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MNEMONICS – KNOWN AND UNKNOWN

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Abstract. The given article deals with the issue of mnemonics, their types and their application in the learning process and daily activities. Examples in several languages and for different study subjects and areas are covered. Mnemonic techniques proposed by artificial intelligence are reviewed. The work presents the results of a survey among 301 participants aimed at revealing people's awareness of the possibilities of mnemonics and their propensity to use them. The idea that mnemonics in school should be considered from two sides – as a finished product on the one hand and as an author's realization on the other hand – has been revealed. Creating your own mnemonics involves high cognitive levels and important soft skills.

Keywords: learning, mnemonics; creativity; memory; artificial intelligence; ChatGPT

Introduction

Modern society is flooded with information of all types and quality. The motivation to memorize facts drops sharply. The ability to remember decreases in stressful situations. It often happens that a person creates a "barrier" to new knowledge and it is difficult for him to remember and reproduce it. The problems of modern times require innovative solutions, but sometimes well-tested methods from the distant past can help us more easily absorb the information that the world gives us. After the introduction of online learning, many educators faced problems related to students' focus on the learning process and their motivation to work. Mnemonic techniques are a method that suggests the easier memorization of certain information of a different nature.

Learning math, science and foreign languages often involves memorizing facts. The implementation of STEM training is aimed at practical application of knowledge and the release of a competence approach, but nevertheless it is necessary to remember facts, numbers, theorems, etc. Mnemonics can help with this task.

The concept of mnemonics

Mnemonics is a set of associative methods that help us remember information

more easily. The word "mnemonics" has an ancient Greek origin and comes from μνημονικόν – the art of remembering, the ancient Greek goddess of memory is Mnemosyne, whose name bears the same root. Mnemonic techniques have been used in people's daily lives even before writing was discovered, when ancient shamans needed to memorize long spells or when travelers needed to remember a route and had nothing to draw a map on. It serves speakers to memorize long speeches, students to memorize blocks of information, facilitates the practice of pharmacists, teachers, doctors, etc. There are different types of memory and different people proceed in a different way when memorizing information - for some it is easier to take a pen and paper and write down certain information to memorize it, others rely on repeated reading of the text that they should memorize, others bet on associations. An interesting aspect of mnemonics is its rich didactic value. The rules are fun for students and, in addition to facilitating faster memorization of the necessary facts and algorithms, they also contribute to increasing interest in the specific study discipline, the positive emotional attitude of the students, and the motivation to learn.

Nowadays, people are regularly flooded with information, and often a person seems to stop processing the received data and fails to reproduce and even realize what he/she heard or read. In the era of easily accessible information, mnemonics can serve as a good method for structuring and remembering important moments of learning and everyday life. The world was faced with a cardinal change during the epidemic of COVID-19 and many of the popular methods were inapplicable in the electronic form of learning. In this situation, mnemonics facilitated the learners' practice and allowed the learning process to proceed in a fun and interesting way. Murashov (2021) points out that "the use of mnemonics protects the brain from overload and prevents somatic and neuropsychic diseases, and through these methods, students have the opportunity not to mechanically memorize the information that is given to them, but to process it more qualitatively and reproduce it more easily".

It is impossible to say exactly when and where exactly the first attempts were made to understand what memory is, but a major factor from antiquity stimulating the need for memorization techniques was the lack of writing. The first scientific concepts of memory are believed to have been developed by the ancient Greeks, 600 BC.

Sixth century BC Pramenides states his theory that memory is a compound of light and dark, heat and cold, which should not be spoiled, but if it is, it will lead to forgetting. It was only in the 4th century BC that a theory appeared that was really close to reality. Plato believed that events become fixed in the brain in a similar way to the way that an object is imprinted on a wax plate that is left on it. Events remain in memory until they are erased over time (Yates 1999).

In his Orator, Cicero tells the story of how Simonides invented the art of memory while delivering a speech on memory as part of rhetoric (Astvatsaturov 2009).

Giordano Bruno wrote several books on the subject of memory, and many of the highest rulers of his time took a keen interest in his skills with memory. One of Bruno's popular writings is The Art of Memory, where memory is viewed as a set of mnemonic principles and methods used to organize impressions, improve recall, and aid in combining and "inventing" ideas. It is an "art" in the Aristotelian sense, that is, a method or set of principles that brings order and discipline to the natural actions of men. The method dates back to before the new era and is mainly associated with studies in rhetoric and logic, but has also been used in the context of witchcraft and religion (Titlin 2017).

Mnemonics find a place in various areas of education and everyday life. "Tackling reproductive-type tasks definitely gives students confidence and confidence in attacking productive-type tasks. Already at an early stage, they learn to make synthetic conclusions" (Ivanova-Nedelcheva 2016). This conclusion gives us reason to believe that schools should consider both the possibilities of using ready-made mnemonic rules and the creation of their own.

Some classifications, techniques and strategies

The principles of the art of memory are five – visualization and spatial orientation, orderliness, limitation of remembered items, associativeness and repetition. The most important principle is the dominance of the visual sense combined with the orientation of "visible" objects in space. In The Orator, Cicero recounts a legend according to which Simonides remembers all those present at a feast according to where they sat (Cicero 1992).

A mnemonic is a memorization technique. According to the modern encyclopedic dictionary, mnemonics is made up of rules and techniques to strengthen memory and facilitate and remember facts and information, making the most of association. Often, one type of information is replaced by another, for example, instead of remembering numbers, words are remembered, instead of words – places, instead of colors – a poem. One of the most common examples are sentences to remember the digits after the decimal point of the Ludolf number – π (3,14...). They are diverse and exist in different variations and in different languages – "How I Wish I Could Calculate Pi Easily", "May I have a large container of coffee beans?" "Как е леко и лесно запомнено Пи, всички знаят, щом желаят!" (in Bulgarian). The translation is: "How easy and soft to remember Pi, everyone knows as soon as they wish!", „Вот и знаю я число, именуемое Пи — Молодец!" (in Russian). The translation is: „I know a number, named Pi — Well done!", another example in Russian is „Учи и знай в числе известном за цифрой цифру, как удачу примечать!" – "Learn and know in the number known for the number of digits, how to note luck!| and many others. We tried to generate an example in Mandarin using ChatGPT – "三一四一五九" (Sān yī sì yī wǔ jiǔ)". The given phrase in Mandarin Chinese is simply written the number pi in Chinese (Table 1) shows some of these examples, according to the number of letters in their words.

Table 1. An example of memorizing the number π

3	1	4	1	5	9	2	6	5	3	6
как	е	леко	и	лесно	запомнено	пи	всички	знаят	щом	желаят
may	i	have	a	large	container	of	coffee	beans		
вот	и	знаю	я	число	именуемое	пи	молодец			

Source: Author's own elaboration.

It is much easier to remember a simple sentence or verse than a series of numbers. There are even platforms where many different "mnemonics" are collected that everyone can use and also have the opportunity to share their ideas. An example of such a platform is https://www.mnemonic-device.com.

Mnemonic uses natural physiological mechanisms of the brain in memorizing information, allowing full control over the process of memorizing, storing and recalling information.

According to Denis Congos (2005), there are nine types of mnemonics. It is possible to consider other taxonomies, but in the present work we will focus on Congos's classification, using also some of the examples he proposed.

Musical mnemonics

Memorizing song lyrics is a much easier task than learning an academic text. Mnemonics gives the idea of remembering through music. A common marketing trick is to come up with a song to advertise a product and prompt buyers to choose that particular product because they remember the song from the ad. Musical mnemonics work best with long lists, they are also used in education, for example, many children learn the English alphabet with the song „ABC".

Name mnemonics

Sometimes it is difficult to remember a name, especially if they are foreign, the name mnemonic solves this problem by giving a solution by coming up with a number of words whose first letters form a given name.

ROY G. BIV – colors from the spectrum (Red, Orange, Yellow, Green, Blue, Indigo, Violet).

Word mnemonics

Practically the most used method of mnemonics. Like name mnemonics, word mnemonics again use the first letter of a code word, but this time each letter is the beginning of another word that is related in some way to the next.

One such example of the easy to remember sequence of rainbow colors is „**R**ichard **O**f **Y**ork **G**ave **B**attle **I**n **V**ain" (Red, Orange, Yellow, Green, Blue, Indigo, Violet). Another example is "ROY G. BIV", which is the reverse logic of

the example above. In Russian there is also such a phrase – „**К**аждый **О**хотник **Ж**елает **З**нать, **Г**де **С**идит **Ф**азан“. The translation is "Every Hunter Wants to Know Where the Pheasant Sits".

To easily remember conjunctions in the English language, there is the following mnemonic rule– **F**or, **A**nd, **N**or, **B**ut, **O**r, **Y**et, **S**o – FANBOYS.

Model mnemonics

According to Denis Congos, some schemes and diagrams can be considered as mnemonics, through which a person perceives and remembers information more easily. Kongos gives an example by illustrating the Krebs cycle process.

Rhyming mnemonics

This type of mnemonic puts the information to be remembered into rhyming text for easier reproduction. This classic rhyme for example provides a simple and effective way to learn the number of days in each month. The rhyme's rhythm and rhyming pattern make it easier to remember and recite (Author unknown).

"Thirty days hath September,
April, June and November.
When short February's done
All the rest have 31."

An example of remembering an artist according to the plots in his paintings (Russian – author unknown):

„Если видишь на картине
Темень вод, девятый вал
То понятно, что картину
Айвазовский рисовал.“

There are such verses for several famous artists. The rhyme is lost in the English translation:

If you see in the picture
Darkness of the waters, ninth wave
It is clear that the picture
Aivazovsky painted.

Connection mnemonics

A connection mnemonic involves establishing a link or connection between the information you're trying to remember and something you already know well. An example of connection mnemonic is „remembering the direction of longitude and latitude is easier to do when you realize that lines on a globe that run North and South are long and that coincides with LONGitude. Another Connection Mnemonic points out that there is an N in LONGitude and an N in North. Latitude lines must run east to west, then because there is no N in latitude"[2].

Spelling mnemonics

Spelling mnemonics are memory aids or techniques designed to help individuals remember the correct spelling of words. These devices often involve creating associations between the letters in a word and a phrase, rhyme, or acronym, making it easier for learners to recall the correct sequence of letters. An example is: A princi<u>pal</u> at a school is your <u>pal</u> and a princip<u>le</u> you believe or follow is a ru<u>le</u>.

A combination of Rhymed Mnemonic and Spelled is often used.

Model mnemonics

The information is constructed in the form of a picture that displays information when you need it. The funnier the image, the easier it is to recall the information associated with it. These images can be mental or sketched in text and lecture notes. The goal is for the person to know what the sketch means, it doesn't matter if other people will understand it. As a variant of this mnemonic, you can consider mind maps (Buzan 1996), which have become particularly popular in Bulgarian education in recent years, in their pictorial implementation.

Is it difficult to remember the meaning of numismatics? Imagine a beach with many coins scattered on it. To many people, this sounds funny and ridiculous, but this usage of mnemonic can help you remember difficult texts, dates, etc.

Note organization mnemonics

The way information is organized in textbooks or from lectures can hinder or help learning. It is not by chance that in Bulgarian *Ordinance on educational books, text-books and teaching aids* has a place for the graphic layout of the lessons, Art. 9(2), Art. 12 (3), Art. 25 (2), etc.

Three examples (Congos 2005) of organizing notes to aid recall are as follows:

– Notes – an easy way to organize the main ideas and relevant details that need to be recalled. Adding questions like they would appear on a test/exam is a prerequisite for easier learning.

– Underlining – clearly separates main ideas from details. This helps organize information in the mind, making it easier to remember.

– The Cornell system – a vertical line is drawn 3 inches (about 7cm) from the left margin of the notebook. Main ideas and questions are written to the left of the line, and details or answers to the right (Pauk 2013).
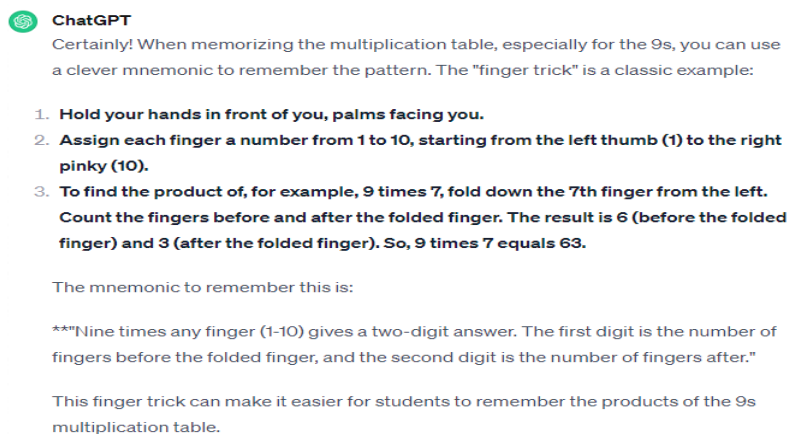
In a more systematized and enriched form, mind maps created by Tony Buzan (1996) are used. With them, the technique is free – you can bet on words, pictures, physical models, etc. The idea is based on associative links organized in a way that is clear to the learner to remember information.

Generating mnemonics using artificial intelligence

In recent years, the use of artificial intelligence in education has entered full force.

There are a number of studies in this area. An extensive abstract review of literature devoted to the application of artificial intelligence in mathematics education is presented in „Artificial intelligence in mathematics education: A systematic literature review" (Mohamed, Hidayat, Suhaizi, Sabri, Mahmud & Baharuddin 2022). Some examples of dialogues student-ChatGPT in the field of the topic „functions" are shown in the article „ChatGPT: A revolutionary tool for teaching and learning mathematics" (Wardat, Tashtoush, Alali & Jarrah 2023). Stimulating students to ask questions and provoke mistakes can also be useful for the learning process „Students are impressed at the wrong answers of AI. They may be interested in looking for different ways to get exactly the wrong answer to see how it works. Looking for areas and reformulating questions is also a valuable skill for the student" (Pavlova 2024). In this regard, we believe that the use of artificial intelligence in the generation of mnemonic rules is useful both for memorization.

As it became clear, there are many famous mnemonic rules of different types and in different fields. However, not every teacher and student know them, and sometimes new ones have to be created. For this purpose, chatbots with artificial intelligence can help us a lot. We will show several examples generated with ChatGPT. When asked a specific question, the chatbot most often returns a certain mnemonic. We must note that the examples offered are not always new and not always appropriate. So, for example, if we ask for mnemonic rules for memorizing the multiplication table, ChatGPT provides a certain mnemonic technique (Figure 1).

ChatGPT

Certainly! When memorizing the multiplication table, especially for the 9s, you can use a clever mnemonic to remember the pattern. The "finger trick" is a classic example:

1. Hold your hands in front of you, palms facing you.
2. Assign each finger a number from 1 to 10, starting from the left thumb (1) to the right pinky (10).
3. To find the product of, for example, 9 times 7, fold down the 7th finger from the left. Count the fingers before and after the folded finger. The result is 6 (before the folded finger) and 3 (after the folded finger). So, 9 times 7 equals 63.

The mnemonic to remember this is:

**"Nine times any finger (1-10) gives a two-digit answer. The first digit is the number of fingers before the folded finger, and the second digit is the number of fingers after."

This finger trick can make it easier for students to remember the products of the 9s multiplication table.

Source: Author's own elaboration, using OpenAI 2023.
Figure 1. Example of the math tutorial

An example of the biology lesson:

ChatGPT

Certainly! In natural sciences, particularly in biology, a common mnemonic device is used to remember the classification hierarchy of living organisms. This hierarchy is often remembered using the following acronym:

D - Domain
K - Kingdom
P - Phylum
C - Class
O - Order
F - Family
G - Genus
S - Species

To remember this sequence, students often use a phrase or sentence where the first letter of each word corresponds to one of the classification levels. Here's an example:

"Dear King Philip, Come Over For Good Soup"

In this sentence, each word corresponds to the first letter of a level in the classification hierarchy. This mnemonic helps students remember the order in which these categories appear, making it easier to recall and understand the relationships between different groups of living organisms.

Source: Author's own elaboration, using OpenAI 2023.
Figure 2. Example of the biology tutorial

We tried to generate a new mnemonic. Thus, on the task "Create your own mnemonics for remembering signs of congruence of triangles", ChatGPT returned the answer from (Figure 3).

ChatGPT

Certainly! Let's create a mnemonic to remember the signs of congruence for triangles, based on the corresponding parts of congruent triangles:

"SAS Fights with ACP"

Breaking down the mnemonic:

- S: Side-Angle-Side (SAS)
- A: Angle-Side-Angle (ASA)
- S: Side-Side-Side (SSS)
- F: Fights
- W: With
- A: Angle-Side-Angle (ASA)
- C: Congruent (All parts are congruent)
- P: Parts (of congruent triangles)

This mnemonic can help you recall the criteria for congruent triangles: SAS, ASA, SSS, and the statement that all corresponding parts are congruent. Associating these terms with a memorable sentence can make it easier to remember and apply the congruence criteria.

Source: Author's own elaboration, using OpenAI 2023.
Figure 3. Example of the math tutorial

Materials and methods

There is conflicting evidence regarding the use of mnemonic techniques in learning. Gruneberg (1973) studied 142 high school graduates and found that matriculation scores did not differ between students who used mnemonics and those who did not. Stadler (Stalder 2005) introduced the study of acronyms to psychology students and found that students who studied acronyms scored much higher than those who did not. Van Voorhis (VanVoorhis 2002) observed that students who were taught using musical mnemonics remembered better than those who simply read the information. Lyubchenko and Tymoshenko (2022) came to the conclusion that mnemonics help the learning of lexical units in foreign language learning, contribute to the expansion of the vocabulary and facilitate the understanding of foreign language texts.

Undoubtedly, the effectiveness of information processing depends on the significance of the information for the learner, his mnemonic abilities and his psychological features of perception. The pedagogical talent of the teacher

and his personal qualities, enabling the creation of a positive environment and predisposition to the perception of the learning material, also have a great influence (Murashov 2021).

In connection with these studies, the idea arose to study the awareness and attitudes of modern people regarding the power of mnemonics. We conducted a survey among users of different types. The survey was implemented through Google Forms and was distributed through popular social networks before 2022. The survey is anonymous and includes 7 multiple-choice questions and one open-ended question to describe the mnemonics used by the respondent. 260 women and 41 men took part in the survey.
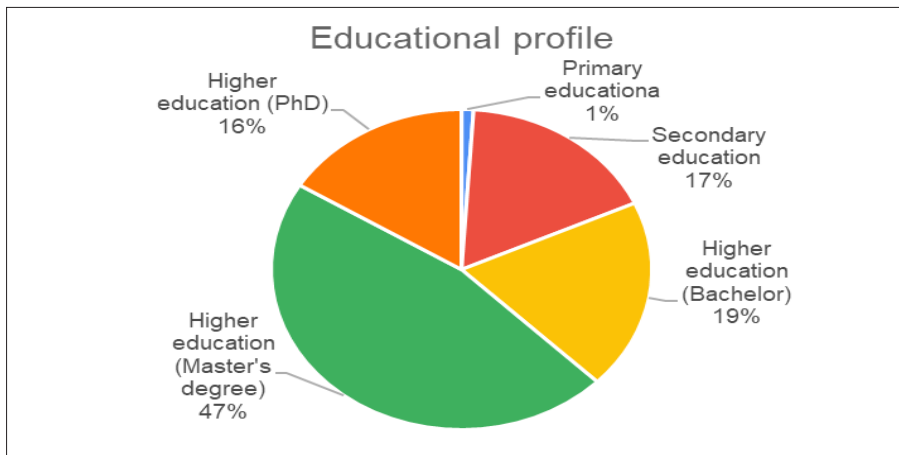
Results and analyses

The age and educational profile of the participants are presented in Figure 4 and Figure 5, respectively.
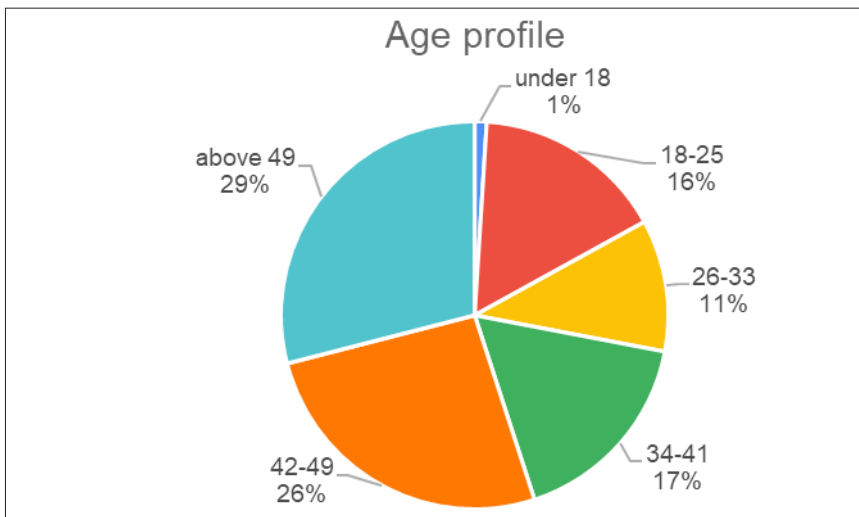
Source: Author's own elaboration.

Figure 4. Age profile of respondents

The survey is voluntary and it can be seen that people over the age of 18 are mainly interested in it. Another reason for this is that the distribution of the survey was aimed at groups of this type.
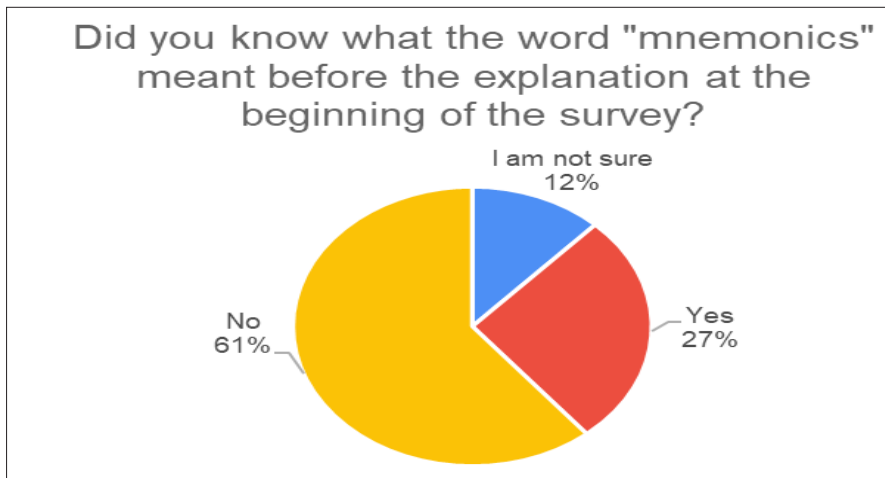
Figure 5. Educational profile of respondents

The educational status of the respondents is high – more than half of the respondents have a master's degree, and 16.6% also have a doctorate.

An interesting result is observed in terms of the terminological awareness of the respondents. Despite the high educational status, 73.1% of the participants answered that they did not know definitively what mnemonics was before the survey (Figure 6).

Figure 6. Respondents' awareness of what a mnemonic is

Although only 81 people answered categorically that they know what mnemonics are, 57.1% of respondents (172 people) answered that they have ever applied mnemonic rules to facilitate the learning of certain facts and/or algorithms, even without know what this technology is called. We can assume that the respondents applied only some mnemonic techniques and were not familiar with the methodology and their extensive application.

The original source of information about mnemonics is also different. Thus, 60 people answered that they were directed by a teacher to use mnemonic rules for learning, 25 by a parent, 61 people shared that they themselves discovered useful mnemonic rules, and 64 – invented them themselves, in the process of memorizing information.

Respondents show activity in sharing useful mnemonic rules – 51 people indicated examples. The rules given by the respondents show the effectiveness of the technique in a variety of fields that require learning. Some respondents shared methods that they invented and applied not only for educational purposes, but also for life purposes, such as remembering a phone number, name or social security number. Most of the examples that respondents offer, are in Bulgarian or describe technology that can be used for different languages, 4 are in English. Within the framework of the free response, participants shared that mnemonics are useful and it would be useful to apply them more purposefully in training.

Discussion

There are a number of interesting studies examining the use of mnemonics in education, covering a variety of educational and subject areas. Research by (McCab 2013; Soler & Ruiz 1996; Stadler 2005) shows that students after grade 8 know mnemonics but prefer to use other methods. An online survey (McCabe 2013, cited in Putnam) shows that 481 students responded that mnemonics did not show such a result as reading notes related to the material additional resources. Another study shows that only 14% of students use mnemonics in the learning process (Karpicke, Butler & Roediger 2009). According to the given studies, the most used in the learning process is word mnemonics.

Mountstephens conducted an experiment among 54 university students who had to mechanically memorize 30 words. Half of them use computer-generated mnemonics. The author's conclusion is that „Recall performance of mnemonics users was found to be significantly better than rote learners, both immediately and one week later, suggesting that the generation of mnemonics by computer is a learning technology worth developing" (Mountstephens 2020).

Conclusions

Despite disagreements in research about the effectiveness of mnemonic techniques in learning, mnemonics have a place in education, both in different subject areas and at different educational stages. The selection of the types of mnemonic rules applied in the learning process depends on the subject studied and the attitudes of the learners.

The positive impact that this type of memorization has on human health is a fact, and it follows all the more that mnemonic methods are studied and expanded and applied to a wider audience. Using ready-made mnemonic rules is useful, but creating one's own mnemonic techniques, both in the learning process and in everyday life, puts the individual on a higher level and affects important skills such as criticality, creativity and the ability to deal with practical tasks. Mnemonics are a fun method that, once mastered, allows the individual to further develop it in all forms and spheres and facilitate memorization in perspective.

NOTES

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