, improve your concentration and speed of learning.

The Pomodoro technique:

- improves concentration,
- intensifies study sessions,
- accelerates learning and makes it more effective
- increases the number of peaks in study sessions.

The brain remembers best what you learned at the beginning and end of a study session. If you study smaller portions of the study material, you will have more peaks throughout study sessions (p. 99).

Principle: One **session** of the Pomodoro technique is composed of an intensive study session and a break, for example:

- 30 - 40 minutes study session (over time you will find out how long you are able to maintain your attention),
- 5 - 10 minutes break,

the break is followed by the 2nd session, the next phase of studying, which must be followed by a break again.

Learning procedures with the Pomodoro technique (4 hours and 20 - 30 minutes):

Procedure 1: 8 sessions,

- session: study intensively for 20 minutes and take a 10-minute break,
- repeat the session 3 more times and take a 20 - 30 minutes break,
- repeat the session 4 more times and you have free time today.

Procedure 2: [the most used method](#), 8 sessions Procedure 2:

- session: study intensively for 25 minutes and take a 5-minute break,
- repeat the whole session 3 times and take a 20 - 30 minutes break,
- repeat the session 4 more times and you have free time today.

Procedure 3: 4 sessions

- session: study intensively for 50 minutes and take a 10-minute break,
- repeat the session once more and take a 20 - 30 minutes break,
- repeat the session 2 more times and you have free time today.

Procedure 4: 4 sessions

- session: study intensively for 40 minutes and take a 20-minute break,
- repeat the session once more and take a 20 - 30 minutes break
- repeat the session 2 more times and you have free time today.

Procedure 5: 4 sessions

- session: study intensively for 45 minutes and take a 15-minute break,
- repeat the session once more and take a 20 - 30 minutes break,
- repeat the session 2 more times and you have free time today.

You can lengthen or shorten time intervals. If you find out that you can manage to concentrate well enough for 25 minutes, for example, you may lengthen it to 30 minutes. The intervals may be shorter than 25 minutes if you are studying for different classes. First try the classic Pomodoro technique, then try to change the intervals and find the time interval that suits you the most. Study session should be followed by at least a 3 minutes break, 2 hours of study sessions should be followed by a 20 - 30 minutes long break. If possible, continue with a completely different study material after the break.

Mechanical timers do not last long when used actively and break down. It is better if you use a computer timer or an application.

Reward yourself during breaks. The brain associates the reward with studying, after a few rewards you will no longer consider studying to be such an evil. Thanks to breaks, you can study for a long time without losing your concentration. If you feel a decrease in concentration, take a break and return to studying in 5-10 minutes when you are mentally rested again. If you feel tired, do not overdo your strengths, stop studying, it would be a waste of time. Study only when it makes sense. Instead, take a longer break, go outside. Nature refreshes and restores your ability to concentrate and gives you energy.

At the beginning of a study session, review the study material you learned the day before. Use the keyword method to review everything you learned the previous day and study the information you could not recall again. At the beginning of each new study session, go through what you learned during the previous one. After a long break, quickly read everything you learned before the break.

During the [Pomodoro technique](#) session, you may:

- review course material,
- create new cards,
- review the information on cards
- write and correct your notes
- study new course material.

During the study session, always focus on only one activity and one course material. Study also the materials from other courses, but in different study sessions, then it is effective.

During the [Pomodoro technique](#) break:

- relax,
- stretch, do a few squats,
- get a drink,
- eat something, e. g. fruit,
- play music that will calm you down or dance,
- talk to someone,
- take a short walk or do other similar activity.

Breaks

During the break, it is most important that you stop thinking about studying. During the break, the subconscious works, which processes information at another level and helps you understand the learned information and store it into memory. [Do not acquire any new information, watch TV news, or read articles online](#). A walk in the garden or relaxing music are ideal. Do not do any very interesting and fun activities, or do not exercise intensively so that it does not distract you from studying. You should rather focus on peaceful things. It is enough for you to stretch or do a few push-ups, squats. Around the middle of the day, take a walk, it will exceedingly excite you.

When you take breaks and you feel rested, you will understand the next part of the study material more easily because you recall the information from the previous session and it is much easier to link it with the new information. Once you have learned something, it is much easier for you to connect it with new information you may acquire. When you study without taking breaks, it is harder to connect the information. During breaks, the brain processes information at a subconscious level, sorts them and establishes connections. A person who does not take breaks will get tired sooner and will retain fewer information. It will be difficult to find a connection between the already learned and new information.

When you study, [you will retain the most at the beginning and at the end of your study session](#). It would be a shame to study for 2 hours and have only two peaks during a study session (at the beginning and at the end of your study session). Instead of two peaks during a 2 hours study session, you can have 4 peaks if you divide your study time into 30 minutes intervals. If you study for 4 hours, you have only 2 peaks during a study session (at the beginning and at the end of a 4 hours study session). If you divide your 4 hours study time into 40 minutes intervals, you may achieve 12 peaks throughout your study sessions. Keep taking breaks, you will retain much more information. Breaks should be short. They refresh your mind and consolidate learned information.

Active reading

Active reading is the foundation of active learning. You will use it every time you study textbooks, which should not be only read. Active reading techniques help with retention of information.

- **Go through the text**

Go through the paragraphs quickly, try to capture interesting or important information. Carefully read the headings and the parts that are visually different from normal text: different text format, words in bold, words in italic font, colourful words, tables, exclamation marks, and other. This method subconsciously focuses the brain on the important parts of the text, which you will subsequently understand better.

- **Answer the questions**

After going through the text briefly, try to answer these questions: “What is this text about? What will I learn when studying the text? What should I read more attentively? What questions based on the text could be in the test?” This simple series of questions will activate the brain and help you understand the study material. If you do not understand something, you will ask.

- **Look at the conclusion**

All texts are written in the following form: opening, core and conclusion. In conclusion, the author mostly lists the most important points, summarizing the most important. Read it in detail. The brain will later look for details in the text.

- **Read the text**

Now proceed to reading the text, read carefully, slowly and mark the important parts of the text. It is important to be able to quickly navigate through the study text and find where the important information is located, so that you can return to it when reviewing.

These may be of great help to you:

A/ **Sticker markers**

If you have a borrowed book, a good option is marking important parts of the text using small coloured sticker markers. When you study and come across a point that is important, stick a marker to it so that it is visible and write a short note on it.

B/ **The keyword method**

You can use this method if you have your own textbook. Highlight or underline important words (p. 49).

C/ **Write in the book**

If you have your own book, you can write brief notes in the margins or directly into the text, which will help you recall what the text is about more quickly. Write only short notes that will summarize individual paragraphs or pages.

In active reading, you try to understand the text and think about it. You will understand the material and also retain it, because it will go through your head several times: first, you go through the text quickly, then you think about it while answering questions, you look at the conclusion, then you read the whole text and work with it actively. By working with the text, you will retain the information faster and better.

Having read the text it is important that you also make notes. Make notes from reading a given chapter using Microsoft word or other text editor or by hand. But not the way you used to do it before. Now do it actively. Make notes based on what you have retained, thus training memory, and increasing retention of information. Look into the book only if you really do not know what to write and look only at the main idea because it will help you recall the rest of the information. If you have written notes thoroughly enough, you will not have to return to the textbook as you can study the notes. Textbooks contain 80% of the data that are not included in the exams anyway, study strategically (p. 128).

Learning by expressing information

Prepare for the fact that learning by expressing information will be difficult and intense. At first it will not go easily. The first days will be bad. The most difficult are two steps: learning keywords and expressing the information from each paragraph. Do not give up, hold on. Page after page it gets easier and you will accept the necessity to express information. In the end, you will get used to it and you will always study this way. Learning by expressing information is part of active learning.

A/ Create a list of keywords

Read a chapter, make a list of keywords, and learn it by actively recalling them from memory. A keyword is a phrase that expresses the main idea of a paragraph, an important point or a new twist. You do not need to be able to list all the keywords immediately and in the exact order. Recall from your memory. It is essential to be able to recreate the text of the chapter according to them. Keep the keyword lists, use them again when reviewing the material.

B/ Learn the sentence after the sentence

This step is at the heart of the whole learning process, it is done by expressing information. It is the most difficult and time demanding step. First, carefully read the chapter, just after reading, write (preferably in an empty file) what you have retained. Then

- carefully read the paragraph that you are going to learn,
- express information from the paragraph you are learning based on what you have retained in a written form,
- check and learn the parts you were unsure about,
- if it was all inaccurate and a lot of it was missing, reread and rewrite it.

Repeat the procedure with each larger logically related part of the text (this may not be just a paragraph).

C/ Express the information from all chapters

Having learned all the parts of the chapter, you need to verify and consolidate the new knowledge. Use the keyword list and put together the entire chapter text. Do not help yourself using the book. Learn the missing parts. Chapter after chapter, you will go through the entire study material.

D/ Express the information from the entire study material

Express the information from the whole study material by heart based on everything you have learned, one chapter after the other. Go through the keywords and put together the study material for the test/exam. It may take 4 – 6 hours. It is not hard you are just

reviewing the learned material a few times. Open a book or notes and check to see if you know it well enough. Read the difficult information intently and multiple times.

E/ **Review the next day**

Review the material you learned the previous day before learning new information. Using the keyword list, express everything you learned the previous day and learn the parts you cannot recall again.

Specific examples of effective learning

Method 1

- **Brief reading.** First, get a quick overview of the text, how many headings and paragraphs it has. Run your eyes over the chapter you are supposed study to know what it contains (headings, highlighting, figures). Then read the text briefly.
- **Thorough reading.** Mark what is important in the text. Read carefully and intently. When you start to lose attention, take a short break. Go through the figures and tables. Read complex parts aloud even twice.
- **Active reading.** Reread the text, underline important information in the text with a pencil and make notes. If the book is yours, you may also use a highlighter.
- The last step is a complete **summary** of the learned information, a review of the whole study material. The most effective thing is to review the study material aloud. Describe everything that you recall without looking at the text. Initially, you will have to look at the text sometimes. Once you have learned to work with the text, it will be sufficient for you to read it only three times (brief, thorough and active reading) and you will be able to repeat the main ideas of the study material in your own words.

Method 2

- First, carefully, and intently read the text and try to understand it, not retain it.
- Get a rest and if possible, take a nap.
- Return to the text for the second time and store the study material in memory using memory techniques and memory associations.
- Again, take a break (take a nap).
- When you return to it for the third time, actively recall your memory associations. Retell the material aloud while standing up to make sure that you understand it.
- The fourth time you try to recall everything what you have learned and repeat steps 1 through 5 for the information that you could not recall.

Method 3

- First, just read the material without trying to retain it.
- Get a rest for a while
- Return to the study material. Try to retain it.
- Actively recall what you learned and what you have retained, ideally aloud.
- If you have not retained correct information, repeat steps 3 and 4.

Method 4

- Read the material quickly once.
- Read the material once again, now slowly and try to understand it. Read it analytically, with understanding. Pay attention to details and think about it.

- Highlight the essential parts of the material in colour: chapters, sub-chapters, sub-headings, and keywords.
- Create mind maps and learn them.

How to tune in to alpha waves

The brain in its modes works on different waves:

- alpha waves: 7 - 13 Hz, relaxation, rest, wakefulness phase just before sleep,
- beta waves: 13 - 35 Hz, normal waking state,
- theta waves: 4 - 7 Hz, deep relaxation, sleep, dreaming,
- delta waves: 0,5 - 3 Hz, completely deep sleep without dreams,
- gamma waves: 40 Hz and more, very deep meditation.

The best waves for studying are alpha waves.

It is important to be calm before studying. Start studying and devote your time only to studying. To induce alpha waves, it is necessary to engage only in one activity. Alpha waves will get you into a **flow** state and you will be able to receive information much faster. The state of flow occurs if you are completely immersed in activity and do not realize the passage of time. *Studying while being in a flow state is ideal.* Set the timer for 40 minutes but put it away so that you cannot see it. When you look at time while studying, you are nervous about how slowly/quickly time passes. When you do not pay attention to time, tuning in to the flow state is much easier. Cut yourself off from the world and immerse yourself in studying.

- Sit up with your back straight (it increases self-esteem).
- Close your eyes. Say to yourself: I am tuning in to alpha waves.
- Take a deep breath.
- Exhale slowly.
- Inhale and exhale deeply - several times.
- Imagine a favourite and safe place.
- Engage your senses - imagine what you feel, see, hear and what you are doing.
- With eyes closed, look up and down.
- Open your eyes.

Try it. Entering the state of flow will become natural for you over time. You will be calmer, you will study more effectively. Be careful, any distraction will stop you from being tuned in to alpha waves. And you have to do it all over again. You can try it even before classes at school. You may tune in to alpha waves by listening to music (p. 103). The music should not be loud so that it does not disturb you.

Affirmations

Believe in yourself. You can do it. When you create adverse scenarios, you use the same amount of energy as when you create favourable scenarios. Fear does not help you. It unnecessarily instils chaos in the mind and robs you of energy. If you are worried, it affects your body language, which affects your behaviour and subconsciously the reactions of others.

Your thinking can be reprogrammed or changed by repeatedly saying and thinking new claims or statements. Thanks to them you will be able to manipulate your subconscious. This procedure is called **affirmation** or **autosuggestion**.

Affirmations before studying:

- **Affirmation 1.** Today, studying will be easy. My memory works great. During the exam I am calm and relaxed, and I answer the questions correctly. My performance is improving from day to day. I enjoy learning.
- **Affirmation 2.** I am happy to explore the abilities that I possess, and I immediately concentrate on what I do. I prepare thoroughly for all exams. I am still calm. All that I have learned I can immediately recall at any time and give quick and correct answers. My attention is concentrated on my goal and my performance is improving. I masterfully manage every situation and I will achieve the goal in the foreseeable future.
- **Affirmation 3.** I learn easily and quickly. I enjoy learning and I am constantly improving. I will pass this exam. My brain is capable.

You can repeat affirmations even before going to bed or during your commute. Positive emotions, such as joy and curiosity are of great help when studying. This does not mean that positive visualizations always work, but using them, you will increase the chances of success. Henry Ford said: "Whether you **think** you can, or you **think** you can't, you're right".

Music

Until recently, experts on effective learning recommended that students should study in absolute silence, so that nothing disturbs them. An experiment was conducted in which students were divided into 3 groups. The first group listened to classical music and the second group listened to jazz while studying. The third group studied in absolute silence. Then the individual groups were shuffled, and the students took the test. Result: the best results were achieved by those who studied and took the test while listening to the same music, the worst results were achieved by a group of students who studied and took the test in silence. This experiment demolished the myth that students should study in complete silence. The brain has no way of connecting new information with the external environment in absolute silence.

You are not allowed to listen to music during tests and exams, but this does not mean that you cannot listen to music while studying. Listening to good music while studying can improve your memory, concentration, and efficiency. Put on background music at very low volume, so that it does not disturb you but rather has a calming effect. Baroque music is suitable. It induces a state of relaxation and tranquillity. Baroque music has 50 - 80 beats per minute, imitating the heartbeat. This sound is soothing and familiar already from the pre-birth period. Many do not tend to listen to classical music. Try it, you may start liking it over time. Music that is suitable for studying may not be loved by everyone. You can also listen to your favourite music, but only to instrumental versions without lyrics (without singing).

When studying, do not listen to songs in which someone sings or raps, such music would disturb you and slow down the learning process. The brain is disturbed by singing, even if you do not consciously perceive it. You focus on the lyrics of the song and not on studying. Loud music is distracting and slows down the learning process. Favourite soundtracks are

not quite ideal during your study sessions either as they will not help you tune into the alpha state. It is best to listen to music that tunes your brain to the alpha state. [When studying, apply techniques of effective learning while being tuned in to these waves.](#) In the beginning, listen to music for 5 minutes and do not think about anything. Then start studying.

Listening to music while studying is unique to every individual. You need to figure out for yourself what kind of music suits you the best when studying (or silence). Some recommend alternating slow and fast music. Others say that one should always study while listening to the same music, because when he or she hears it, the brain will immediately prepare itself for learning. But you do not need to go beyond your limits. Music can serve as an example of positive motivation. Find out what kind of music motivates you and evokes positive emotions in you. Music also increases a zest for learning and makes you feel like everything is manageable and it will not be so difficult. If you need to listen to music while studying, play the kind of music that does not interfere with your concentration.

Music suitable for studying:

- classical music - Bach, Händel, Vivaldi, Mozart,
- alpha waves music and studying music - on YouTube,
- sounds of nature, falling rain, thunderstorm,
- brain.fm - music designed for the brain to enhance focus,
- movie soundtracks (instrumental music) – from *Imitation Game*, *Rush*, *The Theory of Everything*, *Inception*.

Tips for better learning

- **Write a summary of the whole day at school after you get home.**

[It is very useful to write a kind of summary every day after getting home from school.](#) Write down everything you remember from lectures and seminars in individual text documents (according to courses). This technique has a very strong effect on retention of information. The materials you create may be useful when studying for mid-term exams or exams. If you find out that you are unable to recall something, review the material again. Unify knowledge into logical units, [review the material that preceded the material you are about to study](#) to know what the new material could relate to and what it elaborates. This will anchor new information. Use mnemonic devices, draw schemes, sketches, pictures, associate words with pictures.

- **Learning styles**

Most people retain their knowledge through multiple learning styles at once. The more senses you engage when studying, the better you remember the information. It is best to use a combination of reading aloud from the book along with underlining and drawing. Test yourself if you are a visual, auditory or kinesthetic type and adapt it to the way you learn (p. 40). Most people are visual type learners.

- **Study before bedtime**

If you read the study material once during the day, you may recall one tenth of it the next morning. But if you read the same study material in the evening before going to bed, the next morning you will be able to recall more than half of it. This also applies to studying before a short nap during the day. BUT: this does not apply the other way around, sleeping

before studying negatively affects your study performance! [Start your study session not earlier than one hour after waking up.](#) It is most effective to review the material in the evening before your bedtime and in the morning, an hour after waking up. [Do not study at night just before the exam.](#)

- **Think positively**

Be positive (negativity will slowly but surely destroy you). When you think positively, everything goes easier in life. When you look at the world negatively, you only see the bad sides and you suppress the positives. It is largely a matter of nature, but you have judgment, reason, and free choice so that you can change some things in your life and turn your negative view of the world around 180 degrees. Do not think about what you do not know yet and what still awaits you. Focus on what you have already accomplished. In small steps you will slowly reach the goal. Get rid of the belief that studying is challenging, that you are not built for studying, or that you lack a talent for studying. BUT: use affirmations and repeat, for example, "I want to study, I want to study". Or even better: "I can study effectively, I can study effectively". A lie repeated 100 times becomes true and will be easier for you to study. [Associate information with emotions](#), whether positive or negative, so that you can retain the information longer and significantly reduce the duration of your study sessions.

- **Use emotional intelligence**

The best students do not have the highest IQ (intelligence quotient) but have a very high EQ (emotional quotient). Emotional intelligence reflects an individual's interaction with other people, motivation and is responsible for stress. The lower the EQ, the worse a person communicates with others and the harder it is for him or her to cope with stress. EQ can be increased if you approach the study material positively. When experiencing joy, hormones are secreted, which not only facilitate learning, but also favourably affect long-term memory. Feelings of joy have a positive effect on further learning and contribute to the concentration of attention. Do not stress over a bad grade. Always try to find the more positive way. Do not consider learning as something unnecessary and annoying, find something interesting in it. View it as [a training for your brain and overcoming yourself if you force yourself to do what you do not want to do](#). In moments like this, you become stronger.

- **Do not compare yourself with others**

Comparing yourself with fellow students can be counterproductive and has nothing to do with effective learning. You may lose motivation and a desire to learn. This can happen when you are comparing yourself with a better or even worse student. After all, you learn for yourself, you are interested in your results, goals, and needs. This does not mean that you should not be in contact with fellow students. Just do not pay attention to their grades and do not compare yourself with them. [Have friends, but do not compete with them. You are learning for yourself.](#)

- **Combine different sources**

Let the brain work. Learning from multiple sources has many benefits. The brain can compare information and you will gain insight and perfect understanding. First, learn the information from notes (lectures, seminars). As part of the repetition, search for something about the study material online or in an encyclopaedia. Only now the textbook is coming in.

This way you will learn the material perfectly, you will have more information about it and you will see the context. The more you know about the topic, the better you will retain the other details. BUT: if you do not understand the material, search for alternative sources and try to understand it. This habit is essential for successful studies.

- **Study continuously**

Studying continuously is incomparably more effective than studying at the last minute. It is much easier to review something you already know than to quickly learn unknown information. Even if you are studying for an exam or a test at the last minute, you can learn it well enough and pass the exam. BUT: you will not understand the study material so well and you will quickly forget the learned information. In the next semester, you will not be able to draw on this knowledge. The materials from new, follow-up courses will be harder for you to learn.

Studying continuously is not unnecessary and will not take more time compared to one-time studying. In addition, you will retain the information for a longer time and study without stress.

- **Tactics**

Get an overview first. Learn the whole material, then the details and connections. Divide the material into smaller portions, it will not look so menacing. Combine information with what you already know, it will start to make sense to you. Do not underestimate the basics, without them it will be difficult to proceed. Do not study similar materials in a row so that you will not get confused.

- **What if something is too hard to understand?**

If you do not understand something, ask immediately during the lecture or seminar, because once you get lost, it is difficult to get back. Find someone who will explain it to you, without understanding it makes no sense to study. Do not give up and, paradoxically, try to explain it. Explain it to the imaginary five-year-old child using the Feynman technique. If you can do it, you can be sure that you have learned the material well. Being familiar with two ways of thinking as well as mind maps can help (p. 124).

- **Repetition is the only solution to prevent forgetting**

The most effective method of learning is the systematic repetition of knowledge. When reviewing the material, change the study place, the order of the study materials, daily duration of studying with respect to having learned the material the first time, so that different association pathways can be involved in the brain. The study material will not be tied to the surrounding factors and you will be able to retain it better. A few minutes after having learned the material for the first time, try to recall the learned information from memory once more and review it at least 3 times during one study session. You will not learn anything for the first time. To store the information permanently in long-term memory, it is necessary to repeat the information according to the curve of guided repetition. You will achieve perfect retention of information - long-term, reliable, with understanding.

To achieve the best retention of information, actively repeat the material the day after learning. The harder it is to recall when reviewing the information, the stronger the memory is stored.

Example of learning without repetition:

- 1st day: You are leaving the lecture, you understand everything.
- 2nd day: If you do not work with a material from the lecture the next day, you will be able to recall a third of the material.
- Day 7: After a week, you will be able to recall less than a quarter of the material.
- Day 30: After a month, you will be able to recall a fifth of the material.

Before the exam, you feel like you have never seen it and you have to learn it again.

Example of learning with repetition:

- 1st day: You are leaving the lecture, you understand everything.
- 2nd day: The next day after the lecture, you only need to review the material for 15 minutes.
- Day 7: After a week, you will review the material for 5 minutes.
- Day 30: After a month, you will review the material for 2 - 4 minutes.

Before the exam, you just flip through the material. You do not have to learn it, you are able to recall it. Repetition is a reasonably spent time. It is explicitly foolish not to repeat the learned material.

Before studying

- ask the people around you not to disturb you,
- find a quiet place,
- play some pleasant music (without singing),
- Prepare study materials, notes, a laptop (if you use it when studying), pens, a paper for distracting ideas and water,
- switch your cell phone to airplane mode,
- if you are learning from a laptop, log out of Facebook and the like,
- set a goal for what you want to learn,
- motivate yourself, use affirmations, believe in yourself,
- do a start-up ritual,
- tune in to alpha waves,
- and start studying.

When studying

- it is important that you are rested and not influenced by any stressful factors,
- put aside everything that could disturb your concentration, study in a place where no one disturbs you,
- concentrate, it is very difficult to learn without good concentration,
- discover and cultivate your natural curiosity, which stimulates the motivation to learn,
- internal motivation is necessary,
- think about what you are studying so that you understand it and know how to use it, study in depth,
- use real-life examples, they are very effective in retention of information,
- use memory techniques as they simplify learning,
- create mind maps, mark keywords, use colours, arrows and pictures instead of linear notetaking.

- combine information with what you already know, it will start to make sense to you,
- confusion precedes clarity, do not be afraid, **first you are confused by the study material, but then it becomes clear to you,**
- first, you have to master the basics, then other information will be easier for you to learn, you will understand the context, which will further deepen your understanding,
- it depends on your emotional state, it is best to study in a good mood, after experiencing a happy event (an entertaining tv show is enough),
- Stress and reasonable fear can also have a positive effect on the individual as a positive motivating factor. They can lead to increased learning performance and strengthen the so-called learning is a challenge,
- some people find it beneficial if their favourite music is playing in the background as it helps them manage stress and nervousness (p. 104),
- fatigue and exhaustion negatively affect learning, take a break if you cannot handle it anymore, try to exercise for a short while, but if it does not help, it is better to postpone studying to another time.

After studying

- **avoid receiving other information**, do not watch movies, do not read a book, so that the information from them does not disrupt the course of storing the information from the study material; this phenomenon is called **interference**,
- repeat important facts in the evening, 10 – 15 minutes before bedtime is enough, sleep is crucial for your brain to store information,
- one can recall in the morning even more than in the evening before going to bed (overnight consolidation),
- **do not drink alcohol** because it significantly affects the retention of information, for example, a few beers in the evening can erase up to 30% of the information acquired that day,
- suitable activities are walking, physical exercise, dancing, music, meditation, meeting friends, but also chatting on social media.

11. SPECIFICS OF UNIVERSITY STUDIES

A big difference compared to high school is the organization of the courses. Most university courses consist of lectures and practical exercises (sometimes called seminars). The difference is that the lectures are common to all, the lecturer is devoted to explaining the course material. During practical exercises, the students are divided into smaller groups and the course material is being put into practice (in the practice room, in the laboratory, in the dissecting room, in the hospital department).

Lectures

Some lectures are not mandatory and in some practical exercises you may have two or three absences. It sounds attractive, but do not be seduced. Make the most of all study opportunities. Lectures and practical exercises are designed to continuously prepare you for mid-term exams and exams. When you can get the most out of a lecture, you do not have to bother with study materials. You absorb a lot of information gradually, you have time to learn it perfectly. If you do not understand something, feel free to ask the lecturer. Teachers often appreciate the interest of students. You will understand things and you do not have to worry at home and spend a lot of time studying. Those who do not attend lectures often have a problem during practical exercises that usually follow them. Example of effective learning: *If you pay attention during lectures and you are active during practical exercises, you will understand the course material. Subsequently, you do not have to study so hard for the mid-term exam/exam and you will save time.*

The lecturers explain the material gradually and provide you with examples and observations that you will not find in the book. You would not understand it so deeply from the textbook itself and it is questionable whether you would motivate yourself to study at all. When you study week after week, you understand the material in context, and you retain it well. This is effective learning. Learning all at once during the examination period is an example of a traditional, ineffective way of learning. Lectures will give you a good foundation you will be able to build on later. Studying before exams will not be as exhausting and will not take as much time as if you decided not to attend lectures or attended but did not pay attention. The lecturers usually emphasize important facts several times, draw attention to them, highlight them in the presentation and these will then be included in the mid-term exams or exams. This will also help you a lot in preparing for the mid-term exam/exam.

Lectures usually last 90 minutes, sometimes more. One is unable to concentrate for so long. Even though the lecture is interesting, and the lecturer is entertaining, the student is unable to maintain his or her attention throughout the whole lecture.

Tips for improving attention span:

- Prepare your mind for the lecture in advance: if you have the material that will be used in the lecture available in advance, go through it and you will prepare the brain for it. If you do not have such material, look in the textbook or find some information regarding the topic online. This initial interest will arouse your curiosity.

- Come to the lecture in a good mood, full of energy, rested and do not be hungry or thirsty.
- Do not sit close to your friends, you risk talking to them and you will not really perceive what is being explained in the lecture. Then you get lost in the material explained during the lecture and it no longer makes sense to pay attention and you get bored.
- Sit in the front rows, you will hear more, pay attention more and participate in the discussion.
- Ask questions regarding what is not clear to you, make your brain think about the topic. You will understand the material better, get out of the comfort zone and even practice talking in front of people.
- Train your brain to pay attention: even if you are not interested in the lecture, pretend otherwise, nod your head. The brain gets used to it and you really start to be interested in the topic. You will not enjoy the lecture unless you pay attention to it and are able to cut yourself off from the world and immerse yourself in it.
- Write down distracting thoughts whenever they come to your mind. That way you will not have to think about them and worry that you will forget something. Distracting thoughts do not allow you to use the full capacity of the brain. Therefore, it is useful to have a paper or notebook with you and write them down. When the brain realizes that it is written down, it stops thinking about it and you can devote yourself fully to the lecture.
- Do not look at the cell phone during the lecture, it is very distracting. Before the lecture, switch your cell phone to airplane mode, turn on the application called forest for the duration of the lecture (usually a 90-minute interval) and put the cell phone somewhere where you cannot see it (e.g. in the bag).
- Take notes.
- Have an internal dialogue with yourself. Comment on what you see, search for context.
- Reward yourself for staying in the lecture: have a good meal, go to see your friends, go for a walk, play a game, relax for a while.

Notes

Notes help the student learn, whether during preparation for the practical exercise, exam or mid-term exam. Notes simplify learning. They translate complex information into simple language. If they are written well, they will save you time that you would otherwise spend trying to understand complex things. You can write notes by hand or type them up on a laptop. If you prefer a laptop, create separate documents for each lecture. It will be easier for you to find your way around later. Each subject should have its own file of documents.

The notes are an abridged version of the lecturer's long explanation. Notes include the main information presented in the lecture that should be retained, the rest is in the textbooks. It is a unique record of your thinking. Notes are best understood by the one who wrote them. Taking notes during the lecture helps you stay focused and at the same time you retain the information while writing it. By taking notes, you transform thoughts in your own way, you think. With a pen in hand, attention is better maintained. It is necessary to realize that the intention to write everything down pushes out the intention to retain everything. The more you write mechanically, the less you think about it. Therefore, all you

have to do is write only supporting points, brief notes, process them that day, confront them with the information in the textbook. This is the way to get the most out of the lecture and to retain most of it. Students who attend lectures usually achieve better academic results.

The aim of the lecture is not to teach the student everything, but to guide him or her. A full-time student should realize that he or she attends university instead of having a job and should devote 8 hours a day to study obligations and actively use the potential of lectures.

If the lecturer does not publish the presentation, the student is forced to record the interpretation in writing, concentrates on rewriting the texts from the presentations, and thus cannot concentrate on understanding the material covered in lectures. The student will not learn much because he or she will not get into active interaction with the study material. For the lectures to be effective, it is important that students pay attention and **take notes in their own words** and do not write texts only mechanically. This makes them active participants in the educational process. The Institute of Anatomy in Košice publishes each presentation on the Portal of UPJŠ in advance, students can print it out or open it in electronic form during the lecture. As they do not have to slavishly take notes the whole time, they can concentrate fully and just make a note of what is being explained as needed. If someone cannot come to the lecture, they will find presentations on the Portal.

However, the presentation alone is not enough, because during the lecture the lecturer provides an explanation, draws attention to important facts or shares knowledge based on his or her own experience and links it to the material from other courses, which you will not find in the presentation itself. When a student does not attend lectures, it may appear to him or her as a time saver, but it will ultimately become a loss. Do not save time in the wrong place. It is good to come to the practical exercises prepared and without attending the lecture it is necessary to devote much more time to the preparation. Without attending a lecture, it is often impossible to decide what information from the amount of materials is important.

Take notes during the lectures, but do not rewrite everything the lecturer says or shows in the presentation. Try to rephrase it in your own words and simplify it. This will help you understand the material and retain the information more easily. Try to listen to and interpret what is being explained in your own words. You will use your brain more, which will increase your interest in the topic and ensure better retention of information and understanding.

If you take notes carefully during the lectures/practical exercises, but you go through them only before the test or exam, you will find that you are unable to recall the information at all or learn from the notes well. Therefore, **go through the notes immediately after you get back home from school**. Thanks to that, you will sort the thoughts in your head, and what you did not understand during the lecture/practical exercise may become clear to you. This phenomenon is called **percolation** - to filter, to trickle through (p. 117). As you return to the information, you put it in your memory again. You are not learning but reviewing it. You will save time because you will not have to study for a long time before the exam. Individual parts of the study material are usually logically related. If you do not understand them, you are unable to follow up on others, so try to comprehend it that day.

How to take notes

To avoid being disturbed by the internet when typing notes up on your laptop, install a browser add-on that can block access to websites for a specified period of time, so you can attend the lecture without interruptions. The brain forgets the most on the 1st day of learning. Therefore, it is important to return to the notes that day; before the information is completely erased from your memory. There are several ways of taking notes:

- **Well-arranged notes**

The information is clearly arranged in smaller units, in a structured way. Use headings, subheadings, use bullet points, give examples. Take notes as you see fit. Only correctly written notes are understandable and possible to be retained. You can leave an empty line or make more significant spaces to make it look well-arranged. Although this method is very simple, it is better than notes without any format. It is not the most effective method, but it will teach you that notes should look a certain way to learn from them effectively.

- **The Cornell method**

This way of taking notes is used in the USA. It is not difficult, but it will take more time than a well-arranged notes method. You will have to process the information from notes for 2 - 3 minutes at home. It is an effective method and involves effective learning.

You take notes at school, review them at home and you even have to think about the acquired information to be able to write a brief summary of every page. By doing so, you do not even have to study the information anymore. You have already retained it. You will start to like the Cornell note-taking method after a few tries. Try it, you will see that you will retain the material faster and you will understand it better.

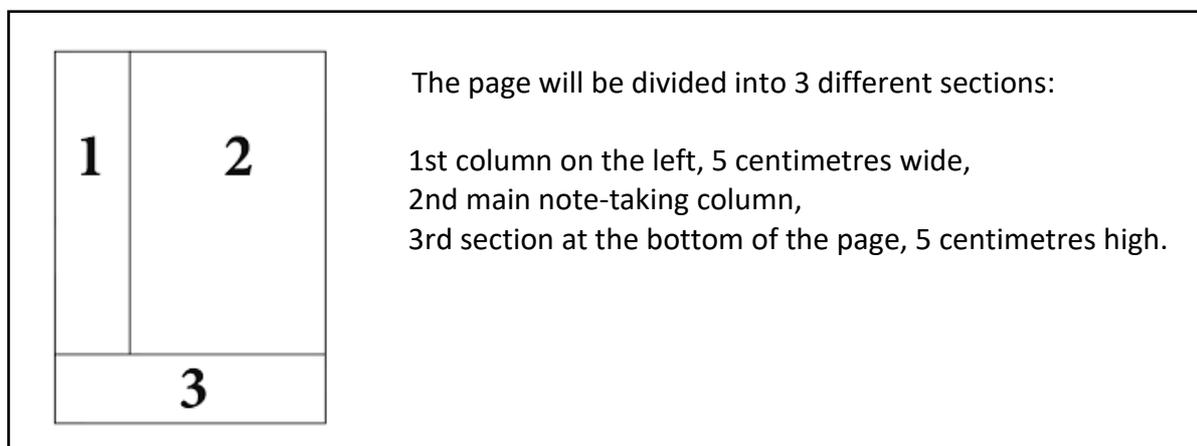


Fig. 20 The Cornell note-taking method

All actual notes from the lecture go into the main note-taking column (2). The column on the left side (1) is for questions about the notes, sketches or comments that make the whole reviewing and exam preparation process easier. You may write in the left column (1) during the lecture, if you have time, or leave it for later. When reviewing the notes, a brief summary of every page should be written into the section at the bottom (3). This section will make you think, learning becomes an active process.

- **Mind maps** (p. 124)

Notes that involve mind maps are completely different from the previous types of notes. Write (draw) the topic you will be writing notes about in the centre of the paper. It is a central idea of your mind map. It is the central point where other, less essential information, branch out from it.

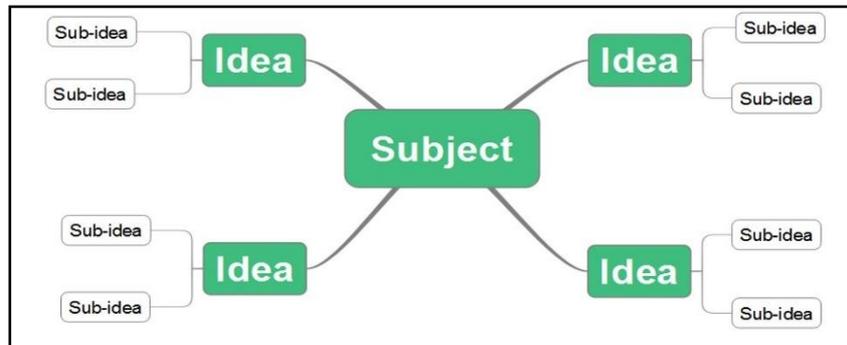


Fig. 21 Mind map example (source: <https://www.imindq.com/blog/5-reasons-why-mind-mapping-is-needed-in-universities>)

- **Flow-based notes**

When you take flow-based notes, your goal is to learn it, while in the lecture. They are based on you writing them in your own words, letting the brain think and interpret the information (it speeds up the learning process). You organize the notes spatially with arrows connecting ideas. Images, diagrams, and your own ideas should help embellish the notes. All of these helps enhance understanding of the topic explained in the lecture. Simplify complex topics using illustrative examples and comparisons. Add a comment. This is what flow-based notes will help you with. You should strive to write things in your own words, not the lecturer's. Drawing arrows helps connecting the information that is related.

- **Writing in the margins**

Some teachers will prepare handouts for you. Your job is to print them, sometimes not even that. Teachers want to make it easier on you, but it also has a disadvantage. When you do not take notes, you retain less. Therefore, it is important to work with materials, mark the most important parts. Write additional information in the page margins. The information will go through your brain and you will retain it more easily. It will also enhance your understanding and overall overview of the topic.

- **Highlighting, underlining**

The task of highlighting is to emphasize what is most important in the text. If there is too much information highlighted in the text, it loses its effect because everything will be on the same level. The whole highlighted sentence has the same effect as the unhighlighted sentence. Nothing stands out from it, and therefore nothing is important. Underlining is the equivalent of highlighting. Return to the highlighted/underlined text on the same day. Read it briefly and try to recall the information from your memory. Sentences are composed of keywords and the others that are needed to make the text readable. The brain can understand text without those other words. Therefore, highlight only keywords (1 - 2 in a sentence). Keywords are essential in retention of information as without them the sentences would not make sense and you would not be able to understand the material.

- **Your own summaries**

From the viewpoint of effective learning, it is better to write summaries in your own words than to highlight/underline. It will take more time, but it is a technique of active learning, where you have to work with the text, invent your own formulations, recall information from memory. You will retain the information much faster.

How to study your notes

- go through the notes again the day you took them,
- think about what you have learned,
- delve into the depths of the study material to understand it,
- give the knowledge you have acquired a while to get consolidated,
- experience the AHA effect of understanding after learning,
- be happy that you understand something, that you have discovered something new,
- when taking notes, leave free space for additional comments and the like.

How to learn effectively from course materials

Learning in university is different from learning in high school. It is more about independence and responsibility to yourself. You need to learn a lot of information from the available materials. It does not matter how much time you spend studying, but how you spend it. You are given a list of mandatory and recommended literature for each course. These are usually textbooks and course materials. What is the difference between them? Both are study materials. The lecturer uses them to explain the topic and students learn from them. Textbooks are in book format and materials are usually in A4 format. Textbooks and materials together with the notes of students take during lectures are the main sources of information for students. You have a textbook or study materials in front of you and you could start studying. You used to start reading right away. You will do it differently if you choose to do it in a more effective way. Before a study session, make sure you have everything you need with you and the distractions are eliminated. Prepare everything you will need in the next few minutes, study materials, your own notes, pens, and a glass of water. Do not forget to turn off your cell phone or switch it to airplane mode.

- **Warming up the brain**

This step prepares the brain to receive new information, making it much easier to store the information in your memory. Find the chapter you are going to study and ask yourself: “What do I know about it now? What knowledge do I have about the topic?” Try to get something out of your head, fight with it for a while, even if you cannot think of anything. It will make you think and wake up neural connections associated with the topic and then store new information more easily. Do not give up, try to come up with something. Retell your knowledge out loud, if that is not possible, write it down.

- **Getting acquainted with the study material**

You do not have to read the textbook or materials from the first page to the last one so as not to miss anything. If you think a chapter is clear to you, just flip through it. If you are going to study a chapter, first go through it briefly. Find out its scope and how much time it will take you to learn it. By flipping through it, you get an overview of the chapter. The brain can subconsciously focus on certain information and then retain it better. Then read the

summary if there is one. The most important information tends to be included in summary. Sometimes there are control questions at the end of the chapters. Try to answer them. It will once again arouse your mind and prepare it for the effective absorption of new knowledge. When you then start reading, the brain will know what to pay the most attention to. The initial flipping through the chapter and reading the summary will arouse your curiosity and make you read the whole chapter.

- **Reading**

Do not read the textbook/materials like a newspaper. Keep asking yourself questions, think about the text, use your imagination. Read carefully, slowly, try to understand what you are reading. Use highlighting/underlining to indicate keywords. Speed reading is not suitable for an initial study session. Reading 500 words per minute impairs comprehension. You can use speed reading in step 5, which is repetition. You can listen to music without words while studying, quiet classical background music is ideal.

- **Retrieval of information**

By only reading it, the information is not stored in memory. The brain stores information in a recognizable form and an accessible form (p. 34). By usual reading, the information is stored in a recognizable form. For example, there will be a question on the test, and you know you have read it, but you cannot recall what it was about. The recognizable form bears the marks of the illusion of learning. The accessible form refers to an actively learned information. You can recall the information on the test the way you read it. When you can recall something, you stabilize the memory trace. The more often you recall something, the better you will retain it. Go through the chapter titles and try to answer the question: "What knowledge do I have about them?! It is most effective if you say the answers out loud. Retrieve information from memory and you can be sure that you are well prepared for the exam. If you cannot recall something, look at the text. Even this brief look will help you reinforce the information you have learned. However, it is important that you can recall it without looking as well.

- **Repetition**

On the first day after learning, you will forget 2/3 of the material you have learned. If you do not want all the acquired information to just disappear, repeat everything briefly the next day. This will stabilize the information and subsequently the amount of forgotten information will not be great. Repetition does not take much time. It takes less time than if you started learning it again from the beginning. It is much easier to review something than to start learning something all over again.

How to pass a mid-term exam or test

According to the study regulations, the course is finished by passing a mid-term exam and exam. In student language, a mid-term exam means a semester test. Study for the mid-term exams more strategically without much effort and without having to study at night.

Tips:

- Attend lectures and practical exercises. When you do not go to lectures, you usually have a problem with practical exercises. You are unable to understand the topic well. Repeat the course material that day.

- Once a week, review everything you learned during the week. It will not take much time. The point is to refresh the information from the whole week in your head. All you have to do is flip through it and stop at the parts that you did not understand well.
- Plan your daily schedule.
- Concentration is the biggest problem in study sessions. The level of concentration is directly related to the speed of learning.
- Pay attention during lectures and practical exercises especially when the lecturer says: This is important, this may be on the test, pay attention to this, etc. Mark such information so that it is visible.
- It is useful to know what the structure of the test will be. With open-ended questions, learn only the main things, no one will ask for details. With closed-ended questions, you need to get a general overview, but you do not have to learn a lot of information by heart.
- Today, tests for assessing students' knowledge are used more than ever. Almost all exams are performed in the form of a test. Research shows that [all tests, including semester tests, reinforce learning](#). When students take tests on an ongoing basis as part of the preparation for the exam, information recall during the exam may even double. Experts consider this technique to be very effective. Get test questions from previous years and prepare for the test according to them or form some new questions.

A few days before the exam/test

Many of you make the mistake of not going to lectures all semester, not preparing for practical exercises, and studying at the last minute before the test. This approach is extremely stressful and exhausting. Many students are unable to catch up and study overnight. But you should never resort to that! Even if you are unable to catch up, do not study overnight. You should rather go to bed earlier and study in the morning. Sleep is extremely important for storing information in long-term memory. If you skip it, your all-day studying will be in vain because the brain will transfer little information from short-term to long-term memory. Get a good night's sleep at least the night before the test.

How to take a test

When you are handed a test, first run your eyes over the questions, the brain will immediately start dealing with questions in the background. Deal with difficult questions first, read them carefully and twice. If you are unable to answer them, move on and return to them later. Then answer the easy ones. If you still have time after completing the test, think of something completely different. Only then proceed to a final check. The answer to a question emerges very often. Percolation is involved. The brain starts to deal with something quickly, the activity is interrupted, but the processes in the subconscious have already started. And suddenly the answer comes up.

Memory lapse

It is very usual that students suddenly **have a memory lapse** during the exam. At such a moment, take a deep breath, hold your breath for as long as possible and then exhale slowly. This prevents the flow of oxygen to the brain and then the brain is restarted. Be careful, it may not work every time. If you know you have learned the information, but you cannot recall it, try to close your eyes, calm down, and recall the exact place where you encountered the information. You will probably be able to recall it. The brain associates

information with places, which is why this method works. If you cannot recall, activate sources in the subconscious by asking these questions:

If I were where, where did I learn the information:

- What would I see?
- What would I hear?
- What would I feel?

It is important to give it space, time, tune in and really start to immerse yourself in your mind. Such recall of information is one of the most important strategies for activating the bridge between the subconscious and consciousness.

If you are right - handed (for left - handers, the opposite) and

- when you think about what you saw, look at the top left corner,
- when you try to recall what you heard, look to the left straight to your ear,
- when you think about how you felt, you look at the bottom left corner,

that way you will increase the likelihood that you will recall the information. But when knowledge is not stored enough, there is no certainty that you will recall it.

Examination period

The examination period will test your organizational skills, how to plan your exams, your ability to learn, retention of information or how to deal with stress, etc. If you want to prepare for the exam effectively, learn continuously and start 2 months before the exam. The key to understanding the study material is time. The brain must have enough time to connect the information, understand it and store new information and to review it. Continuous learning helps manage and reduce your stress levels, helps you avoid time pressure and save time. The reward will be long-lasting knowledge. Of course, it is also possible to learn all at once, for example two days before the exam, but you will quickly forget such quickly acquired knowledge.

Exam scheduling strategy is important. Make your decision in time so that you can choose exam dates according to your needs, your nature, and abilities. Most students want to have their exams done as soon as possible. Have one or a maximum of two exams per week. Do not leave the most difficult exams in the end, so that you can use exam retake dates if necessary. It is best to register for the difficult exam as soon as possible, you will be able to retake it in case you need it. If you do not pass it, you will at least find out what information you need to focus on. On the second try, you will no longer go into the unknown and you will know exactly what and how.

If you have exams in a few weeks or even months, you can learn continuously. It may take several days for the brain to understand a complex study material. The key to lasting knowledge is regular study routine right after the lecture/practical exercise and, of course, repetition. Step by step and you will reach your goal. **You only need to spend 20 minutes studying right after school.** Review the main points, rehearse the learned information. If you do not understand something, you have time to study it more deeply, search online, or ask fellow students or a lecturer. If you learn continuously throughout the year, you do not have to study so hard for the exam. **One week before the exam, review all course materials.** All

you have to do is flip through the material, so you do not even study just before the exam. You can pass the exam without unnecessary stress.

Especially during the summer examination period, students struggle with procrastination. There are no reliable guidelines on how to overcome it. Therefore, do not think about whether you want to start studying.

Study plan

Studying during the examination period differs from studying during the semester in many ways. First, you are at home or in the study room and you are preparing for the exam the whole time. **Develop a detailed study plan each time you prepare for the exam.** Divide the exam questions you can learn into individual days. Keep in mind to take into consideration an extra time you may need not only for reviewing the whole study material the last few days before the exam, but also for difficult-to-learn questions that will require more preparation time. If you set a time for each task, your brain will try to meet the set limit. It will be under time pressure, which will ultimately bring the desired result.

Start early in the morning. A strong will is the strongest in the morning, it gets exhausted during the day. Take advantage of this and schedule your study sessions in the morning. Students often study in the evening and at night, which is not very sensible, because then you no longer have a lot of mental energy. During the examination period, study as much as possible in the morning. In the morning you have the greatest strength to do things you do not want to do. Sure, you can argue that you are more of a night owl and prefer to study in the evening. That may be a fact, but the second fact is that it is easier for you to motivate yourself to study in the morning.

During the examination period, you have to follow a strict regime every day. Wake up at 7:00 in the morning, for example, after breakfast and personal hygiene, sit at your desk and start studying. First, look at your daily study plan to see what awaits you on this day. For example, divide your study time into 45-minute intervals, followed by short breaks. Around 10:00, during a short break, make coffee or have fruit. Your brain is working at full speed, consuming a lot of energy, and therefore constantly requiring an energy supply. After two hours of studying, take a break for lunch and treat yourself to a short online mode (cell phone, computer). Check your time online and do not get carried away from reality. Continue studying again until 16:00 at pomodoro intervals, then enjoy your time having coffee and something sweet. You will feel happy how much you have accomplished in one day.

In the early evening, treat yourself to a short walk or run. During these activities, the brain may relax. Do not burden it with any information, allow knowledge to be stored, do not switch to online mode. If it is necessary and you are under time pressure, have a dinner and return to the material around 08:00 pm. This time may surprise you with an increased concentration of attention, as it the daily hustle and bustle goes away. You can use it not only to study new material, but also to review the material you have studied. Try to finish your study sessions around 10:00 pm. However, before that, take 10 - 15 minutes to review the most difficult part of the study material. Recap what you learned, check or circle the questions you managed to learn, highlight them in colour. It will make you feel good, which

will make it easier for you to fall asleep. Such a regime requires a great deal of self-discipline and it is necessary to follow this study routine throughout the examination period.

After passing the exam, reward yourself, go to a café that day, meet friends, or clean your room. For some, the biggest reward is cleaning the room, closing, and putting away textbooks and the books that accompanied that specific course. Closing the book means a great victory for the student that he or she has managed to pass the exam and has finished the course.

Sometimes you will not be able to pass the exam during the regular examination period and you will have to spend the whole summer preparing for the exam retake. Do not despair but start following a strict regime again. Plan. Schedule the required exam questions for each day. When creating a study plan, take into consideration an extra time for repetition. As you should also relax in summer, include it in your study plan. Study from 08:00 am to 03:00 pm. Follow a similar regime as during the regular examination period but finish your study sessions around 03:00 pm. Then spend time with friends, in nature or in the swimming pool and do sports. Enjoy the summer at least in this way because you need to relax to manage further studies. Always return home before 11:00 pm so that you go to sleep before midnight. Good sleep is a precondition for better concentration and effective learning. If your leisure activity lasts longer, you return home later and you go to bed around 02:00 am, you will lose one day of your study plan. You will have plenty of free time after successfully passing the exam. Therefore, do not forget about your plan, overcoming obstacles (tests) will lead you to the goal - to be a doctor.

How to prepare for an exam or test

Thorough preparation is an important precondition for passing the exam/test. However, there are other factors that can affect the result, here are some useful tips:

- Thorough preparation is essential, even the best strategist will not achieve a good result without the necessary knowledge.
- Find out all available information about the exam, examiner, or test. It is good to know what you should expect from the exam, what are the parts (written, practical, oral, number of questions) that make up the evaluation of the exam. Also [find out what type of test awaits you](#) and how the test is evaluated.
- Do not let yourself be overwhelmed by negative thoughts like "I will not pass the exam or test, I am sure I will fail it". [Use affirmations](#) (p. 103). [Believe in yourself](#). [Think positively](#): "I was preparing for this exam and I can do it!" The day before the exam, try to have a positive attitude.
- Do not be unsettled by negative-minded and frightened fellow classmates who spread panic around them.
- Realize that [an exam or test is not the most important thing in life](#). Exam failure does not mean that you will not achieve your goal. Only the way to it is a little more winding.
- Do not have exaggerated expectations, do not overestimate yourself, but also do not underestimate yourself. [Critically assess yourself](#).
- As you study, disconnect yourself from the world. Pay full attention to studying for the exam/test. Do not care about anything else. Disconnect from social media, do not be in

contact with anyone. Do not look at the cell phone. Things like these distract you from studying.

- Do not take on too much, **do not set exaggerated goals**. The brain gets scared and makes you procrastinate even more. Set small goals that you may find achievable. Do not say you have to learn the whole textbook but say that you will study 10 pages. Do not cause yourself unnecessary worries.
- **Never study for a long time in one session**. The brain is not built for long-term attention. Sure, you can study for 4 hours in a row, but it will not be effective and you will not learn as much as if you studied for the same amount of time and included breaks as well. It is effective to study for a maximum of 40 - 50 minutes, then take a short break and continue again. After 45 minutes, the brain is tired and unfocused. Study particularly difficult things for only 25 minutes and take a break.
- **Breaks** are extremely important for learning. During breaks, the brain stores information in memory and creates connections for better understanding and retention of information. During breaks, the brain rests and gains new energy for learning and the opportunity to replenish cognitive resources.
- It may happen that something important comes to your mind during study sessions. You can keep around 7 items in mind at once but being constantly reminded of them unnecessarily deprives you of the ability to think. You cannot study properly when you are constantly thinking about what you should not forget. You need to unburden your memory, write down everything you need to think about all the time - dates, thoughts, and ideas. When the time comes, look at it.
- Do sports especially during the examination period. **Sport has a positive impact on learning**, you will regain your energy, it will help you concentrate better and get rid of stress.
- **Drink water**, the brain needs to be refreshed all the time. **Eat healthy**, heavy meals will make you feel sleepy.
- Be strategic and effective during the test. Divide your time.

HOW TO DIVIDE YOUR TIME BEFORE AN EXAM					
2 WEEKS BEFORE	1 WEEK BEFORE	THE NIGHT BEFORE	THE MORNING	AN HOUR BEFORE	FEW MINUTES BEFORE
<ul style="list-style-type: none"> • Make a plan • Space out in smaller parts • As often and as little as possible 	<ul style="list-style-type: none"> • Look over study materials • Find someone to study with 	<ul style="list-style-type: none"> • Don't cram all the information at once • Do a review • Relax + get enough sleep 	<ul style="list-style-type: none"> • Have a good, filling, healthy breakfast • Make sure to be on time 	<ul style="list-style-type: none"> • Relax and hang out with friends 	<ul style="list-style-type: none"> • Take a deep breath and stay calm
					WWW.STUDYHEALTHY.ORG

Fig. 22 How to divide your time before an exam (adapted from www.studyhealthy.org)

Do not study late into the night, not only you spoil your eyes, but you do not learn much either. Get enough sleep before the exam, so that you are rested in the morning. Lack of sleep will negatively affect performance and the ability to manage stress. Sleep 8 hours a day, even if you have a lot to learn. Sleep is extremely important. If you study for an exam at

night, you will not be able to recall any of it in a week. You can afford it if you will never need the information for anything. Sleep before the test affects the proper brain function during the test. [Do something else during the examination period](#), you cannot study all day long. Some students are so deeply immersed in preparing for the exams that they do not do anything else besides studying. Do not let that happen to you. It is not good for the brain either if you are just learning all the time. The brain needs distraction so it can better understand and store information. Do not avoid your friends, feel free to play a computer game, play sports. Sleep 8 hours, study for a maximum of 5 hours (then the brain does not work so well anyway).

[The reason for the fear of exams is your uncertainty](#) - what they will ask, whether you will be able to recall the information, etc. The best solution is to have an overview of the exam requirements, more confidence and learn the material well enough. Stress can be compared to fog in your head, it affects your performance. If you are under pressure, it is difficult to retrieve the necessary information. You know everything at home, but the stress will not let you recall it during the exam. Do not struggle with stress, do not suppress it. Say to yourself silently or out loud: "I feel stressed". Once you admit it, stress often subsides. Or write down what you are worried about. Deep breathing is one of the best ways to lower stress in the body. Simply feel how you inhale and inflate your abdomen and exhale. **Mindfulness techniques** will also help you with stress in the long run. Mindfulness is the quality of being present and fully engaged with whatever you are doing now. This meditation technique focuses on bringing one's attention to experiences occurring in the present moment. This means that you should try to keep the consciousness present in the current moment and harmonize with the thoughts, feelings, bodily sensations, and the environment around you. The principle of mindfulness is to focus fully on what is happening now, at this moment, and not on what has already happened or is yet to come.

Study productively. Productivity is a measure of efficiency of a person completing a task. So not only to study, but to study effectively. Set 1 - 2 priorities to focus on, do not jump from activity to activity. [The important thing is not only what you do, but how you do it](#). Do not confuse your busy schedule with productivity.

- During the oral exam, first talk about the main points and then add more details. Do not deviate from the topic. Speak at a reasonable pace (neither fast nor slow), loudly enough and clearly enough. Do not jump into the examiner's speech.
- During the exam, focus also on nonverbal communication. Watch the examiner's reactions during your responses to questions. The examiner's facial expression will often tell you whether you are answering correctly or not.
- When you pass the exam or test successfully, reward yourself. Celebrate your success with friends or loved ones and be happy. If you did not pass the exam or test, do not despair. Learn from the mistakes you made in a failed exam or test.

12. MEMORY-BASED AND OTHER LEARNING TECHNIQUES

Most effective learning techniques have already been mentioned in this textbook - highlighting and underlining, taking notes, repetition, active reading, practice tests, asking questions, metacognition and more. Techniques show how you can study more effectively, but it does not mean you have to follow these procedures strictly. You may combine techniques to suit you. Each technique requires some time to understand what it is all about. Many students use a variety of learning techniques without knowing it, and it never occurs to them that this is a learning technique. You may play with other techniques and use them occasionally. The basis of memory-based techniques is playing with information. When you play with information, you pay attention to it, you **connect what you already know with something new**. You are searching for **connections and associations**. Sometimes you cannot find any sense of what you need to learn. Thanks to memory-based techniques, you can make boring information special and interesting. Then you will learn it easier and faster.

Memory-based techniques

They are often also called mnemonics or mnemonic devices. They are graphic constructions that transform abstract concepts (words, numbers), which one can hardly retain with the help of free associations (connections). Abstract information cannot form connections in memory, so it is necessary to involve associated ideas and senses that support their processing; the brain thinks with the senses, not the signs.

Mnemonics themselves can help you learn simple words or terminology, or they are part of larger memory systems. Experts say that **the ability to learn and retain is not a matter of natural talents, but of learned techniques**. Engage associations, imagine something you like, something unusual, contrasting, humorous or even erotic. Instead of learning clusters of letters representing unfamiliar words, create information that can be captured by multiple senses. Imagine the information you need to know, engage all your senses, create crazy and interesting stories, the strangest associations that may be funny and colourful. Mnemonics are not limited by short-term memory capacity.

Memory-based techniques are not the essence of effective learning, they are just learning aids that help you retain the information. Memory-based techniques have short-term effects. Once you have the information well stored, you do not need the aid. Mnemonics do not lead to an in-depth understanding of important contexts. Using mnemonics will not improve your ability to retain and think logically, but you will improve your skills in using mnemonics. All mnemonics work on the principle of associations and ideas, connecting the known with the unknown. Associations are closely linked to the imagination. By imagining information and experiencing a story that includes it, it is retained better and faster than if you were just reading the text.

Try to answer these questions when creating a mnemonic device:

- What does it resemble?
- Can it be associated with something familiar?
- Is it related to something?
- What is it connected to?

When using memory-based techniques, apply the following:

- **Creativity:** If you are creative, you can create associations with what you want to learn, it is easier to find your own ways of learning, you learn more effectively and simply.
- **Imagination:** If you develop your imagination, you can retain new information much faster and create long-lasting strong connections. Imagination is associated with creativity.
- **Sense of humour:** You only laugh a few times a day. What makes you laugh will stay in your memory much longer than boring things. Things that are funny and out of ordinary are easy to retain.
- **Memory training** (p. 95).

Mnemonics include:

- A/ acronyms,
- B/ interconnection system,
- C/ mind maps,
- D/ memory palaces,
- E/ study flash cards.

A/ **Acronyms**

Acronyms are abbreviations formed from the initial letters of other words, such as UPJŠ (Pavol Jozef Šafárik University) and the like. They can be used in your study sessions everyone can create such acronyms. The first letter will tell your brain what is hidden behind the whole acronym. This abbreviation works as a kind of memory hook that activates other memories. In anatomy, for example, SVC (the superior vena cava), TMJ (the temporomandibular joint).

B/ **Interconnection system**

It is essential to make an imaginary chain between the individual items, which connects the words in the order in which you have to retain them. You do not have to draw it, just imagine it. Connect each word with the previous and next word using a vivid, funny idea. But be careful, if you make a mistake, you will not proceed further.

C/ **Mind maps**

Da Vinci, Einstein, Picasso, Edison, and many others also used mind mapping. Mind maps that reflect the study material help you create associations, you involve the brain as a whole, you perceive words and graphics, you use your imagination, you use a different way of writing down your thoughts. Using mind maps enhances your learning, you see the whole topic on a paper including the things that are important and less important. They are well retained because it is motor learning. Mind maps are not about sentences, but about words, concepts, symbols. The connections are expressed graphically which clarifies the complex study material and it stops looking difficult. Create multiple mind maps from one study material, do not push a lot of information into one mind map. You should rather create simple mind maps they will be clear, and it will be easier for you to learn from them. It is advantageous to start each repetition of the material with mind maps, you proceed logically - from basic to detailed information.

Handmade maps: You need paper, pen, and markers. In a mind map, a central topic is placed in the centre of a blank page. From the central topic associations radiate out.

Associations are often drawn as curved lines. Less important information are drawn as thinner lines. Everything is connected into a nodal structure. You can always write additional information to the lines, which is not always possible with regular notes. Also include pictures. Once a mind map is created, redraw the map once more to save space on the paper. In an hour, cover the map and draw it again based on what you have retained. Draw what you did not know with a different colour. Put the map in a visible place so that you can always see the complex information reflected in the mind map.

Computer-generated maps: Graphic diagrams are easy to use, you enter information in windows sorted according to hierarchy. Such maps are clear, downloadable, and saveable. Create, print, colour the map. Learn the contents of the windows so that you can write them again by heart. Then redraw the map on blank paper: twice using the mind map, the third time based on what you have retained. Do not make it easier on yourself in any way. Only when you know how to draw a map without any mistake, you can start to learn another one. Discard the redrawn maps (they are useful only for motor learning, you will no longer need them), save the printed ones for repetition.

D/ Memory palaces

This technique was used in Ancient Greece. But the technique was forgotten after the decline and fall of Ancient Greece. It has only recently started being used, you can find it under the names: the method of loci, the memory journey, or the mind palace technique. It allows you to store hundreds (even thousands) of data in long-term memory. You retain information by creating corresponding visual images that you mentally place along a path in a familiar location. When you walk the path again, you will the information placed in the familiar location. You should have at least 10 of those locations along the path. The advantage of this memory-based technique is maximum efficiency and the ability to retain a lot of data in a short time.

The downside is that you have to train the memory palace technique before it starts to be really effective. It will pay off if you repeat them here and there, you will be able to retain it for a long time. Memory palaces are a matter of creativity and imagination. Many students try it, but do not stick with it. It takes training. Do not give up. The key is to train your imagination. You may be able to do it successfully for the fifth time. Why do memory steps work? It is all connected. Thanks to colours and mind maps, the study material becomes a huge structure where information is interconnected. When you recall one part of the material, you can also deduce other things, such as text, headings, or other chapters.

E/ Study flash cards

This technique helps you practice storing information in long-term memory. It does not go deep, therefore it is necessary to read the notes and understand the study material first. You cannot learn everything using study flash cards, the study material that is connected to the following materials cannot be learned in this way. It is a good technique for learning terminology and chemical formulas. Write a question on the front of the card, the answer on the back. You can also use pictures, draw them on study flash cards, they will help you retain the information sooner. You do not have to draw the exact meaning of the word, you just need it to represent some sort of association. Do not worry that your pictures will not look nice, you do not have to show them to anyone. When using study flash cards in study sessions, say your answers out loud because it will help you recall information from memory.

Review the answers on those study flash cards which you cannot recall and do not waste time with the answers on the study flash cards you have already learned. Learn the front and back of the study flash cards. By randomly reviewing the study flash cards, you would not learn effectively or quickly. After you finished studying, place the study flash cards into a box (or put them in piles, tie them with a rubber band and mark the piles).

- Group 1: cards that you are just starting to learn and have to review every day,
- Group 2: cards that you review every other day,
- Group 3: cards that you review every week,
- Group 4: cards that you review every two weeks,
- Group 5: cards that you review every month.

For example, you are going to learn Latin expressions:

Day 1: Place all new cards in the 1st pile. Take the card and if you can retain what it says on both sides, you can place it in the 2nd pile. If you cannot recall it correctly, it remains in the 1st pile.

Day 2: Review the 1st pile the same way as on the 1st day, if you recall it correctly, it goes to the 2nd pile, if not, it remains in the 1st pile. Also review pile number 2 (every other day). If you can recall both sides, you can place it in the 3rd pile.

If you recall the card correctly, you can place it in the following pile, if you recall it incorrectly, it goes to the 1st pile. The brain learns by forgetting, if you do not know the word from the 5th pile, it goes back to the 1st pile. That is how it gets anchored in your memory. And if you cannot recall the information on the card, it goes to the 1st pile, no matter what pile it was in before. Do not cheat, be honest with yourself. For weekly and monthly repetitions, choose the days when you have the most time. You do not have to worry about spending a lot of time doing this. Forty cards, that is a maximum of four minutes.

There is also an application for creating study flash cards for computers and cell phones. The application is free, has almost unlimited capacity, and is user-friendly. When you review a card using the application, it calculates when is the ideal time to review it again. The application motivates you to review the cards at precise intervals so that you retain the information on them. The application motivates you to schedule regular study sessions. If you did not use it for a few days, the study flash cards would accumulate, and you would have to review a lot at once. This is how you learn continuously, not at the last minute. You transfer your knowledge into long-term memory, and you will not forget it right away.

Use study flash cards for every information that is suitable to be learned this way, it will take you 10 minutes after school and you will review everything you already know for the next 2 minutes. The examination period will no longer be such suffering because you will have the main concepts firmly entrenched in your head.

Speed reading

If you want to learn to read quickly, first find out what is your normal speed at website or by counting.

Reading speed:

- 0 - 150 words per minute: slow reading speed,

- 150 - 250 words per minute: average reading speed,
- 250 - 400 words per minute: above-average reading speed,
- 400 or more words per minute: the slowest speed reading,
- 1000 - 1500 words per minute: average speed reading.

Usual reading is characterized by these features:

- it is taught at elementary school,
- the eye reads 1 - 2 words at a time, usually letter by letter,
- reading aloud is limited by the speed of speech,
- saying words in your head while reading (subvocalization),
- regressions (going back to check things),
- university students have a faster reading speed.

Speed reading is characterized by the following features:

- one has to learn to speed read by himself or herself,
- the eye reads more words at once,
- no saying words in your head while reading,
- words are transformed into their true meaning - pictures and feelings,
- it can be done by anyone, the improvement is obvious after a short training,
- reading comprehension is about 50 - 90%.

How to do it?

- Start reading the line with the second or third word. End reading with the penultimate word in the line. If there are ten words in a line, you will also save a quarter of the time.
- Read a few words at once to expand your field of vision.
- Increase the speed of eye movement.
- Change the speed and try to read even faster.
- Skip the details, focus on the important parts. Skip the words that you do not understand, you can deduce their meaning from the text.
- Focus.
- Do not say words in your head while reading so that you are not limited by the speed of speech.

Using a speed-reading technique can work with easy-to-learn texts. But if you want to learn effectively, you have to read carefully and think about words. Instead, use speed reading to repeat. For example, if you capture 80% of the text, you can easily deduce the rest.

Regression - a backward movement of the eye when reading a line of text. You are reading an article and you feel that you have not read something exactly, so you go back to check it. It delays you, and at the same time there is no need to go back to check it. Try to reduce the number of regressions. Nothing happens if you skip one or two words. However, with complex texts that are difficult to read, it is sometimes necessary to go back and read it again. Try, read, and make yourself not to go back to check things unnecessarily. You will recognize the difference in speed and understanding.

Eye fixation - the point where your eyes take a rest during the reading process. The key to reading speed is to read more words at once. Double your reading speed using eye fixation. During usual reading, the eyes come to rest at each word. During speed reading,

one take in more words with each fixation, which speeds up reading. If you want to read faster, you have to take in more words with each fixation (a point where your eyes come to rest as you read). Learn to take in 2, 3, 4, 5 words and then try to take in the whole line.

When children read, they point their fingers to the line they are reading because it helps them navigate through the text and maintain concentration. During speed reading, you have to point to the lines faster than you are actually able to read. It will be difficult in the beginning, you will understand almost nothing in the text, but gradually the brain will get used to the given speed. All you have to do is practice speed reading for 15 minutes every day. These exercises are not easy at all, it will take a few days to get used to it.

Speed reading can save a considerable amount of time. You need a suitable environment without interruptions and focus on the text. Do not pay attention to the end of a line or spaces between words. Over time, the eyes get used to moving faster from the end of the line to the beginning of the next one. Speed reading is not suitable for learning a new study material. You will especially appreciate it when reviewing the material.

The Pareto principle

In 1906, Italian economist Vilfredo Pareto found that **20% of correctly selected activities will bring 80% of result**. In effective learning, this means that in 20% of the time you can learn 80% of the right information or that in a minority of time you will gain most of the necessary knowledge. This is effective you just need to know what information it is.

Economist Pareto studied the distribution of wealth in society. He noticed that 80% of the wealth of a society is held by 20% of its population. He found that the 80/20 rule may be applied to almost every area of life:

- studying - in 20% of the time you can learn 80% of the necessary information,
- information - 80% of information is useless, only 20% will be used in practice,
- effort and results - 20% of effort brings 80% of results,
- skills - 20% of high-quality training brings 80% of results,
- money - people spend 80% of their money on 20% of the same things,
- vocabulary - 80% of the time you use 20% of your vocabulary for normal communication with people,
- foreign languages - only 20% of all words are enough for you to speak a foreign language,
- thoughts - 80% of your time is devoted to 20% of thoughts (you still think of similar things).

People who have learned to make full use of the Pareto principle have a simpler and more successful life. They dedicate their time to what brings the most results. Do not waste your time on 80% of activities that bring you only 20% of results. Turn it around. Engage in activities that make sense. Cultivate relationships that bring you 80% of joy and only cost you 20% of your effort. Learn 20% of study materials using effective learning techniques that will bring you satisfactory learning outcomes. Every sensible student should learn how to shorten the time spent learning and how to make it more effective. Choose only important information and learn it, do not waste time on studying unnecessary information. Do not

devote 80% of your time to irrelevant activities (20%), you do not have to learn everything to achieve a good result.

What information is important?

For successful study, it is enough to learn 20% of essential information. It is extremely important to choose the essential information and learn it carefully. Pay your attention to:

- information that you already knew or were familiar with even before it was explained in the lecture/practical exercise will be easier for you to learn.
- information that the teacher often repeats, subtly emphasizes, suggests that you should pay attention to it. Make a note of it. It is possible that it will be included in the test/exam.
- to what previous tests looked like, whether questions are open-ended or closed-ended, adjust the way of learning accordingly.
- what is highlighted in the textbook, written in a different font, in colour. Almost every textbook has some highlighted parts, tables, graphs, summaries, something that differs in some way from ordinary text.
- intuition; If you have a strong feeling that something will be included in the test, you should rather learn it, although feelings can very often deceive you.

However, this is not enough. Flip through everything but devote the most energy to important information. As a result, you will study for a shorter time, but most importantly more effectively. The process of choosing essential information is very efficient because you will be forced to think about the study material, and it will make it easier for you to retain it later. For many students, 80% of the information is not enough, they want to learn everything. The last 20% of the information is the most difficult to learn. The Pareto principle may apply even here: it takes 80% of the time to learn 20% of the remaining information. For example, it takes 2 hours to learn 80% of a chapter. To learn it in detail, you need to study for another 8 hours.

However, the curve of guided repetition applies also here, therefore do not take the Pareto principle literally! The 80/20 rule cannot be applied to all courses. In some of them you have to learn literally everything. The Pareto principle applies to each course differently. Focus on the right learning techniques, learn the techniques that really work and reduce the time spent studying.

The Feynman technique

The Feynman technique, or a simple approach to self-directed learning, helps you understand what you do not understand, retain better, formulate understandable sentences orally and in writing. You may also use it for learning the things you understand.

- Choose a concept you want to learn about.
- Study the concept, search for information from available sources.
- Write the heading on a paper and describe the concept in your own words. If you get stuck, go through the book, and try to explain it again. If you do not know how, try to use other sources, encyclopaedia, internet. Draw and use arrows.

- Teach it to a child, use simple language a child can understand, Speak aloud and simply, it is a good way to understand the concept at a deeper level, other centres in the brain are involved, you will find out what you really do not know.
- Study again what you did not know, explain it aloud.
- Simplify if you still feel like you do not understand it well enough, explain it again.

You often start to understand later during the day. This is because the information was consolidated (percolation).

Sit in the front row

Old research showed that students sitting in the front rows performed best in exams. Students were randomly seated in the auditorium:

- in the front rows, students achieved an 80% success rate in the exam,
- in the middle rows, students achieved a 71.6% success rate in the exam,
- in the back rows, students achieved a 68.1% success rate in the exam.

Students sitting in the front rows pay much more attention. They can see everything well and hear well, they focus, they can discuss the topic with the lecturer. They do not have to study so hard at home as they recall a lot of information they heard during the lecture. [Students in the front rows achieve better results.](#) This technique of effective learning does not require any special activity.

13. WHAT EVERY STUDENT SHOULD KNOW

This chapter brings you (not only) a collection of practical advice from the whole textbook:

- You need to know what you want, you need to **have a goal** because it enables you to have the right **motivation** and sensible plan. If students do not use **good-quality learning techniques**, their study can be strenuous and accompanied by feelings of fear and stress. But if you understand the study material, new knowledge has something to build on. Understanding is not the same as retention, understanding precedes retention.

The secret to effective learning is the right timing of repetition and continuous learning in the right way and with breaks.

- The basis of success is **regular physical activity and good-quality sleep**. The brain needs **good nutrition**, otherwise it has no energy and cannot concentrate on studying. **The brain full of energy will learn in an hour as much as the tired brain in 5 hours**. If you concentrate intensely, the brain works at full speed and naturally consumes more energy, so do not forget to refresh yourself regularly and drink water all the time.
- **One can fully concentrate for 4 hours a day with breaks**, then the quality of learning is reduced. Therefore, do not study for too long, keep in mind that the brain after concentrating for 4 hours is no longer able to receive information that well. The mind is not able to concentrate for a long time without breaks, study in 40 minutes intervals. Then take a break. Do not do anything intense or fun during breaks, it could distract you from learning. Go for a walk, make something to eat, have coffee, tea, stretch your muscles or talk to someone.
- The brain can only engage in one activity at a time. Concentrate on only one activity at a time, you will work more efficiently. If you try to do more activities at once, you will worsen your concentration, your brain will get tired much faster and its performance will be reduced as well. **Multitasking is an illusion**. It makes you feel like you can do a lot of things to do at once. If you try to do something while the brain is still working on the previous task, it will stop. The cerebral cortex cannot immediately divert attention from one task and focus on another. There will be a short break in processing. Breaking off in the middle of an activity leaves the brain stuck circling previous ideas. It is a phenomenon called **attention residue**. If you tend to constantly jump from task to task, it can permanently weaken your ability to concentrate well. The brain is not able to perform even two similar activities at once. For example, when you are listening to a recorded text and reading it at the same time, the activated areas of the brain overlap, which causes problems in perception.
- **Be careful not to overwork yourself**. Breaks, rest, sleep, and physical exercise are just as important as studying itself. Do not try to catch up on responsibilities at the last minute. Especially before the exam, you are under a lot of pressure and you consider every minute that you do not spend studying to be wasted. It is not truth. It is effective to

have short and regular study sessions with breaks and not last-minute cramming sessions. [Taking breaks accelerates learning.](#)

- You need [rest](#) for optimal performance. Treat yourself to a quiet moment during the day, when you just relax, and nothing disturbs you. At that time, do not receive any information, if you can, take a walk in nature. Create a kind of boredom that the brain also needs. Do not relax by sitting at the computer, listening to music, chatting with people on social media. This is not rest, but exhausting multitasking.
- Learning is most optimal when you are most productive (observe your biorhythm), the temperature is around 19 degrees Celsius, you are not hungry or thirsty, there is enough light (one 60 W light bulb), there is enough fresh air (air out the room), you sweat once a day during physical activity, you have an adequate diet (phosphorus, lecithin).
- Take a positive approach to learning, do not deal with negative thoughts like, "What if ...". You do not have to know everything, you do not have to understand everything. [Realize that you cannot be perfect.](#) Do not want too much from yourself, watch out for burnout.
- Natural stimulants are sports, friends, hobbies and a reasonable rhythm of life, time-management and enough sleep naturally increase your energy, because experiences and emotions cause endorphin release that are important for satisfaction, motivation, energy, and concentration.

Meditate

Meditation enables you to concentrate for a longer time. Those who can concentrate well can immerse themselves in learning and thus learn more. Meditation prolongs the maximum time during which you can concentrate on learning. Do not imagine anything complicated under the term meditation. Anyone can meditate.

It is easy, just close your eyes, sit comfortably, and focus on your breath. Feel the air flowing into and out of your lungs. Do not try to suppress your thoughts, let them flow and leave. Just feel your breath. Every time you resist a disturbing thought and let it go, you strengthen your concentration.

Start meditating regularly. Find 5 minutes each day, set a timer, close your eyes, and focus on your breath. When the timer rings, you can stop meditating. It is best to start meditating at about the same time each day. A 5-minute training will strengthen your ability to concentrate.

How to study when you have little time

Make every effort to prevent this from happening to you. You need to build discipline and learn continuously. But once that happens, the solution to such a problem is not to omit effective learning techniques, but rather to apply them intensively:

- set aside more time for studying, you must temporarily give up other activities,
- do not use textbooks that include a great amount of information, get fully answered study questions,

- study actively: read the material actively and repeat it by heart, preferably aloud,
- do not forget about the breaks, after the break review everything you learned before the break,
- do not take supportive drugs, you may become addicted to them and the learned information is best recalled in the state in which the person studied, you would have to take them before the exam as well,
- eat healthy foods, take vitamin supplements, drink plenty of water, but drink coffee and energy drinks in small amounts,
- when experiencing fatigue (even if you do not want to), try to exercise intensely for a few minutes, it will wake you up again, reduce stress levels, improve concentration and memory.

Remember that **sleep is not a waste of time.**

What you should and should not do when you want to study

- Think about how much time you spend on **social media, playing computer games** and so on. It might be fun, but it is very superficial and a waste of time. Try to calculate the time spent being on your cell phone and social media. Be honest and count it accurately. You will be surprised how many hours you spend being on your cell phone or social media per day and the effect is basically zero. This way you will never achieve your goal, nor will you approach it. Be aware of this and be more critical of yourself. Nobody says you must push this activity completely out of your life but define the exact rules for this fun activity. Set aside the exact time that will be spent on social media and the exact time for studying.
- 15 minutes before your study session, eliminate all **distractions** (cell phone ringtones, incoming message notifications, etc.).
- When you are very tired or you have a sleepless night, there is no need to force yourself to study, it will have no effect. Be **rested, sleep well, eat well**, do not overeat, and take only short breaks while studying.
- **Do not multitask**, that is, do not perform multiple tasks and things at once. Always do only one activity, you will be more successful in completing tasks.
- It is also advisable to imagine that you are learning and how you are learning with joy: **fake it until you make it. Pretend that you are learning**, engage with idea of learning, the brain will believe the imagination and you will really feel motivated. **Imagine how you answer correctly**, how you receive an excellent evaluation.
- Do not believe it, when someone says they do not have to study and make a great effort, it is not true. **Even the best one study at home.**
- It is important to realize that nothing is for free and everything has its price. In this case, students **pay for knowledge by learning.**
- Study **with a friend** who wants to study too. Not everyone knows it, but it helps because you have to study and not waste time talking about unimportant things. Talk only when you need to explain something regarding the topic you are studying; moreover, it will be easier for you to study when you will see that the other also studies. Or study in designated places for studying, **in the library or in the study.** Everyone is there to study, and it is easier than for you, too.

- **Good concentration is the key to effective learning.** There is nothing worse than trying to learn from a book and not being able to retain anything. Try to focus as much as possible on the study material. If it does not work again after a while and you still lose concentration, take a short break. But return to studying anyway.
- Close the door in the room where you are studying and wear comfortable clothes.
- Set a reminder in your phone - "I am going to study".
- Rehearse the learned information after your study sessions. It will be a bit of a stress at home as well, but you are learning how to manage a lot more stress that you may experience at school, in front of the committee and so on.

Final tips

- **Find your most productive time.** It is a limited part of the day that differs from person to person. During that time, everything is easier for you, you are full of energy. Do not waste it on unnecessary activities, use it for the most difficult tasks.
- For example, when you are returning home from school by yourself, try to recall what you have learned today: "What were the lectures about? What was the most important? Is the new study material related to something you have already learned? Was there something completely new?" The time will pass quickly, and the information will be stored more firmly in your memory. When you repeat it in your head, you will find that you have already missed something, study it briefly at home (read it briefly and recall it). Doing so will save you a lot of time in the long run.
- **Meet people who have similar goals.** "You become the average of the five people you spend the most time with" (Jim Rohn). The environment shapes you the most. Have friends who encourage you to move forward. Meet people with similar interests and goals. Learn from your friends, they should be your role model and you should be their role model.
- **Eat healthy,** do not miss breakfast, it is the most important meal of the day to help you start the day. Bring snacks, eat fruit. It is better to spend some time cooking lunch than to have a fast food that will make you feel tired. Eat a lot of fruit, fish, avoid greasy and heavy foods, do not eat baguettes and dessert bars. Drink water regularly, it is best for your body. Rarely have carbonated and sweet drinks.
- Equally important is **physical exercise** as it not only beautifies your body but also increases brain function. It also increases energy, concentration, and overall performance. Download an application do a short workout and then go to study again. During exercise, some neurotransmitters are released, which speeds up learning and you feel healthier. It also increases blood flow to the brain and enables you to learn better. Exercise also reduces stress levels, improves mood, and prepares the brain for learning. Add regular movement to your everyday routine. Do not use the elevator, walk a lot. Get out of breath every day. Exercise will not tire you, but it will charge you with the energy you really need. Just take 7 - 15 minutes a day to do some activity, pump up your heart properly, cardio is better than strength training.
- **Sleep** is as important as learning. You can learn hundreds of new information during the day, but if you do not sleep, you will lose it. Do not let your efforts come to nothing. Learning at night with a tired brain that will not retain anything because it does not get the sleep it wants is complete nonsense. You can also use to calculate the optimal

length of sleep using the web site. If a person sleeps little, he or she cannot learn well the next day. 10 - 15 minutes before going to bed, repeat key information. The brain will process it at night thus it will enhance retention of information. This does not apply if you have been studying for hours before going to bed.

- Students should not be constantly locked in their rooms. On the contrary, they should spend as much time outside as possible. Sunlight has many benefits: it improves sleep, speeds up learning, improves brain function, reduces the risk of disease. The sun provides energy and vitamin D.
- **The brain is dependent on the environment** in which it learns and can only recall information well where it was learned. It has a problem to retrieve information elsewhere. Do not study in the same place all the time, but change places, it can be a room, a library, a study, or nature. It is better to learn in different places, the brain gets a different context, which leads to better retention. When you learn in more places, the brain will not depend on the environment and you can recall the learned information everywhere. Do not study in bed, the brain associates it with rest, and it switches off. Always make sure that the place where you are studying is tidy.
- Prepare everything in advance before your study sessions.
- **It is advantageous to study different course materials during the day.** You will involve different areas of the brain you will not be tired quickly and you will think better. In one study session focus only on one specific course material, then in another session you will focus on a different one. You will learn it better and you will understand it better.
- **Learn from multiple sources**, remember, and understand the material. It will be stored in other places in the brain. Each source will make you think a little differently about the material, so you will have a much better chance of recalling the information during the exam.
- **Motivate yourself with a reward.** Just planning a reward after study sessions will force you to learn better and more effectively. The brain has something to look forward to, dopamine is released, which is associated with fast and effective learning. Reward will make you happy (hobbies, fun).
- **Learn continuously.** Continuous learning does not take longer than learning just before the exam. Continuous learning helps to learn more effectively, takes less time, prevents stress, and leads to long-term retention. If you leave everything at the last minute, you will be under a lot of time pressure and stress, you will not understand and retain the information so well. **Continuous learning is the most effective technique for effective learning.**
- Do not spend all your free time studying, your brain will be tired, unconcentrated. Do not study one day a week. Take breaks from studying. Optimally 4 hours a day, maximum 7 hours (if the exam takes place very soon). **Think about studying while studying, otherwise not.** The brain needs a break to store information.
- **Body posture:** You should maintain the correct study posture during your study sessions, otherwise your productivity decreases. When you sit upright, you get good blood flow to the brain. Sitting up straight may not be the easiest thing but it prevents you from overloading the skeletal system and neck. That is why it is important to choose a proper chair. Studying while standing up is another suitable study posture. If you are unable to

last long, try to stand up for a while and then sit down. Seating options, such as kneeling chairs, fit balls, or balance discs are also suitable.

- Wear the same perfume during your study sessions and exams. The scent will remind you of what you have learned. Wear the same jewellery, watches, clothes (you do not have to go through this if you can create it in your imagination).
- When you **combine a new study material with the previous one**, plenty of new neural connections are formed, so it is easier to recall. When a study material is not related to the previous one, it is more difficult to recall. Knowledge acquired through linear learning that lacks coherence cannot be well understood and will not be retained. To remember such data, it is necessary to link them to things you know, logically or sensually, use mnemonics.
- **If you come up with the information yourself**, it is one of the most effective ways to retain. You tend to remember better what you did, what you searched for than what you did not participate in.
- Those who teach others learn the most - they actively repeat their knowledge, thus it is consolidated in their memory. **You still need motivation, you have to have a reason to retain the information.** In one experiment, students were told that they would have to explain the topic to another group of students. Students changed their view of the study material. They were able to learn more effectively, and thus understood the topic better. After all, Comenius already demanded that every student "becomes" a teacher.
- When studying, **the power of experience** is very important. It may later be evoked through associations. This is greatly aided by the involvement of the senses, as sounds, tastes, smells, images, emotions, and feelings help to create the necessary associations.
- **Cheat sheet** is intended to aid one's memory. When making a cheat sheet, you have to force the brain to evaluate information, think deeply about it, recognize its importance, reformulate and shorten sentences. This is exactly how the brain learns. It thinks about the material and tries to understand it.

Observations about learning:

- the brain breaks as well as focused study sessions to process the study material,
- you forget because you do not review the learned information,
- comprehension and associations are half of success when studying,
- it is useful to sort the knowledge into groups that you can define,
- read the information from multiple sources, compare them, combine available sources in a new way,
- also consider where and how you can put the acquired knowledge into practice,
- knowledge is dead if you do not have the ability to recall it from memory and use it,
- when reviewing the learned information aloud, the information is being sorted and fine-tuned, 70% of it goes to long-term memory,
- it is advisable to take notes, it is easier to maintain attention while holding a pen,
- positive results motivate you to continue the activity,
- infinite resources are hidden in you, you just need to learn to use them,
- the best way to enrich your memory is by telling others what you have read,
- the quality of the questions you ask determines the quality of the answers you receive,
- **to learn, to learn, to learn - but in accordance with the processes of the brain.**

14. MISTAKES IN LEARNING

A student who does not learn efficiently:

- does not learn continuously during semesters,
- cannot distinguish between the important and less important information and tries to retain everything and every detail,
- does not know how to decide which are the most important information and thinks that everything is equally important,
- he or she writes notes in detail, he writes whole sentences, he does not think about what he writes; the result is more information than he can process, and it takes a long time to read the notes,
- it is hard for him or her to retain the information,
- studies late into the night and rarely takes breaks, which impairs concentration and the ability to retain the material,
- the next day he or she is tired, which reduces the motivation to continue, but the feeling that he or she cannot do it forces him or her to study even more,
- he or she considers studying with somebody else to be a waste of time,
- he or she does not meet friends, he or she misses trainings and other activities that he or she enjoys so that he or she can study even more,
- apart from studying, he or she cannot think of anything else and is not sure he or she knows anything,
- he or she has a fear of exams and feels like he or she has not studied enough,
- he or she cannot rest,
- he or she is irritated and sleeps poorly.

Barriers to learning

These are usually distracting sounds and noise (loud music, TV on, roommates' screams), doing several activities at once (learning while you are on Facebook, playing computer games or making phone calls), chaos and clutter on your desk (you do not know where you have things and you still look for something), missing study materials and tools (you lost the ruler, you do not have notes), unpleasant atmosphere (you do not like the room, you do not feel good there), hunger or overeating (you did not eat or you have just eaten), fatigue and exhaustion (you did not get enough sleep and rest), time stress (you study at the last minute, you have a lot to learn at once), worries and fear (you are afraid that you will not be able to learn it, you are afraid of test). Barriers need to be identified and removed in advance, otherwise study sessions are often long and ineffective. Not all of this is always possible, but efforts must be made to ensure that barriers do not appear again.

Ineffective, traditional ways of learning

The student opens the textbook or study materials and starts reading the first page. It gets boring more and more as he or she goes through the pages. While reading, he or she is on the phone or listens to music. He or she comes up with activities that will take him or her away from the textbook for a while. This way he or she can study for several hours. Reads,

reads, and reads. BUT: just reading is not enough, he or she will learn little for that amount of time and effort.

A different student opens a textbook or study materials and starts reading the first page. He or she starts underlining/highlighting and in the end highlights almost the entire text during as he or she reads. He does not think about it. Excessive highlighting makes it impossible to find out what is important in the text. BUT: to highlight the important information correctly means to highlight one sentence in a paragraph and think about what is worth emphasizing.

Both examples are boring, and it is natural that you will not be able to focus on such learning. You will not really learn anything just by reading. You just have a good feeling that you are not procrastinating and doing something for your studies. Traditional ways of reading/highlighting are inefficient. They will take you a lot of time, but they will not bring the expected result. You can spend hours studying inefficiently or you can take a different approach and learn more. Do not make the mistake of starting to learn line by line right after opening a book or study materials. It is strenuous, slow, knowledge will be sketchy, without context and without comprehension.

Traditional ways of learning create the delusional illusion of learning, you feel that you have perfect control over the study material, and you have studied enough. You think you know something, even if the reality is completely different. This is because the brain can recognize information after reading it several times. The brain realizes that the information is familiar, and the illusion of learning emerges.

Major mistakes in learning

- **Studying without breaks**

You can concentrate for 35 - 40 minutes, then fatigue comes but you continue studying. Taking a break seems as a waste of time to you, you cannot rest, you think about studying all the time. BUT: a break is necessary, during which a scattered type of attention occurs, which is necessary for sorting of learned information. Think about studying when studying, but other times give information the opportunity to get processed and stored.

- **Studying too much and for a long time**

You should never study for more than a maximum of 45 - 50 minutes at a time, about 4 hours a day. BUT: study in approximately 40-minute intervals followed by a few minutes break. During the break, you can eat something, take a short walk, talk to someone and so on and then get back to studying again. It is an effective way and you will not be so tired after studying.

- **Passive learning**

You learn passively when you read and try to get information **in** your head. Paradoxically, you will not store them in your memory, understand them, or pass the test/exam. BUT: To retain the information, you have to learn actively, get information **from** your head, recall it, practice memory techniques.

- **Learning by heart**

Rote learning is very demanding and such information will not stay in your head for long. BUT: It is better to understand the study material. If you understand something, it is much easier to retain, you can express it in your own words.

- **Lack of concentration**

This mistake is very common. The student looks at the cell phone while studying, replies to text message or is on social media. Another student eats snacks more than he studies and another one listens to inappropriate music while studying. And if you look at the phone several times, you will never reach the flow state in which learning is the fastest. BUT: practice undisturbed studying, first 15 minutes, then 20 minutes and gradually you can study undisturbed for the duration of the whole study session.

- **Irregular and disorganized learning**

University students often study only before a test, mid-term exam or exam. By studying regularly, you improve your intelligence and memory skills.

- **Studying in bed**

Bed is the worst place for studying. It is a place that is associated with sleep, and when you are in bed, the brain tries to adjust. It is slowing down you are tired, and you are falling asleep. When you study in bed, you will be tempted to slow down and take a nap. BUT: study in places that are related to productivity or in places that force you to be productive. When you live in a dormitory where you do not have enough space, study in the study room, but never in bed.

- **Music**

Music in which someone sings, or raps should never be played while studying because it subconsciously interferes with studying and slows the learning process down. BUT: not every music has the same effect on learning. A lot depends on your personality - if you are extroverts, music will not bother you as much as when you are introverts. It also depends on the study material - the more complicated it is, the less music you should listen to as you study. In time, you will find out what types of tasks music helps you with and when you should not listen to it.

- **You are missing a goal**

If you start studying without any specific goals, you do not have a chance to learn much. BUT: set yourself a small goal that you can start studying with. Ask yourself and answer aloud, "What do I want to learn? What will I know when I finish my study sessions?" It is enough to be determined, strong-willed, persistent, and not giving up after initial failure and believe that you can do better.

- **Studying at night and at the last minute**

What was not done during the semester must be completed at the last minute overnight. At night, the body slows down, the person is tired, and studying is not effective. Sleep is key to learning. If you do not sleep, you will not retain much. During sleep, the brain works hard, consolidates learned information, and transfers it from short-term to long-term memory. If you study the night before the exam, you will be under a lot of stress, you might or might not pass the exam, and in addition you will be repaying your sleep debt for a few days. Moreover, the learned information is not stored in long-term memory during this type

of studying and, eventually, it will come to nothing. BUT: learn continuously and you will never have to sacrifice sleep. Studies show that students who sleep well before exams achieve better performance.

- **Too much caffeine and energy drinks**

If you drink a lot of coffee and energy drinks, you build a strong tolerance for caffeine. A normal dose of caffeine will not be enough, but you will need to constantly increase it to feel energized. Addiction to energy drinks is very easy. Their effect on your energy will not increase if you drink more of them per day, because your body will get used to it. In addition, they contain a lot of sugar. Caffeine is not bad, but a lot of it may be harmful to your health. If you have a lot of caffeine in you, you will not be more focused, rather more distracted, and that will not help you during your study sessions. One, a maximum of two coffees a day is enough. Only rarely get energy drinks when you really need to wake up. BUT: look for other, healthier ways to have energy - sleep more, exercise, eat healthier or you can take a quiet nap in the afternoon. Do not drink coffee within 90 minutes after waking up, caffeine increases cortisol, which helps fight stress and instructs the body to wake up. If you drink coffee in the morning, you build up caffeine tolerance faster. Coffee has the biggest effect in the afternoon, around 02:00 - 03:00 pm, when the energy drops, and coffee helps us to feel energized again.

- **Study drugs**

Students sometimes resort to taking study drugs before exams. They are usually only available on prescription. Although these drugs provide you with energy and increased attention for a while, they are addictive and have side effects. They can increase blood pressure and heart rate, negatively affect a person's judgment, cause nervousness, impulsivity, mood swings, hallucinations, aggression, and anorexia. Although attention may be increased, drugs will not improve the ability to process information, the way of learning or the quality of knowledge. If you do not know how to study properly, taking study drugs will not do any good. BUT: whoever masters learning and concentration techniques will influence their performance much better than if they have resorted to questionable study drugs or other stimulants. The increased concentration caused by drugs does not bring you much.

A little philosophizing at the end:

- It is better to know how to study properly than to study without such knowledge.
- It is better to learn according to the memory principles than to ignore them when you learn.
- Success is the realization of what you set out to do.
- Success is a positive result of your efforts.

We wish you success in your studies and in realization of everything you have set out to do.

15. OBSERVATIONS FOR TEACHERS

The teacher should stand in front of the students with confidence, relaxed and should arouse interest in the course. He or she lets students think, discuss, make mistakes, and find the right answers. A good teacher should constantly work on himself or herself, he or she should have the need for further education and professional growth as well as the need for feedback. The teacher should be interested in the opinions of students and colleagues on his way of teaching. A fair teacher "does not play" the role of infallible in front of students.

Tips for teachers

- At the beginning of the lecture/practical exercise, acquaint students with what will the course look like and what the study material is about, so that they know why it is important for them to learn it.
- Apply communicative methods in teaching that motivate the student and not threaten him or her by a directive approach.
- Do not treat all students equally, but optimally choose differentiated approaches for effective work, respect natural learning styles, accept their opinions and interests.
- In the teaching process, it is important to create and maintain an interest in creativity and exploring and to maintain curiosity of students about the interactions among them.
- Allow students to interpret new knowledge in their own words in different ways, with an emphasis on accuracy and essence.
- Teach students to connect new study material with everything they have ever encountered.
- Use many examples so that the student sees the meaning and significance, involve as many senses as possible.
- Involve as many positive emotions as possible in teaching, prefer positive attitude when speaking.

Petlák (2009) based his requirements for teaching on the findings of brain research, which emphasize not only learning and memory, but also emotions and motivation in learning:

- teaching should be informal, fun, and enjoyable,
- teaching should be broadly supported,
- Teaching should be focused on life,
- the content of the study material must be presented to students by various methods.

The current education system does not prepare young people for a successful life. Many times, the student is expected to learn things he or she does not need and he or she is not presented with what may be useful in practice. The role of the teacher is to explain the importance of course to the student.

„If the teacher is the master and must enforce his authority,
such a teacher has no authority in students' eyes,
such a teacher will be hated by students,
and because of this they will hate his course,

because of that they do not devote any time to studying the course material,
because of that they will not learn the course material,
because of that they will hate it all their lives.

At the same time, he only has a positive intention and just wants to teach them.“
(Hlinka, 2011)

Students do not like when the teacher:

- ignores their questions, or answers contemptuously,
- gives them orders and does not inspire them,
- lectures them and not teaches them,
- enforces undeserved authority.

The teacher who helps students solve problems is better than the one who has encyclopaedic knowledge but is not related to it. At present, it is difficult to engage students' attention when they are surrounded by the same information sources as the teacher himself.

The effectiveness of learning is supported by these brain-compatible components:

- Friendly environment: agreed rules, meaningful communication, support, recognition, appreciation, trust, positive teacher-student relationships.
- The meaning of learning: focusing on topics that are important to students. Many times, even teachers do not know why students have to learn some things.
- Feedback: it is necessary to know immediately what the student understood correctly and what needs to be changed. Focus on the student's strengths and achievements.
- Collaboration: it helped survive in the distant past. When teaching, it is appropriate to divide the tasks and assign them to groups of students, thanks to which they learn the responsibility for working together.
- Engagement of the senses: students need direct experience from the real world, to see, hear, touch, smell, try and test. They will best retain what they try for themselves.
- Respect learning styles: people do not learn in the same way, each brain is unique.
- Teach the study material effectively: to know how to use the learned information in the real world and to be able to teach others.
- Sufficient time: for learning and repetition according to the student's pace.
- Movement: movement-related learning increases retention by approximately 68%.
- Enriched environment: inspires to learn. The environment should be cosy, clean, aesthetic, practically organized.

Lecture

The lecture is one of the most frequently used methods in the teaching process at universities today. It belongs to the traditional methods of university education. It is an oral presentation intended to present information or teach students about a topic by a university teacher. It does not require active involvement of students in the educational process. Students do not learn to work with information and understand it.

The traditional 90-minute lecture is characterized by several shortcomings, which are mostly in conflict with the principles of BCL:

- it is a monologue of one person,

- passivity of students,
- supports the authoritarianism of the teacher,
- does not respect the brain's ability to concentrate for only a certain amount of time,
- not every teacher can explain the topic well,
- ignorance of the principles of PowerPoint presentation,
- attendance checks, mandatory lectures, attendance at the lecture as part of the overall evaluation.

Today's technologies offer more options as well as common teaching styles to make it more interactive. It all depends on the preparation, motivation, and the ability of teachers to adapt their teaching to the needs of students. Multimedia technologies enable active learning in a motivating environment, engagement of multiple senses in receiving and retaining information. Educators should explain to first-year students how to perceive the lectures and how to get the most out of them.

The fact is that not all teachers are willing to adapt or change the teaching methods they have had for years. It is necessary to realize that only loud reproduction of texts from the presentation, which students can read themselves, is not an effective teaching method. The brain is not capable of multitasking, it can only quickly switch between activities. Looking the text from the presentation while listening to it being read at the same time is tiring, the brain focuses on either reading or listening. If the lecturer only reads the text, such a lecture is ineffective for the student. It is an outdated form of passive reception of information, the student has no way to get involved in the activity and loses interest in the course. Such activity lacks meaning and is unnecessary.

In passive learning, the student is not involved in the learning process and has no immediate feedback on what he or she has learned. That is why he or she does not even retain the information. Through active learning, the student tries to get information out of memory and finds out how much he or she can recall. The student knows that he or she has retained the information when he or she is able to recall it from memory. The condition for teaching at a university should be the mastery and development of skills to teach university students effectively. A monotonous teacher is unable to teach. He or she should have a sufficient EQ to be able to identify with the position of a student.

The introduction of the lecture is very important, the students retain it. They are still fresh and naturally curious, most of the events that determine whether a student will retain something is at the beginning of the teaching process. It is necessary to start the lecture in such a way that it attracts attention right at the beginning. Of course, it has to be related to the topic of the lecture in order to maintain the listener's attention in the lecture.

The introduction may be:

- an interesting story that catches the listener's attention, that might possibly remind him or her of something from his or her life,
- a rhetorical question, provocative, encouraging to think, to identify with the role of a lecturer,
- shocking statistics that supports curiosity,
- concise quote from a famous person,
- a compelling image that increases imagination and understanding, and thus retention,

- case study related to the topic,
- demonstration of the model, props that will strengthen the understanding of the topic,
- a short video that increases curiosity and reveals the topic presented in the lecture.

Teachers often overwhelm students with information that is new to them, and students need time to process it. It is therefore necessary to make pauses in the lecture. The brain cannot concentrate on boring things for a long time, students are only able to pay attention for a limited time, so it is necessary to include the so-called **emotionally engaging stimuli** that awaken students - examples, case studies, stories, jokes that are related to the topic. During the lecture, it is advisable to repeat important facts several times at intervals of at least 10 minutes, so that new knowledge can be retained.

Presentation

The most common tool for explaining ideas in a lecture is a presentation. The multimedia presentation uses words (in written or audio form) together with graphics - pictures, illustrations, photographs, animations and/or video in connection with the content of the course material. The lecture is effective when the text and graphics are combined in a suitable way.

Mayer's principles of multimedia learning shape the design and organization of multimedia presentations:

- Multimedia principle - people learn better from words and pictures than from words alone. Spoken text is one of the auditory media, written text represents visual perception. The student retains 65% more when pictures are used than when the lecture is only verbal.
- Modality principle - people learn better from graphics and narrations than from animation and on-screen text.
- Temporal contiguity principle - people learn better when corresponding words and pictures are presented simultaneously rather than successively. Try to use as little text as possible, the words should be perceived by hearing.
- Spatial contiguity principle - people learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.
- Coherence principle – people learn better when extraneous words, pictures and sounds are excluded rather than included.
- Redundancy principle - people learn better from graphics and narration than from graphics, narration, and on-screen text.
- Signalling principle - people learn better when cues that highlight the organization of the essential material are added.

When creating individual slides, it is necessary to avoid large text blocks so that the listener is not burdened with reading. The spoken text is more effective, which relieves the visual perception and the student's working memory can divide the strengths in terms of perception. Simple text bullets to support spoken text are sufficient. In addition, it creates space for graphics in the presentation. Images are processed by the brain 60,000 times faster than written text. Confucius said that one picture can say more than a thousand words. It is advisable to use animations, objects in the slides that may appear at the right time and anchor the meaning of the story.

Using a suitable combination of pictures, written texts and narrations, a high level of attention can be achieved by the student, who is able to decode and retain perceptions. The dual coding theory talks about separate processing of visual and verbal information, that is, the observed object is encoded as an image and at the same time as a word.

Pictures, photographs, animations, and video in connection with the content of the study material amplify the information acquired. The use of ornate, unnecessary graphics that distracts from the teaching process and listening to interpretation should be avoided. Various elements, such as illustrations, animations, and the like, are to be used thoughtfully as a special effect to increase attention.

Do not use a colour combination in images: blue on red, green on red, red on black. Red with green is completely inappropriate because regarding population, 9% men and 0.5% of women are colour-blind. The choice of font also affects the quality of the presentation. A frequently used font, for example, *Comic Sans*, looks boring. Just combine two types of contrasting fonts, for example, *Calibri* and *Cambria*. Imitation of scripted letters *script* is difficult to understand and the disadvantage is that such letters have no diacritics.

To find out how effective the lecture was, try to use a short test that should serve as a feedback at the end. It is also a good motivation for students to pay attention. Using this type of test, you evaluate the quality of the lecture, therefore yourself.

Pay attention to the student

When a student stares "into emptiness", the mental process of retrieval of information from the past takes place. This dissociation from the present is a natural manifestation of the brain function, the recall of images from memory. In this activity, the student cannot simultaneously focus on things in front of him and thinking. That is why you should not ask him or her to look at you when he or she answers your questions during exams. In this kind of dissociation, the position of the eyes can be different, and it is possible to deduce from it how a person thinks - eye accessing cues. When a student is looking up, he or she is imagining images. When he or she is looking sideways, he or she is imagining sounds. When he is looking down, he or she is in an emotional world. If the student is looking down (right-handed towards right side, left-handed towards left side), then he or she is stressed.

Eye accessing cues for right-handed student. If he or she is looking:			
	at the top left corner visual memories		at the top right corner visual thoughts
	left sideways auditory memories		right sideways auditory thoughts
	at the bottom left corner internal monologue		at the bottom right corner feelings, stress

. 23 Eye accessing cues for right-handed students

Eye accessing cues for left-handed student. If he or she is looking:			
	at the top left corner visual thoughts		at the top right corner visual memories
	left sideways auditory thoughts		right sideways auditory memories
	at the bottom left corner feelings, stress		at the bottom right corner internal monologue

Fig. 24 Eye accessing cues for left-handed students

If a student is looking up or sideways, he or she tries to recall. However, there is no guarantee that he or she will succeed, it will only increase probability of recall. When knowledge is not stored well enough, it cannot even be recalled.

16. INTERESTING FACTS ABOUT THE HUMAN BRAIN

- New connections are formed in the brain throughout life, regardless of age. Whenever a person recalls something or thinks of something new, a new connection is formed in the brain. They are mostly formed during learning, they are strengthened after learning and are consolidated during sleep.
- Neural circuits in the adult brain are constantly being modified by experiences. Everything that a person discovers, perceives, or experiences during his or her life affects the structures and functions of the brain. The brain is being constantly transformed throughout life.
- Childhood experiences and emotions associated with them play a key role in the development of brain functions, life experiences lead to brain remodelling.
- Although genes determine the potential of human abilities, the environment transforms the brain according to what a person does, reads, perceives, what he or she looks at or who he or she is talking to.
- The brain is the most complex organ in the body, serving as the control centre of the nervous system of all vertebrates and most invertebrates. Only some invertebrates (jellyfish and starfish) do not have a brain, only a nerve net dispersed over the organism near the sense organs in the head.
- For a long time, scientists were convinced that the brain did not change in adulthood. The truth is that until old age new connections between neurons are formed and new nerve cells are formed (especially in the hippocampus).
- There are 90-100 billion neurons in the brain, which is 15 times more than the number of people on Earth. 98% of the mass of a neuron is represented by neural dendrites. The longest can be more than 1 m long. There are 186 million more neurons in the left hemisphere than in the right one. In addition to neurons, there are glial cells in the brain that make up about 85% of brain volume.
- In the average person, the cerebral cortex consists of 15 - 33 billion neurons, each of which communicates by synapses with up to 10 000 other neurons. The total surface area of the cerebral cortex is about 1500 to 2200 square cm. Furrows increase the total surface area of the hemispheres by 70%.
- One has about 25 - 70 thousand thoughts a day, but most of them are the same. The brain cannot stop thinking about things. In the waking state, it comes to one thought per one second.
- The brain is an energy-demanding tissue. The brain needs a constant supply of energy, it cannot store it. The source of energy for the brain is glucose, the brain consumes about 115 g per day. Hypoglycaemia induces significant changes in the brain function. One of the first symptoms is confusion. However, it may lead to hypoglycaemic coma, sometimes associated with cramps and death.
- The brain is composed of about 80% water, 12% fat and 8% proteins. If the brain is removed from the body (during autopsy) and fluids leak out, 2/3 of the remaining weight of the brain will be fat (myelin).
- The female and male brains are not the same. The male brain has about 4% more cells than the female brain. The female brain has multiple functional connections between

the hemispheres. The male brain has multiple functional connections within one hemisphere.

- The weight of the brain has increased because of evolution. The average male brain weighed 1 372 g in the 19th century, today the male brain weighs 1 424 g, the female brain weighs 100 g less. The largest documented male brain weighed 2 049 g, the female brain weighed 1 565 g. Tall people have bigger brains than short ones. There is no connection between brain weight and intelligence. Einstein's genius did not lie in the size of his brain, as it weighed only 1 230 g. Even Lenin's brain was below average, weighing 1 340 g. Man has the largest brain of vertebrates in terms of body size. In comparison, the 9-meter dinosaur had a brain that weighed 70 g.
- There are more than 100 - 150 thousand kilometres of blood vessels in the brain (which is 4 times more than the circumference of the Earth). In childhood, the blood flow through the brain is higher than in old age, because in old age the resistance of blood vessels increases and their elasticity decreases. About 750 - 800 g of blood flows through the brain per minute. A complete interruption of blood flow to the brain is manifested by unconsciousness. The cortical neurons survive without oxygen for 4 - 6 minutes, then begin to die which causes permanent brain damage. Brain stem neurons survive without oxygen for 20 - 30 minutes. Time decides whether a patient is completely cured, remains disabled, or dies after a complete interruption of blood flow to the brain.
- At the beginning of embryogenesis, neurons are formed at a rate of 250 000 neurons per minute. At birth, there are 14 billion cells in the brain, the number of which decreases during life. The new-born's brain forms new synapses at a rate of 2 million per second. Most important brain connections, main patterns of behaviour, and character are formed by the 4th year of life. There is a huge potential in the development of children's mental abilities. The neural network is densest at the age of 4 and by adulthood its density will drop by half.
- Symbolic thinking starts working in the 3rd year of life. The brain at 5 years is 95% the size of an adult's brain. At 17 years of age, an individual's intelligence is complete. Continuous learning prevents the decline in IQ. The ability to empathize with others is not stabilized until the age of 20. The brain develops by the age of 40 - 50, later its weight decreases. In the 65th year of life it has 100 g less and in the 90th year of life 15% less than in the 50th year of life. The general intellect does not change, performance and mental flexibility do.
- Up to 100 000 chemical reactions take place in the brain in one second. The neuron is activated 5 - 50 times per second. Each neural signal carries one bit of information. Information spreads at different speeds (2 - 430 km/h) in different types of neurons).
- The unconscious mind can process up to 5 million times more data flow than the conscious mind at the same time. The conscious mind controls brain function in 5% of the day, the subconscious in 95%.
- The human brain is much more complex than a personal computer, it has a capacity equivalent to 4 terabytes hard drive. The possibilities of human memory are so great that they cannot be used in a lifetime.
- The brain consumes the same amount of energy as a 10 - 25 W light bulb, even during sleep.

- The brain is much more active at night than during the day. It processes data acquired during the day. Lack of sleep reduces the ability to create new memories. The person has impaired memory, attention, and other cognitive functions. After restoring adequate sleep, brain function returns to normal in 2 - 3 weeks.
- The average person remembers their dreams for only 2 - 3 seconds after waking up and forgets up to 90% of them. Most people dream for 1 - 2 hours a night and have 4 - 7 dreams. Everyone has dreams, but 5 minutes after waking up, half of it is forgotten, 10 minutes after waking up, it is up to 90%. Even blind people who lost their sight during life have dreams. Dreams are symbolic connections of the subconscious.
- The brain can recognize its own and other people's touches and reacts differently to them (for example, a person cannot tickle himself or herself).
- The brain itself does not feel pain. There are no pain receptors in it. It does not feel changes in temperature or pressure.
- Intellectual activity supports brain health and function, more educated people are less prone to diseases and brain damage.
- Meditation can increase IQ, relieve stress, and improve learning skills.
- Listening to music and reading fairy tales to children before putting them to bed strengthens the activity of the brain.
- Photographic memory which enables a person to retain and recall the details of an object or phenomenon could not be proved experimentally.

17. QUOTES ABOUT SCHOOL AND EDUCATION

The school should provide education for all people. However, education is more than just sitting at a desk. This is also mentioned in quotes from famous and less famous people:

- The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn. **Alvin Toffler**
- Children must be taught how to think, not what to think. **Margaret Mead**
- The mind is not a vessel to be filled but a fire to be kindled. **Plutarchos**
- The difference between school and life? In school, you are taught a lesson and then given a test. In life, you are given a test that teaches you a lesson. **Tom Bodett**
- Tell me and I forget; show me and I may remember; involve me and I learn. **Chinese Proverb**
- Treat people as if they were what they ought to be and you help them to become what they are capable of being. **Johann Wolfgang Goethe**
- A well-educated mind will always have more questions than answers. **Helen Keller**
- If people never did silly things nothing intelligent would ever get done. **Ludwig Wittgenstein**
- The best teachers are those who show you where to look, but do not tell you what to see. **Alexandra K. Trenfor**
- Intelligence is not to make no mistakes, but quickly to see how to make them good. **Bertold Brecht**
- It is what we know already that often prevents us from learning. **Claude Bernard**
- Learning is not the product of teaching. Learning is the product activity of learners. **John Holt**
- Simplicity is the ultimate sophistication. **Leonardo da Vinci**
- The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires. **William Arthur Ward**
- True teachers are those who use themselves as bridges over which they invite their students to cross; then, having facilitated their crossing, joyfully collapse, encouraging them to create their own. **Nikos Kazantzakis**
- You cannot teach a man anything, you can only help him find it within himself. **Galileo Galilei**
- I never teach my pupils I only attempt to provide the conditions in which they can learn. **Albert Einstein**
- Education is not the learning of facts, but the training of the mind to think. **Albert Einstein**
- Any fool can know. The point is to understand. **Albert Einstein**
- If you cannot explain it simply, you do not understand it well enough. **Albert Einstein**
- Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results. **John Dewey**
- Education is not preparation for life; education is life itself. **John Dewey**
- I am always ready to learn although I do not always like being taught. **Winston Churchill**
- Creativity now is as important in education as literacy, and we should treat it with the same status. **Sir Ken Robinson**

- Knowledge helps only when it descends into habits. **Jerome Bruner**
- Every student can learn, just not on the same day, or the same way. **George Ewans**
- Rarely will you find two children that you could lead the same way. **John Locke**
- Nothing is in mind that would not have been in the senses before. **John Locke**
- There is no end to education. It is not that you read a book, pass an examination, and finish with education. The whole of life, from the moment you are born to the moment you die, is a process of learning. **Jiddu Krishnamurti**
- Education is learning what you did not even know you did not know. **Daniel Joseph Boorstin**
- An educated man should know everything about something and something about everything. **Cicely Veronica Wedgwood**
- The principle goal of education in the schools should be creating men and women who are capable of doing new things, not simply repeating what other generations have done; men and women who are creative, inventive and discoverers, who can be critical and verify, and not accept, everything they are offered. **Jean Piaget**
- Education is for improving the lives of others and for leaving your community and world better than you found it. **Marian Wright Edelman**
- The education of a man is never completed until he dies. **Robert Edward Lee**
- Education is the foundation upon which we build our future. **Christine Gregoir**
- Knowledge which is acquired under compulsion obtains no hold on the mind. **Plato**
- To know means to be able to recall. **Plato**
- The direction in which education starts a man will determine his future life. **Plato**
- The only person who is educated is the one who has learned how to learn and change. **Carl Rogers**
- Change is the result of all true learning. **Leo Buscaglia**
- The most result of every education is to know yourself. **Ernst Feuchtersleben**
- The great aim of education is not knowledge but action. **Herbert Spencer**
- The function of education is to teach one to think intensively and to think critically. Intelligence plus character – that is the goal of true education. **Martin Luther King, Jr.**
- The goal of education is the advancement of knowledge and the dissemination of truth. **John Fitzgerald Kennedy**
- The purpose of education is to replace an empty mind with an open one. **Malcolm Forbes**
- The object of education is to prepare the young to educate themselves throughout their lives. **Robert Maynard Hutchins**
- An investment in education gives the best returns. **Benjamin Franklin**
- If you fail to plan, you are planning to fail! **Benjamin Franklin**
- We need to move beyond the idea that an education is something provided for us, and toward the idea that an education is something that we create for ourselves. **Stephen Downes**
- Actually, all education is self-education. **Louis L'Amour**
- Memory is the mother of all wisdom. **Aeschylus**
- You have to learn to retain. **William Shakespeare**
- Knowledge is dead if we do not have the ability to recall it from memory and use it. **Kurt Tepperwein**

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