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DIPLOMOVÁ PRÁCE

The Effectiveness of the Mind-mapping Learning Strategy to Extend Vocabulary Knowledge among Elementary Students

Efektivita myšlenkových map jako výukové strategie pro rozšíření slovní zásoby žáků základních škol

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ABSTRAKT

Znalost slovní zásoby je důležitou součástí lingvistické kompetence. Mnoho studentů se pro rozšíření slovní zásoby učí nazpaměť seznamy slovíček metodou překladu, což může vést k tomu, že naučenou slovní zásobu student neumí použít ve větách a vhodném kontextu. Učení zpaměti je pro některé žáky monotónní. Cílem této práce je posoudit efektivitu myšlenkových map jako výukové strategie pro rozšíření slovní zásoby žáků základních škol. Výzkumu se zúčastnilo 31 žáků (15 mužů and 16 žen) ze dvou různých základních škol. Žáci vyplnili test, který zjišťoval jejich vstupní znalost slovní zásoby. Poté proběhla výuka slovní zásoby s využitím myšlenkových map. Test na konci hodiny ověřil osvojení probrané slovní zásoby. Znalost slovní zásoby byla změřena o týden až dva týdny později. Žáci vyplnili subjektivní dotazník hodnotící používání myšlenkových map pro výuku slovíček. Výsledky této práce ukázaly, že se žáci v dané slovní zásobě zlepšili. Slovní zásoba tedy byla uložena v dlouhodobé paměti žáků a žáci si byli schopni slovní zásobu ve střednědobém horizontu znovu vybavit. Výsledky dotazníku hodnoticího použití myšlenkových map navíc ukázaly, že se žáci učí slovní zásobu raději pomocí myšlenkových map než zápisem slov do slovníčků.

KLÍČOVÁ SLOVA

Citoslovce, paměť, myšlenkové mapy, slovní zásoba, učební strategie, vizualizace, výuka anglického jazyka

ABSTRACT

Knowledge of vocabulary is an essential part of linguistic competence. Many students learn English vocabulary by translation and rote memorisation of vocabulary lists, which can result in the inability to use the words in well-formed sentences and appropriate contexts. Some students may find rote memorisation monotonous. This study examines the effectiveness of using the mind-map learning strategy to extend English vocabulary. Thirty-one elementary school students (15 men and 16 women) from two different elementary schools completed a short test before vocabulary instruction to obtain baseline data. Vocabulary instruction with the use of mind maps learning strategy followed. The recall was measured at the end of the lesson and one to two weeks after vocabulary instruction. A subjective assessment of the mind map learning strategy to learn vocabulary was taken. The results show that the knowledge of vocabulary items improved compared with the baseline. Moreover, students retained similar knowledge even after one to two weeks. New information was moved to the long-term memory of the students. Students were able to recall vocabulary from a medium-term perspective. Subjective assessment of the learning strategy showed that students enjoy learning vocabulary with mind maps more than writing vocabulary lists.

KEYWORDS

English language teaching, interjections, memory, mind maps, learning strategy, visualisation, vocabulary

The List of Abbreviations

BOI	Basic Ordering Ideas
ISO	International School Olomouc
MM	Mind-mapping
PPDI	Pretest-Posttest-Difference Index

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1 Introduction

There is a significant need to move away from the traditional teacher-centred educational approach and increase the implementation of an active student-centred learning environment. Teaching vocabulary is a major part of the teacher's art, and students need to see words in the context to see how they are used (Harmer, 2015). Gillies (2017) describes a mind map as a way of organising information on a piece of paper. Budd (2004) defines a mind map as a graphic organiser in which the major categories radiate from a central image and lesser categories are portrayed as branches of larger branches. Buzan (2000) promotes MM as a tool to generate ideas, take notes, develop concepts, and improve memory. Mind mapping is a way to facilitate access to knowledge and retrieval through visual evidence such as pictures, arrows and colours and visualisation and contextual knowledge enhance the possibility of longer vocabulary retention (Buzan, 2000). Using mind maps in language classrooms is an innovative technique to facilitate comprehensive vocabulary knowledge of elementary students. AlSaleem (2019) highlights four significant advantages of mind mapping (MM): structure, personalisation, creativity and motivation. Mind mapping allows students to be active learners and take ownership of their learning, which aligns with the cognitive approach in language learning. Belkhir (2020) describes cognition in language study; it concerns the acquisition, storage, transformation and use of knowledge. In terms of vocabulary instruction, study Al-Jarf (2015) presented how MM software can be used in categorising and classifying lexical items based on morphological, syntactic, phonic or semantic concepts. Study Luangkrajang (2022) investigated opinions and information retention of 93 students, and it revealed that MM techniques helped to increase knowledge and understanding of vocabulary and grammatical comprehension. In addition, using MM activities resulted in the developing affective domain among students. It developed collaborative, creative, critical thinking and organisational skills in the participants. Many students in this study enjoyed mind mapping and the creative process behind it. Study Heidiri and Karimi (2015) explored that teaching English vocabulary using mind maps could help students outperform students who learn vocabulary through the traditional way (translation) in a medium-term perspective (on delayed post-test). However, Li, Yang & Chen (2010) point out that using mind maps in language instruction might not be optimal for each student

because students have different learning styles. This diploma thesis examines the effectiveness of using the mind-map learning strategy to extend English vocabulary in elementary students. The opinions of students on the MM learning strategy were also analysed.

2 Human Brain

The human brain will be described in terms of its components and information transmission to understand the learning process.

Roger Wolcott Sperry, an American neurologist, won the Nobel Prize in Physiology and Medicine in 1981. Sperry (1961) researched the human brain's components and functions. He found out that the parts of the two hemispheres are different. The brain's right hemisphere has centres responsible for specific skills: rhythm, spatial awareness, imagination, Gestalt (whole picture), daydreaming, colour, and dimension. In other words, the right hemisphere is the source of creativity. The left hemisphere of our brain deals with words, logic, numbers, sequence, linearity, analysis, judgment, reasoning, and lists (Sperry, 1961). The mental skills are distributed throughout the cortex, and each hemisphere is dominant in certain activities. It means that while the left cortex is engaged in the activities connected with logic, the right cortex is more in the resting state, ready to assist. It is essential to mention that the hemispheres always work together; for example, the brain's left hemisphere undertakes logical thinking, while the right hemisphere stores information regarding images and symbols (Buzan & Buzan, 2000; Sperry, 1961).

The branches of the brain cell are called dendrites. Axon is the main exit for information transmitted by the cells. When an electric impulse travels through the brain cell, chemicals fill the space between the synaptic boutons, called the synaptic gap. The urge travels through the receiving brain cell and causes a cascade of biochemical information. A brain cell may receive incoming pulses from hundreds of thousands of connecting points every second. A biochemical electromagnetic pathway is established as a given message is passed from a brain cell to a brain cell. Each neuronal pathway is known as a memory trace (Buzan & Buzan, 2000).

Over the past years, cognitive neuroscience has emerged as an essential branch of neuroscience. Cognitive neuroscience combines the experimental strategies of cognitive psychology with various neurology techniques to examine how brain functions support mental activities. The techniques used are positron emission tomography: Functional

magnetic resonance imaging, or optical imaging with near-infrared spectroscopy (Raichle, 2008).

It has been calculated that in the last 15 years, we have accumulated as much as 95 per cent of all information ever gathered about the human brain. The human brain has five primary functions – receiving, holding, analysing, outputting, and controlling (Buzan & Buzan, 2000):

- Receiving - Receiving information and stimuli
- Holding – Human memory, including retention (the ability to store information) and recall (the ability to access stored information)
- Analysing – Pattern-recognition and information-processing
- Outputting – Any form of communication or creative act, including thinking
- Controlling – Referring to all mental and physical functions

These five functions all reinforce each other. For example, having received information efficiently, it is easier to hold and analyse it. Conversely, efficient holding and analysis will increase the ability to receive information. Similarly, analysis which involves a complete array of information-processing tasks requires an ability hold. The quality of the analysis is affected by the ability to receive and hold the information. The first three functions converge into the fourth – the outputting, which a mind map, speech, gesture or writing can express. The fifth category refers to the ability to monitor what was received, held, analysed, and expressed (Buzan & Buzan, 2000).

3 Memory

Memory plays a vital role in the process of learning. The following chapter provides a brief overview of psychological theories of human memory.

Cognitive psychologists described the basic process of memory mechanism in three steps (Baddeley, 2003):

- Input (encoding into memory)
- Storage
- Output (information retrieval)

The traditional model of memory is based on time retention: Short-term, long-term, and permanent memory. Short-term memory can store a small amount of information in mind and keep it available for a short period. Long-term memory is the most significant component of the memory system. Information enters long-term memory through short-term memory. It has been estimated that long-term memory records as many as one quadrillion separate bits of information. The commonly cited total is seven items that can be remembered in the order of seconds (Loftus, 1998).

Information that comes through the senses is stored in sensory memory for a few seconds or milliseconds. Another distinction of human memory is based on the type of information input. Sensory memory stores stimuli from our senses: visual (iconic), aural (echoic) and tactile (haptic) memory. Visual memory is the storage of images. Visual stimulus proceeds through the visual system and sensory memory hold this image. The image lasts briefly in the memory, and unless it enters short term-memory or long-term memory, it is lost. Visual memory can be described as a photographic memory. Sensory memory holds information that people pick up with their senses (Loftus, 1998).

Transferring information from short-term to long-term memory requires repetition and practice, the best timing for repetition will be dicussed in Chapter 3.5 Forgetting. Buzan and Harrison (2007) point out that with each period of recall, students are not only revisiting the information that they have learned but the more information is revised, the more it is linked to other information and knowledge that students already retain. (Buzan & Harrison, 2007)

Every experience or impression a child remembers in the long term must first pass through the ultra-short-term and short-term stages of memory. Only then is information stored in long-term memory. There is already much knowledge about what happens at these levels of memory (Vester, 1997).

3.1 Ultra-short-term Memory

Ultra-short-term memory is the first stage of selective control. All sensations, impressions, ideas and impulses, i.e. information received by sight, hearing or skin, first circulated in the form of electrical impulses and vibrations through our brain. The received information is

stored or forgotten. This information is stored in three storage stages of varying lengths of time. After ten to twenty seconds, this information is lost. If we do not pay attention to them, or if they do not take hold of already acquired thought combinations, this information disappears unnoticed, just like, for example, the sounds of the street or the sounds of a foreign language. Ultra-short-term memory only considers them necessary to store (Vester, 1997).

3.2 Short-term Memory

New insights are saved from complete erasure if there is a certain resonance with an already existing memory or if we recall (repeat) it within a few seconds and thus recognise it as an important store (Vester, 1997).

The transition from ultra-short memory to short-term memory is like a filter. The filter has an important function: It protects us from being overloaded with too much information and thus makes it easier for us to navigate. We can also consciously evoke associations or knowledge to capture fleeting impressions and recall them later as memories. One important letter or word to the topic can evoke various associations. People remember some unimportant details for years because they resonated with us with a corresponding association pattern store (Vester, 1997).

We can forget important events or information to which we paid increased attention or which had a deeper meaning for us and which we consciously processed. Thus, even strong impressions that have definitely left the ultra-short memory, and thus the phase of electric ion currents, can be completely cancelled once more. Such cancellation is imminent until the knowledge has been stored in a long-term memory store (Vester, 1997).

3.3 Long-term Memory

The memory of older people sheds light on some principles of long-term memory. An older person (90 years old) can vividly describe memories from the last century as if they happened yesterday. However, if we ask an older person about yesterday's events, he becomes confused. The information stored in the memory of the previous day has disappeared. Events from years ago have been hard-coded and can therefore be recalled. The previous day's

events probably entered only the ultra-short-term or short-term memory and were erased independently of the state of physical condition and intelligence. The reason for this is the worse ability of the synthesis of proteins with increasing age. The ability that requires a quick reaction to the amount of simultaneously received information (fluid cognitive performance) decreases from age thirty (Vester, 1997). Buzan (2007) reported that mind-mapping exercises and activities are for foreign language learners' vocabulary acquisition because the strategy helps learners send the newly acquired words to their long-term memory with a stronger association and more dependable retrieval links.

3.4 Memory Principles

Buzan and Buzan (2000) claim that research has shown that during the learning process, the human brain primarily remembers:

- Items from the beginning of the learning period (the primacy effect) and items from the end of the period (the recency effect).
- Items associated with things or patterns already stored or linked to other aspects of what is being learned.
- Any items emphasised as being in some way outstanding or unique.
- Any items which appeal particularly strongly to any of the five senses.
- Those items are of particular interest to the person.

Buzan and Harrison (2007) describe the Ten Memory Principles, which help to recall information efficiently. The Ten Memory Principles are designed to reinforce the strength of the impact of imagination and association on memory and to trigger the involvement of the brain as much as possible. The principles use every aspect of the human mind.

According to Buzan and Harrison (2007), The Ten Core Memory Principles are:

1. Senses
2. Exaggeration
3. Rhythm and movement
4. Colour
5. Numbers
6. Symbols
7. Order and patterns
8. Attraction
9. Laughter
10. Positive thinking

The senses reinforce the ability to remember and be able to recall information when it is needed. People should visualise, hear, taste, smell, feel or sense the things they are trying to learn. People should become more sensitive to the information they receive to remember more. The second principle is an exaggeration. The more exaggerated images are, in size, shape, and sound, the better people can remember them. Rhythm and movement add to the potential for something to be remembered easily, new associations are made, and imagination connects the items so they are recalled simultaneously. Images can move, and words can rhyme. Colours also stimulate our visual senses. Colours should be used in notes and drawings to enjoy the experience of seeing and to improve memory. Another important principle that aids human memory is numbers that bring order to information and make it more specific. Symbols can also aid memory because they simplify and structure information and trigger the imagination. Symbols represent something more significant than the image itself. As was mentioned earlier, ordering thoughts or putting them in the right sequence helps to memorise items more quickly and over an extended period. Items can be ordered in terms of location, size, and time. Another important aspect of human memory is remembering an attractive image more readily than an unattractive one. Therefore, using imagination to include attractive, positive images and associations is better. In connection with that, laughter helps us to enjoy thinking about what we want to remember, and thus it is easier to summon up information. Humour, absurdity, and a sense of fun should be included to enhance the ability to remember and recall. Finally, the Core Memory Principle is positive thinking. The brain tends to remember positive things that make people feel good about life and their experiences. Negative associations and experiences are more likely to be

blocked or modified by our brains. If people think positively, their imagination and associations will have more positive power. Thus, recalling positive images and experiences is easier than negative ones (Buzan & Harrison, 2007).

3.5 Forgetting

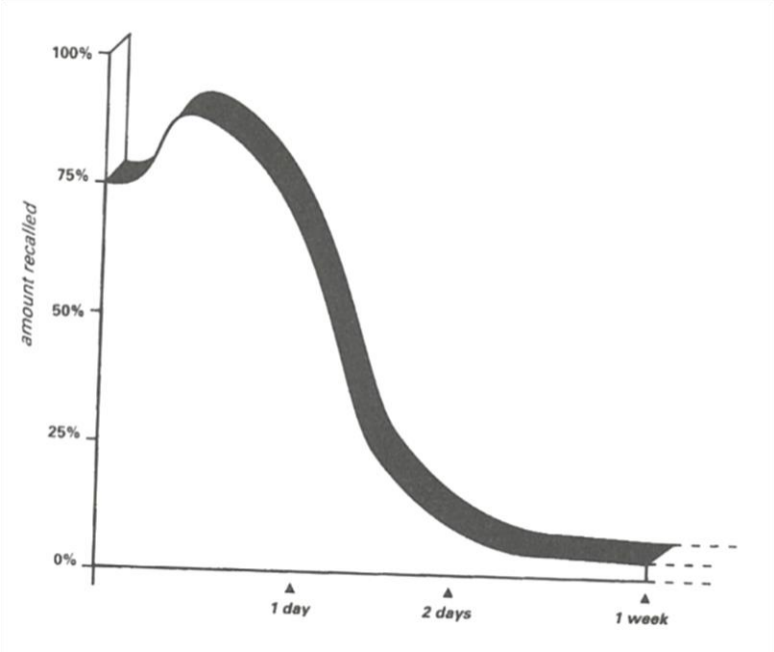
Forgetting is due to not finding the connections to the information stored in mind. If the information is processed at a deep and meaningful level, it is much easier to retrieve it when needed. The more paths between ideas, the greater chance to recall a word when necessary. In the levels of processing, the deeper the level at which an item is processed, the better the memory because the memory trace is more integrated (Schunk, 2012). Schunk (2012) describes that memorising English vocabulary, for instance, remembering only the spelling and the meaning, causes the lexical item to be quickly forgotten. The deeper we process the information we receive through our senses, the longer it will stay in our memory. It can explain why students can spend much time memorising vocabulary and still not have satisfactory results, for example, retrieving the vocabulary when necessary. Forming associations between bits of knowledge helps to facilitate vocabulary acquisition and storage in memory. Additionally, organising material into a central topic and subtopics improves memory because items are systematically linked (Schunk, 2012).

The different nature of short-term and long-term memory means that we do not always forget in the same way. Vester (1997) describes two types of forgetting: irreversible (permanent, associated with the loss of information in ultra-short-term memory or the breakdown of the RNA matrix in short-term memory), or in other words, forgetting of information that did not enter long-term memory. The second type of forgetting is losing information when we cannot recall information or learned material. The so-called sudden forgetting of the concepts "on the tip of my tongue" is due to interference (disruption of the reception of information in the brain due to the influence of the reception of other perceptions). Erasure from long-term memory does not have to be a chemical or energetic process. Breakdowns can occur on a stress-based basis. These experiences can disable entire groups of synapses, i.e. by blocking nerve fibres, i.e. interfering with transmitter substances (transmitter

substances ensure the transmission of information from cell to cell). Although such forgetting is unpleasant, it is important for our psychological balance (Vester, 1997).

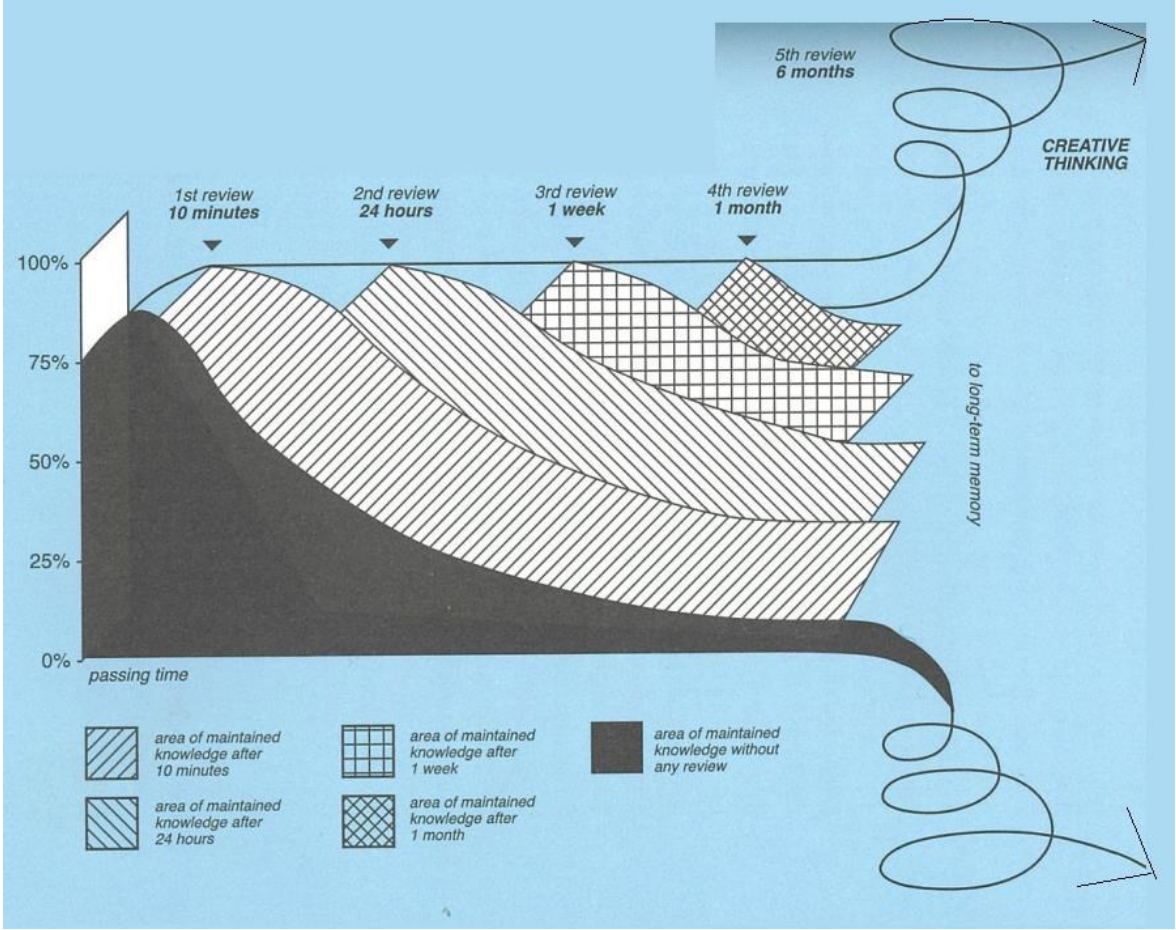
When learning, we remember the information we experience intensively and store it in our memory. If we do not use the material, when we only read or listen to the material, the memorisation is much smaller. That is why it is important to repeat each new piece of information. Furthermore, our brain connects information with already stored knowledge. This long-term potentiation, therefore, takes place in a part of the large brain (hippocampus) or the temporal lobes, i.e., in a part of the limbic system. Only these parts can combine ideas and limbic sensations and thus at least partially replace the true experience, in which other sensory organs such as sight, smell, touch, hearing and taste otherwise participate. Information received by one sensory organ must be processed as information perceived by more senses and experienced. At the same time, there is a purposeful change in the structures of synaptic connections and further construction of the neuronal network. At the same time, the way is prepared for recalling information later: The more associations correspond to associations, the less it is necessary to study a certain material or to recall it laboriously from long-term memory (Vester, 1997).

One of the least understood aspects of memory and learning is what we recall immediately after learning. After being lectured for one hour, recall goes down very quickly in five days. However, recall rises after learning because the brain needs time to integrate knowledge and create associations. The following graph (Buzan & Buzan, 2000) shows how human recall rises for a short while after learning and then falls steeply (80 per cent of detail forgotten within 24 hours) (Buzan & Buzan, 2000).



Picture 1: Human recall a short while after reading (Buzan & Buzan, 2000)

As was already mentioned, new information is stored in short-term memory. Repetition has to take place to transfer information to long-term memory. On average, students must repeat an action or information at least five times before it is transferred to long-term memory. The following picture shows how quickly forgetting occurs after learning and reviewing something. Reviews move the pieces of information to long-term memory. After a new piece of information is moved to long-term memory, it can be used creatively.



Picture 2: Timing of review and the amount of maintained knowledge without it (Buzan & Buzan, 2000)

Picture 2 shows that a piece of information should be first reviewed shortly after it was learnt (after 10 minutes), a second review should take place after 24 hours, a third review after one week, and a fourth review after one month. After that, the piece of information stays in long-term memory and can be easily retrieved from it and used creatively. If there is no review within 24 hours, students forget as much as 60% of the information (Buzan & Buzan, 2000).

4 Vocabulary Instruction

Scrivener (1994) contrasts vocabulary and grammar. He claims that vocabulary is a powerful carrier of meaning. The accumulative effect of individual words can communicate meaning. Even though the speaker avoids grammar, the vocabulary conveys the meaning alone. Scrivener (1994) provides an example: "*Yesterday. Go disco. And friend. Dancing."* Scrivener further provides an example to illustrate the importance of vocabulary in contrast with grammar. "*I wonder if you could lend me your …"* means nothing without a word to fill the gap, whereas the missing word – *calculator* – can communicate the intended message: "*Calculator?"* On the other hand, knowing the meaning of many words does not mean that the speaker can use the words in well-formed sentences and communicate meaning effectively (Scrivener, 1994).

English vocabulary learning constitutes an essential part of English teaching and learning. It influences performances in writing and speaking; it impacts the accuracy and fluency in productive skills. Additionally, knowing vocabulary helps to understand the meaning while listening and reading. It means that vocabulary is integral to productive and receptive skills (Wang & Dostal, 2018). According to Heilman, Blair, and Rupley (2000), vocabulary knowledge is mainly associated with effective reading. Vocabulary instruction should be thought of as teaching about the interconnectedness of ideas and concepts indexed by words (Scrivener, 1994).

Scrivener (1994) calls for a systematic approach to help learners at each stage of learning vocabulary. When the learners:

1. Meet new words and understand their meaning and how they are used.
2. Practice using the words.
3. Find ways that help the learners memorise the words.
4. Recall and use the words appropriately.

Cronbach (1942) describes four skills in terms of vocabulary knowledge: 1. Generalisations - the ability to define a word, 2. breadth - the knowledge of synonyms and multiple meanings of the words, 3. application - selecting an appropriate use of the word, 4. precision - the ability to apply a term correctly (Conbach, 1942).

Scrivener (1994) distinguishes between productive and receptive vocabulary. Productive vocabulary constitutes active vocabulary storage (Scrivener, 1994). Receptive vocabulary is the set of words that the learners recognise and understand but tend not to use themselves.

Buzan & Harrison (2007) present productive and receptive vocabulary data. The average person's spoken vocabulary is about 1000 words. The number of available words is over 3,000,000. In writing, people use more varied vocabulary. However, the largest number of words is called receptive vocabulary. Receptive vocabulary denotes the words we recognise but is not used actively in writing or speaking. It is possible to increase the size of the three groups. Language teaching aims to teach the students to use words actively; for example, to increase active vocabulary, students should know pre/fixes and suffixes and add them to word roots (Buzan & Harrison, 2007).

4.1 Interjections

Opinions vary on how interjections should be defined. The following basic descriptions of interjections illustrate how similarly they were defined across the ages despite the controversy surrounding them (Stange, 2016).

pars orationis siginificans mentis affectum uoce incondita
(Donatus, 2008: 122, original text from the 4th c. AD)

a part undeclynyd the which under a rude voice betokeneth some passion of the mynde
(Linacre, 1512)

a word or sound thrown into the sentence to express some feeling of the mind
(Crystal, 1999, s. 206)

an exclamatory insert used in speech to express emotion or attitude
(Biber, Conrad & Leech, 2005, s. 457)

A common denominator of the definitions is that interjections are emotive exclamations assigned to the spoken domain. Biber et al. use the term insert because interjections do not form an integral part of a syntactic structure (Biber et al., 2005). Most interjections would be placed at the periphery of language (Norrick, 2011).

Duškova (2003) describes interjections as indeclinable words that differ significantly from other parts of speech in terms of formality and meaning. Primary interjections are mostly monosyllabic and often contain sounds or combinations of sounds that do not otherwise occur in the respective language, e.g. in English, the bilabial fricative ɸ in the word ***pshaw*** [pɸː], [pʃɔː], [ʃɔː] (an expression of contempt or impatience), long consonants, e.g. ***hush*** [ʃː], [hʌʃ], a snapping sound transliterated ***tut*** (also pronounced according to the spelling [tʌt] (an expression of impatience, contempt, rebuke), in Czech *brr, au, jé*. Secondarily, other parts of speech pass into interjections, e.g. ***For the lord the king! Dear me! For the lord! Heavens!*** (Expression of surprise, astonishment, impatience) or ***Why!*** (Expression of surprise, protest) (Dušková, 2003).

Syntactically, interjections are characterised by the fact that, if they occur in a sentence, they are not syntactically related to any of its members, e.g., ***Oh dear, what a mess!*** In English, they often occur as an initial element of speech that begins a speech, e.g., ***Ah****, you're back.* Other times, interjections are used independently in the validity of an exclamatory clause (Dušková, 2003).

The meaning of interjections is quite vague and dependent on context and intonation. They generally have little communicative value. They express the speaker's moods and feelings, e.g. ***oh*** [əʊ] (surprise, fear), ***ah*** [aː] (surprise, satisfaction, regret), ***aha*** [əˈhɑː] (satisfaction, triumph), ***oho*** [əʊˈhəʊ] (surprise, triumph), ***phew*** [ɸː], [fjuː] (astonishment, impatience, disgust), ***ugh*** [ʌx], [ʊx], [uːx] (disgust), ***ouch*** [aʊtʃ], ***ow*** [aʊ] (pain), ***bravo*** [ˈbrɑːˈvəʊ] (appreciation) (Dušková, 2003).

Other interjections address the audience (interjections with an appeal or contact function). The speaker wants to draw attention to himself or to provoke some other reaction in the addressee, e.g. ***hey*** [heɪ] (also a surprise or questioning expression), hullo [ˈhʌˈləʊ], [hʌˈləʊ]

haló (also to express surprise), ahoy [əˈhɔɪ] - a sailor's salute or warning, ***hush*** [ʃː], [hʌʃ] (impolite request for silence), ***eh?*** [eɪ] ***what?*** (Impolite request for repetition). Some interjections substitute agreement ***uh-huh***, ***mm*** or disagreement ***uh-uh*** or serve as a filler in speech, e.g. ***well***, ***ahem*** [əˈhem], ***er*** (hesitation) (Dušková, 2003).

Finally, interjections are sound-painting (onomatopoeic) words that imitate different sounds, e.g. ***miaow*** [mi(ː)ˈaʊ], ***mew*** [mjuː], ***cock-a-doodle-doo*** [ˌkɒkəˌduːdəlˈduː], ***bang boom***, ***splash*** *(in Czech žbluňk)*, ***crash*** (Cz: prásk), ***tick-tock*** (Cz: tik-tak). In contrast to Czech, where these interjections can have the function of a sentence member, most often a predicate, in English, they change to the appropriate part of speech and take on all its formal features: The frog **splash<u>ed</u>** into the pond. Cz: Žába žbluňk do rybníku (Dušková, 2003).

Interjections predominantly serve as reflex-like expressions of emotions, lacking syntactic integration into utterances. Interjections are generally seen as spontaneous verbal expressions in reaction to a certain event or stimulus. Despite an increasing interest in this particular linguistic phenomenon, interjections still require a consensual definition (Stange, 2016). Stange (2016) points out that interjections do not get so much attention in linguistics due to their controversy in terms of violating phonotactic constraints (*Psst!* has no vocalic nucleus), potentially containing extra-linguistic sounds (for instance, the sequence of post-alveolar clics found in tut-tut!).

Norrick (2011) suggests that the confusion and disagreement in the definition of interjections are due to unsubstantiated claims based on intuitions without real evidence and a failure to recognise the difference between spoken and written discourse. Some interjections are only natural signs of our mental notions, or passions, expressed by sounds, several of which are common with many animals. Animals express their desires through sounds that are not found in human speech (thus, the use of interjections by humans and the use of certain sounds by animals are said to be on the same extra-linguistic level (non-speech sounds) (Norrick, 2011).

Interjections are closely linked to gestures and body reflexes. As a result, a wide chasm exists between the meaning of interjections as represented in theoretical accounts based on introspection and the actual range of functions in which speakers use them. For example, the expression *Ow!* can refer to pain of various nature (experienced pain, imaginary pain,

anticipated pain, and it can also be used to refer to someone else's pain – real, imaginary or anticipated). Additionally, it is also possible to produce *Ow!* or *Ouch!* to express sympathy upon hearing unpleasant stories. As can be seen, interjections are multifaced in their range of functions (Wilkins, 1992).

Our research focused on the use of selected emotive interjections (*phew, yikes, gee, ouch)* and interjection describing sounds *(pow, wham)* as described in the empirical part of this study (chapter 7.2). The topic of interjections is usually not included in students´ books, and it is usually not part of English curricula at elementary or secondary schools.

5 Mind-maps

Mind maps are an associated network of images and information (Buzan & Harrison, 2007).

Anthony Peter Buzan[1] popularised mind mapping as a technique used for a wide spectrum of activities in education, team building, or time management. Mind mapping is a technique for ordering and structuring the thinking process. The thinking process mirrors the mind-mapping process; thus, understanding the thinking process helps us understand mind-mapping from the inside. (Buzan & Buzan, 2000; Buzan & Buzan, 1993; Wang & Dostal, 2018).

Mind maps help to manage information effectively and increase the potential for personal success. Mind mapping can be used for efficient note-taking, note-making, preparing for essays and examinations, learning vocabulary, the development of creative thinking, and writing. Mind mapping is also a dynamic and organic revision tool, tie manager and memory stimulator. Mind maps are particularly adaptive for reading and planning for exams efficiently. They are invaluable for gathering and ordering information and for identifying the key trigger words and facts in textbooks, books, lectures, tutorials, and the mind-mapper own mind (Buzan & Harrison, 2007).

Mind maps are a graphic, networked method of storing, organising and prioritising information using a key or trigger words and images, each encouraging new thoughts and ideas. It can be done on paper or electronically. Buzan and Harrison (2007) claim that the mind-map effectiveness lies in its dynamic shape and form. It is drawn in the shape and form

of a brain cell and is designed to encourage a brain to work quickly, efficiently and in the style it does naturally. Mind maps illustrate the thinking process (Buzan & Harrison, 2007).

5.1 Application of the Mind-map in Vocabulary Instruction

Liu (2016) describes several paths for MM to apply in English Vocabulary teaching. Teachers can make mind maps and teach students to learn from them. Liu (2016) argues that teachers can undertake the main task of making mind maps because they can explicitly note the logical relationship between vocabulary and not mislead students; for example, teachers should pay special attention to the distinction of logical relationships between words and expressions that form min maps. The second option described by Liu (2016) for applying mind maps to vocabulary teaching is to encourage students to make mind maps. In this second approach, students play an active role in language teaching. Teachers can guide the students to make mind maps (Liu, 2016). Al-Jarf (2011) used mind-mapping software to help college students improve their spelling and pronunciation skills. He found out that i was effective to integrate mind mapping into English as a Foreign Language courses to help students discriminate different pronunciations of vowels, digraphs, double consonants, homographs or elision. The study showed that MM software could be used for reviewing phonic rules.

The application of the MM in vocabulary instruction starts as follows: A key concept has to be determined first. The keyword or a picture is positioned in the centre of the mind map. It is the topic discussed and the concept which will be learnt. Then, the first level of branches radiates from the word. Arrows connect the associations to the keyword in the centre of a mind map. Several branches are formed by linking the central word and the first level of subordinate words. Then, the second level of subtopics is introduced from the first level of subordinate topics. The second level of branches are associations of first-level words. Words are connected with lines to the respective associations. In this way, a mind map can contain [1]a central word/picture and infinite sub-centred words. The sub-central words are called nodes. Mind maps are characterised by a hierarchical structure which reflects the character

[1] Anthony Buzan, known as Tony Buzan, is the world's leading author and lecturer on this topic. He advises governments, businesses, universities, and schools on the brain, learning, and thinking skills. His brother Barry Buzan, Professor of International Studies at the Westminster University London and Research Director at the University of Copenhagen, focuses in his research on the gap between thinking and writing.

of logical thinking. In constructing a mind map, students use divergent thinking to develop subtopics. The process helps us to organise the knowledge visually under certain sub-topics. Secondly, a mind map incorporates words, colours, images and graphics, which make it easier to remember given items. It is a visual map and a thinking tool. Mind mapping activates the right hemisphere of the brain, thus improving memory. Associations are the major factor in improving memory, understanding, and creativity (Wang & Dostal, 2018).

Concerning English vocabulary acquisition, teachers can use mind maps to visualise the learning process as the mind map grows. Mind maps help to gather the immediate and current state of knowledge on areas of interest. It also helps to organise knowledge to facilitate understanding and memorising. Teachers and students classify vocabulary and get a deeper understanding of the words and the relationship among them. Mind mapping can help improve teaching and learning efficiency compared to rote memorisation. In addition, mind maps can also be used as a tool for assessment by asking the students to create a mind map about a certain topic, so the teacher can understand the way students think about a certain topic and evaluate the vocabulary level. Mind maps can facilitate active student-centred learning. Reviewing the old and new vocabulary and finding their relationship is also beneficial, which helps form a knowledge network and make the knowledge structure systematic. Students can also use mind maps for summarising individual knowledge structures (Wang & Dostal, 2018).

To control and apply vast mental power, students need to structure their thoughts, and mind-map help them to show hierarchy and lexical relations. Buzan and Buzan (2000) highlight the position of the Key concepts within which a host of other concepts can be organised. Mind maps are based on a hierarchy and classification of information. A mind map is composed of a central topic and several branches. The branches are associated with the central topic. It can be seen as a radiating graph and structure that represents how we think and illustrates the relationships among areas of knowledge. The mind map helps to memorise the given items better because it implies a hierarchy of words. **Generalisations and subordination** are the key semantic links included in mind maps. The mind maps take advantage of the existing logical relationship between the target information. It is recommended to use arrows to outline connections within and across the branching patterns

in mind maps to represent some connections between certain images or words. (Buzan & Buzan, 2000). The importance of hierarchies in aiding the learning process is described in the study by Bower et al. (1969). In this experiment, the subjects were divided into two groups. Each group was shown four cards, with 28 words written on each card. The people in Group 1 were shown words organised hierarchically. The people in Group 2 were shown the same words. The results of this study showed that the people in Group 1 could recall more words than those in Group 2 (Bower et al., 1969).

5.1.1 Keywords and Key Images

Buzan & Harrison (2007) explain that a keyword is a special word chosen or created to become a unique reference point for something important. Words stimulate the left side of the brain and are vital components of mastering memory, but they are not as powerful on their own as when accompanied by a picture forming a key image. An effective key image will stimulate both sides of the brain and draw upon all the senses. The word on its own usually does not trigger recall of targeted information. A picture triggers more associations than a word. Human imagination is stimulated more by pictures than individual words. A word as a part of a sentence will not trigger the entire experience either because a sentence defines and limits it. The purpose of a keyword that has been transformed into a Key Image allows connecting with both the left-brain and the right-brain functions. This action will radiate connections and trigger the recall of complete associated information. Keywords and their context are vitally important to aid memory and help to establish the network inside the mind. The crucial element is the selection of appropriate keywords and key images that encapsulate the subject matter's essence. The keywords provide the source and frame for the creative process of associations. Buzan & Harrison (2007) further describe that mind mapping is a study technique in which information from a variety of sources is converted into a diagrammatic representation of the important keywords associated with the study topic. During production, an image representing the main study topic is initially drawn in the centre of the mind map. As students build up mind maps, their brain creates an integrated map of the whole topic.

5.2 Visualisation

Visualisation is a means of enabling detailed information to be understood quickly. It is a way of transferring abstract information to factual content. Knowledge visualisation is done through graphic organisers. Representations of visualisations are images, graphics, maps, animations, use of colours (Eppler & Burkard, 2004). Cognitive psychological studies found that visualisations help to remember information faster. Nowadays, visualisation plays an important role in teaching practice. It is used in mathematics, physics, chemistry, and biology. A mind map is a visual representation because it incorporates colourful images, pictures, graphics, and proxemics. It enables us to represent knowledge in a visual format. The concept of using the mind map in the education process is supported by the theory of knowledge visualisation (Wang & Dostal, 2018).

Buzan's theory emphasises the role of a **central image** instead of a central word. Combining images and words results in combining the two cortical skills of our brain, which multiply the intellectual power of an individual. Mind mapping uses the full range of cortical skills – word, image, logic, colour, and spatial awareness. A more significant proportion of the centres in our brain is used when we learn vocabulary with mind maps, including pictures (Buzan & Buzan, 2000).

The central image helps to attract attention to the core concept or connecting idea. Using images is recommended throughout mind maps because images attract eyes and drawing works as a memory aid. Using images wherever possible gives all the benefits, such as creating and stimulating balance between the visual and linguistic cortical skills and improving visual perception. The brain's right hemisphere controls images, colour, space and music. It is a source of creativity. However, most people are accustomed to logical thinking instead of thinking in images. Thus, for most people, the potential of the brain's right hemisphere is not fully developed and the mind map is a visual map that helps activate the brain's right hemisphere using colours, images and graphics. It is a method that brings the power of two hemispheres together. The synergy of the two hemispheres in learning can improve learning efficiency (Wang & Dostal, 2018).

The human brain works via senses by creating associations between images, colours, keywords, and ideas. Imagination and associations form memory traces. Imagination and

Associations are stimulated mainly when people use their senses, exaggeration, rhythm and movement, colour, laughter, pictures, numbers, words, symbols, order and patterns. In addition, people are attracted to something that makes them feel good and enjoy. Mind maps should be positive representations of things, plans or events; it should be attractive to look at them. A mind map that includes these important factors will encourage the brain to associate, link and connect the information more creatively than regular note-taking. A mind map triggers associations in the brain that help the brain to revise ideas efficiently (Buzan & Harrison, 2007).

5.3 Contextualisation

The mind mapping method can help to present vocabulary in a logical and related matrix because each related idea is mapped with a line from an already mapped related idea. An interesting implication of this process is that mind maps are infinite because every keyword or image added to a mind map itself adds the possibility of a new and greater range of associations, which themselves add the possibilities of new and greater ranges. The process of mind mapping encourages a continuous and potentially endless flow of thought. With mind maps, each new piece of information students add to a mind map gets connected to the information they already know. Therefore, the more students know, the easier it is to learn. By contrast, vocabulary lists directly oppose the workings of the mind in that they generate an idea and then deliberately cut it off from the ideas preceding and following it (Buzan & Buzan, 2000).

5.4 The Process of Vocabulary Mind-mapping

Mind mapping needs some planning to be successful. The first step is to realise what the goal is and what the sub-goals are. The goals of MM in general can be to plan a study project, brainstorm ideas, prepare an essay, note-take a lecture or learn vocabulary connected to a specific topic. A picture in the centre represents the goal or topic; the first step is to draw a picture in the centre of the mind map (Buzan & Buzan, 2000).

A structure is needed for the mind map. The next step is to decide on the Basic Ordering Ideas (BOIs). BOIs are the “hooks” on which to hang all associated ideas. BOIs represent the chapter headings of the thoughts: the words or images representing the simplest and most

apparent categories of information. BOIs are the words that will automatically attract the brain to think of the most significant number of associations. Sometimes it can be complicated what the BOIs should be. Therefore, the mind mapper or a teacher can ask simple questions, for example:

- What knowledge is required to achieve my aim?
- What are the five most important categories in this idea?
- Why? What? Where? Who? Which? When? How?
- What are my specific objectives?
- If this were a book, what would its chapter headings be?
- What is a larger or more encompassing category into which these fit?

(Buzan & Buzan, 2000)

Alternatively, mind mappers can write down several words or images that spring to their mind and then ask themselves which can be combined under more general headings to discover primary BOIs.

The advantages of having good BOIs are that the primary ideas are closer to the key concept, and secondary ideas follow naturally from them. Another advantage is that the BOIs shape the mind map and encourage the mind to think in a naturally structured way (Buzan & Harrison, 2007).

As mentioned, the mind mapper starts with a central image and a central word. The first BOI is a word connected to the central image or central word, and then a spray of associations emerges. To illustrate this process, Buzan and Buzan (2000) give an example of creating a mind map on the central theme of happiness. The First BOI that comes to the interpreter's mind is ACTIVITIES, and then a quick spray of associations follows: a sailing boat, sharing, running. The words radiate from the idea of activities. Then the mind mapper writes down another BOI, e.g. People and another spray of associations follow, e.g., family, friends, clowns. Further, some of these associations generate ideas such as to family is added mum, sister or brother. The mind mapper adds a few more BOI, e.g., FOODS, ENVIRONMENTS, and SENSATIONS, and more associations are written down (Buzan & Buzan, 2000).

Each mind map should include pictures. The eyes automatically focus on an image, and the brain triggers numerous associations. Images are effective memory aids. In addition, the appealing image will draw attention to itself and stay in the memory. Using pictures throughout the mind map will make the mind map more attractive. It also helps trigger more associations, stimulating both the left and right brain hemispheres. In terms of vocabulary, mind maps, the information needed to be remembered to know a word and use it in a sentence should be included in a mind map. Choosing specific colours for coding purposes gives the learner faster access to the information in the mind map and helps to remember the items more quickly. Using codes also saves much time and adds to the efficiency of a mind map as a learning tool. Codes enable us to make instant connections. Between different parts of a mind map, however far apart they may be on the page. Codes may take the form of ticks, circles, crosses or underlining, which helps to emphasise certain items in the mind map and establish associations. The look of branches on the page can help communicate the hierarchy and categorisation of ideas. Successful spacing makes mind maps more attractive and easier to read. It is important to leave the right amount of space around each item in the mind map (Buzan & Harrison, 2007).

5.4.1 Emphasis

Colour is one of the most powerful tools for enhancing memory and creativity. Colours stimulate memory and creativity and can emphasise a vocabulary item. Using emphasis in mind maps helps things stand out, making vocabulary items more easily remembered. Giving keywords prominence is necessary to attract learners' attention to the key concept. A mind mapper can use colours, three-dimensional objects, letters, shades or attractive fonts to emphasise the images and words. Varying the size of the type introduces a sense of hierarchy and gives a clear message regarding the importance of the items. The central lines can be thicker, emphasising certain associations and sending the brain the message that they are the most important (Buzan & Harrison, 2007).

5.4.2 Clarity of Associations

Each word will conjure up many thousands of possible connotations and associations. The mind map stays clear by placing a maximum of one word per line. It allows the potential to make associations for each word. Using one keyword per line allows one to radiate

associations in all possible directions. Clarity on the page encourages clarity of thought. A clear mind map will be more pleasant to use. The landscape/horizontal format of the page gives optimum freedom to draw and create mind maps and makes it easier to read once the mind map is finished. Upright printing, in terms of the angle of the words, gives the brain easier access to the thoughts expressed on the page. If a mind map is large and difficult to orient, number the items in the mind map. To number the thoughts chronically or in the sequence of importance helps the learner to recall the items. Letters of the alphabet can also be used instead of numbers (Buzan and Harrison, 2007).

Arrows suggest the connections within and across branches. Plus, arrows guide eyes in a way that automatically joins things together. Arrows suggest movement, a valuable aid to effective memory and recall. Arrows can also point in one direction or several directions at once and can be of all shapes and sizes. Each mind map is different and reflects the way of mind mapper thinking. Learner remembers something they created better (Buzan & Buzan, 2000).

5.4.3 Common Mistakes

This chapter describes two common mistakes made during the process of mind mapping.

Ideas should be interconnected and not cut off from other ideas. The dynamic connection between the branches encourages the brain to spark new ideas (Buzan & Harrison, 2007).

Another common mistake is that people should put down phrases rather than words. Putting down phrases makes a mind map ineffective because the individual words allow more associations to arise. Each word enables free associations. Phrases limit the brain's creative response to words. Furthermore, it is not completely clear which of the words is the core concept when phrases are used. Each word should be taken separately, forming connections with other words. When these principles are followed, choice and change are possible in the mind map (Buzan & Harrison, 2007).

5.5 Vocabulary Mind-maps in Education.

Buzan & Buzan (2000) claim that mind mapping makes teaching and learning much easier, more enjoyable and more productive. Students who use mind maps usually report that they feel a sense of confidence that their aims are achievable. Tony Buzan describes his

experience with coaching others: Pupils who had been described as learning disabled, hopeless, dyslexic and delinquent were changed into good students, a number of them rising to the top of their respective classes thanks to the new method of learning. His brother Barry Buzan claims that it is very common for thinking to separate from writing while students learn through conventional methods. He compares a mind map to a city map. The centre of a city is the centre of a mind map. The main road in the city is equal to the main thought. The side roads represent the secondary thoughts. The major advantage of a mind map is that the students always know where they are going and where they have been. According to Buzan and Buzan (2000), mind mapping is a learning technique that enables one to remember items effectively based on the rules mentioned in the previous chapter on vocabulary. This claim is built on the findings about our brain structure, meaning that radiant thinking reflects our brain structure and processes: The mind Map is the external mirror of our radiant thinking. (Buzan & Buzan, 2000 (Buzan & Buzan, 2000).

5.5.1 Vocabulary Mind-maps vs Vocabulary Lists

Some speakers are not able to fit comfortably known words into their sentences. Scrivener (1994) suggests that the translation approach is a part of the problem. Scrivener (1994) points out that long lists of words and their translations in our exercise books defy memory.

Buzan and Buzan (2000) highlight the advantages of mind maps over vocabulary lists. One of the advantages lies in the way words are organised. Mind maps can reflect real-time or space which can improve recall and creativity. Using vocabulary lists is not a natural way of working for the human brain. Lists cut off the ideas preceding and following them. Dissociating each idea from its context reduces the probability of creativity and recall (Buzan & Buzan, 2000).

Nowadays, much vocabulary is written down at schools as vocabulary lists; students are encouraged to take notes in bullet-point form. The limitation of this approach is that it can take longer to understand the core issue of the matter. Moreover, students can only memorise pieces of information if they understand the context. The human brain is multi-dimensional, meaning it can take non-linear information and does so very often, e.g. interpretation of images and environment. The human brain takes in the information as a whole and interprets

it. Whole-brain thinking is the essence of mind mapping. Mind mapping helps us to put the information in the context of existing knowledge (Buzan & Harrison, 2007).

Vocabulary mind maps have multiple advantages over vocabulary lists:

- The central concept is more clearly defined - mind maps give the brain a central focus.
- The relative importance of each vocabulary item is clearly defined.
- The links between the key concepts are immediately identifiable - encouraging associations of ideas and concepts and improving memory. Mind maps help to integrate knowledge.
- The structure of a mind map allows additional vocabulary items or concepts to be added easily, allowing the learner's ideas to relate to those introduced by the teacher or a book.
- Each Mind map is a unique creation which will, in turn, aid accurate recall.

(Buzan & Harrison, 2007)

It is helpful to know more about how the human brain thinks (chapter 2) and remembers information to understand why mind maps are effective. As explained above, the human brain does not think linearly. Rather, people think in multiple directions simultaneously, starting from central trigger points in key images and keywords. The term radiant thinking used by Buzan and Harrison (2007) suggests thoughts radiate outward like the branches of a tree. In the same way, mind map streets with a central concept and ideas radiate outwards, mirroring the brain's activity effectively. The more closely information is recorded in a way that reflects the natural workings of the brain, the more efficiently the brain will be able to trigger the recall of essential information. Mind mapping is a powerful graphic technique that uses and unlocks the potential of the human brain and thus makes it easier to recall information (Buzan & Harrison, 2007).

Many students learn vocabulary lists by rote memorisation. The drawback of this technique is that students find it monotonous and boring. Some students have difficulty with simple rote memorisation. Even though rote memorisation of vocabulary items may seem effective in terms of short-term memory, mind maps help learners to understand the vocabulary items in context, visualise and, thus, helps to retain the vocabulary items longer. Using mind maps

makes studying a personal, interactive, continually changing, and stimulating experience rather than a rigid, impersonal, and monotonous task (Wang & Dostal, 2018).

To sum up, the advantages of using vocabulary mind maps over vocabulary lists are 1. It can spark an interest, 2. It can make lessons and presentations more spontaneous, 3. It is a flexible, creative and enjoyable method, 4. It can give students a deeper understanding of the subject, 5. It can help students relate new and old knowledge. 6. It can help create interconnectedness among isolated inputs of items. 7. While creating a mind map, students use imagination and logic to understand the meaning. 8. It helps the students to organise their knowledge. In addition, mind maps can illustrate that new knowledge is built up during the learning process. In addition, using colours, images, and graphics can facilitate learning and vocabulary retention (Wang & Dostal, 2018).

Empirical Part

6 Research Aims, Hypothesis and Study Design

6.1 Introduction the Empirical Part

This research focused on the effectiveness of mind-mapping learning strategy to extend vocabulary knowledge. At first, students completed a pre-test to obtain baseline data. Students dealt with the names of superpowers and the use of selected emotive interjections (*phew, yikes, gee, ouch)* and interjections describing sounds *(pow, wham)* (Chapter 4.1) during the lesson. MM technique was used to visualise the superpowers and the emotions connected to the given interjections. MM process starts with establishing the Key Word and a Key Image (Chapter 5.2.), which the teacher did. Students connected the newly acquired information with those they already knew. Additionally, students visualise the vocabulary, which helps to remember information faster. Students also visualise the abstract lexis and the relationships between the words. BOIs described in Chapter 5.4 were established to organise new information. Emphasis (Chapter 5.4.1) plays an important role in remembering information, so orange was used to highlight BOIs. At least four memory principles described in Chapter 3.4 were used in the lessons: Senses, Symbols (=, ->), Color and Laughter and students engaged both hemispheres of the brain (Chapter 2). Students completed a post-test at the end of the lesson to measure the immediate effect of the MM learning strategy. After one or two weeks, students completed a post-post-test to measure how much information moved to long-term memory. The motivation for choosing the theme of mind-mapping was to find out more entertaining and effective technique to teach vocabulary.

6.2 Research Aims and Hypothesis

The research aim is to examine the effectiveness of using the mind map learning strategy to extend vocabulary knowledge.

H1: Using the mind mapping learning strategy in vocabulary instruction positively affects vocabulary knowledge from a medium-term perspective of most students.

H2: Added value between the pre-test and post-test is non-negative.

H3.1: All students assess the mind map learning strategy positively.

H3.2: Students with better test results assess mind mapping more positively than students with lower test results.

7 Participants

The research was performed at International School Olomouc (ISO) and Elementary School St. Vorsila in Olomouc. Thirty-one participants (16 women and 15 men) with an average age of 14.19 (±1.01) years took part in the study. Students from ISO formed Group A, and students from St. Vorsila Elementary School formed Group B.

ISO is a private school and it offers education from preschool to high school. Preschool is for children 2-6. Primary school is for children from 6 to 11, and lower secondary is for children from 11 to 15. The school provides elementary education to approximately 120 pupils. Students at ISO can acquire the International General Certificate of Secondary Education (IGCSE) and The General Certificate of Education Advanced Level (A-levels). The primary language of instruction is English. Students in primary school learn everything according to topics for a specific period apart from the base subjects of Math, English and mother tongue language. The secondary curriculum is based on Cambridge International and English National curriculum. The maximum class sizes are 15 students per class. The classes are usually even smaller, allowing an individual approach for each student. International schools are essential for families who travel and search for consistency in children's education (Nagrath, 2011).

The research was held at lower secondary schools in classes 8 and 9. Students in years 8 and 9 study together in one classroom. The small number of students allows an individual approach based on students' needs. The total number of participants was 7 (4 men and 3 women). Students were 12-13 years old. Five students studied in year 8, and two students studied in year 9. The average number of years spent at an international school was 5.57 years. The lowest number of years spent in international school was one year, and the maximum was nine years. Three participants attended international preschool. Participants spoke various languages at home. One participant speaks Czech, English and Spanish at home. Two participants speak Czech and English at home. The third participant speaks Turkish at home, and the other three speak only Czech at home. All participants use English in the lessons at school. One participant uses only English to talk to his friends during breaks, and two participants answered that they use mostly English during breaks to talk to their

friends. Three participants use Czech and English to talk to their friends during breaks; one uses mostly Czech during breaks.

Elementary school St. Vorsily is a public school that offers education based on Christian principles. The school focuses on language communication and information technology. The school provides elementary education for approximately 258 pupils. The average number of pupils in classes is 25.

Group B from St. Vorsily Elementary School in Olomouc consisted of 24 students (13 women and 11 men) from year 9, with an average age of 14.67 (±0.48) years. On average, students learnt 7 years of English as a second language. Students self-assessed their level of English: 6 students A2 level, 12 students B1 level, 4 students B2 level and 2 students C1 level. On average, students assessed their English level as B1. Students were also asked whether they watch movies in English to assess their level of informal English indirectly. Three students do not watch movies in English, seven students watch movies in English with Czech subtitles, three students sometimes watch movies in English, eight students watch movies in English with English subtitles, and four students watch movies in English without subtitles. Students were also asked whether they read books in English. Ten students do not read any books in English, 1 student does it rarely, 8 students sometimes read books in English, 1 student does it often, and 4 students read books in English regularly.

8 Methodology

8.1 Tests

According to the classification of didactic tests (Byčkovský, 1983), the tests used can be characterised as follows: the test measures the level of knowledge, it is a non-standardised test measuring the cognitive activity of the test taker, and the tests are objectively scorable. Test tasks in objectively scorable tests can be clearly distinguished as to whether they were solved correctly or incorrectly, or the degree of incorrectness, inaccuracy, or incompleteness of the solution (answer) can be assessed. Evaluation of objectively scorable tests can be performed by a person without special qualifications according to a precise prescription (scoring key). Three tests created to verify knowledge of the vocabulary were used. The tests were divided according to the time sequence in the teaching. The entrance test, the so-called pre-test, verified vocabulary knowledge before the vocabulary instruction to obtain baseline data. The test was given at the beginning of the lesson. The post-test was completed immediately after vocabulary instruction and measured the immediate effect of vocabulary instruction. The post-post-test was completed one week (Group B) or two weeks (Group A) after the vocabulary instruction to measure the delayed effect of vocabulary instruction. The thematic scope of the test concerns the use of interjections and superpowers.

Subjects completed three tests named according to the time sequence in the teaching: pre-test, post-test and post-post-test. Completing each test took 5-10 minutes, depending on the student's pace. The tests focused on vocabulary in the area of superpowers and interjections. This topic was chosen based on the consultation with the English teacher at ISO; the topic of superpowers was supposed to be covered in the given period when the research data were collected. The topic of interjections was chosen because it usually does not appear in regular students' books and English curriculums, so insufficient knowledge of the subject matter was expected. Students could reach 16 points maximum in each of the three tests. Each test consisted of two gap fill exercises where students chose from the given words. In the first gap-fill exercise, students were given one extra word. In the second gap-fill exercise, students choose A/B/C or D – three extra options were given. Students were asked to name synonyms in question 3, explain a word and use it in a sentence in questions 4.1 and 4.2. Students were asked to name 6 superpowers and self-assess themselves. The self-assessment

was included in the tests to align with the common practice at ISO to promote the learning competence of the students. Difficulty (p), sensitivity (p) and pretest-posttest-difficulty (PPDI) were calculated for every test item.

8.2 Lesson Plan

Vocabulary instruction with the use of mind maps followed the pre-test. The lesson aims were:

1. Students can use the exclamations ***phew, yikes, gee, ouch, pow*** and ***wham*** in the correct context to express the emotions or describe the sounds.
2. Students can use the phrasal verb ***gee somebody up*** in a sentence.
3. Students can name three synonyms of pain: ***anguish, suffering and torture.***
4. Students can name six superpowers, explain the word ***telekinesis***, and use it in a sentence.

Every student had a sheet of paper to create mind maps. The teacher determined the keyword and the key image. Students were completing their mind maps, and a big one was simultaneously drawn on the whiteboard. First, students come up with their ideas. Then students pick a name of a superpower from an envelope and choose the right picture for it. Students incorporated the new information into what they already knew and drew pictures of each name of a superpower.

Then, students flipped the page, and the question was asked: *"What can interjections express?"* Ss fill in the mind maps with their ideas, e.g. fear, pain, happiness... These associations wormed BOIs. A big mind map of interjections was drawn on the board. Then, examples of interjections were filled in. A picture illustrated each interjection. Special focus was paid to the interjection *gee*, and a phrasal verb *to gee somebody up* was derived from it and explained by the teacher. Different colours were used for BOIs (pain, happiness, fear) and their associations (ouch, yeah, yikes).

Further, the teacher asked students to name synonyms of *pain*. Students fill in the correct answers in the mind map using the symbol = (equals). At the end of the lesson, students completed the post-test. The level of knowledge of the vocabulary introduced in the lesson was tested. The post-test consisted of the same form of questions as the pre-test. After one

week (group B) or two weeks (group A), students completed another test which measured vocabulary recall.

8.3 Subjective Assessment Form

Pupils also completed a subjective assessment form which examined their opinions on the mind map study technique to learn vocabulary. Students were instructed that there were no wrong or correct answers in it. The questions in the subjective assessment form were formulated so that more positive answers show satisfaction with the technique. The form consisted of 10 statements pointing out the advantages of using mind maps described in the theoretical part of the thesis. Participants answered on a five-point scale to what degree they agreed/disagreed with the statements (*Strongly agree-Agree-I am not able to say-Disagree-Strongly disagree*), and they could add comments. In addition, students were asked how often they use MM to learn new English vocabulary and five point scale (*Never-Rarely-Sometimes-Often-Always*) was used to answer the question.

9 Data Analysis

9.1 Test Results

Byčkovský (1983) recommends calculating statistical indicators and comparing their values with the required ones. The goal of measuring difficulty is to detect tasks that are not suitable for the purpose of the test and tasks with deficiencies. Those jobs that meet the required criteria are kept, and others are discarded or reworked. This procedure can be repeated, bu it is impractical for teachers. The teacher usually does not have enough time to check the assignments in advance (Byčkovský, 1983).

The statistical analysis examines how individual test tasks contribute to the wide variability of test scores in a population of test takers. A high variability of scores is a condition for a high degree of predictive validity, which is the main reason for the quality of discriminating tests. The theory of statistical analysis is developed for objective type binary scored tasks (Byčkovský, 1983). In this data analysis, we focus on determining the tasks' difficulty and sensitivity.

9.1.1 Test Item Difficulty (p)

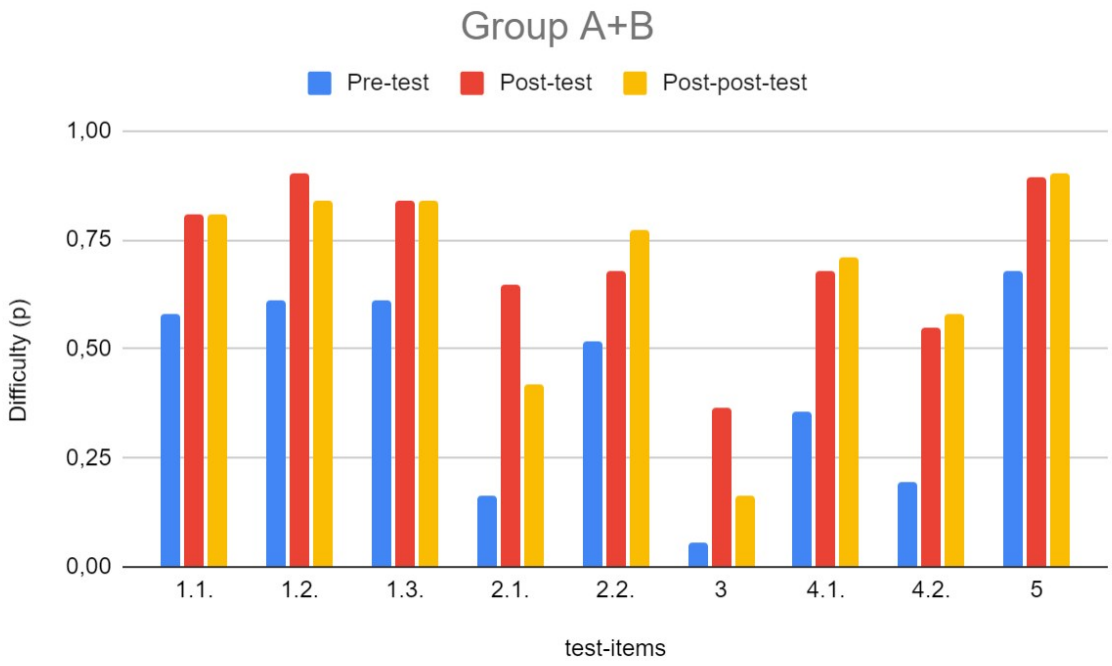
The tested student can answer the task correctly or incorrectly or not answer. The task's difficulty is expressed by the proportion of correct answers and the number of test takers.

$$p=N_i/N$$

The p-value can take on any value between 0.00 and 1.00. High p-values indicate easy tasks; low values indicate difficult tasks. Test items with p-values between 0.3 and 0.7 should be mainly included in tests. For discriminating tests, such as study prerequisite tests, $p<0.2$ and $p>0.8$ tasks are considered extremely difficult and easy, and they should not be included in the tests without special reasons (Byčkovský, 1983). Crocker and Algina (1986) determined that p should be near 0.50. For closed problems where we offer answers, the student can arrive at the correct answer by guessing, which makes the test task easier, and the p-value shows the number of participants who know the answer to the test task plus the number of participants who could correctly guess the answer. The form of the exercise plays an important role because, in typical multiple choice, several participants may answer correctly

even though they do not know the answer; the test-takers are likelier to answer wrong in the open-response item (Crocker & Algina, 1986).

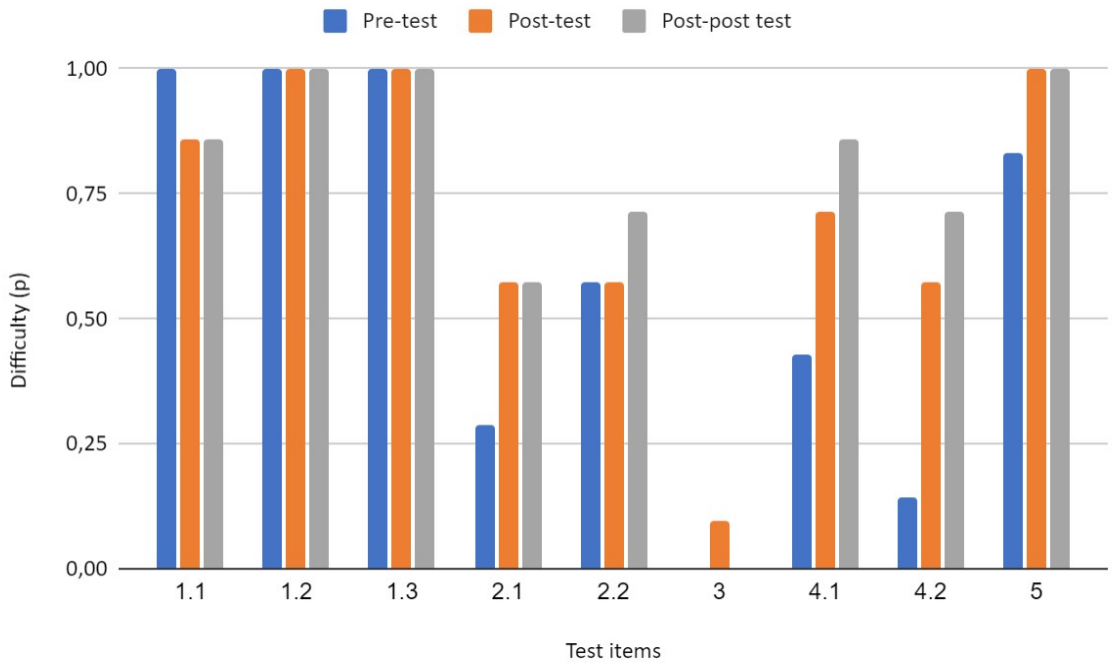
The following graph shows the result of the p-values of individual test items in three tests. The average *p* of test items in the pre-test is 0.42. The average *p* rises in the post-test to 0.71 and slightly decreases to 0.67 in the post-post test. Naming three synonyms for the noun pain was the most difficult test task, and naming six superpowers was the least difficult test task for the participants.



Picture 3: Test-item difficulty

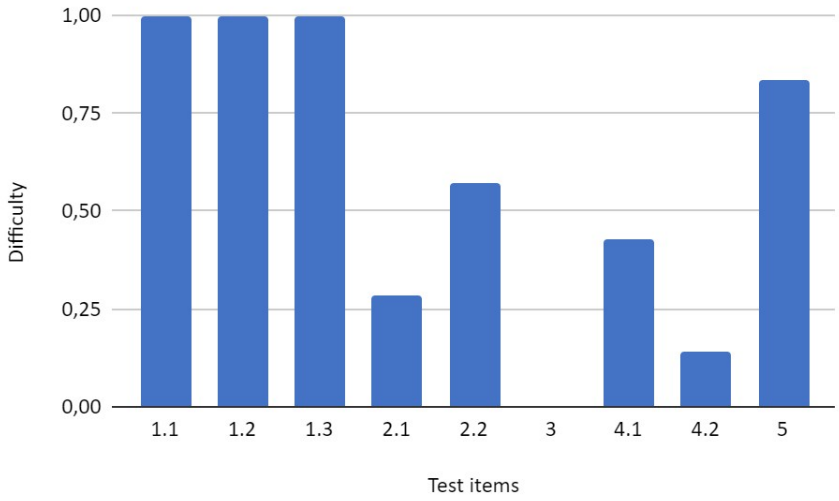
Group A

The next graph shows the changes in the p-value of individual test items in the pre-test, post-test and post-post-test in group A.



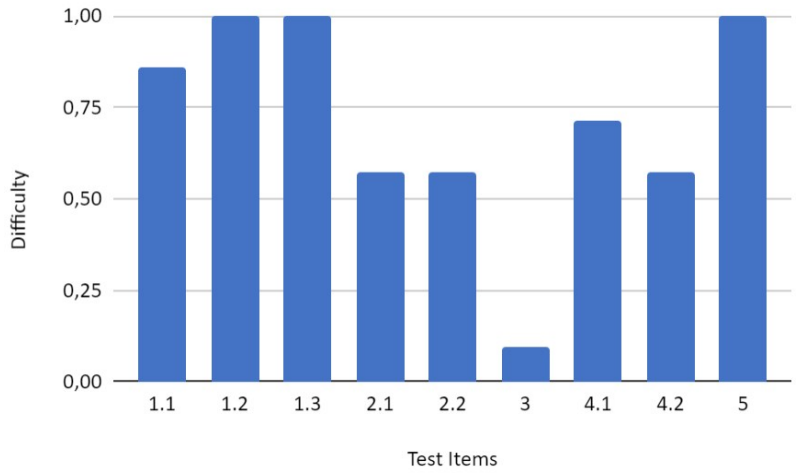
Picture 4: Difficulty of test items (Group A)

The average p-value in the pre-test was 0.58 (±0.39). The maximum value of difficulty was 1, and the minimum was 0. The easiest test task was to fill in missing interjections from the list (tasks 1.1, 1.2 and 1.3). The students had a choice of words, which made the task easier. All students from group A answered the whole test question 1 correctly. The most difficult test task was to name synonyms of the word *anguish*. Any student did not know the answer in the pre-test.



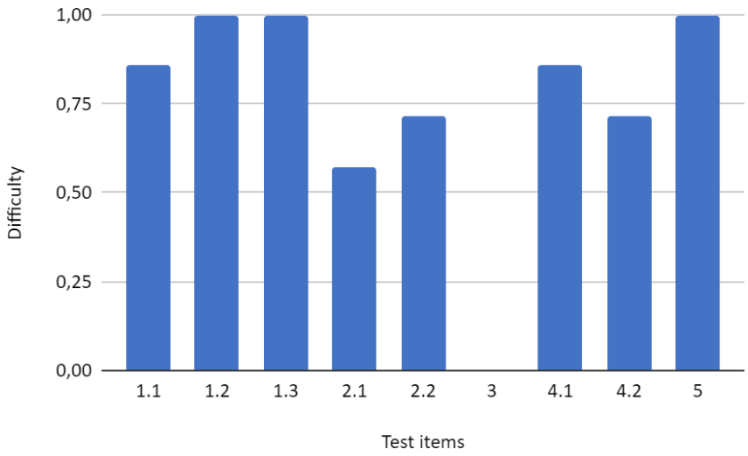
Picture 5: Difficulty of test items in the pre-test (Group A)

The next graph shows each test item's difficulty value in the post-test. The average p-value was 0.71 (±0.3) in the post-test. None of the items reached the 0 value of difficulty in the post-test. Three test items had the maximum level of difficulty 1. All students were able to *name 6 superpowers* and *fill in correct interjections* in questions 1.2 and 1.3 in the post-test. Question 1.1 in the post-test was more difficult than in the pre-test even though the same test item (*phew*) was examined; however, different test distractors (different vocabulary choices) were included in the post-test than in the pre-test.



Picture 6: Difficulty (p) of test items in post-test (Group A)

The next graph shows the value of difficulty of test items in the post-post-test. We can see that three test items, 1.2, 1.3 and 5, reached the maximum value of *p* and test item 3 had the minimum value of *p=0*, the same p-value as in the pre-test. The average difficulty of test items in the post-post-test was 0.73 (±0.32).



Picture 7: Difficulty (p) of test items in post-post-test (Group A)

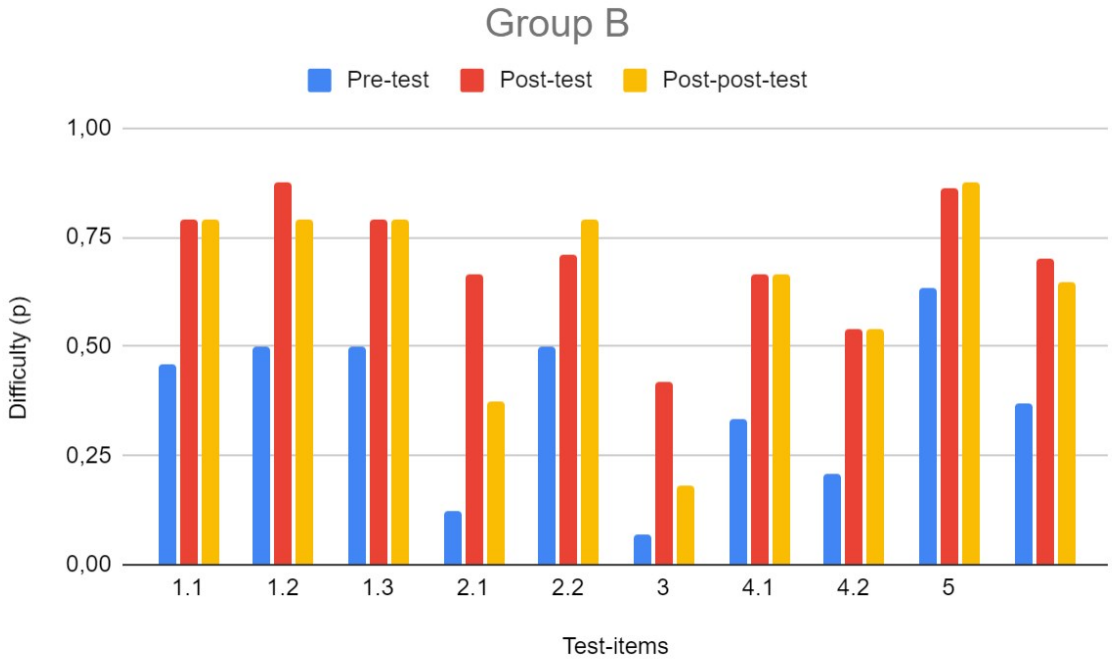
Group B

The difficulty value of test items in Group B was lower than in Group A in all three tests. The average p-value in the pre-test was 0.37(±0.2). The most difficult test item was 5 - *Name*

3 synonyms of the noun pain (p=0,07). The least difficult test question was *to name 6 superpowers* (p=0.62).

The average difficulty of test-task in the post-test was 0.7 (±0.15). The most difficult and the easiest test question remained the same; only their p-value changed from p=0.62 to 0.42 and from p=0.7 to 0.86.

The average difficulty value of test items in the post-post-test was 0.65 (±0.23). Again, the most difficult and easiest test questions were *naming synonyms of the noun pain* (p=0.18) and *six superpowers* (p=0.88), respectively. The following graph shows the data and the changes in difficulty values from the pre-test to the post-post-test.



Picture 8: Difficulty (p) of test items (Group B)

9.1.2 Test Item Sensitivity (d)

If the didactic test is to fulfil its basic function, i.e., to measure the extent to which individual students have mastered the subject matter, each test task should contribute to this. More students with better scores than students with worse ones should solve each test task. The sensitivity of the task expresses this. The simplest of the sensitivity indicators is

the ULI (upper-lower-index) coefficient, referred to as *d*. The value of *d* is determined by the difference in the values of the difficulty indicators determined for the group of "better" and "worse" students. The student's performance in the test is used to differentiate between students with better and worse overall results. Students are ranked in descending order according to their test performance. The upper half has better results, and the lower has worse results. If better students solve the task correctly than worse students, the numerical value of d is positive; otherwise, it is negative. If the task is solved by the same number of better and worse students, d=0, which means that the task does not distinguish between better and worse students, it is not sensitive (Byčkovský, 1983).

Sensitivity (d) of test items is the difference between the difficulty of test items of the group with overall higher points acquired and the difficulty of test items with overall lower points acquired in the test. Students who answered a given question correctly were likelier to answer other questions correctly (Singh, 2022).

Test item sensitivity:

$$d=p_i' - p_i''$$

p_i' difficulty of test-task for a group of test-takers with better test scores

p_i'' difficulty of test-task for a group of test-takers with lower test scores

(Byčkovský, 1983)

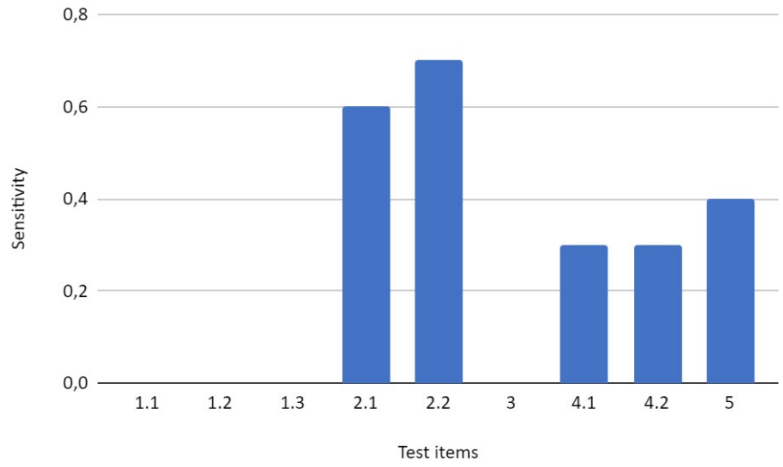
The value of sensitivity of test items was mostly positive. The biggest sensitive value had the test-item 4.2 (use the word telekinesis in a sentence). Test-item analysis showed negative sensitivity in test-item 3 (*name synonyms of the word anguish*) in the pre-test and 1.1 (interjection *phew*) in the post-test.

Picture 9: Sensitivity (d) of test-items

The average sensitivity value in the pre-test and post-test was 0.31, and the average sensitivity value in the post-post-test was slightly lower, 0.29.

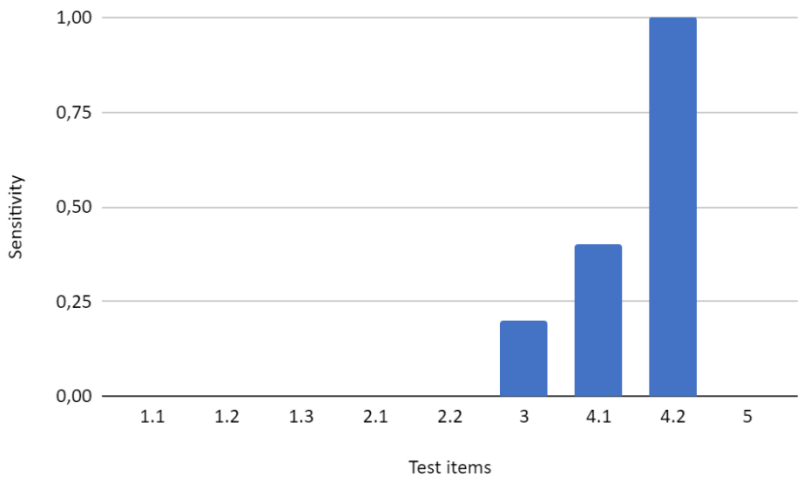
Group A

The average sensitivity of items in the pre-test is 0.26 in group A. Four test items were insensitive d=0. In test items 1.1, 1.2 and 1.3, interjections *yikes, phew*, and *pow* were tested, and the synonyms of *anguish* were tested in test question 3. Test item 2.2 was the most sensitive in the pre-test; it reached a d-value of 0.67 and tested the meaning of the interjection *wham*.



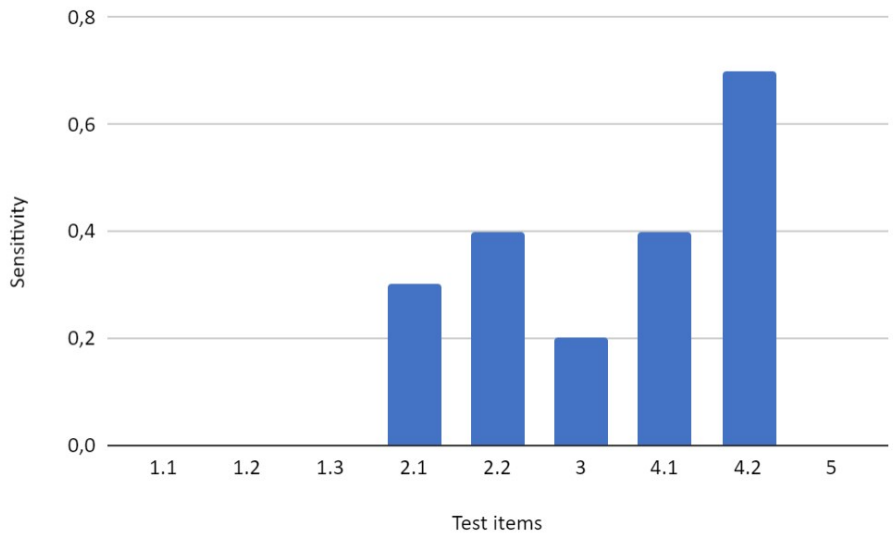
Picture 10: Sensitivity (p) of test items in the pre-test (Group A)

The average sensitivity of test items in the post-test was 0.17 in group A. Only three test items reached some value of sensitivity. Question 3 tested the synonyms of the word pain, test-item 4.1 tested the ability of the students to *explain the word telekinesis* and test-item 4.2 tested the ability *to use the word telekinesis in a sentence*. Only the students with overall better results could fill in the question correctly. Test items 1.1, 1.2, 1.3, 2.1, 2.2 and 5 were insensitive. All the students from group A filled in the right questions. The following graphs show the sensitivity of test items in the post-test in group A.



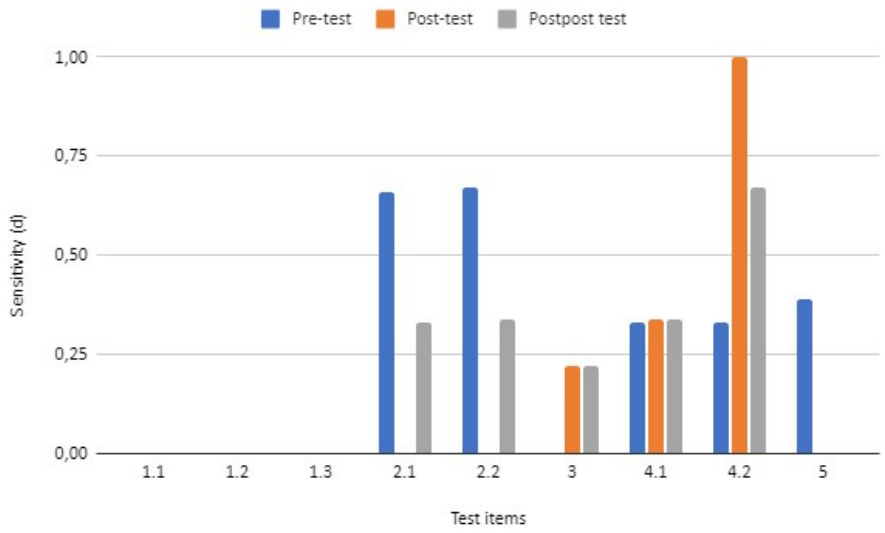
Picture 11: Sensitivity (p) of test items in post-test (Group A)

Picture 12 shows the sensitivity of test items in the post-post-test in group A. None of the test items reached the maximum value of 1. Four test items were insensitive; all students were able to answer the test items 1.1, 1.2, 1.3 and 5 correctly. The average value of sensitivity was 0,21 (±0,23).



Picture 12: Sensitivity (p) of test items in post-post-test (Group A)

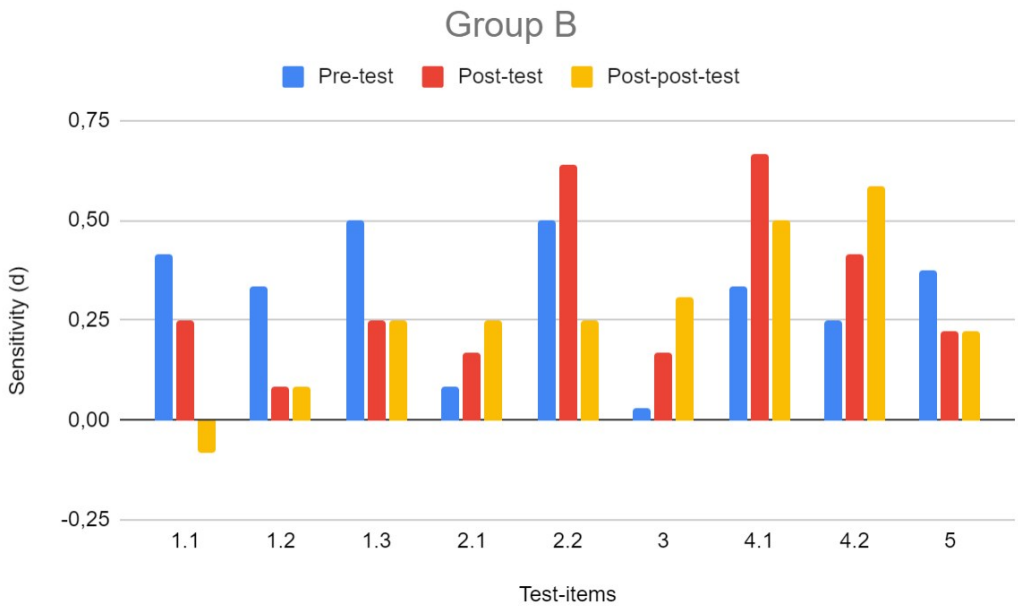
The following graph shows how test items' sensitivity levels changed from pre-test to post-test and post-post-test in group A. We can see that the sensitivity of test item 4.1 (*explain the word telekinesis*) remained relatively stable, changing only from 0.33 to 0.34. In contrast, the sensitivity of test item 4.2 (*use the word telekinesis in a sentence*) changed from 0.33 in the pre-test to 1 in the post-test and 0.67 in the post-post test. The sensitivity value of items 1.1, 1.2 and 1.3 remained 0 throughout all three tests. Test item 5 was sensitive only in the pre-test; test item 5 lost its sensitivity after vocabulary instruction.



Picture 13: Changing level of sensitivity (p) of individual test items (Group A)

Group B

The average sensitivity value in the pre-test in group B was 0.31. The highest sensitivity value was 0.5 in test items 1.3 and 2.2, and the lowest sensitivity was 0.03 in test item 3. The average value of sensitivity remained the same in the post-test. However, the highest d-value was 0.67 in test item 4.1, and the lowest was 0.08 in test item 1.2 in the post-test. The average value of sensitivity in the post-post-test was 0.26. Test item 1.1 had a negative sensitivity value (-0.08). The highest sensitivity was test-item 4.2, reaching 0.58.



Picture 14: Changing level of sensitivity (p) of individual test items (Group B)

9.2 Instructional Sensitivity

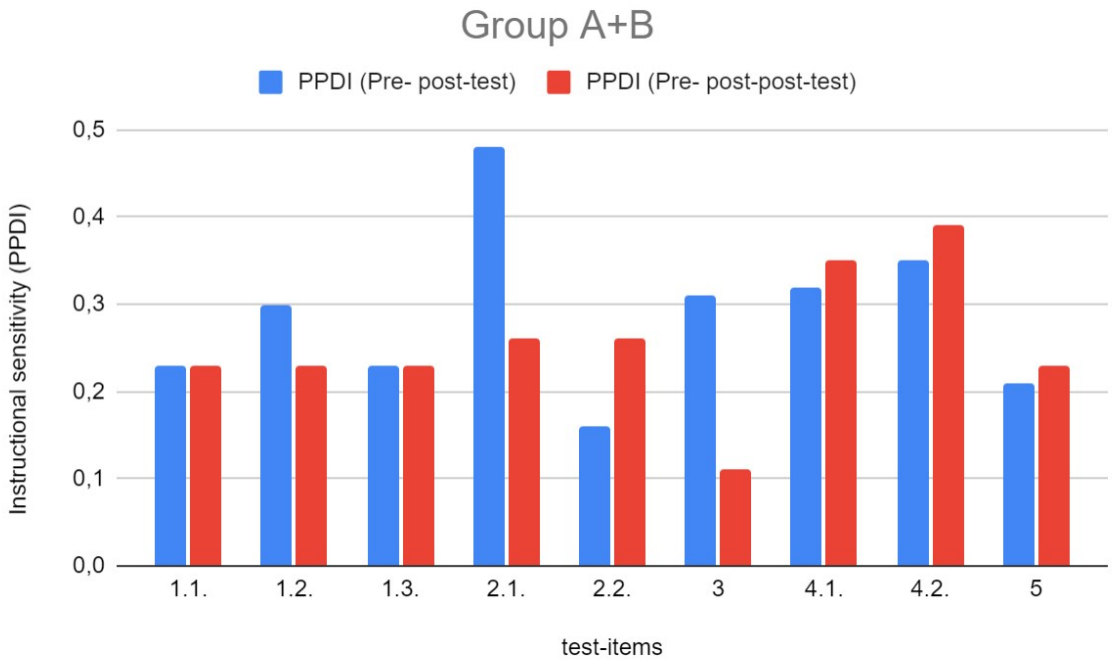
The effect of instruction can be measured by Pretest-Posttest-Difference Index (PPDI; Cox & Vargas, 1966). The PPDI takes on the time-points perspective and measures absolute item sensitivity as the difference in difficulty *p* between pre-and post-test:

$$PPDI=p_{post\text{-}test}-p_{pre\text{-}test}$$

The higher the difference, the higher the item's instructional sensitivity is conceived. Accordingly, an item with difficulty $p_{post}= 0.50$ and $p_{pre} = 0.50$ is insensitive as PPDI=0.50-0.50=0 (Naumann et al., 2019).

Different values of instructional sensitivity were measured between the pre-test and post-test (immediate effect) and pre-test and post-post-test (delayed effect). All PPDI values are positive. Test-item 2.1 (phrasal verb *to gee somebody up*) showed the biggest added value (0.48) in the post-test. However, students forgot the phrasal verb after one week - the instructional sensitivity of test-item 2.1 in the post-post-test is only 0.26. Test-item 4.2 *(to*

use the word telekinesis in a sentence) showed the biggest added value (0.39) in the post-post-test.



Picture 15: Instructional sensitivity (PPDI)

Group A

Five test items show positive instructional sensitivity (2.1 *gee sb. up,* 3 *synonyms of pain,* 4.1 *explain telekinesis,* 4.2 *Use telekinesis in a sentence and* 5 *Name six superpowers*). Three items have zero instructional sensitivity (1.2 *yikes,* 1.3 *pow and* 2.2 *wham*), and one test item had negative instructional sensitivity (1.1 *phew*). The highest instructional sensitivity was measured in test item 4.2 (*use the word telekinesis in a sentence*). The average PPDI was 0.12 in group A.

Table 1:

Instructional sensitivity (Group A)

	Difficulty Pre-test	**Difficulty Post-test**	**PPDI (Pre- and pPost-test)**
1.1	1	0.86	-0.14
1.2	1	1	0
1.3	1	1	0
2.1	0.29	0.57	0.29
2.2	0.57	0.57	0
3	0	0.1	0.1
4.1	0.43	0.71	0.29
4.2	0.14	0.57	0.43
5	0.83	1	0.17

Vocabulary knowledge was measured after two weeks; one test item showed negative instructional sensitivity (1.1 *phew*) in the post-post-test. The negative instructional sensitivity of this test item was also measured in the post-test. Three items showed zero instructional sensitivity (1.2 *yikes,* 1.3 *pow,* 3 *synonyms of pain*) and five test items showed positive instructional sensitivity in medium-term perspective (2.1 *gee sb. up,* 2.2 *wham,* 4.1 *explain telekinesis,* 4.2 *telekinesis in a sentence,* 5 *naming superpowers*). Students improved in 4.2 *using the word telekinesis in a sentence* the most. The average PPDI of Group A was 0,16 from medium term-perspective.

Table 2:

Instructional sensitivity from medium-term perspective (Group A)

Test-items	**Difficulty Pre-test**	**Difficulty Post-post test**	**PPDI (pre- and post-post-test)**
1.1	1	0.86	-0.14
1.2	1	1	0
1.3	1	1	0
2.1	0.29	0.57	0.29
2.2	0.57	0.71	0.14
3	0	0	0
4.1	0.43	0.86	0.43
4.2	0.1	0.71	0.57
5	0.83	1	0.17

Group B

All test items showed some degree of positive instructional sensitivity between the pre-test and post-test, as is shown in the table. The average PPDI was 0.33. in group B. Test item 2.1 (*gee somebody up*) registered the highest instructional sensitivity. The added value was 0.54. The lowest added value in the post-test had test item 2.2, which tested the interjection *wham* (PPDI = 0.21).

Table 3:

Instructional sensitivity (Group B)

Test-items	Difficulty Pre-test	Difficulty Post-test	PPDI (pre-post test)
1.1	0.46	0.8	0.33
1.2	0.5	0.88	0.38
1.3	0.5	0.8	0.29
2.1	0.13	0.67	0.54
2.2	0.5	0.71	0.21
3	0.07	0.42	0.35
4.1	0.33	0.67	0.33
4.2	0.21	0.54	0.33
5	0.63	0.86	0.23

The next table shows added value measure between the pre-test and post-post-test (medium-term perspective). The instructional sensitivity was measured in all test items one week after the vocabulary instruction in Group B. The highest instructional sensitivity showed test-item 4.1: *Explain the word telekinesis*. The lowest instructional sensitivity was measured in test item 3 *Name synonyms of the noun pain*. The average PPDI was 0.28 (±0.07).

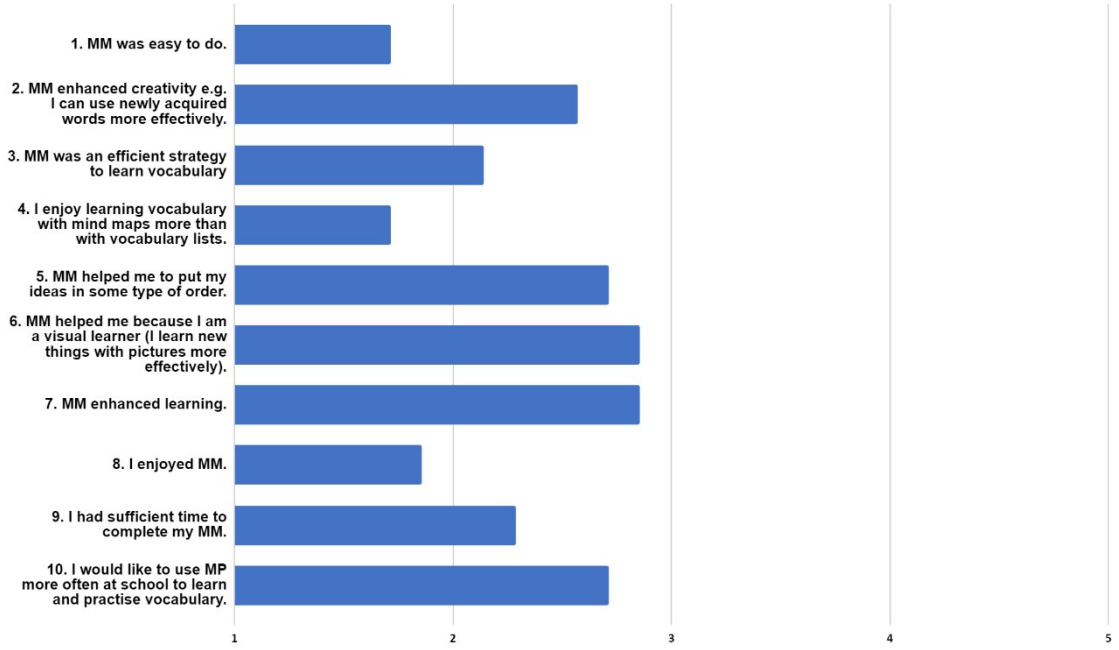
Table 4:

Instructional sensitivity from medium-term perspective (Group B)

Test-items	Difficulty Pre-test	Difficulty Post-post-test	PPDI (pre-post-post test)
1.1	0.46	0.79	0.33
1.2	0.5	0.79	0.29
1.3	0.5	0.79	0.29
2.1	0.13	0.38	0.25
2.2	0.5	0.79	0.29
3	0.07	0.18	0.11
4.1	0.33	0.67	0.34
4.2	0.21	0.54	0.33
5	0.63	0.88	0.25

9.3 Subjective Assessment Form

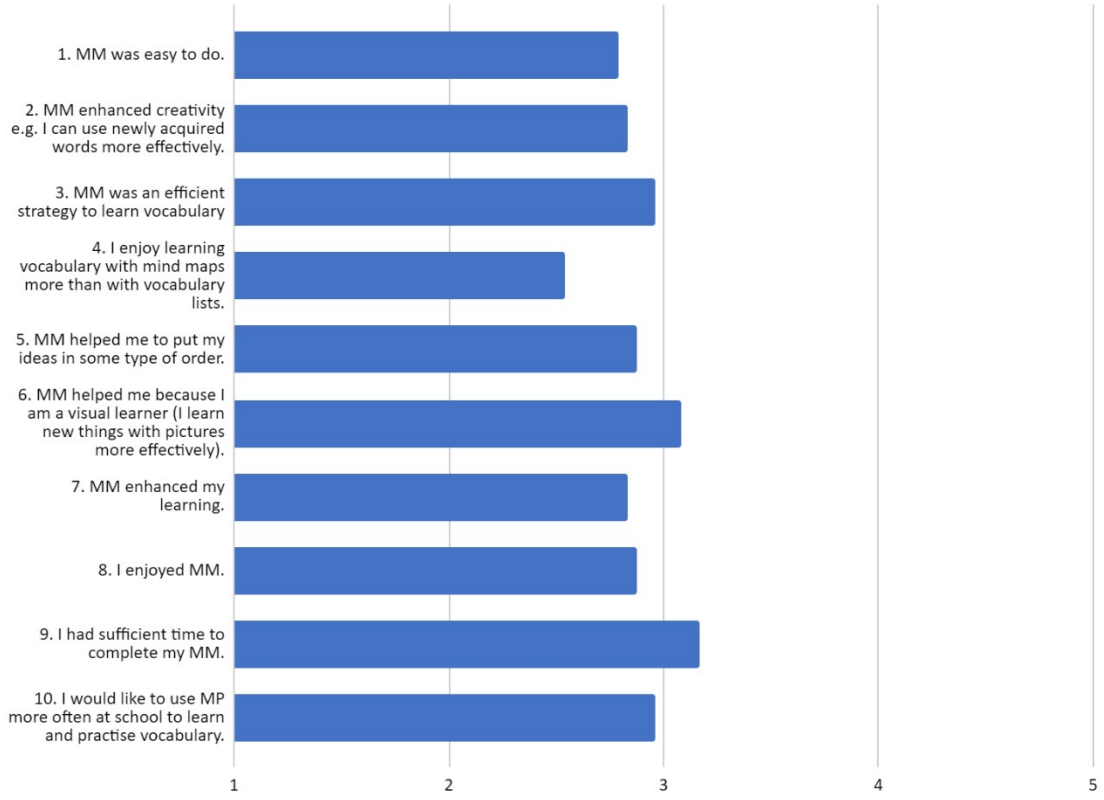
All statements reached positive results on average. The following graph shows the average answers of group A. The results show that participants think the mind mapping (MM) strategy *was easy*, and they *enjoy learning vocabulary with mind maps more than with vocabulary lists*. Participants also agreed that they *enjoyed MM* in general. In group A, statements 6 and 7 reached average answers of 2.86, which means that participants leaned toward the answer*: "I am not able to say*" whether *"MM helped them because they are visual learners (=learn new things with pictures more easily)*" and whether *"MM enhanced their learning*." On average, the group did not have any negative answers.



Notes: 1=strongly agree, 2=agree, 3=I am not able to say, 4=disagree, 5=strongly disagree

Picture 16: Average subjective assessment results (Group A)

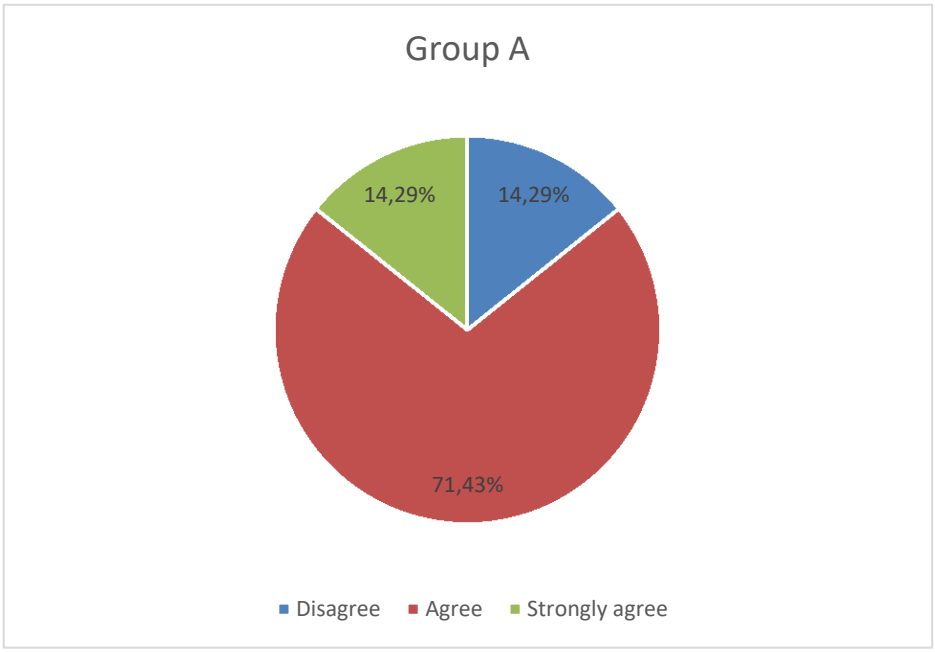
Group B assessed the MM technique differently. The most common answer to any statement was *I am not able to say/I don't know*. The most negative answer in Group B was that they *did not have sufficient time to complete the mind maps*. The most positive answer in this group was that students *enjoyed learning vocabulary with mind maps more than with vocabulary lists*.

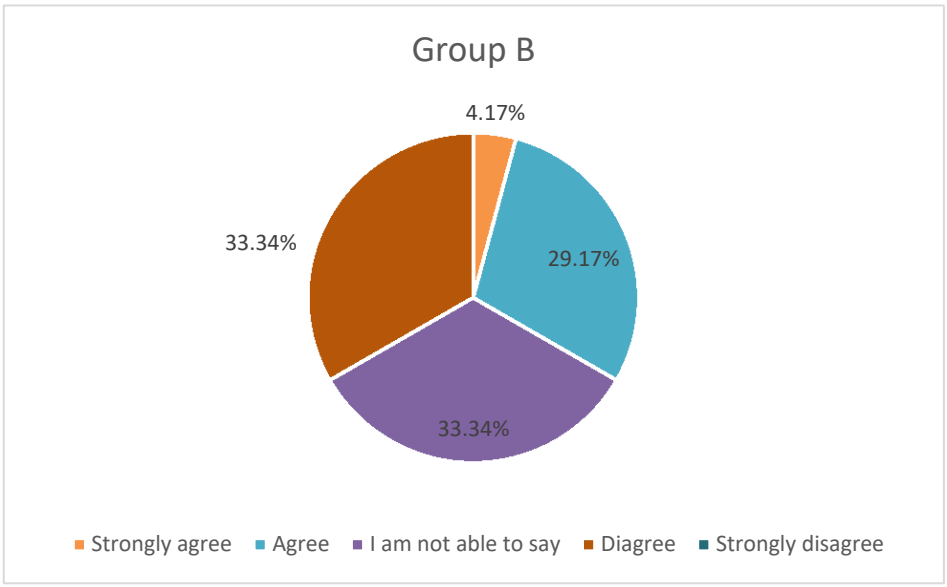


Picture 17: Average subjective assessment results (Group B)

The following graph shows groups A and B's responses to question 3: "MM was an efficient strategy to learn vocabulary." Students in group A think that MM was an efficient technique for learning vocabulary. 73% of students (5 students) *agree* that *MM is an efficient technique for studying vocabulary*, plus 14.29% of the students (which is one student) *strongly agree* with the statement. Only 14.29% of the students from group A (one student) *disagree* with the statement.

Compared to group A, more students from group B (33.34% of students) *disagreed* with the statement that *MM is an efficient strategy for learning vocabulary*. Eight students (33.34%) *are not able to say/do not know* whether it is *an efficient strategy to learn vocabulary*, and seven students (29.17%) *agree* with the students, plus one student (4.17%) *strongly agrees* with it. The following pictures show the percentage difference between the opinions of the students in groups A and B.

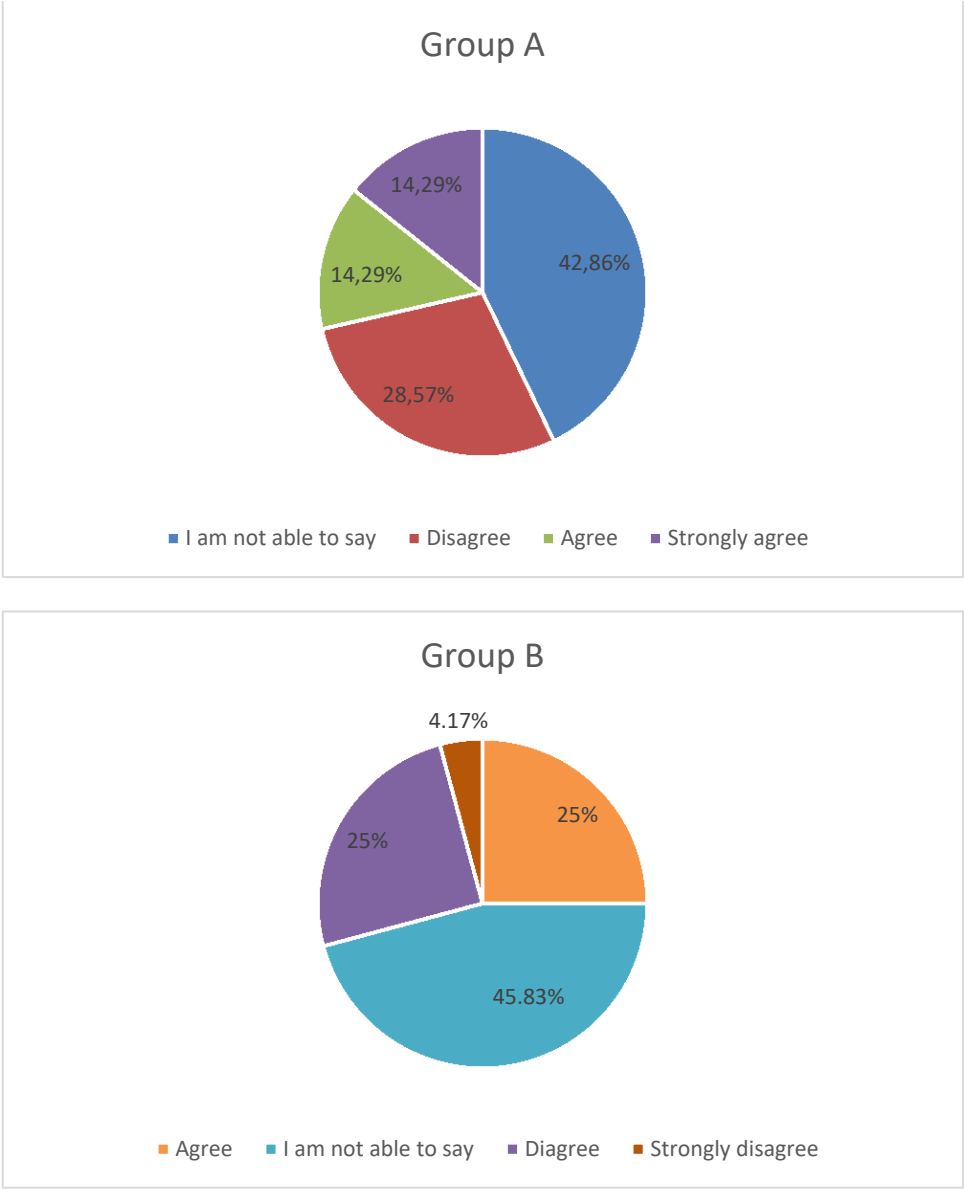




Picture 18: Students' response to "MM is an efficient strategy to learn vocabulary."

The next graph shows the responses to statement 6. Students assessed whether *MM helped them to remember items because they are visual learners (=they can learn new things more easily with pictures)*. The majority from group A, 42.86%, were *unable to say*. 28.57% *disagreed* with the statement, and 14.29% of the students *agreed* and *strongly agreed* that *MM helped them remember items because the items were visual learners*.

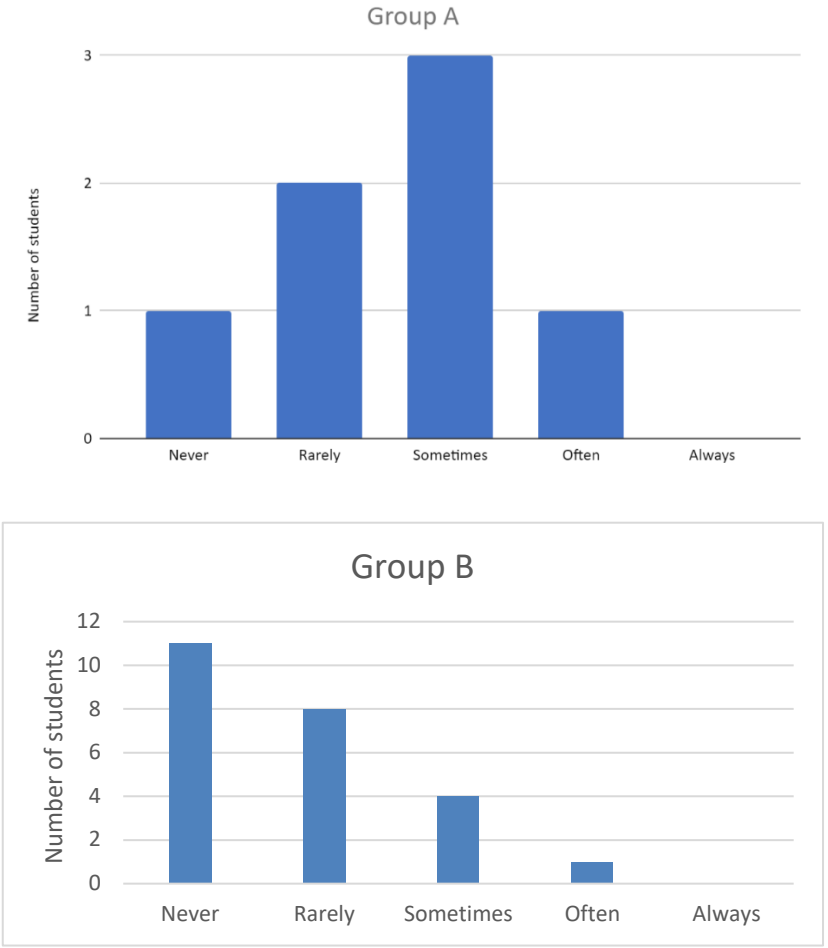
Most students from group B (45.83%) are *also not able to say* whether *MM helps them to remember vocabulary items because they are visual learners*. A quarter of the class *disagreed* with the statement, and the same proportion of the students *agreed*. One student *strongly agreed* that *MM helps him to remember items because he/she is a visual learner*.



Picture 19: Students' responses to "MM helped me to remember items because I am a visual learner (=I learn new things more easily with pictures).“

Further, the students were asked *How often they use mind maps when learning new vocabulary*. Five-point scale: *Never, Rarely, Sometimes, Often* and *Always* was used. 14.29% of the students from group A *never* used MM to learn vocabulary. 28.57% of the participants *rarely* use MM to learn English vocabulary. The majority, 42.85% of the participants, *sometimes* use MM and 14.29% of the participants *often* use MM to learn English vocabulary.

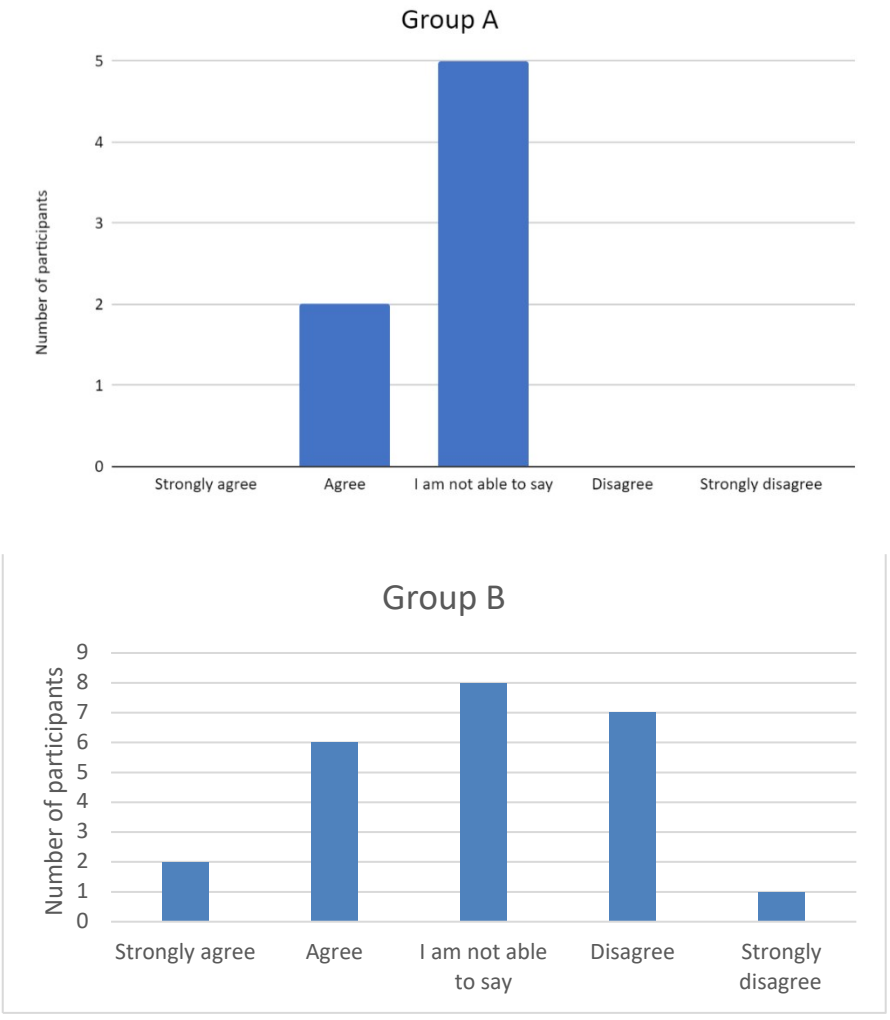
45.83% of students from group B *never* use mind maps to learn vocabulary. 33.33% of group B students *rarely* use it, and 16.67% of the students *sometimes* use it. In group B, 4.16%, which means one student *often* uses mind maps to learn vocabulary. There are no students who *always* use mind maps to learn English vocabulary.



Picture 20: Students' responses to "How often do you use mind maps when learning new English vocabulary.“

Then, the students assessed whether they *would like to use MM more often at school to learn and practise English vocabulary*. Most students in Group A (71.23%) answered that *they do not know/are not able to say*; the rest of the students would like to use MM more often. Only two answers were represented in the assessment of group A.

Similarly, most students in group B *do not know/are not able to say* whether they *would like to use MM more often at school to learn and practise English vocabulary*. Group B students answered more negatively than students in Group A. 33.33% of the Group B students (eight students) *disagree*d or strongly *disagree*d with the statement, and 29.17% (seven students) *agree*d or *strongly agree*d with it.



Picture 21: Students' responses to *"I would like to use MM more often at school to learn and practise English vocabulary."*

The comments in the mind mapping Student Assessment Form were that the difficulty of making a mind map "*depends on the topic"* and one positive feedback about the lesson: "*It was pretty good*."

10 Data Interpretation

10.1 Immediate Positive Effect

All PPDI values are positive. The average PPDI of both groups is 0.22. Students' knowledge of given vocabulary items improved from the pre-test to the post-test. The biggest improvement in correct answers was measured in test items 2.1 (PPDI = 0.49) and 4.1. (PPDI = 0.32) and 4.2. (PPDI = 0.35) Test item 2.1 tested the ability of students to use the phrasal verb to *gee somebody up* in a sentence which was one of the lesson aims. More students also could *explain the word telekinesis* (test item 4.1*)* in the post-test than in the pre-test and *use it in a sentence* (test item 4.2). The added value between the pre-test and post-test is non-negative; thus, Hypothesis 2 is confirmed. All students except one improved on the post-test. One student had the same test result on the pre-test and the post-test.

In group A, the average score in the pre-test was 10.25, more than in group B. Five items show the positive effect of vocabulary instruction. The average p-value was 0.58 in the pre-test. Test item 4.2 has the highest PPDI, 0.43. The question tested the ability of students to use the word *telekinesis* in the sentence. Before vocabulary instruction, the students could not use the word in well-formed sentences even though they could explain the meaning (test item 4.1). In the post-test, more students manage to do the task correctly. The least positive effect of the instruction showed test item 3, which tested the ability of students to name 3 synonyms of the noun *pain (anguish/agony/torture/suffering).* At the end of the lesson, all students from this group could name six superpowers.

In group B, the average score in the pre-test was 6.63 points. The base level of knowledge was not as high as in group A. The average p-value was 0.37 in the pre-test. Students in this group improved in every test item on average. The average PPDI in the post-test was 0.33; there was a bigger added value than in group A. Students improved in test item 2.1 (*gee somebody up*) (PPDI = 0.54) in the post-test Zero Effect.

10.2 Immediate Zero Effect

Zero effect was registered only in group A. Group A consisted of only seven students with a relatively high level of English measured in the pre-test. Three test items in group A show zero effect of vocabulary instruction. Test item 1.2 and 1.3 was answered by all the students

correctly in the pre-test. Test questions 1.2 and 1.3 tested the ability to use the exclamations *yikes* and *pow* in the appropriate context. Students might have been familiar with the exclamations tested, or they could guess the correct answer because there were four options to fill in three gaps. Test item 2.2 *wham* also shows zero instructional effect in this group.

10.3 Immediate Negative Effect

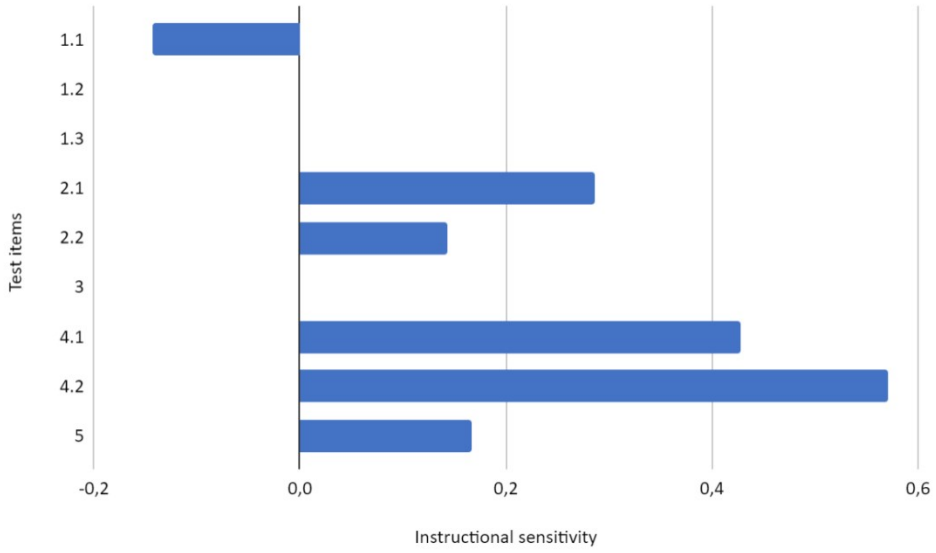
A negative effect was registered in test item 1.1 in group A. Test item 1.1 tested the ability to use the exclamation *phew* in the appropriate context to express an emotion. At the beginning of the lesson, all students answered the test item correctly. However, one student from Group A made a mistake on this vocabulary item in the post-test. It could have been caused by polysemy of the interjection. As explained in the lesson, *phew* can express relief or surprise depending on the intonation. No immediate negative effect was measured on the average test scores of each student; thus, Hypothesis 2 (*Added value between the pre-test and post-test is non-negative.*) was confirmed.

10.4 Delayed Effect

Students' knowledge of vocabulary items improved from the pre-test to the post-post-test (medium-term perspective). Students' level of vocabulary knowledge was tested one week after the vocabulary instruction (Group B) or two weeks after vocabulary instruction (Group A). So, Hypothesis 1 (*Using the mind-mapping learning strategy in vocabulary instruction positively affects vocabulary knowledge from a medium-term perspective*.) was confirmed. Regarding delayed effect, the biggest added value was measured in test item 4.2 (*Use the word telekinesis in a sentence*). Different test results were measured in Groups A and B.

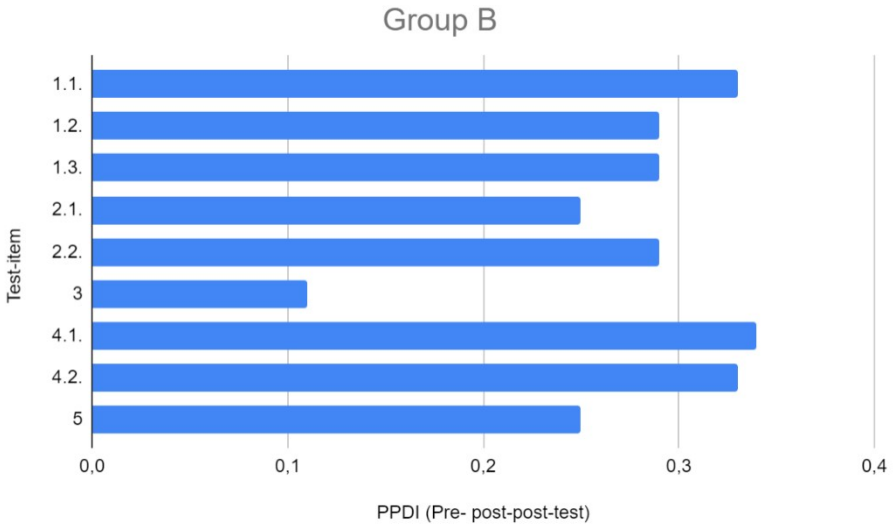
The following picture shows instructional sensitivity in group A: the difference between the pre-test and post-post-test difficulty of each test item. Five test items show a positive delayed instructional effect. The technique used in the instruction helped to move the vocabulary from short-term to long-term memory. The delayed positive instructional effect was calculated in test item 4.2 (*use the word telekinesis in a sentence*), then in 4.1 (*explain the word telekinesis*), 2.1 (*gee somebody up*) and 2.2 (*wham*) and 5 (*name six superpowers*). Instructional sensitivity in the short-term perspective matches instructional sensitivity in the medium-term perspective. Students improved their vocabulary in the area

of interjections and superpowers from a medium-term perspective. Three test items showed zero instructional effect, and one showed a negative instructional effect from a medium-term perspective. The test item 1.1 had negative instructional sensitivity (-0.14) in the post-post-test in Group A.



Picture 22: Instructional sensitivity in a medium-term perspective (group A)

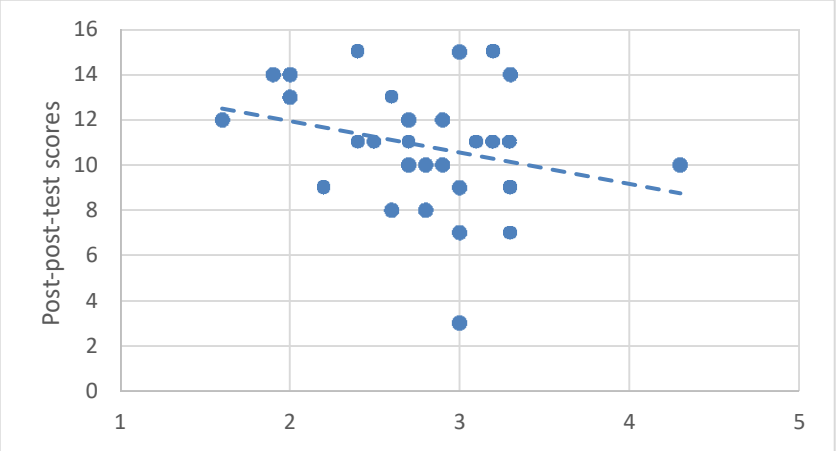
Students in Group B improved in every test item from a medium-term perspective, as is shown in Picture 23. Students in this group improved the least in test item 3: *Name three synonyms of the noun pain.* The most positive delayed effect was registered in test item 4.1 in explaining the word *telekinesis* (PPDI = 0.34) in Group B. Both immediate and delayed positive effect was registered.



Picture 23: Instructional sensitivity in medium term-perspective (Group B)

10.5 Subjective Assessment Form

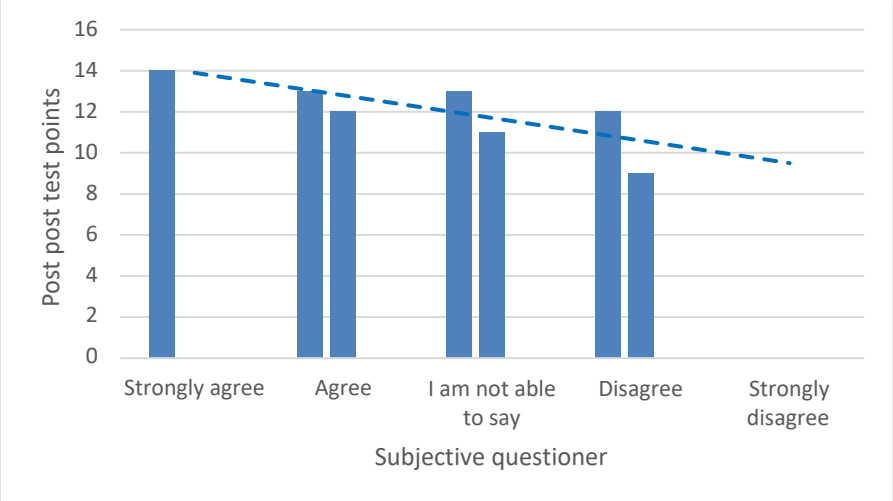
Thirty-one students filled in a subjective assessment form designed to find the student's opinions on using mind maps for vocabulary teaching. The following graph shows the post-post-test scores and corresponding average answers. The results show that positive assessment correlates with better test results. However, the trend is not that strong, and there are many exceptions; for example, three people reached 15 points; one of them had an overall positive assessment of MM, the second one had an average neutral assessment, and the third one did not agree with some of the advantages of mind mapping and assess the learning strategy slightly negatively. The blue dotted line shows the trend; thus, it can be said that the positive assessment correlates with better test results, so Hypothesis H3.2 was only partially confirmed.



1=strongly agree, 2=agree, 3=I am not able to say, 4=disagree, 5=strongly disagree

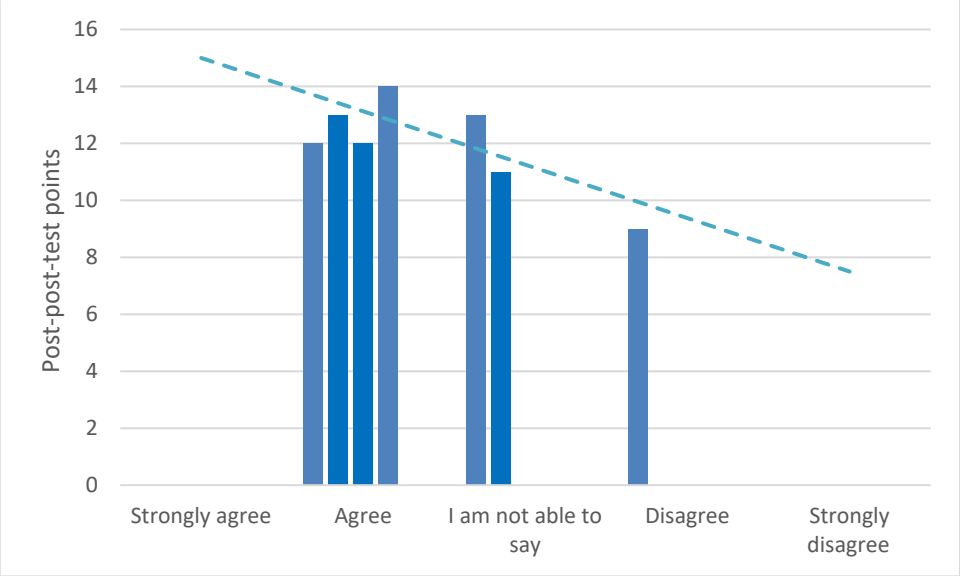
Picture 24: Dependence of post-post-test scores on the subjective assessment

The next graph shows the results of group A to one of the questions in the subjective questionnaire. We see that the maximum points reached in the post-post-test correlate with *strongly agree* evaluation, and the trend decreases with a more negative assessment of the mind map learning strategy. Students assessed whether mind maps helped them to organise ideas. The participant with the lowest number of points *disagreed* with the statement in Group A.



Picture 25: Dependence of test points on the subjective assessment (Mind maps helped me to organise my ideas) – Group A

Participants in Group A with more points agreed that the mind-mapping learning strategy enhanced their creativity. The participant with the lowest number of points reached in the post-post-test disagreed with the statement in the subjective questionnaire.



Picture 26: Dependence of test points on the subjective assessment (MM enhanced my creativity) – Group A

The subjective assessment form found out students' opinions on the effectiveness of the mind-mapping learning strategy. Twenty-nine (95,55%) out of thirty-one participants had an overall positive assessment of the learning strategy. Only two participants (6,45%) had a slightly negative assessment which means that Hypothesis 3.1 (*All students assessed the mind-mapping learning strategy positively.*) was partially confirmed. These two students were from Group B, and their test-score in the post-post-test was 7 and 10 points (the maximum number of points was 16).

11 Discussion

The main goal of the diploma thesis was to examine the effectiveness of using the mind map learning strategy to extend vocabulary knowledge. Students in ISO (Group A) reached higher scores (p=0.58) than students in St. Vorsila school (Group B, p=0.37) in the pre-test. The average p-value in the post-test was 0.71 in Group A and 0.7 in Group B, meaning that the vocabulary knowledge level after vocabulary instruction was similar in both groups. The added value in Group A was less significant than in Group B. The results of the post-post-test show that students in both groups retained the knowledge. The average p-value of 0.73 in Group A and 0.65 in Group B in the post-post-test means that students in Group A retained more information than students in Group A. However, both p-values show that students in both groups retained some new vocabulary, and the mind-mapping learning strategy used in the lesson was effective.

Study Heidari & Karimi (2015) explored the effect of mind mapping on vocabulary learning and retention in 40 Iranian students. Students were divided into two groups: Group 1 used the mind-mapping technique, and the other group used translation to learn vocabulary. The results of the data analysis showed a difference between the groups' performances on the post-test and post-post-test. Students in the mind-mapping group outperformed the second group on the post-test and post-post-test. In addition, the decline for group 1 was less for the mind-mapping group than for the second group. This study showed that mind maps could help Iranian high school students learn and remember L2 vocabulary more easily. Also, this diploma thesis showed that integrating newly acquired words with the old, previously learned ones is effective in terms of immediate and delayed effect.

Regarding students' subjective assessment, most students in Mento, Martinelli & Jones (1999) appreciated the mind-mapping learning strategy for its simplicity, power and significant advantage over linear note-taking for recall and creative thinking. This study showed that 61.29% of the students enjoyed learning vocabulary with MM more than with vocabulary lists. A significant difference between Group A and B occurred. The most negative answer in group B was that the students did not have sufficient time to complete MMs. The reason can lie in the group sizes: Group B consisted of 24 students, which is less

than 7 students in Group A. The most common answer in group B was *I am not able to say*, and the most common answer in group A was *Agree*. Students in Group A appreciated the technique more than students from Group B. The subjective assessment form also showed that students in Group A use MM more than students from Group B.

Study Goodnough et al. (2002) studied using MM in a sixth-grade classroom with 16 students and found that 66.66% of the students perceived MM as an entertaining approach. Most of the participants in the study preferred individual MM, and some preferred group MM. The majority of students thought MM enhanced their learning.

The study in this diploma thesis had even more positive feedback from the students. However, a few negative responses in the subjective assessment form show that MM does not have to be a universal learning strategy for every student. As students in Goodnough et al. (2002) point out, MM can be confusing in the construction and interpretation of the maps. One student in Goodnough et al. (2002) found it easier to express herself in words than in pictures. Even though students have individual learning styles, there can be, the average results of the subjective assessment form in this diploma thesis show that students enjoy it, it helps them organise their knowledge, and it is effective for vocabulary instruction.

11.1 Limits of the Study

This study was conducted at International School Olomouc and St. Vorsila elementary school Olomouc. The sample from ISO is not representative of the population, the group had only seven students, and they use English as their first language at school. The pre-test results in group A showed knowledge of vocabulary items: *yikes, phew, pow*, which resulted in difficulty (p) = 1 and sensitivity (d) = 0 and zero or negative instructional sensitivity. Test item 1.1 showed negative instructional sensitivity (-0.14) in the group. The sample size directly influences research findings. According to Faber and Fonnesca (2014), small samples undermine a study's internal and external validity. Another limitation of the study was that no control group was facilitated.

Conclusion

At first, the scientific basis for using mind maps in teaching and learning English vocabulary was presented. Mind maps are a graphical technique for visualising connections between ideas and pieces of information. Each idea or fact is written down and then linked by arrows, creating a web of relationships (Al-Shdaifat, 2019).

The main goal of the diploma thesis was to examine the effectiveness of using the mind map learning strategy to extend vocabulary knowledge. In total, 31 participants took part in the study, with an average age of 14.2 years. Students from ISO formed group A, and students from elementary school St. Vorsila formed group B. Subjects completed a short test before vocabulary instruction to obtain baseline data. The recall was measured at the end of the lesson and one or two weeks later, depending on the group. Students filled in subjective assessments of the mind map technique to study vocabulary.

At first, the difficulty (p) and sensitivity (d) of test items were analysed. The most difficult test item was *to name three synonyms of the noun pain*, and the least difficult test item was *to name six superpowers*. Sensitivity was analysed in all test items in all three tests. The sensitivity of test items in the post-test was always positive. The difficulty of test items 1.2 and 5 < 0.2. The results differed in the groups. Group A reached very good results in the pre-test and post-test, so only test items 3, 4.1 and 4.2 were sensitive in this group.

Further, Hypothesis 2 (*Added value between post-test and pre-test is non-negative.*) was confirmed. Students reached higher scores on the post-test than on the pre-test. Only one student had the same test score on the pre-test and the post-test. Students improved in test item 2.1 (*gee somebody up*) the most in the post-test compared to the pre-test. Students improved in all test questions on average and retained the knowledge for one or two weeks.

Hypothesis 1 (*Using the mind maps technique in vocabulary instruction positively affects vocabulary knowledge in the medium-term perspective of most students*) was confirmed. Participants' average score was 7.26 points on the pre-test and 10.87 points on the post-post-test. Only one participant had the same test score in the pre-test and post-post-test. Other participants improved. Regarding delayed effect, the biggest added value was measured in

test item 4.2 *(to use the word telekinesis in a sentence*). Higher instructional sensitivity was measured in group B than in group A.

61.29% of the students enjoyed learning vocabulary with mind maps more than writing vocabulary lists. 29.03% of the participants were not able to say whether they enjoy MM more than this traditional technique, and 9,68% did not enjoy learning vocabulary with mind maps more than writing vocabulary lists. If we take the average assessment of the MM learning strategy in the subjective assessment form, 93.55% of the participants had a more positive assessment of MM than a negative one. Only 6.45% of the participants felt more negatives than positives. The most common answer in the Subjective assessment form was *I am not able to say*. Hypothesis 3.1 was partially confirmed. The positive results of the subjective assessment correlated with higher test scores, and less positive subjective assessment correlated with lower test scores. However, many exceptions occurred, so hypothesis 3.2 was confirmed only partially.

This study proved that using mind maps learning strategy to extend vocabulary knowledge is effective. On average, all students improved their test-score from pre-test to post-test and post-post-test. Students retained the newly acquired information for one or two weeks when the post-post-test was facilitated.

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Appendencies

Lesson plan

Grade: Year 8+9

Level of English: B2-C1

Materials: paper to draw mind maps for each student (mind-map 1 and 2), a board to draw big mind maps, marker, pictures of superpowers, emoji, adhesive gum or tape, pre-test and post-test for each student.

The topic of the lesson: Interjections and superpowers

Main aims:

1. **Interjections**

- Students can use the exclamations ***phew, yikes, gee, ouch, pow, and wham*** in the appropriate context to express emotions and describe sounds.
- Ss can use the phrasal verb ***gee somebody up*** in a sentence.
- Ss can name 3 synonyms of pain (suffering, agony, anguish, torture).

2. **Superpowers**

- Ss can name at least six superpowers.
- Ss can explain the word ***telekinesis*** and use the word in a sentence.

Subsidiary aims: Ss can use the mind-mapping learning strategy to extend vocabulary knowledge

Time needed	**Activity**	**Material and aids**	**What a teacher does** (+ instructions)	**What do learners do**	**Interaction patterns**	**Objectives** (its relations to the overall aim)
5	**Introduction**		Announce the lesson aims and introduce yourself	Ss sit in their desks and listen to the teacher	T->Ss	To know what to expect
7	**Pre-test**	A copy of the test for each student.	T monitors the Ss	Ss fill in the test	Individual work	to assess the current level of knowledge of each student
5	**Superpowers you know**	Mind map 1  A marker	T asks what superpowers Ss know, listens to Ss' answers and reacts to them; T leads the discussion.	Ss name superpowers. The speaker always writes down the name of the superpower on the board and draws a picture underneath the name. Ss listen to their classmates and draw their mind maps using their classmates' ideas.	The whole class together	to activate students' current state of knowledge about superpowers

5	**More superpowers**	Envelope 1 with names of superpowers, another envelope with matching emojis/pictures Mind map 1	The T explains the task. Then, the T listens to Ss and their descriptions of the superpowers, T gives hints, if necessary, T makes sure that Ss picks the right picture and monitors the Ss that they copy the mind maps from the board. The T elicits the meaning and appropriate usage in a sentence of the word *telekinesis*.	Ss choose a name of a superpower from envelope 1, choose the right picture from envelope 2, describe the superpower in their own words, and glue the picture and the name in the mind map on the board. Ss copy the names of the superpowers and the pictures into their mind map.	A S to the whole class	To be able to name six superpowers. To be able to explain the word *telekinesis* and use it in the sentence
6	**Interjections - Basic Ordering Ideas** Ss create a second mind map, "Interjections."	Mind map 2 	T asks: What can interjections express?	Ss come up with their ideas, for example, pain, sounds, happiness, fear, guilt, surprise, and relief … and write down examples of exclamations they know.	A S to the whole class and individual work	to know what interjections can express.

		Envelope 3 with Basic Ordering Ideas	The T fills in the big mind map with the ideas (+draw emoticons) using the pictures in the envelope.	Ss fill in their mind map with their ideas and examples+draw emoticons.		
3	**Synonyms of the noun pain**	Small cards with the synonyms	The T asks the students where to place anguish, suffering and torture in the mind map.	Ss add synonyms of the noun ***pain*** into the mind map (anguish, torture, agony). Ss fill in the mind map with the words.	A S to the whole class + individual work	To know the meaning of the word ***anguish, torture*** and ***agony***.
7	**Interjections - Examples**	Envelope 4 Mind map 2	T gives Ss one of the following exclamations with the corresponding emoticon. - **ouch** - something hurts - **yikes** - expresses alarm, extreme emotions of surprise or disgust	Ss get an exclamation and a corresponding emoticon. They read the interjection, place it in the mind map to the right emotion, and explain what	A S to the whole class	To know the meaning and appropriate usage of the interjections *yikes, gee, phew, pow, wham, ouch.*

			- **gee** - expresses surprise, sympathy and admiration, / - **phew** - expressing relief, /fjuː/ - **pow** - a word that represents the noise of an explosion as a gun being shot /paʊ/ - **wham** - the sound of punching	the exclamation expresses. Ss fill in their own mind map with the interjections		
2	**Phrasal verb**	Mind map 2	T elicits or explains the meaning of the phrasal verb-> **gee sb. up** /dʒi/ -> to encourage someone, and uses the word in a sentence	Ss fill in the phrasal verb in their mind map	T->Ss	To be able to use the phrasal verb to *gee sb. up* in the appropriate context
2	**Sum-up**		The T sums up the lessons - Ss learnt to name superpowers and learnt interjections which express certain feelings and describe certain sounds. The T wipes the board so Ss can't copy the words when writing the test. The T calls for questions.	Ss can ask questions	T->Ss	To know what was covered in the lesson

7	**Post-test**	Post-test for each student	The T monitors the Ss	Ss fill in the test	Individual work	To check the lesson aim
2	**Close-up the lesson**		The T appreciates Ss' hard work.			To end on a positive note

If we have time, watch this video: https://www.youtube.com/watch?v=9kPkTncSxCM&t=3s - students circle mentioned superpowers in their MM; ask the ss what superpower would they like to have and why: If I had…, I would….

Attachments:

1. Mind map 1: Superpowers
2. Mind map 2: Interjections
3. Envelope 1: Names of superpowers
4. Envelope 2: Pictures of superpowers
5. Envelope 3: Interjections

SUPERPOWERS

INTERJECTIONS

invisibility

telekinesis

telepathy

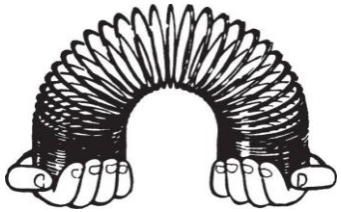
regeneration

elasticity

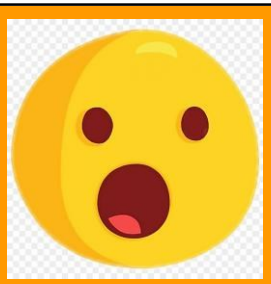
superhuman strength

to teleport

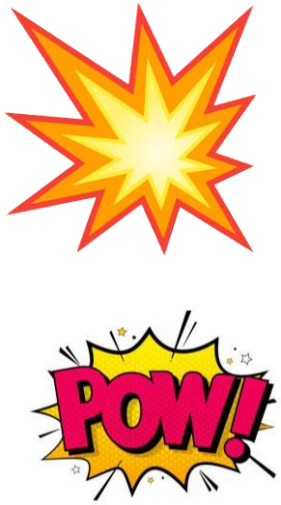
Envelope 2: Pictures of superpowers



Envelope 3: What can exclamations express?

 pain	 fear	 happiness	 surprise
 Relief			

Envelope 4: Interjections

Pre-test

Date: **Name:**

Question 1

Fill in the words from the speech bubbles in the right sentence.

.

1. ……! I'm so glad I don't have to give that speech. (expressing relief)
2. ……! I didn't see you there. (expressing shock)
3. Suddenly, we heard ……. – like a shot being fired.

Question 2

Fill the gaps with the correct words.

1. ….. up, Kate! You look tired!

   A. cheered B. encourage C. gee D. better

2. The boys in the cartoon were punching each other - ....., zap! (describe the sound)

   A. oops B. woah C. wham D. yeez

Question 3

Provide synonyms of the noun ***anguish***.

1.

2.

3.

Question 4

Explain the word ***telekinesis*** and use it in a sentence.

Explanation:……

Your sentence:.....

Question 5

Name 6 superpowers:

1. 4.
2. 5.
3. 6.

Self-assessment

How did you do? Evaluate yourself:

Post-test

Date:

Name:

Question 1

Fill in the words in the right sentence

.

1. ……. What a relief!
2. …….! I didn't see you there. (expressing shock)
3. When I shout "....." that means I've shot you, and you have to pretend to be dead.

Question 2

Fill the gaps with the correct words.

1. Lionel Messi, ….. up by his early goal, scored another.

A. cheer B. hiked C. geed D. better

2. The bombs went down — …… ! — right on target. (describe the sound)

A. oops B. woah C. wham D. yeez

Question 3

Provide synonyms of the noun ***torture***.

1.

2.

3.

Question 4

Explain the word ***telekinesis*** and use it in the sentence.

Explanation: ……

Your sentence:

……

Question 5

Name 6 superpowers:

1. 4.
2. 5.
3. 6.

Self-assessment

How did you do? Evaluate yourself:

Post-post-test

Name:
Date:

Question 1
Fill in the words from the speech bubbles in the right sentence.

.
1. ……! I'm glad it's sorted out. (expressing relief)
2. …….. I didn't see you there!
3. ……. The dynamite lit by the railroad workers blasted through the mountainside.

Question 2
Fill the gaps with the correct words.

1. The players wore combat gear and ……. up the supporters beyond acceptable levels.

made encouraged geed better

2. Everything seemed fine and then - .....! He punched me in the face.

awww gee wham crunch

Question 3

Write three synonyms of the noun ***anguish***.

1. 2. 3.

Question 4

Explain the word ***telekinesis*** and use it in a sentence.

Explanation:……

……

Your sentence:.....

……

Question 5

Name six superpowers:

1. 4.
2. 5.
3. 6.

Self-assessment

How did you do? Evaluate yourself:

Subjective Assessment Form

Answer each question by placing a checkmark in the appropriate box. You can add comments to explain your answers.

	Strongly agree	Agree	I don't know / I am not able to say	Disagree	Strongly disagree	Your comments:
1. Mind mapping was easy to do.						
2. Mind mapping enhanced my creativity, e.g. I can use newly acquired words in essays more easily.						
3. Mind mapping was an efficient strategy for learning and remembering vocabulary.						
4. I enjoyed learning vocabulary with mind maps more than writing vocabulary lists.						
5. Mind mapping helped me put my ideas in some order.						
6. Mind mapping helped me to remember vocabulary items because I'm a visual learner (=I learn new things using pictures more easily).						
7. Mind mapping enhanced my learning.						
8. I enjoyed mind mapping.						
9. I had sufficient time to complete my mind maps, so I can imagine using this technique to learn new English vocabulary.						

10. How often do you use mind maps when learning new English vocabulary?	Never	Rarely	Sometimes	Often	Always	
11. I would like to use mind mapping more often at school to learn and practise English vocabulary.						

You can write even more comments about the lesson here:

Thank you for your participation and feedback!

Data tabulation

Student	Item	Pre -test	Post-test	Post-post test
1B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	0	0
	02.II	1	1	1
	3	1	3	3
	04.I	0	1	1
	04.II	0	1	1
	5	6	6	6
	Sum	11	15	15
2B	01.I	0	0	0
	01.II	0	1	1
	01.III	0	0	1
	02.I	0	1	1
	02.II	1	1	1
	3	0	3	0
	04.I	1	1	1
	04.II	0	0	1
	5	6	6	6
	Sum	8	13	12
3B	01.I	0	1	0
	01.II	0	1	1
	01.III	0	1	1
	02.I	0	1	0
	02.II	1	1	1
	3	0	0	0
	04.I	1	1	1
	04.II	0	1	1
	5	2	6	6
	Sum	4	13	11
4B	01.I	0	1	1
	01.II	1	1	1
	01.III	0	1	0
	02.I	0	0	0
	02.II	0	1	1
	3	0	0	0

	04.I	0	0	0
	04.II	0	0	0
	5	4	5	4
	Sum	5	9	7
5B	01.I	1	1	1
	01.II	0	0	1
	01.III	0	1	1
	02.I	0	1	0
	02.II	0	0	1
	3	1	3	2
	04.I	1	1	1
	04.II	1	1	1
	5	3	6	6
	Sum	7	14	14
6B	01.I	0	1	1
	01.II	0	0	0
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	1	0
	3	0	0	0
	04.I	0	0	0
	04.II	0	0	0
	5	2	3	4
	Sum	4	7	7
7B	01.I	0	0	1
	01.II	0	0	1
	01.III	0	0	1
	02.I	0	0	0
	02.II	0	0	0
	3	0	0	0
	04.I	0	0	0
	04.II	0	0	0
	5	2	6	5
	Sum	2	6	8
8B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	1	1
	3	0	3	2

	04.I	0	1	1
	04.II	0	1	1
	5	5	6	6
	Sum	9	16	15
9B	01.I	0	1	1
	01.II	0	1	1
	01.III	1	1	1
	02.I	0	0	1
	02.II	0	0	0
	3	0	1	0
	04.I	0	1	1
	04.II	0	1	1
	5	4	6	5
	Sum	5	12	11
10B	01.I	1	1	1
	01.II	0	1	1
	01.III	0	1	0
	02.I	0	1	0
	02.II	0	1	1
	3	0	0	0
	04.I	0	0	1
	04.II	0	0	0
	5	4	4	5
	Sum	5	9	9
11B	01.I	0	1	0
	01.II	0	1	1
	01.III	0	1	1
	02.I	0	0	0
	02.II	0	0	1
	3	0	0	0
	04.I	1	1	1
	04.II	1	1	0
	5	0	3	4
	Sum	2	8	8
12B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	1	1
	3	1	1	0

	04.I	0	0	0
	04.II	0	0	0
	5	0	5	5
	Sum	5	11	10
13B	01.I	0	1	1
	01.II	0	1	0
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	1	1
	3	0	2	0
	04.I	0	1	1
	04.II	0	1	0
	5	6	6	6
	Sum	8	15	11
14B	01.I	0	0	0
	01.II	0	1	0
	01.III	0	0	1
	02.I	1	1	0
	02.II	0	0	1
	3	0	0	0
	04.I	0	0	0
	04.II	0	0	0
	5	0	0	1
	Sum	1	2	3
15B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	0
	02.I	0	1	0
	02.II	1	1	1
	3	0	1	0
	04.I	1	1	1
	04.II	1	1	1
	5	2	4	6
	Sum	8	12	11
16B	01.I	0	1	1
	01.II	1	1	0
	01.III	1	1	0
	02.I	0	1	1
	02.II	0	0	1
	3	0	0	0

	04.I	0	1	1
	04.II	0	1	1
	5	6	6	5
	Sum	8	12	10
17B	01.I	0	0	1
	01.II	1	1	1
	01.III	0	0	0
	02.I	0	1	0
	02.II	0	1	1
	3	1	0	0
	04.I	0	0	0
	04.II	0	0	0
	5	4	6	6
	Sum	6	9	9
18B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	0
	02.II	1	1	1
	3	1	3	3
	04.I	1	1	1
	04.II	1	1	1
	5	6	6	6
	Sum	13	16	15
19B	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	0	0
	02.II	0	1	0
	3	0	1	1
	04.I	0	1	0
	04.II	0	0	0
	5	6	6	6
	Sum	9	12	10
20B	01.I	1	1	1
	01.II	1	1	1
	01.III	0	1	1
	02.I	0	1	0
	02.II	0	0	0
	3	0	2	0

	04.I	0	1	1
	04.II	0	1	1
	5	4	4	5
Sum		6	12	10
21B	**01.I**	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	0	1
	02.II	1	1	1
	3	0	3	0
	04.I	0	1	0
	04.II	0	1	0
	5	6	6	6
Sum		10	15	11
22B	**01.I**	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	1	1	0
	02.II	1	1	1
	3	0	2	2
	04.I	1	1	1
	04.II	0	0	1
	5	1	6	6
Sum		7	14	14
23B	**01.I**	0	1	1
	01.II	0	1	1
	01.III	0	1	1
	02.I	0	0	0
	02.II	0	1	1
	3	0	2	0
	04.I	0	0	1
	04.II	0	0	1
	5	6	6	5
Sum		6	12	11
24B	**01.I**	0	0	0
	01.II	0	1	0
	01.III	0	0	1
	02.I	1	1	1
	02.II	1	1	1
	3	0	0	0

	04.I	1	1	1
	04.II	1	1	1
	5	6	6	6
Sum		10	11	11
1A	**01.I**	1	0	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	1	1	1
	02.II	1	1	0
	3	0	0	0
	04.I	1	1	1
	04.II	0	1	1
	5	6	6	6
	Sum	12	12	12
2A	**01.I**	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	0	1
	02.II	0	1	1
	3	0	1	0
	04.I	0	0	1
	04.II	0	0	1
	5	6	6	6
	Sum	9	11	13
3A	**01.I**	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	0	0
	02.II	0	0	0
	3	0	0	0
	04.I	0	0	0
	04.II	0	0	0
	5	3	6	6
	Sum	6	9	9
4A	**01.I**	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	1	1
	3	0	0	0

	04.I	0	1	1
	04.II	0	1	1
	5	6	6	6
	Sum	10	13	13
5A	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	0
	02.II	0	0	1
	3	0	1	0
	04.I	0	1	1
	04.II	0	1	1
	5	4	6	6
	Sum	7	13	12
6A	01.I	1	1	0
	01.II	1	1	1
	01.III	1	1	1
	02.I	0	1	1
	02.II	1	0	1
	3	0	0	0
	04.I	1	1	1
	04.II	0	0	0
	5	4	6	6
	Sum	9	11	11
7A	01.I	1	1	1
	01.II	1	1	1
	01.III	1	1	1
	02.I	1	0	0
	02.II	1	1	1
	3	0	2	2
	04.I	1	1	1
	04.II	1	1	1
	5	6	6	6
	Sum	13	14	14