

# Using Word Associations in Learning the Human Biology- A Case with Teacher Students of the Pre-school Education in Kosovo

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## ABSTRACT

**Background:** This research, which is the first one of this kind in Kosovo, deals with the use of associative tests in learning biology and in creating concepts, more concretely assessing students' knowledge on five main human body organs. This study aims to assess the use of free associations for five human body organs and to formulate conceptual sentences in order to assess teacher students' knowledge on biology and human body.

**Material and methods:** The research has been conducted with teacher students of third year of studies in the Preschool Education Programme. This research included 25 students, all females. The research took place before the period when students attend the part of the course that covers human biology. The research questionnaire consists of two parts: the first part includes written associations for each human body organ, whereas the second part is formulation of written conceptual sentences for those organs.

**Results:** The research resulted in 191 associations by respondents, with total frequency of 532 or an average of 4.2 associations per respondent. About half of the associations consisted of the 5 most frequent associations for each of the five organs. In the second part a total of 98 conceptual sentences were formulated with an average frequency of 3.9 sentences per respondent. The formulated sentences were grouped in 3 categories: regular biological sentences, sentences with misunderstandings about certain human body organs, and sentences from everyday life related to human body organs. Number of sentences that included misunderstandings related to the biology of respective human body organs was 18.

**Conclusions:** The relatively large number of associations for the five body organs was closely linked with the number of correct conceptual sentences written by students and it helps in learning biology more easily. Based on this, use of word associations in creating biological concepts may serve as a good methodological tool of assessment of learning outcomes in the subject of biology and should be promoted to new teachers. The research opens need for similar researches with teacher students of primary education level, but also teacher students' of biology subject in pre-university education system of the Republic of Kosovo.

**Keywords:** association, biology, frequency, concepts, organs

## INTRODUCTION

To understand how students transfer knowledge to their minds and how they structure this knowledge is one of the most important issues that researchers are interested in (Kurt, 2013). Constructive learning

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approach indicates that individuals construct knowledge actively through associating this knowledge with pre-existing knowledge and previous experiences (Anderson, 1992; Bodner, 1986). According to this approach, due to the associations with previous experiences, the existing cognitive structures in mind affect individuals' perceptions of new events and the new cognitive structures that they will construct.

The process of association making is at the heart of all types of learning, but the interpretation of the concept and the attitude to it depend very much on the theoretical bases upon which they are discussed. Associative processes take place at different levels of learning. They are those processes that lead to the development or maintenance of cognitive connections (associations) between events, behaviors, feelings, thoughts, visual images (Kostova, 2008)

The ability of the brain to make associations and facilitate learning and intellectual development has been studied and elucidated by many scientists. Some studied the nature of associations and the mechanisms of their building by the brain (Bain, 1894; Bradley, 1922; James, 1890; Pavlov, 1927). Others directed their investigations to associative memory (Hinton & Anderson, 1989; Maki, 2007; Willshaw, 1989), associative learning (Levine, 2000; Locke, 2000; Novak & Govin, 1984; Wills, 2005). Still others were attracted by word association technique (Colgan & McGuinness, 1998; Dollinger et al., 1991; Galton, 1880), cluster analysis and concept or mind map construction in teaching (Deese, 1966; Halford, 1993; Mervis & Rosh, 1981), association of emotions and thinking (Field, 2005; Zajonic, 1990).

The human conceptual system is characterized by two main concepts- category and schema. The visual representations of these concepts are concept maps (Novak & Gowin, 1984), mind maps (Buzan & Buzan, 1996), intellectual maps (Kostova, 1998, 2000). In science teaching students are asked to study scientific terms and then recall or recognize them when given words as test cues (Novak & Govin, 1984). In this activity several mental processes are involved: comparison, analysis, comprehension, model construction, elaboration, retrieval (Bruner, 1960). Conceptual mapping organizes learning at the level of conceptualization in the sense of the theory of constructivism, the foundations of which were laid by J. Piaget.

Most neo-Piagetian theorists of cognitive development incorporate the concept of relational mapping (Case, 1985, 1992; Halford, 1993; Pascual-Leone, 1987). Halford is the only neo-Piagetian who has formally proposed that analogy plays a central role in the development of logical reasoning, and who has linked analogical processes to performance in traditional Piagetian tasks. In his structure-mapping theory of cognitive development Halford proposed that most logical reasoning was analogical.

Word association is a powerful research technique, introduced by Galton (1880) and subsequently developed by Carl Gustav Jung for studying human conceptual systems. Galton looked for a link between a person's I.Q. (intelligence quotient) and word associations and did not find convincing data. Carl Jung theorized that people connect ideas, feelings, experiences and information by way of associations. According to him, ideas and experiences are linked, or grouped, in the unconscious in such a manner as to exert influence over the individual's behavior. These groupings he named complexes. Bahar (2003) provided following strategies to induce and measure conceptual understanding and change: word association, structured grid, diagnostic tree, concept maps, texts of conceptual change, analogy, and predict-observe-explain. On the other hand, alternative techniques such as surveys, interviews, concept maps, fortune lines, and word association tests are used to determine students' opinions, understanding, or attitudes towards a specific issue (Bahar et al., 2008; White & Gunstone, 1998).

Word association, also known as associative experiment (Davidov, 1983) is a test, consisting of a list of words, administered to the respondent, who has to answer to each word by means of the first word coming to his or her mind. This research technique has a long history and has been in use for more than a century. It can be of several types according to its structure, mode of application, aims etc. In controlled word association test the informant's response is constrained in terms of category, word class or concept for response selection. Free association test requires responses that are not restricted to any specific category or class of words. In discrete word association test each participant is asked to produce only a single associate to each word (Dollinger et al., 1991), while in continued association test the same stimulus word is presented several times at certain intervals for giving associative responses. When the stimulus word or the list of stimulus words is presented to the respondents only once and they are asked to give as many associations as they can in a pre-specified period of time, the test is called continuous. If the whole list of stimuli is presented several times, the test is called successive.

For solving a number of practical problems word association technique proved to be very valuable. It is applicable in public opinion research about the use of science in the field of inquiry to collect necessary

information about public likes and dislikes and use it in advertising and attracting the customers. It provides the possibilities to compare the first and the last word of associations, repetition of words and pathways of associations, treatment of people with some psychological problems, visualization of concept associations, using concept density maps, proper message by market researchers, level of anxiety of students in different classroom activities, conceptual knowledge organization (Colgan & McGuinness, 1998), effect of multimodal stimuli on associative learning, thesaurus construction (Spiteri, 2002), preverbal numerical competence (Jordan, 2008).

Word association technique applies different types of questionnaires: a table with two columns (first column – list of stimulus words, second column – associated words), sentence completion (a list of sentences to be finished with more than one example for each sentence, list of stimulus words with spaces to fill in the associated words at a given time under a given situation).

Category learning can be accomplished by means of multiple cognitive forms that depend on different brain systems: analogical reasoning (Goswami, 2001), concept clustering, concept hierarchies, connectionism. Taxonomies of concept hierarchies are crucial for knowledge-based systems, including natural sciences. Connectionism is a paradigm in cognitive science that is used in the fields of artificial intelligence and cognitive psychology, neuroscience (Knowlton, 1999) and philosophy of mind. The analysis of the mentioned studies supports the assumption that development and use of a word association test is a scientific technique for obtaining valuable and reliable results, whose interpretations can help to make some insights in understanding and assessing learners' conceptual systems. So far results from word association tests have not been used for concept maps construction.

The concept (intellectual) map is a “nonlinear diagrammatic representation of meaningful relationships between concepts” (DiCarlo, 2006), a mental model, a schematic representation, which is a hierarchical structure from interconnected words, ideas, problems, solutions, arranged around a key word in radial circles (Buzan & Buzan, 1996). It can represent a structure of concepts, derived from a textbook by means of content analysis or retrieved from the memory by means of association test or brain storming (Kostova, 1998, 2008; Novak & Govin, 1984).

Constructing concept (intellectual) maps is a useful teaching and a learning method for systematizing and organizing not only the concepts under study, but also the already learned concepts. It is used to create a context for incorporation of new knowledge, for reconstruction of already acquired cognitive experience (Bruner, 1960), or for building a new system of meanings of our external world after Vygotsky. It is radial, spatial, with increasing concentric circles from groups of words, coming out from a central key word or words as a structure by means of subordination. Basic rules were developed for its successful construction, incorporating the use of the two hemispheres-logical thinking and imagination (Buzan & Buzan, 1991). Different graphical organizers are used in visual construction of concept maps. The results of word association test depend to a great extent on the information (knowledge) and the predisposition of the respondents (Zaller, 1992).

Combining the word association test and concept construction, using concept (mind, intellectual) maps of the obtained data could be of great help in revealing the conceptual structure that is on top of people's minds in a given situation. Such maps can then be used to enhance discussion and concept clarification, which is the intention of this study.

## METHODOLOGY OF THE RESEARCH

The purpose of this research was firstly to find out to what extent can teacher students relate the names of five of human body organs with learning of biology from experience and everyday life, and to formulate conceptual sentences that are related to given body parts in this research and eventual misunderstandings. The research has been conducted with students of third year of studies in the Preschool Education Programme in the Faculty of Education of the University of Prishtina. Those students after graduation (240 ECTS completed) become educators in kindergartens for children aged 3-5. This research included 25 students, all females. The research took place before the period when students attend the part of the course that covers human biology.

Firstly an open questionnaire has been prepared for associations and written sentences, by selecting five human body parts that are recognisable and easily identified by students: heart, eyes, brain, tongue and bone. The questionnaire has been given to students with 30 minutes time to write five associations for each body

**Table 1.** Number and frequencies of associations for five body parts

	Heart	Eyes	Brain	Tongue	Bone	Total
Number of associations	36	43	43	31	38	191
Frequency of associations	113	107	112	109	91	532

**Table 2.** Five most expressed associations according to the frequencies per each body part

	Heart	Eyes	Brain	Tongue	Bone
<b>5 most frequent associations</b>	Organ (15) Circulation (13) Pumps (9) Ventricle (9) Red (9)	Sense (16) Colour (13) Pupil (10) Seeing (9) Looking (5)	Big (16) Small (15) Middle (12) Organ (5) Processes (5)	Taste (19) Speaking (17) Sense (11) Organ (6) Cold (6)	Strong (14) Skeleton (10) Protection (6) Soft (5) Tissue (5)
<b>Total</b>	<b>55</b>	<b>53</b>	<b>53</b>	<b>59</b>	<b>40</b>

part and one conceptual sentence that includes the name of the body part in its content. In some cases students have not written five sentences as required, while in some cases they have left empty the space dedicated for writing sentences.

## RESULTS AND DISCUSSION

In this research each student wrote five associations for each of the given body organs: heart, eyes, brain, tongue and bone. The total number of written associations was 191 from which the majority of associations were for eyes and brain 43 each, bone 38, heart 36 and tongue 31. **Table 1** shows the number and frequencies of associations for 5 words.

From 191 written associations, we drew five most frequent associations according to the frequency per each body organ. **Table 2** shows that for the 25 most frequent associations 260 associations were expressed or 48.9 % of the total.

From the total of associations, the most represented of the five given organs were: *sense* 27 times, *organ* 26 times, *taste* 19 times, *speaking* 17 times and *big* 16 associations.

In the case of associations related to heart, students used 36 associations with a general frequency of 113 times. Five most used associations related to heart according the frequency were: *organ* 15 times, *circulation* 13 times, *pumps*, *ventricle* and *red* 9 times each. The second group of associations according to frequency consisted of those used 7 times (*atrium*), 6 times (*blood*) 5 times (*muscle*) 4 times (*veins*, *beats*). The number of 4 associations included those with frequency of 3 times (*function*, *life*, *capillaries* and *left*) until only one time. In total there were 16 associations or 12.3% that were used only once by respondents. Some of the used associations were not related to the heart as a biological structure e.g. words like *anxiety*, *panic*, *emotion*, *tick-tack* and *stents*.

For eyes as an organ a total of 43 associations were used with a frequency of 107 times. Associations most used according to the frequency were: *sense* 16 times, *colour* 13 times, *pupil* 10 times, *seeing* 9 times and *looking* 5 times. The second group of associations according to frequency consisted of those used 4 times each, such as: *iris*, then those with 3 times: *important*, *see* and *size*, and words used twice such as: *retina*, *organ*, *sensitive*, *optical*, *disease*, *muscle*, *various*, *tears*. In the group of associations for the eyes, there was a bigger number of words that were used only once, 26 word or 24.3 % of associations according to the frequency, such as: *delicate*, *infection*, *necessary*. Here we also identified words that were not related to the biological aspect of the eye, such as: *perception*, *protection*, *emotions*, *optical*.

For the brain, 42 associations were used with a frequency of 112 times. The most used associations according to the frequency were: *big* 16 times, *small* 15 times, *middle* 12 times and *organ* and *processes* 5 times each. The second group of associations according to frequency consisted of: 4 times: *neurons*, *sympathetic*, *skull* and *nerve fibres*, words used 3 times: *parasympathetic*, *central*, *parts* and words used twice: *marrow*, *complex*, *controls*, *system*, *head* and *types*. There were 28 words that were used only once or 25% of associations, such as: *infarct*, *spinal*, *wrinkles*, *stimulus*, *disease*. Some words that were used were unrelated to the brain, such as: *heart*, *breathing*, *spinal*, *system* but also words were used for other organs except for the brain, such as: *infarct*, *directs*, *commands*, *processes*, *parts*, *stimulus*, *diseases*.

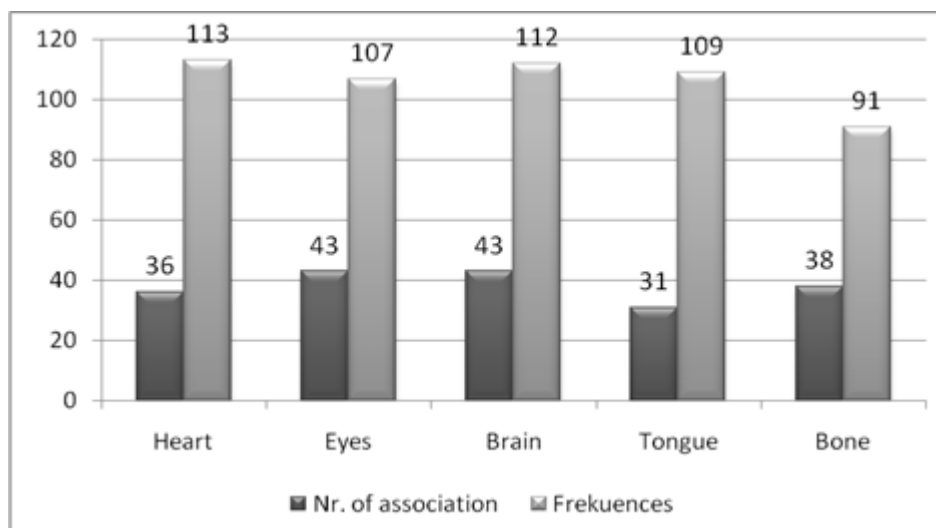


Figure 1. Number of associations and the frequencies for the five organs

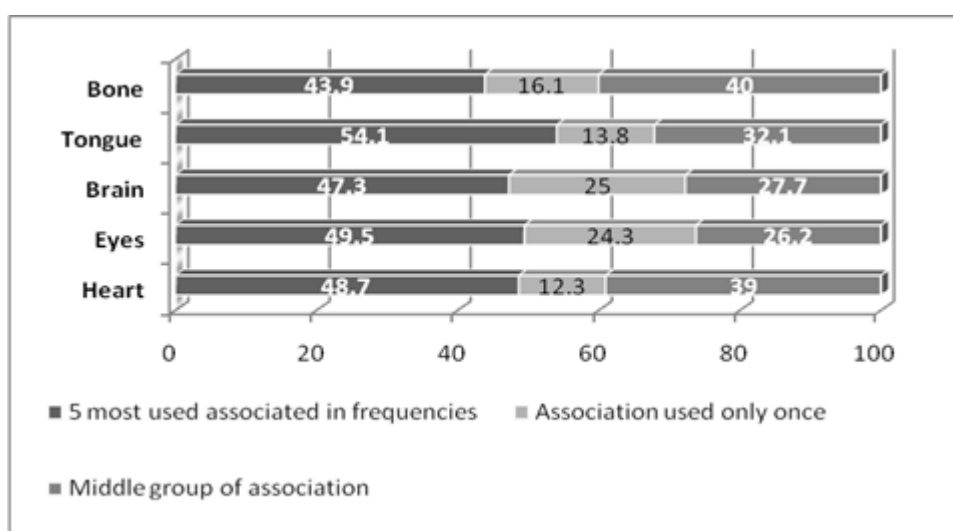


Figure 2. Distribution of associations in three groups (in %)

Tongue resulted in a smaller number of associations: a total of 31 with a frequency of 109 times. The most frequently used associations were: taste 19 times, *speaking* 7, *sense* 11, *organ* and *cold* 6 times each. In the second group of associations according to the frequency, those used 5 times were (*warm*) then 4 times (*sounds*, *pronunciation*) and 3 times (*mouth*, *teeth*, *communication* and *food*), two times: *sensitive*, *sweet*, *important*, *red*, *long*. There were 15 associations that were used only once or 13.8 %, such as: *articulation*, *elastic*, *swallows*, *digestion*, *sour*. Some words that were used were unrelated to the biological aspect of the tongue, such as: *written*, *delicate*, *twisting*, *communication*, *long* but also other body parts that were not related to the tongue such as: *larynx*, *teeth*.

In the case of the bone, 38 associations were used with a frequency of 92 times. The most frequently used associations were: *strong* with 14 times, *skeleton* with 10 times, *protection* with 6 times, *soft* and *tissue* 5 with times each. The second group of associations consisted of those used 4 times (*solid* and *in humans*), those used 3 times (*backbone*, *5 types*, *206* and *construction*) and those used twice (*breakable*, *important*, *skeleton*, *in animals*). 24 associations have been used only once or 16.1%, among which words were expressed as numbers (*306*, *15 types*, *3 parts*) and words that were unrelated to the biological aspect of such as: *parts*, *connected*, *different*, *function*.

In the research we also grouped the associations in categories based on what they represented. This categorisation is presented in the **Table 3**.

**Table 3.** Groups of associations according to their categories

Category	Number of associations	5 most frequently used associations according to categories
<b>Description</b> (analogy, state, dimensions, visualisation)	183	Big (16), small (15), strong (14), colour (13), middle (12).
<b>Anatomical and morphological structure</b>	161	Sense (27), organ (21), pupil (10), skeleton (10), ventricle (9).
<b>Function and role</b>	122	Taste (19), speaking (17) circulation (13), seeing (9), pumping (9).
<b>Disease</b>	6	Infarct (1), short-sightedness (1), blindness (1), infection (1), foresight (1).
<b>Other</b>	60	Sounds (4), parts (3), life (3), optics (2), form (2).
<b>Total</b>	<b>532</b>	<b>233</b>

**Table 4.** Number of sentences expressed by students and their categorisation in 3 groups

	Heart	Eyes	Brain	Tongue	Bone	Total
<b>Total sentences</b>	23	21	20	20	14	<b>98</b>
<b>Regular biological sentences</b>	14	11	17	14	10	<b>66</b>
<b>Sentences with misunderstanding</b>	3	4	2	5	4	<b>18</b>
<b>Common sentences (non-biological)</b>	6	6	1	1	0	<b>14</b>

The biggest number of associations belonged to the category of descriptive associations: 183 or 34.4% of the total. In the category of anatomical and morphological structures of the body, there were 161 associations or 30.3 % of the total. In the category of function and role of the body organs in this research, there were 122 associations or 22.9% of the total. The smallest number of associations was used in relation to the diseases that were related to these body parts: a total of 6 or 1.1 %. A number of 60 associations or 11.3% of the total have been grouped in the category, which in most cases were associations that were unrelated to any of the above mentioned categories or they were words from the general vocabulary.

In the second part of the research, students wrote conceptual sentences including necessarily the names of the given body parts, based on their knowledge, with a recommendation that the sentences were as much as possible related to the biological function of organs. Total number of sentences is presented in the **Table 4**.

As it is shown in **Table 3**, the total number of sentences for five given organs was 98. Of total, 66 sentences or 67.3% were regular biological sentences that were related to key words of organs given in the research. Sentences that contained misunderstanding in the construction and function of the five human body parts were 18 or 18.4%. Common sentences, i.e. from the everyday life but which were related to the 5 given body parts were 14 sentences or 14.3%. When distinguishing them according to organs, sentences with most misunderstandings were those related to the tongue (5 sentences), then eyes and bone (4 sentences each), heart 3 and brain with only 2 sentences with misunderstanding. In **Table 5**, we give examples of sentences with misunderstanding in terms of biological aspect, which were written by students involved in the research.

**Table 5.** Examples of sentences with misunderstanding

Word	Sentences expressed by students
<b>Heart</b>	Muscular organ composed of 4 valves ...; Blood circulation starts from the left ventricle until the right atrium; Main organ that is divided in veins and capillaries...
<b>Eyes</b>	Sensory organ ...where brown colour dominates; Sensory organ ... sensitive in emotional conditions; A sense that we need in life; Component with an important role in life ...
<b>Brain</b>	Nerve system where information is stored; Part of body that is found in the head, protected and it is a centre for regulation of breathing and circulation;
<b>Tongue</b>	Organ for ...creating sounds; Human sense that helps us in the pronunciation of words and feel the temperature; Organ ... helps us ... creating sounds; Organ of taste, where sounds are created; Organ ... to chew the food.
<b>Bone</b>	Covered with tissues; Human body has 206 bones ... Helps us stand ...moving and maintaining balance; Component of the skeleton without which we can't perform walking.

Among these sentences we found sentences that bore misunderstanding that was created due to their formulation (e.g. eyes as important components with which we see), misunderstandings where the function of the organ had changed (e.g. language as an organ that creates sounds) or reduced from many other functions of the organs (e.g. brain as an organ that regulates breathing and circulation).

## CONCLUSIONS

In this research we analysed two components of learning human biology by 25 students of the preschool programme: using associations in the names of certain given body organs, and formulating sentences which contain within them the name of one of the 5 body organs. In the first component, students who participated in the study formulated 191 associations for the 5 body organs, with a general frequency of 532 associations or with an average frequency of 4.2 per student. In the five most frequent associations we saw a dominance of those which described the characteristics of organs, their anatomical and morphological structures, and their function and role. Student respondents related fewer cases to diseases.

In the second part of the research we dealt with conceptual sentences formulated by students using the name of organs within them. Students wrote 98 conceptual sentences or with a frequency of 3.9 sentences per respondent (4 out of 5 sentences available). The biggest number of conceptual sentences was written about the heart, then eyes, brain and tongue, while the smallest number included the bone. From these sentences, 18 sentences or 18.4% included conceptual misunderstanding which were related to the misunderstandings, by decreasing frequency, in terms of the function of given organs, its construction and its role in human body.

The relatively large number of associations for the five body organs was closely linked with the number of correct conceptual sentences written by students and it helps in learning biology more easily. Based on this, use of word associations in creating biological concepts may serve as a good methodological tool of assessment of learning outcomes in the subject of biology and should be promoted to new teachers. As the first one in Kosovo in the field of biology, the research opens need for similar researches with teacher students of primary education level, but also teacher students` of biology subject in pre-university system of the Republic of Kosovo.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Notes on contributors

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