

# **Teaching Greek and Latin Roots to Premedical Students with Mind-Mapping Software**

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## Abstract

The article shows how mind-mapping software can be used to help premedical students learn, apply and relate terminology sharing Greek and Latin roots. Mind-mapping software use a center, branches, and sub-branches to show connections between Greek and Latin roots generated on the mind map. Instruction with the mind-mapping software goes through the following stages: Orientation, presentation and modeling, guided practice, independent practice and assessment. Further details are given in the article.

**Keywords:** *mind mapping, concept mapping, medical terminology, premedical students, English for medical purposes, roots, prefixes, suffixes, morphological mind maps, phonological mind maps, syntactic mind maps, semantic mind maps.*

## 1. Introduction

Mind maps are type of graphic organizer in which the major branches representing major categories radiate from a central idea or topic and sub-categories are represented as sub-branches of main branches. They can be used to generate and organize ideas and information and improve memory. They are a powerful tool that teachers can use with students to enhance and create a foundation for students' learning. They are helpful for visual learners because illustrative tools that help with organizing thought, making connections between ideas and directing students' learning. They constitute a skill that is suitable for all ability levels and all subject areas. Using the e-mapping technique gives instructors the freedom to show interrelationships between the subject matter of a course and concepts in a very visual, clear and nonlinear structure that is lucid and beneficial for all students. Mind mapping has considerable utility for tracking changes while students are learning and has the capacity to distinguish between meaningful changes that those that are not. Surface, deep, and non-learning are tangible measures of students' learning that can be observed directly as a result of mind mapping (Buzan, 2000; Goldberg, 2004; Budd, 2004; Hay, 2007; Stephens and Hermus, 2007; Ruffini, 2008).

In a study by Nesbit & Adesope (2006) in which they reviewed experimental and quasi-experimental studies of students in grade 4 to postsecondary who learned by constructing, viewing and modifying, node-link diagrams and used mind maps to learn psychology, statistics, science, and nursing revealed that across several instructional conditions, settings, and teaching techniques, use of mind mapping resulted in increased retention of information.

In second and foreign language learning contexts, Chularut and DeBacker (2003) explored the impact of using mind maps as a language learning strategy. Their results revealed a statistically significant interaction of time, instructional method, and English proficiency level for self-efficacy, self-monitoring, and achievement. For all four outcome variables, the mind mapping experimental group showed significantly more gains in the post-test than the individual study control group. Students who used context, morphology, background knowledge, and dictionaries learnt vocabulary more effectively and were able to

adapt a vocabulary map consisting of 8 identical bubbles to provide students with a vocabulary map, vocering most of the elements to clarify word meaning which is significant in vocabulary acquisition (Rosenbaum, 2001). When bilingual knowledge maps were used as tools for learning German-English word pairs by 72 undergraduate students, the bilingual knowledge map learners outperformed list learners on all dependent variables (Bahr and Dansereau, 2001).

In teaching English to premedical students who are non-native speakers of English, a review of the literature indicated that there is a great need for integrating mind-mapping techniques in the teaching and learning medical terminology. Results of a questionnaire showed that students studying at the Nelson R. Mandela School of Medicine, in Durban, South Africa reported that they lacked the basic conceptual foundations necessary for learning and understanding their physiology course. The students mainly identified terminological and conceptual difficulties (Tufts and Higgins-Opitz, 2009). Since pre-medical students, in general, and Saudi pre-medical students, in particular, have difficulties learning medical terminology, the current study aims to show instructors how a free mind-mapping software can be used to create to help premedical students connect, combine, apply, learn, retain, and relate the different medical terms sharing the same root/base and/or the same prefix or suffix, medical term cognates, derivatives of the same medical term, Latin and Greek singular and plural forms of medical terms, and medical terms with similar pronunciation. It shows instructors how the mind-mapping software can be applied to attach different prefixes and/or suffixes to the same root, different roots to the same prefix and/or suffix, sorting out, classifying, grouping terms according to the prefixes, roots or suffixes that they share, and interpolating medical prefixes, roots and suffixes. By focusing on roots, prefixes, suffixes and derivatives and then looking for branches on the mind map that radiate out from the center and show connections between medical terms, the students can map medical terminology knowledge in a way which will assist them in understanding and retaining new medical terms in their courses.

For students majoring in medicine, dentistry, pharmacy, applied medical sciences, i.e., knowledge of medical terminology is an important element. Learning new medical terms will enhance students' listening, speaking, reading, and writing ability and will improve their comprehension and production ability in English for medical purposes. Nassaji (2004) found that students learning English as a foreign/second language who have deeper vocabulary knowledge make more effective use of certain types of lexical inferencing strategies than weaker students. Depth of vocabulary knowledge made a significant contribution to the students' inferential ability than the contribution made by the students' degree of strategy use. August, Carlo, Dressler & Snow (2005) also found that English language learners who experienced slow vocabulary development were less able to comprehend texts at their grade level than their English-only classmates. Such learners were likely to perform poorly on assessments in these areas and were at risk of being diagnosed as learning disabled.

## **2. Context**

In Saudi Arabia, Arabic is the medium of instruction in public schools until the end of secondary school. English is the medium of instruction in colleges of medicine, pharmacy, applied medical sciences and engineering. In their pre-medical year, students take English for medical purposes (8 hours a week) and foundation courses such as physics, biology, and biochemistry in English and they encounter too many new medical terms that are new for them. In addition to reading simplified medical texts and grammar, pre-medical students study basics of medical terminology in their English for medical purposes course.

Results of a questionnaire-survey administered to a sample of pre-medical students at Umm Al-Quara University in Makkah, Saudi Arabia indicated that medical terminology constitutes a major difficulty for beginning pre-medical students. Pre-medical students reported that they have problems in pronouncing, recognizing the component parts of medical terms and what each part means. They have difficulty in connecting the different medical terms derived from the same root/base; in recognizing, relating, and distinguishing the different derivatives of a medical term, and spelling changes that take place when combining prefixes, roots/bases and suffixes to form medical terms.

### 3. Curriculum, Tasks and Materials

Instructors teaching English for pre-medical students in Saudi Arabia use materials developed in-house, in addition to few chapters selected from published medical terminology textbooks. The number of medical terms covered is too limited and is insufficient for enhancing the premedical students' knowledge of medical terms to a level that would enable them to read and comprehend authentic medical texts and listen to and comprehend medical lectures delivered in English, and recognizing and relating the singular and plural forms of Latin medical terms.

#### 3.1 Skills Emphasized

The medical terminology component of the English for Medical Purposes course that pre-medical students take aims to develop the students' ability to identify the following:

- Basic structure of medical terms: Word root, suffix, prefix, combining vowel or consonants as in *cardiogram, electrocardiogram, gastric, epigastritis, transgastritis, gastrointestinal*.
- Phonetic change that takes place when a prefix is added before certain consonants as in *apt: aptitude. Ept: inept*).
- Prefixes and Suffixes added to Latin bases such as:
  - *Dia: Diagram, diagnosis, diastole, diaphragm*
  - *Epi: Epiglottis, epigastric, epigram*
  - *Para-: Parathyroid, paranormal, paramedical, paratyphoid, paraplegia*
  - *Pro: Program, prognosis*
  - *Psych: Psychology, psychopath, psychometry, psycholinguistics, psychoanalysis, psychosis*
  - *Tele: Telegraph, Telescope, Telegram, Telecast*
- Affixes referring to quantity such as:
  - *Biceps, triceps, quadriceps.*
  - *Double, triple, quadruple, quintuple.*
  - *Liter, centiliter, milliliter, deciliter.*
  - *Million billion, trillion, quadrillion quintillion.*
  - *Replicate, Duplicate, triplicate, quadruplicate, centuplicate.*
  - *Twin, triplets, quartet, quintet.*
  - *Uniped, biped, tripod, centipede, millipede.*
- Negative prefixes *in-, im-, il-, ir-, non-, un-, a-, an-, anti-, de-, mal-, mis-* as in:
  - *Antacid, antitoxic, antiseptic.*
  - *Atrophy, apathetic, amorphous, amnesia.*
  - *Disinfect, disconnect, disease.*
  - *Illegal.*
  - *Immature, immune, immutable, immense, immortal, impossible.*
  - *Insomnia, incurable, intolerable, inglorious, incomplete.*

- *Irregular, irreversible, irresistible, irreparable.*
- *Malodorous, malignant, malpractice, malady, malnutrition, malicious.*
- *Misuse, mislead, misplace.*
- *Non-alcoholic, non-smoker.*
- *Unhealthy, unpleasant, uncommon.*
- Derivatives sharing the same base such as:
  - *Circle, circulate, circulation, circulatory.*
  - *Motive, motivate, motivation.*
- Opposites such as: *interior ≠ exterior; anterior ≠ posterior.*
- Latin singular and plural forms of medical terms such as: *bacterium > bacteria; stratum > strata, radius > radii; phenomenon > phenomena; vertebra > vertebrae; analysis > analyses.*
- Medical acronyms and abbreviations such as: *DNA, RBC, IV, OR, UV, MRI, IQ, MD, GP, ER, BP.*

### 3.2 Instructional Strategy with the FreeMind Software

There are 5 stages for *in-class* instruction with *FreeMind*: (i) Orientation, (ii) presentation and modeling, (iii) guided practice, (iv) independent practice, and (v) assessment. Each stage is explained in below.

#### 3.2.1 Orientation

To help pre-medical students categorize, visualize, and recall relationships among medical terms under study, a mind mapping software called “*FreeMind*” can be integrated in *in-class* medical terminology instruction. In the first week of classes, premedical students are introduced to the *FreeMind* software and the purposes of using it. They are given the link to the *FreeMind* software and are asked to download *it* free of charge. The components and tools in the *FreeMind* homepage are introduced and explained.

#### 3.2.2 Presentation and Modeling

The instructor can train students to use the *FreeMind* software using a smart board or an LCD projector. Every week the software is used to create mind maps for the medical terms to be covered or those that have been covered with the help of the instructor. The following types of mind maps can be created: (i) *Morphological mind maps* which focus on words or word parts sharing the same prefix, suffix, roots, forms derived from the same word or root (derivatives), word families, and singular and plural form. (ii) *Phonological mind maps* that focus on words sharing the same pronunciation; (iii) *Semantic mind maps* which focus on synonyms and antonyms and words categorized according to the part of the body, system, disease ...etc. (iv) *Syntactic mind maps* that focus on parts of speech, sentence types, question types, types of tenses, prepositions, articles, types of nouns, and others.

A mind map begins with placing a target concept or category in the middle of the screen. This concept or medical term category is used as a basis for grouping, categorizing and sub-categorizing medical terms. Branches radiating from the central medical terminology category are drawn for the sub-categories and examples of medical terms sharing the same category or rule. Sub-categories, example medical terms are elicited from students, grouped into related sub-categories and placed radiating out from the central category. The instructor introduces new terms and related concepts attached to them. For example, the instructor places the target terminology category “*negative prefixes and suffixes*” in the middle of the screen. Branches and nodes are created for ‘*a- an-, in-, il-, im-, ir-, dis-, de-, anti-, -less*’. For each prefix or suffix, a list of medical terms is prepared with the help of the students. Terms

containing each negative prefix or suffix expand outwards into branches and sub-branches. Examples medical terms containing those prefixes or suffixes expressed are selected and printed using upper- or lower-case letters. Each term sits alone on its own line. The lines are connected, starting from the central focus (See Mind map 2).

Mind map 1 shows an example of a phonological mind map. The central focus is on pronunciation. Each main branch on the mind map represents one silent letter or double letters and the medical terms that radiate from each main branch are examples containing that particular silent letter, or double letters. Mind maps 2, 3, 4 & 5 show morphological relations, mind map 6 shows syntactic relations, and mind maps 7, 8 & 9 show semantic relations. Colors are used throughout the mind map. Associations are shown in the mind map terminology mind map clear by using a radiant hierarchy, numerical order or outlines to embrace branches representing the subcategories. The central lines of the mind map are made thicker, organic and flowing, becoming thinner as they radiate out from the center of the mind map.

The students develop their personal style of medical terminology mind maps. They draw empty lines, collect the words, and classify them. They change colors to reenergize their mind. Sometimes the students are able to see relationships and connections between the different medical terms immediately and can add sub-branches to a category and label them. Sometimes the students cannot, so they can just connect the subcategories (subbranches) to the central focus. Organization always comes later; the first requirement is to get few terms and categories out of their head onto the screen.

While students are engaged in the mind mapping activity, the instructor serves as a facilitator. She provides technical support, answers students' questions and helps with the mind maps, subcategories, examples representing each category in and out of class.

### **3.2.3 Guided Practice**

Out of class, the students can use the *FreeMind* software to practice connecting new medical terms studied in class with medical terms that they already know. They keep their morphological, phonological, semantic, and syntactic mind maps. They continue to add subcategories and related terms to each map, every time a lesson is covered in class. With the help of the ESP instructor, the students make medical term lists and add terms related to each phonological, morphological, syntactic, or semantic mind map. New features, categories, skills are explored and added through discussion.

### **3.2.4 Independent Practice**

The students continue to use *FreeMind* at home and continue to add words related to each. The students are handed out questions that require them to group, classify or connect the medical terms they have studied on their own in class or at home. Mind maps can be created and added during and after reading medical texts in the different courses.

### **3.2.5 Assessment**

Students can keep their medical terminology mind maps in a folder or e-portfolio. Mind maps created by the students can be posted in an online course as well. They can exchange mind maps and may work on mind maps collectively.

## **4. Conclusion**

The present study shows how the *FreeMind* software is used in grouping, categorizing, and classifying medical terms on the basis of phonological, morphological, syntactic or semantic categories. Those mind maps can be used in introducing, categorizing,

visualizing, and reviewing medical terms and as mnemonic devices. Through the graphic depiction of words, these mind maps build upon what students know to help them see relationships with newly introduced medical terms. Students develop related rather than isolated knowledge of medical terms and develop skill in differentiating concepts as well as defining words.

These mind mapping strategies have been reported to improve word and concept knowledge as well as comprehension across grade levels, in a variety of content areas, and with a variety of learners, including struggling ESL, and learning-disabled readers.

Semantic mapping increases cognitive processing and develops the cognitive structure. Semantic mapping that involves the application of medical terms meanings with pre-medical students is highly motivating for adult students because it allows them to interact with their instructor regarding the context of the lesson, rather than merely on a specific point of skill development. The ultimate goal of semantic mapping is to introduce the students to a technique that they can use regularly to organize medical terms they have studied, relate what they already know, and expand their store of knowledge of medical terms while reading medical texts.

It is noteworthy to say that the aim of creating mind map using the mind mapping software is not to teach the students how to apply the details of the *FreeMind* software. Focus should be on placing a phonological, morphological, semantic and syntactic category that would be used as a basis for grouping and classifying medical terms in the center, how to add branches for the related medical terms, how to add pictures and change the font color, size and case and enclose branches in a cloud.

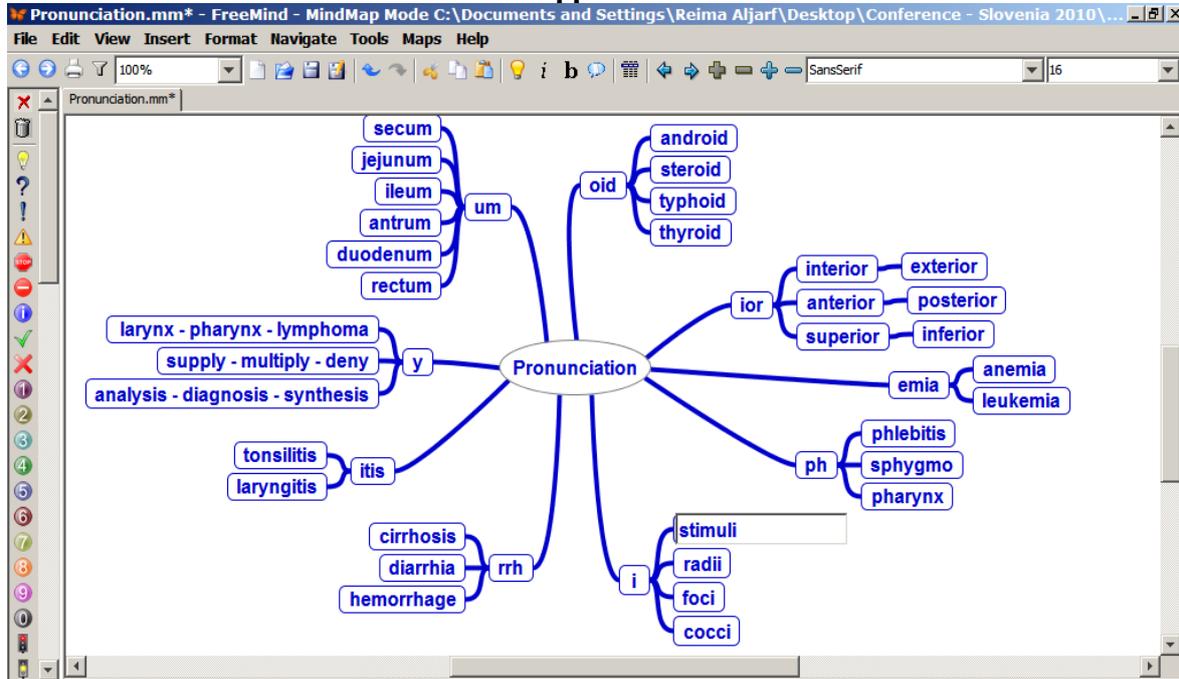
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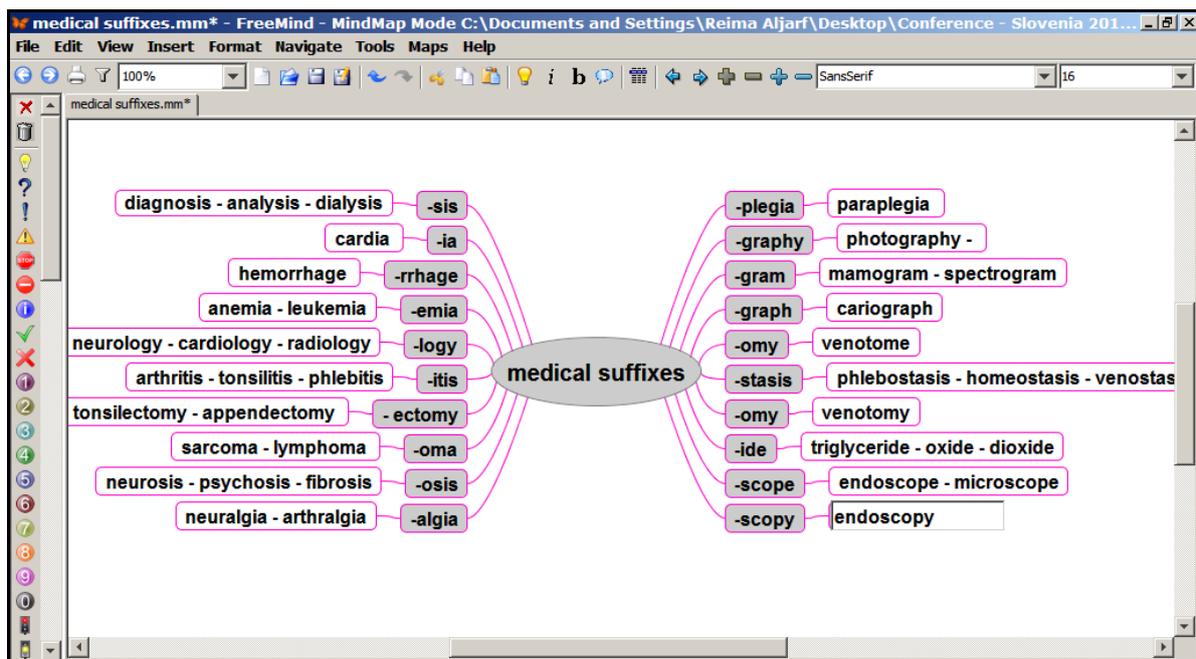
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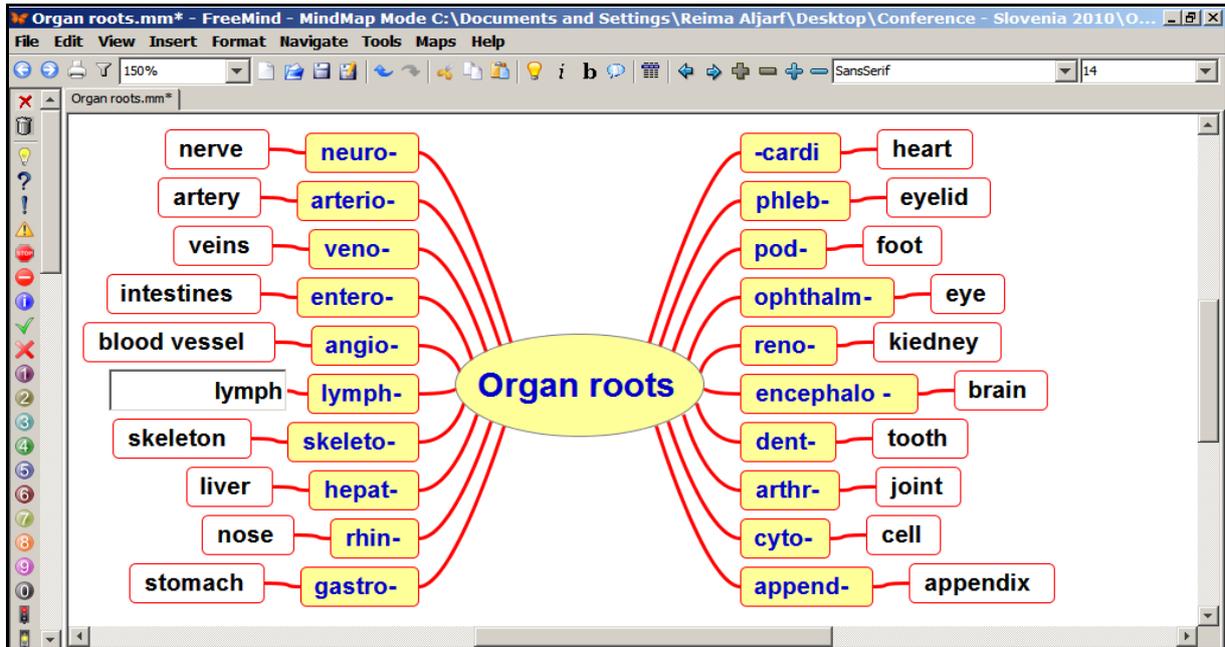
### Appendix



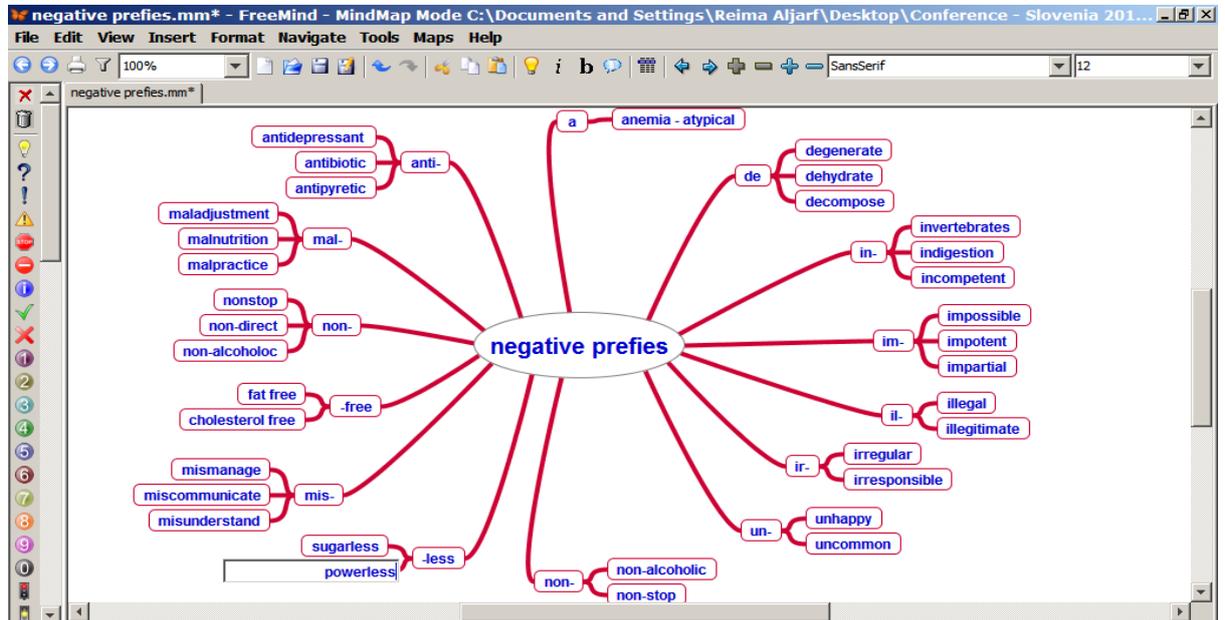
Mindmap (1): Pronunciation



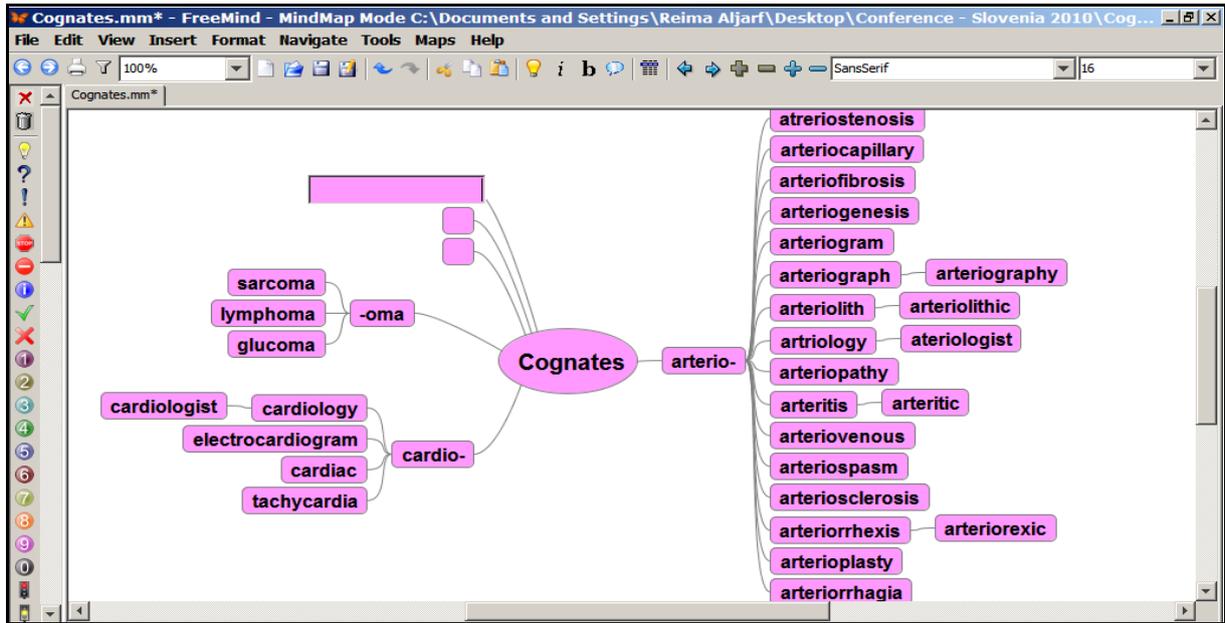
Mindmap (2): Medical Suffixes



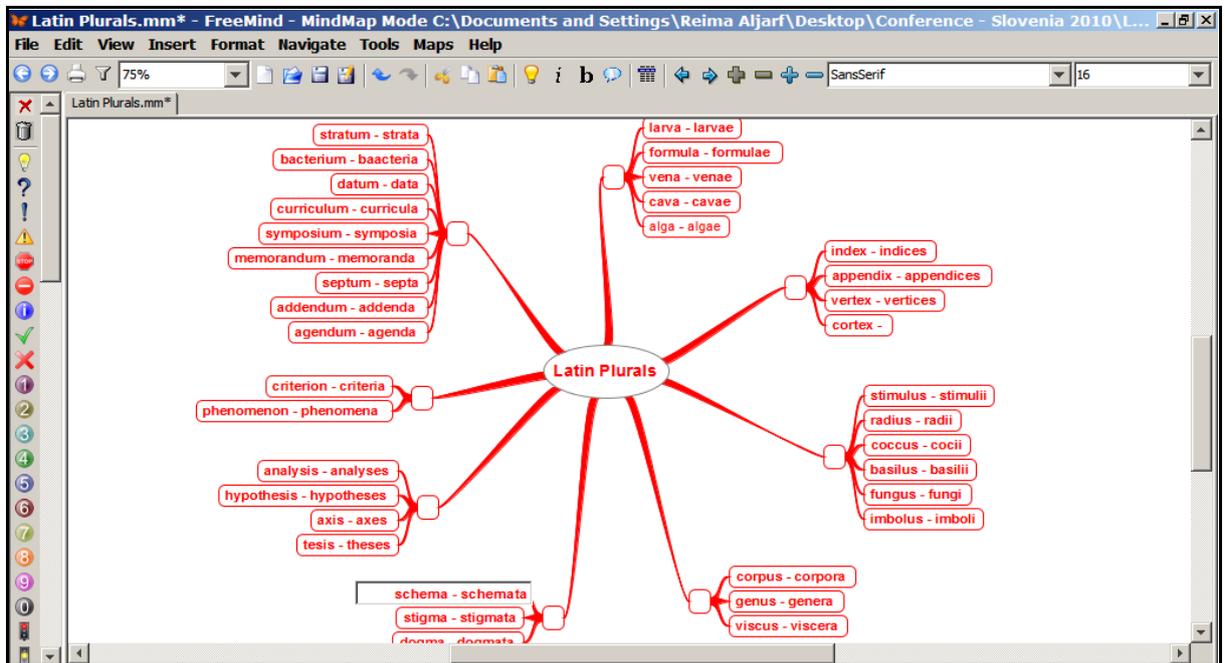
Mindmap (3): Organ Roots



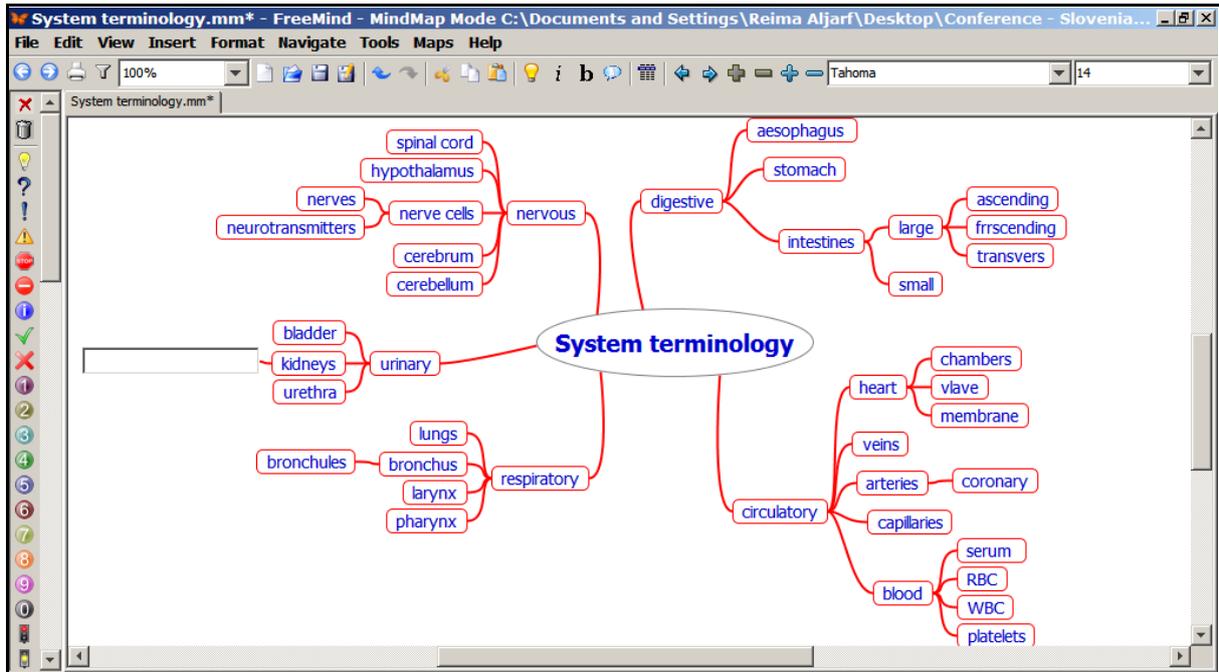
Mindmap (4): Negative Prefixes



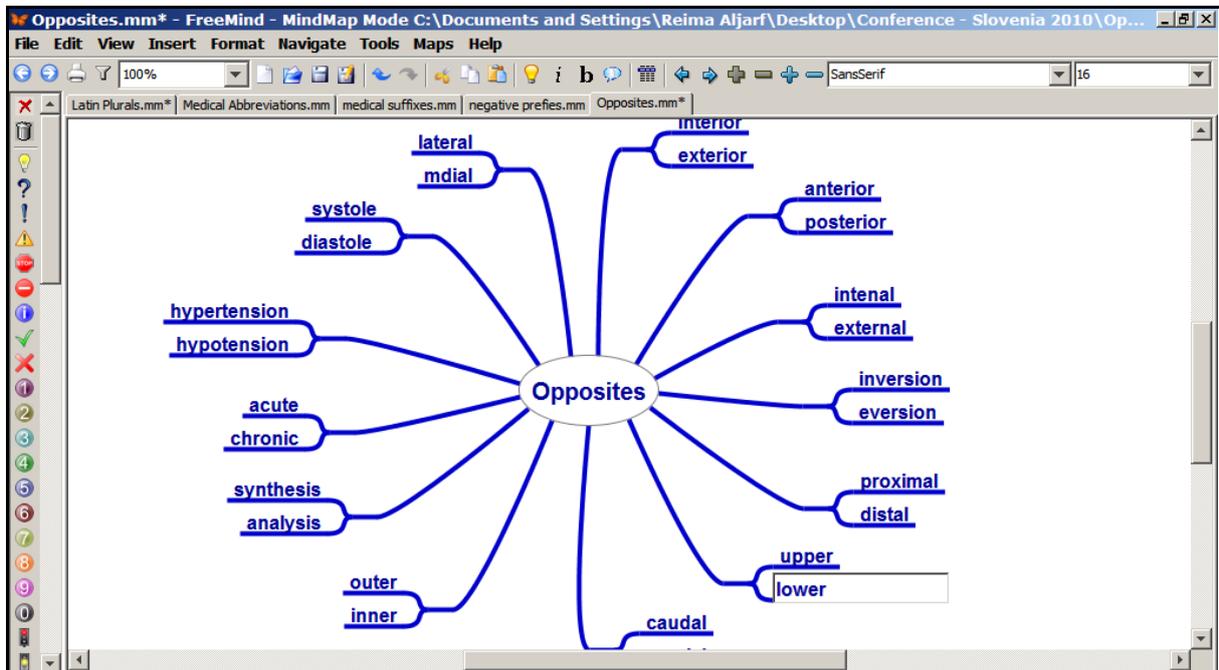
Mindmap (5): Medical Term Cognates



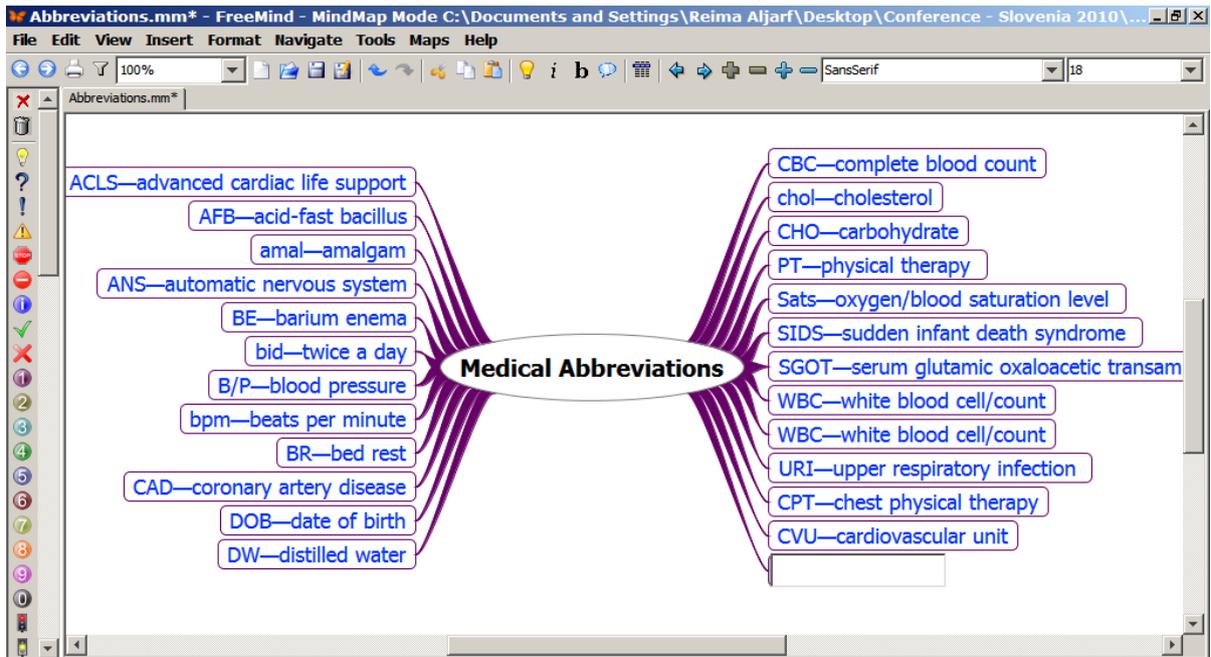
Mindmap (6): Singular and Plurals forms of Latin Terms



**Mindmap (7): System Terminology**



**Mindmap (8): Opposites**



**Mindmap (9): Medical Abbreviations and Acronyms**