# THE USE OF CONCEPT MAPS IN MATHEMATICS TEACHING

# MATEMATİK ÖĞRETMENLİĞİNDE KAVRAM HARİTALARI

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**Abstract**

Though mathematics is a tool in every period of our lives, it is considered as a difficult discipline to be learnt because of its theoretical structure. Recent research show that with new approaches, success can be improved in mathematics teaching. In mathematics teaching in developed countries, towards 19 th century, instead of transferring ready information and memorization, concepts teaching methods, which try to answer how and why questions, began to be important. However, in our country, it is seen that mathematics teaching methods are not used effectively due to economic insufficiencies, teachers' lack of training in that field and the lack of opportunities to improve themselves. This study focuses on the methods providing students with realizing meaningful learning, instead of memorizing the subject, linking the logical connections between subjects, and ways that students can learn mathematics more easily. For this purpose, mentioning conceptual basis of mathematics, concept, concept teaching, interrelations of concepts, operation knowledge, the relationships between concepts and operational knowledge, the benefits of associative understanding, concept maps, tables of semantic analysis, and webs of concepts will be examined.

**Keywords**: concept teaching, operation knowledge, operational knowledge, concept maps, tables of semantic analysis.

**ÖZET**

Matematik, yaşamımızın her döneminde kullanılmakta olan bir araç olmasına rağmen teorik yapısından dolayı öğrenilmesi güç olan bir dal olarak değerlendirilmektedir. Son dönemde yapılan araştırmalar yeni yaklaşımlarla matematik öğretimindeki başarının yükseltilebileceği belirlenmiştir. 19. yüzyıla doğru kavram öğretim yöntemleri bilgi nakli ve ezber yerine 'nasıl' ve 'neden' sorularını cevaplamaya yönelik bir değişim göstermiştir. Ancak, ülkemizde ekonomik yetersizlikler, öğretmenin alandaki eğitiminin yetersizliği ve kendilerini geliştirememeleri nedeniyle matematik yöntemlerinin etkin şekilde kullanılamadığı görülmektedir. Bu çalışma, öğrencilere ezberden ziyade anlayarak öğrenme,

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konular arasında mantıksal bağlantı kurabilme ve daha kolay matematik öğrenebilme yöntemlerini sunmaya yöneliktir. Bu amaçla, matematiğin kavramsal temeli, kavram, kavram öğretimi, kavramların birbirleri ile ilişkileri, iletişimsel bilgi gibi konulara değinilerek kavramlar ve iletişim bilgisi, eşleştirme öğretim ve anlayışının yararları, kavram haritaları ve anlambilimsel analiz tabloları ve kavram ağları incelenecektir.

## INTRODUCTION

Mathematics teaching can be defined as the categorization of the series of abilities, values and attitudes which were aimed to develop individuals with the ability of creation communication improving formative and intuitive thinking.

In Turkey, nearly all of the schools experience several problems about mathematics teaching and education. For example, primary and secondary school students have some difficulties in learning of mathematical issues, in addition to this, the students loose enthusiasm and got anxious about it. There are many reasons of these negative situation which has ever been observed, and determined via some research and some negative effects accelerate this procedure. Mathematics is a tool that individuals frequently use to solve their problems in their everyday life from birth to death apart from being the basis of other sciences. Though mathematics is a most significant tool, one of the main reasons of low level of success of

mathematics teaching, and being a nightmare of students are the wrong methods of teaching. Some teaching-learning activities in order to realize teaching of concepts, eliminate students' learning difficulties and conceptual errors behind the common miscalculations can be carried out. For this purpose, it is supposed that in a classroom environment which includes the concepts to be taught and the abilities of operation, in order to provide an effectiv interaction between the teacher and learner, a teaching with a structuralist/formalist approach will be more effective and useful. When considering the common problems in mathematics learning, it can be said that some of these reasons occur since learners cannot use learning strategies enough and they are not faced learning styles appropriate to an education design. It is here important to determine the ways that students use while learning mathematics.(Kaput.J.1983)

We believe that mathematics teachers' knowledge and skills in the use of concept maps will help them be successful in teaching activities, and be productive in teaching environments. Therefore, this study focuses on concepts, conceptual teaching, interrelations of concepts, operational knowledge, concept maps, tables of semantic analysis and semantic web in mathematics. Mathematical activities require an attitude that focuses on the objects which we call a concern about relations among them.

## Mathematics and Teaching of Mathematics

To be busy with mathematics is to accept such an attitude to be focused on the objects that we call the very concern and relation in thinking. If a person can isolate the relations in real and complex situations, and then if he can use them to create new situations to be benefited so as to discover higher level of relations, he can be regarded as a mathematician. To teach mathematics is to help student recognize his mental freedom to form his own ideas and relations. The meaning of this is to make students develop such an attitude and direct them to see this attitude as a human richness towards increasing the power of mind in dialogue of human and universe, and to make them volunteer to such an inclination. Though there have been many definitions of mathematics, today, mathematics is seen as a system consisting of structures and relationships which was developed as a process of consecutive abstraction and generalization. In this definition three aspects catch attention. One of them is that mathematics is a system and the other one is that it consists of structures and relations, and the third one; these structures exist through a process of consecutive abstractions and generalizations. Therefore, mathematics is a system of symbol and thought which is made by the human mind. This situation makes mathematics abstract. To acquire abstract concepts is a difficult process. It is perhaps the reason that mathematics is found difficult by students. But this difficulty can be overcome or at least reduced by mathematical concepts are changed into concrete ones and by using some concrete tools during teaching process. Mathematical structure consists of prepositions, elements, and the relationships between these concepts. The occurrence and development of mathematical structures and relations require intuition. Intuition includes the processes of creativity, inductive thinking and surprising thinking. Inductive thinking is the process of observing events separately and to be able to see the relations between these and to be able to reach some conclusions through these relations. Surprising thinking can be defined as occurrence of ideas suddenly, and putting forward different ideas than the others. Students should be perceived about this structure of mathematics from primary education within their level of understanding, and value of mathematics and attitudes of appreciation in students' minds should be developed. Deductive thinking is the thinking process that leads from general to specific. Mathematics teachers see are beneficial to divide mathematical knowledge into conceptual knowledge and operational knowledge. Conceptual knowledge consists of relations formed internally by the individual and through the knowledge at that moment the individual has. Operational knowledge includes the rules and operations to solve the routine mathematical problems, and the symbols that are used to represent the mathematical knowledge, and there are some logical links between them. But, the individual does not have to understand this logical reason in order to apply them. Meaning is important in conceptual knowledge. This meaning is the exposure of new knowledge by means of using the knowledge available. Thus new knowledge integrates with the existing knowledge. It is internalized by individual. Both operational and conceptual knowledge are needed for learning mathematics. Conceptual knowledge support operational knowledge by giving it meaning. So, understanding can be defined as a measure of quality and quantity of the connection between new knowledge and the knowledge available. For example, in order to express the number "ten", the symbol used is 10. This number is read and called "ten". In order that any individual finds the concept "ten" meaningful, he must have understood that the symbol "ten" is used for ten objects and it represents the relations such as ten pieces of one, two pieces of five or any other numerical relations such as 2 and 8. As a second example, considering the three rectangles in Figure 1, if the rectangle B is accepted as a whole, then the rectangle A becomes half. Moreover, if the rectangle C is accepted as a whole, then rectangle B becomes half, and rectangle A is a quarter (1/4).

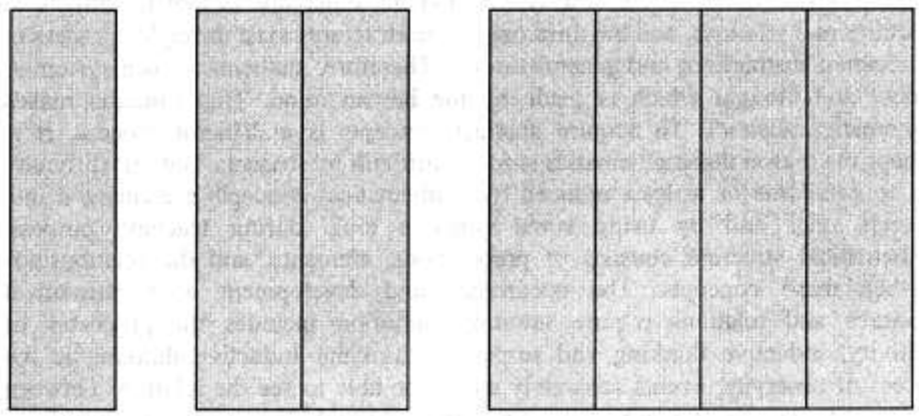

**figure 1.( half and quarter)**

Thus, whole, half, and quarter or one-fourth are the relations between shapes, which human forms in his mind looking at. Regarding the same shape, it is possible to fix some other mathematical relations. For instance, A is smaller than B (A< B) and C is bigger than B(C>B). Paying extra attention, through the object to be compared, B can be both bigger and smaller. Thus, B's relations with other shapes are also important as well as what it is, in terms of having a meaning.

While operational knowledge is learnt via rather memorization conceptual learning requires understanding. One step ahead, the multiplicity and easy recalling of operational knowledge depend upon how much they have been supported by conceptual knowledge and to what extent they have been linked to one another. That is why; one of the requirements of understanding of mathematical knowledge is the integration of operational and conceptual knowledge. The goal of a teaching appropriate for the logic of mathematics must be to provide students with understanding mathematical concepts, understanding mathematical operations and being able to create the relations between concepts and operations. These three goals are called relational understanding. In order to achieve the learning which depends on effective understanding, , students should be provided with a classroom environment offering opportunities in which;

a) They can develop appropriate relationships,

b) They can enlarge and use their mathematical knowledge

c) They can reflect their own mathematical experiences

d) They can easily state what they know

e) They can form their own mathematical knowledge.

Mathematical programs should include

1) Increasing the level of thinking

2) Improving the ability of applying what he has known

3) Giving the ability to generalize

4) Improving creativity

5) Perceiving the systematical structure of mathematics and taking exercises on it

**Concepts**

The grouping of goods, events, people, and thoughts according to their similarities is called concept. As a result of experiences, two or more things are differentiated from other things grouping together according to their common features. This group takes place in minds as a thought unit. The word or words that we utter to state this thought unit is a concept. Concepts are not the concrete things, events, or objects but the abstract thought units that we reach when we gather them under certain groups. Concepts are in the real world but in thoughts. In real world, only the samples of concepts can be found. If objects were not grouped according to their common features a situation would be faced where thousands of impressions not distinguished and not established the interrelations and this would come to mean a chaos. One of the mental processes that human being uses to develop concepts is the generalization process. The student should be reached a generalization through the prototypes. Overgeneralization causes the limit of meaning to be gone beyond, an insufficient generalization results in narrowing the meaning. One of the important mental processes as for developing concepts is the discrimination process.

Psychologists define this process as discriminating similar two simulative and reacting them separately. In developing concept, discriminating process is as important as generalization process. To be able discriminate is not as easy as generalization. Discriminations lead concepts to clarity and accuracy of knowledge. When discriminations are not reached the meanings of concepts remain general and sometimes they become mistaken. Another mental process to develop concept is description. Concepts are the thoughts exist in minds. Terms and similar words are the names of concepts. The proposition, which tells a conception through words, is called the description of that concept. Descriptions can be mistaken too. If a description leaves one of the real elements of a category forming a concept behind then it makes the meaning of the concept narrow. Developing of some concepts through description is easy. For example, right triangle can easily be defined. Because the qualities that make a triangle a right triangle (descriptive qualities) and the qualities differentiate right triangle from the other triangle (discriminating qualities) are certainly definite (Pedro.H.M. 2004)

Unfortunately, in many concepts descriptive and discriminating qualities cannot be clearly determined. In this case, the most suitable elements to the concept are attempted to define, not all the elements of the category that the definition includes. As indicated above, concepts are defined through the typical and the best examples which they represent. While telling the mathematical concepts, the followings can be proposed.

1) That only the abstract definitions of mathematical concepts are given is not enough for entire understanding.

2) The explanation of each mathematical concept as for the purpose and function in its teaching can be useful to be understood.

3) The relations of any mathematical concept to be taught with its up- down concepts and with other concepts should be pointed out.

4) To remove insufficiencies towards basic concepts in mathematics that candidate teacher students have, it is recommendable that one of the electives be for this purpose.

**Concept teaching**

Learning is a rather permanent change as a result of a certain experience that individual has through the interaction with his environment. That is why, in the process of concept teaching, to visualize and place the concept involved in the mind of student some cognitive strategies such as categorization and symbolization of knowledge should be developed. Since concepts are abstract not concrete and they exist in human's mind not outer world, concept teaching is carried out for creation of concepts in the minds of students. For this purpose, many graphics and materials in concept teaching have been developed. Some important points in concept teaching should also be taken into consideration.

1) Contemporary teaching approaches agree that permanent learning is not operational but conceptual. Learning is a mental activity. The structuring of knowledge requires some mental procedures. Knowledge is not directly given to the learner. Knowledge is obtained in a meaningful way.

2) Only student can be considered that he has learnt the phenomenon if he can use his knowledge in new situations.

3) The previous knowledge of the student affects learning. The new information should be given connecting with his previous knowledge. There may be some wrong understanding that may prevent teaching of new information in learner's mind. Students should be informed changing this wrong understanding with the knowledge which is scientifically acceptable.

4) As a result of new research and with the knowledge available day-by-day new findings have been held. This improvement is so fast that it goes beyond human capacity. Therefore, to acquire fundamental knowledge conceptually becomes more significant.

5) Without correcting the wrong understanding that students had acquired through the interaction with environment and during formal education process, it is impossible that conceptual learning can realize in a scientifically acceptable way.

6) Since there are students in different levels (to the mental development theory of Piaget) they cannot learn at the same speed. The teacher should prepare a teaching plan appropriate for every level emphasizing concept teaching.

7) In concept teaching, there is a hierarchical order from simple to complex. It will be more effective if teacher determines the hierarchical place of his students and teaches concepts.

8) Learning occurs more effectively in case students are proved that their existing knowledge are wrong or not sufficient. In order to show the students their knowledge is sufferance and to realize a meaningful learning the experiences obtained by students can be used. If the student can make a correct guess using his own knowledge as for his experiences then the meaningful learning will have occurred.

9) Since learning at the same time is a social process cognitive development occurs as a result of social interactions. Learning realizes more easily through the communication that is occurred in a criticizing way.

10) Learning requires some additional applications about any concept. New activities provide student with reinforcing the previous knowledge about the topic.

**The Relations between Concepts**

While concepts form the molecules of structure, the relations between concepts create the scientific principles. Individuals, from their childhood, learn concepts, which are the units of their ideas, and the words, which are their names. Then, they use them categorizing concepts and finding out the relations among them. Thus, while their knowledge has meaning they produce new knowledge, and new concepts via learning, rearrangements, and rebalancing. This mental learning and new formation processes continue in whole life of human.

**There are some relations in different levels between concepts.**

Through showing the relations between concepts that the mathematical subject to be taught includes, concepts can be taught more easily. The mathematical concepts involved have relationships between each other and these relationships are related to some other concepts. For example, a straight is an undefined element, but it consists of points. Therefore, the concept straight is related to the concept points. That is, the concept straight is the relation of points. Similarly, straight line piece, and radius are the relation of straight and points. The number 2/3 indicates two equal pieces of three ones of a whole thing. Thus, this number is a relation between a whole and its equal pieces. For the acquisition of mathematical concepts, these relations should occur in the mind of the child. In the course of new occurrence of these concepts in the mind, these are firstly linked with the concepts that had been formed. For example when the child begins to acquire the concept natural number he firstly acquires one and then the more, after this, he forms 2, and 3…. organizing relations among them in his mind. The more the number of these relations increase the more complex the concepts become. Similarly, adding and subtracting are interrelated and both are in relation with numerical concepts. The child firstly founds numerical concept then adding, subtracting and finally he creates the relation between these two operations in his mind. In order that mathematical concepts become the very concepts created in human mind and to acquire these concepts, the child must create them in his mind. In this case, the role of teaching and teacher is to help child form these concepts in his mind. Since mathematical concepts are the relations occurred in human mind the child must reach a certain level of intelligence. That is why, since the children may be in different processes of mental development though they are in the same ages, it should not be expected that any concept can occur at the same period of time in all children's minds. When teaching is carried out neglecting the occurrence of concepts, since the relations in child's mind are yet to exist it causes that the concepts are not acquired and the former learning become hard, as these concepts are interrelated with other concepts, and even become impossible. Mathematical concepts are taught successively. That the former one is not learnt or not learnt well causes difficulties of learning of the latter concepts. That is why, before teaching new concepts and abilities it is required that whether the concepts and abilities as prerequisites have developed be determined, and if necessary, some activities to eliminate these deficiencies should be organized.

**Knowledge of operations**

Knowledge of operations is defined as the knowledge of the symbols, rules used in mathematics, and using the operations in mathematics. The symbols in this definition are the marks within a mathematical expression. For instance, in 7x5+3=38, 3,5,7,8, =, and x are symbols each. Symbols do not express the meanings of concepts but they only are used in writing. For example the symbol 3 does not express what "three" means. The operations in mathematics are the ways to be applied in detaching two mathematical concepts and fulfilled step by step. As an example, in the addition of 3 and 2, that 1 is added to 3 first and reaching 4 and then again adding 1and reaching 5 is an operation. This operation was carried out by adding 1 in every step. The operations are definitions each and they have no proof. That the operations are successive can be seen similar with any operation is carried out by means of computer programs. In the computer, the program of the operation is loaded to the memory of the computer and in each phase it is realized step by step. After the program is loaded it is regarded that the computer has the knowledge of operation and can fulfill this operation. This comparison leads us that to carry out an operation in mathematics as a process is a mechanical event. Indeed, though some students can fulfill four main operations correctly, while solving problems through these operations, the reason for having difficulties is that they have learnt the mechanic operations but they have not perceived the meaning of operations. For instance, when a student is asked that which operation he would apply while solving a problem he firstly replies "addition" and towards the warnings such as "no", "is it true?", or "think again" then he can say subtraction and at the end of new warnings he can direct himself to multiplying. As a second example, when the student calculate the arithmetic mean of 12 and 25 he cannot think that when the result is less than 12 or more than 25, then this operation will be wrong.

**The Relations between Conceptual and Operational Knowledge**

To establish the relation between concepts and operational knowledge, explaining the concepts appropriate, the necessary rules and operations via appropriate to concepts and a meaningful thinking are symbolized. The meaning of the steps that re followed in the mathematical process to be formed should be explained and it should be linked with the concept. To establish this connection between concepts and operations is important in terms of two aspects. One of them is important in the decision of what operation or operations should be applied to solve a problem, and the other one is important in doing the operations. When operations and knowledge of rules enter the conceptual knowledge of the child, he may not only explain how operations are done but also why they are done. When the conceptual basis of the operational knowledge is not acquired, the relations between operational knowledge and concepts are not created these factors cause that where the operations will be used cannot be decided. This case results in a failure in solving problem. For a child who has learnt the operations as rules and cannot create the links with the concepts, either the concepts concerned may have not occurred or the links between the operations and concepts may have not established or some of them may have not realized even if these concepts have come to the existence. To realize the associative understanding both teacher and student should make much effort. More time, equipment and activities are needed for this. Only with the realization associative understanding the student begins to get pleasure from mathematics study and learning becomes more permanent. His self-determination, the ability of problem solving increases and he needs help less.

**Concept Maps**

All in all, concepts are abstract thought. An entire learning of abstract contents especially for a low level of education, even if not impossible, is most difficult. That is why, some effort to make concepts concrete to some extent has been seen. For this purpose, some graphic materials to be used in concepts teaching have been developed. The most important ones are the meaning analysis tables and concept maps.

Concept maps are the tools displaying the concepts and the relations between concepts about an event or subject graphically. A map of concept is used to display the sub concepts about any concept and their relations in hierarchical order. Concept maps are the visual method having a wide range of use within learning and teaching activities. Humans use some methods such as natural languages (speaking-writing), music, and pictures for communication. Concept maps are the graphical ways of communication knowledge. Concept maps can also be used to determine conceptual errors. The research about cognitive learning, manifests that many cognitive strategies such as framing, categorization, mental visualization, symbolization have been developed during knowledge structuring. While student is preparing a map of concept about any subject he benefits from these strategies. This provides student with having direct and fast analytical data about the process of knowledge organization. Therefore, the maps of concept in which individual structuring and organizations created are frequently used to organize and evaluate the learning and teaching activities. Maps of concept as graphical presentations that link the interrelated concepts in order to establish a chain of relations are used to reach the cognitive structure of learner and both for teacher and student, to unearth the knowledge available of the student. Novak and Gowin claim that doing the maps of concept with the active participation of students will be more effective. Because, with such an activity, the student must create a relation between the ideas in his mind and the map created. As a result, new knowledge can be built establishing some relations between concepts. With this respect, maps of concept can be handled as one of the results of complementary approach. If knowledge has a structure this knowledge can be displayed in some subunits. The subject is divided into organized subunits and they are divided into sidelong and main ideas and finally into the concepts which are the smallest units of knowledge. Concepts can be handled by their features, which make or do not make them concepts. Establishment of the relations between the concepts and operations in mathematics shows that those concepts and the relations have been perceived. When the concepts and relations in mathematics are used alone in mathematics they do not have any mathematical meanings. This model coming from the studies of structures of knowledge in cognitive area causes from the acceptance that the internal presentations of knowledge are related to some beneficial ways. Since the educational applications of maps of concepts used in unearthing internal processes have a feature learning strategy and an evaluation tool in various fields are effectively used to determine the misunderstandings of a student. While students' preparing maps of concept about the subjects that they have seen in school encourages them the teacher are provided with evaluating student's levels of intelligence, making decision, knowledge, proficiency. Here, since the student does not experience the anxiety during the evaluation phase both the evaluation will be sound and the misunderstandings can be interfered on time. There are many published reports of students' errors in writing simple algebraic equations (e.g., Clement, Lochhead and Monk, 1981; Cooper, 1984; Kaput and Sims-Knight, 1983; Mestre,1988)

It is known that concept map

i) provides a permanent learning,

ii) helps students who have learning difficulties

iii) provides students with perceiving complex structures as a whole

iv) provides the teacher with the opportunity of observation what the students have about any subject and the opportunity of discrimination which student needs more help

v) helps semantic negotiation and

vi) is effective in observation of the development through student's portfolio. The common concept maps are the flowchart concept maps, the hierarchy concept map, the spider concept map, the systems concept map.

**Benefits of Concept Maps**

The benefits of concept maps that make it superior are as follows:

1) The prominent advantage of concept maps is making visual presentations of real ideas available.

2) They increase learning prominently.

3) They are appropriate for different styles of learning, and the various individual differences. They are also suitable to many other subjects, teaching phase and score level.

4) They are easy to learn, teach and apply.

5) They are extent grounded.

6) They are easily used to form the extent and the evaluation of complementing.

7) Concept maps are student centered and student- active methods, and when the student and the teacher create the map by discussing, it encourages the teacher-student interaction.

8) They provide a useful alternative to define linear relations between concepts

9) They are the useful alternatives to display the relations within a system.

10) In the course of education period of students, as they learn to create concept maps they will be accustomed to establish the links between the concepts rather than considering the concepts separately or as disconnected. As they learn a new concept they will be eager to organize some other maps. As they keep on forming concept maps their ability to organize knowledge and attach concepts through syntheses will develop. Concept maps are the wholes both students and teachers form. That is why, concept maps can be drawn differently towards the same subject or concept because they reflect the formers' own specific views.

**Formation of Concept Maps**

In the formation of concept maps the general rules to be followed are below :

1) The concepts of the subject concerned are listed. Any explanation about the concepts are not necessary, the singular examples of goods and events, proper names are not included in the list since they are not concepts. The relations between principles and concepts are not included in this list.

2) The word, which is the commonest or at the top level within the list of concepts is written at the beginning of a new page. This can be either a concept or a theme. Then, the related concepts to be taught are placed on the page orderly. In the vertical organization, the most common concept is placed at the top, the concepts in equal generality are at the same line, the others in a descending order according to levels of generality are placed down the page.

3) The concepts must be easily distinguished than the other words in the map; for this, concepts are taken into boxes or circles.

4) The relations between concepts to be taught, the generalizations and principles are also listed.

5) In the concept map, in order to manifest the relation between two concepts two concepts are linked with a line. The relation is written with a phrase on this line. This relation is a proposition concerning at least one of these relations. The relations and the principles are not put into the boxes. In some cases, the direction of the relationship to be pointed out is showed with an arrow since the direction of the

relationship is important. A concept map, which does not include the relations, resembles rather a flow chart and it does not become effective enough in teaching.

6) Concept map must not be exaggerated. The map must be kept simple at the very outset. If the map includes so many concepts, relations and principles then, firstly, a general map showing the most important elements as a whole should be done and after this, the detailed maps displaying the parts of the general map separately should be created.

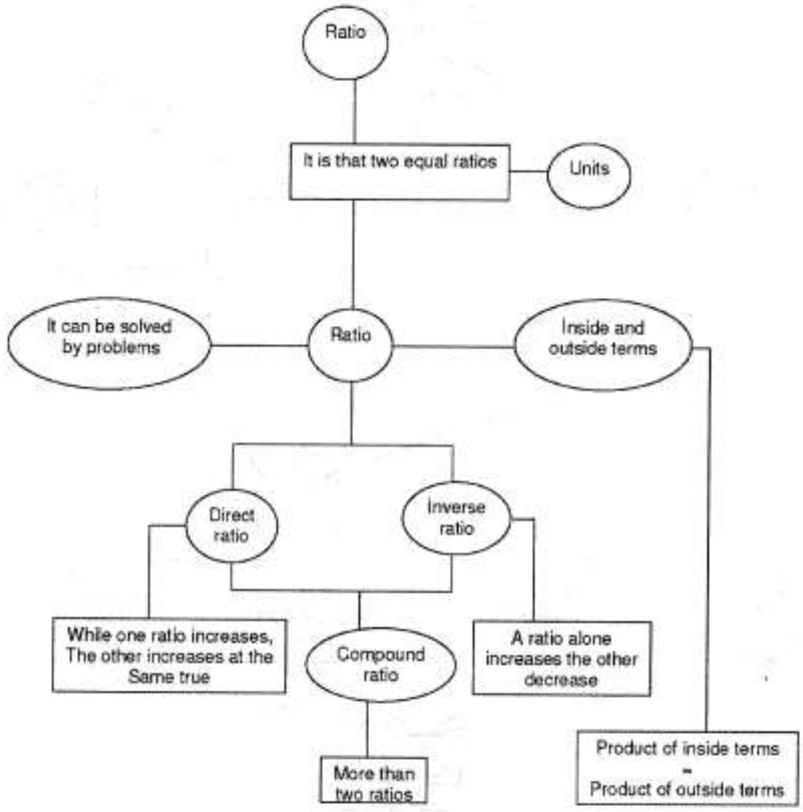


**Figure 2. (Concept map related to ratio)**

Students' resistance to accepting that their reversed are wrong (S.Rosnick 1980) and their feelings of uncertainty when they are correct (MacGregor,1991)

Following these steps, concept map will have been completed. But, in this process there are some points to be paid attention. In whole map, it must not be acted randomly; the titles that are not sound based should not be preferred. While selecting these titles, the strongest reason is to be the continued feature of the students' previous knowledge. In the course of the lesson, the new concepts should be linked with the knowledge previously learnt. The concept maps as for ratio, proportion and right prism are given in figure 2 and figure 3.

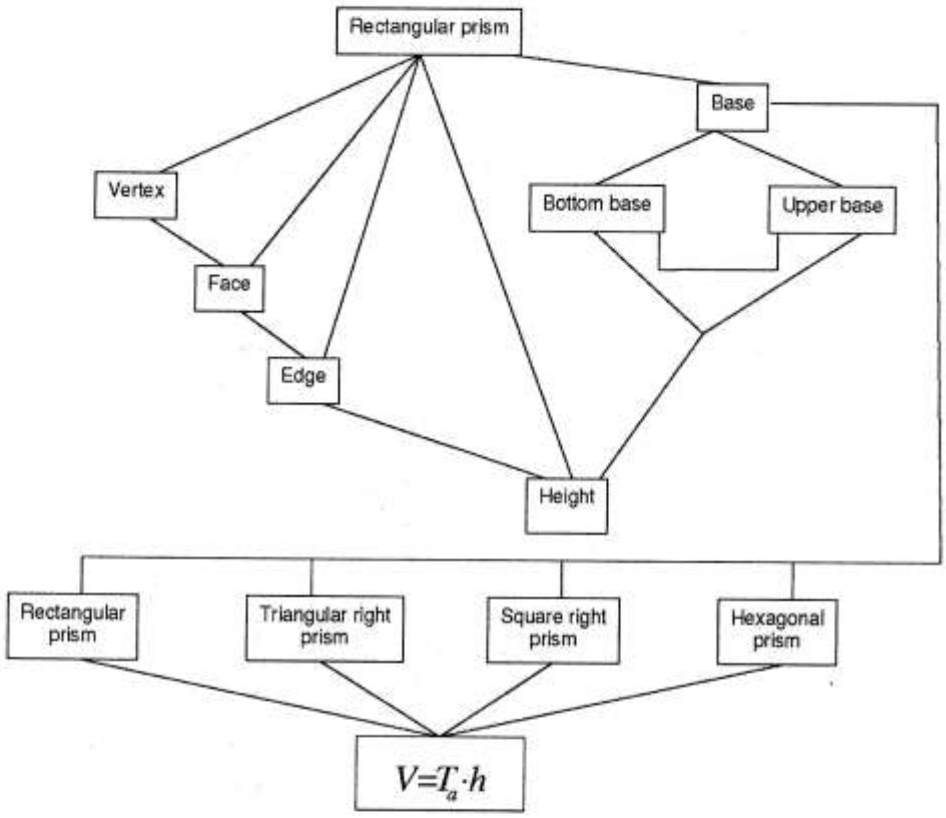


**Figure3. (concept maps)**

The type error shown in the examples above, where the numeral is associated with the wrong variable in a simple linear equation is referred to in the literature as the reversal error. It is currently accepted ( Herscovics, 1989; Mestre,1988)

**Tables of semantic analysis**

Tables of semantic analysis have been developed as a table with two dimensions. Concepts are listed in one dimension of the table; in the other the features are listed. Giving the table of semantic analysis to the students, and they are asked to find and mark which feature corresponds to which concept. Tables of semantic analysis are the effective tools in learning of the descriptive and distinguishing features of concepts. When the student studies with this tool he connects the newly learnt words with the words already known, thus, the concepts will have been developed. Tables of semantic analysis are also frequently used to reinforce concepts. A classroom activity can be developed for a table of semantic analysis as follo.

1) The teacher selects a topic from the course book or some written texts.(the topic that he will follow)

2) He writes the title on the board.

3) The teacher writes the concepts that his students found at the left side of the board orderly

4) The students are asked the features of the concepts written, and they are asked to say the features and these features are listed on the board.

5) Then, a table of concept features with two dimensions is prepared. Every student draws the table of which line and column titles have been fixed.

6) The students are asked to put an "X" on the table to show the existence of a feature in a concept. Once tables of semantic analysis are prepared they can also be used to reinforce concepts. A table of semantic analysis about the types of triangles according to side lengths and the angle measures is given in Table 1:

| Kinds triangle of types of triangles according to side lengths and angle measures | Equilateral triangle | Isosceles triangle | unequal triangle | acute-angle triangle | angle triangle. |
|---|---|---|---|---|---|
| $a=5$ , $b=5$ , $c=5$<br>$A=60^0$ , $B=60^0$ , $C=60^0$ | X | | | X | |
| $a=3$ , $b=4$ , $c=5$<br>Pisagor triangle | | | X | | X |
| $a=1$ , $b=2$ , $c=\sqrt{3}$<br>$A=30^0$ , $B=90^0$ , $C=60^0$ | | | X | | X |
| $a=1$ , $b=\sqrt{2}$ , $c=3$<br>$A=45^0$ , $B=90^0$ , $C=45^0$ | | X | | | X |

**Table 1(semantic analysis the types of triangles)**

**Semantic web**

Semantic webs are the maps, which show the relations of the concepts each other in categorical way. Semantic web is a graphical tool showing the impressions and ideas in accordance with concepts and principles. This tool helps students

1) to move the existing knowledge

2) to develop new concepts

3) to find out the relations between concepts

4) to understand the written texts well and mental activities such as reorganizing concepts.

A classroom activity for a table of semantic analysis can be developed as follows:

1) The teacher writes a concept or sentence, which will be the center of a topic in the class on the board.

2) The students are asked to find out some words about this central concept. The words found are listed on the board.

3) The students are asked to group these words according to their meanings and relations. It is remembered that each group must include at least one word.

4) After word groups are written on the board the students are asked for a name to each group. Concept webs can be used at the preparation phase of a unit, and during performance and at the final phase of the unit can also be used. This tool helps the child especially group concepts and through this way helps him reach the higher level of perception organizing mental structuring of him. The concept web in terms of types of triangles according to side lengths and angle measures is given in figure 4:

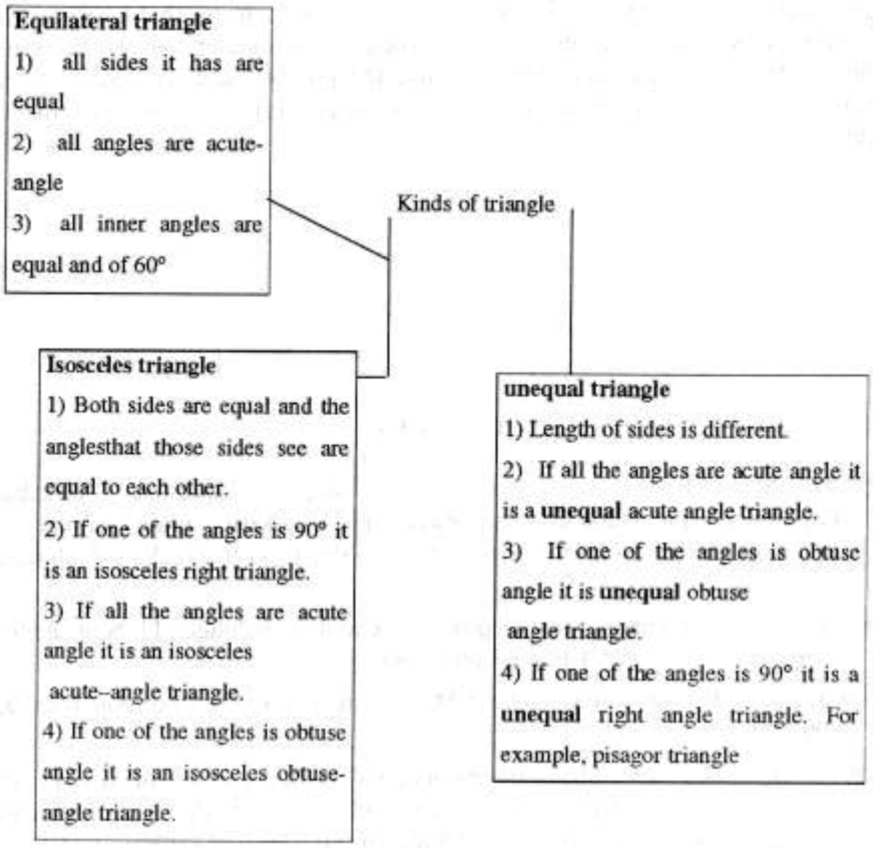


**Figure 4.( types of triangles according to side lengths and angle measures)**

## SUGGESTIONS

At the end of this article, mathematics teachers and candidate mathematics teachers will understand mathematical concepts and the relations between them, main mental processes and their significance as for developing concepts well. Also, they can learn to organize concepts in stages, analyze these relations and to be able to reach some generalizations, to prepare and to use concept maps, tables of semantic analysis, concept webs.

We believe that in case these theoretical findings, which we cannot display their correctness experimentally because of limited time, are applied in our country it will be reached the similar conclusions like nearly all countries. That teachers who are the guides to students' learning process and especially mathematics teachers and candidate mathematics teachers know and use the purpose and technique of this systematical knowledge will increase the level of success effectively in mathematics teaching.

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