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About Methods of Teaching Concepts

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Abstract: The article describes different methods of teaching concepts (specification, generalization); discusses examples of usage of these methods in math teaching; shows and analyses common mistakes made in the process of teaching such as incorrect extension of the concept meaning in the consciousness of a student, caused by reduction of number of samples; lists possible preventive means for avoiding similar mistakes. The article presents samples of charts about hierarchical (causal and consequential) properties of a concept, methods of usage of the presented charts and introduction of alternative definitions on its basis; analyses the sample of concept map as a clear visual scheme that displays hereditary nature of properties and shows didactic specifications of its usage. Difficulties that emerge due to the generalization method of teaching are explained via certain examples and recommendations are suggested on proper usage of the above-mentioned method to increase the efficiency of the differentiated teaching process.

Key words: content and volume of the concept, hierarchical scheme of features, a concept map

1. Introduction

While teaching different subjects we use concepts and we don't often think how adequately a student perceives the explained material; though the used concepts are the foundation that new knowledge is built on and thus the efficiency of a teaching process mostly depends on a proper perception of the concepts. Mistakes made at the initial stage of training in the future are very difficult, and sometimes simply impossible to fix. Methods of teaching concepts in many respects depend on the subject and the professional level of the teacher. Meanwhile, as practice shows, there are certain approaches to learning, which serve as a prevention of errors regardless of the subject and level of training. Let's reflect on this.

2. Main Body

Concept itself is an abstraction that is formed in our minds. In a better case, we can imagine a concept as a multitude of certain objects; this multitude is called a volume of a concept. To be the part of the concept volume, all objects need to have certain features, so-called unity of concept characteristics or content of a concept. There might be links between concepts. E.g., we have two concepts: "a triangle" and "isosceles triangle". To perceive an object as isosceles triangle it should have additional properties: we add new characteristics "two sides are equal" to the essence of a triangle and thus we distinguish sub-multitude in general multitude of triangles that is a unity of isosceles triangles and this becomes a volume of a new concept. The given example shows clearly that the more extensive the concept volume is, the poorer its content is and vice versa, rich in content concept aspires to specification and consequently less is its volume. It's natural if we assume, that there is a universal initial concept,

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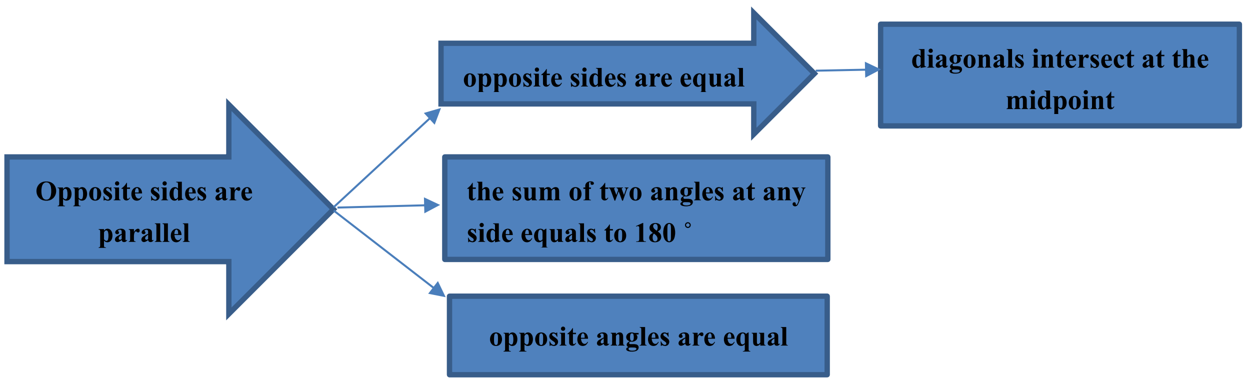
the volume of which is all-encompassing. E.g., Hegel starts his "Logic" with the most abstract and notional concept and for this, he chooses the concept of existence, that comprises everything that exists. Though according to its content this concept is the poorest, as he ascribes the infinity of the objects to that one property of existence and "leaves it on the other hand in total indifference" (Buachidze T., 1987, p. 611). No one is indeed going so far or deep with students and in the process of teaching we start with basic concepts, to which we don't set limits, but as a rule, we trust it to a student's intuition. E.g., we, mathematicians, often use the "location between two objects" without any comments or with a couple of illustrations. Students fill up the lack of information with their fantasy and as a result later they are not able to tell "between" from "in the middle of two objects", because in their imagination these two concepts coincide. Such a problem sometimes may be caused by a teacher. E.g., if while teaching about rectangle a teacher for a certain period of time shows the same shape on the board, for instance, "wide rectangle", soon we can discover that the majority of students will also line-draw the same shape and after a short while some of them won't accept that the rectangle may turn out to be a square. In this case, the content of the concept of a rectangle is expanded in the student's mind by adding an image of a "wide rectangle", accordingly, the volume of the concept decreases, for example, all the squares fall out of the volume. That means that we should avoid representation of the concept with the same examples and on the contrary, we'd better try to use the wider range of options and draw the students' attention to them.

It's important to remember that the content of a concept is a unity of all those properties, that are common between all the objects which are included in the content of the concept. In many cases, this unity is quite solid and represented by several facts. It's natural that in defining a concept the thorough representation of the content is not appropriate. So how can we formulate a definition — what criteria should be used to choose properties mentioned in a definition? If, for instance, we want to define a parallelogram and do it like this: "parallelogram is a quadrangle the opposite sides of which are parallel, opposite sides are equal in length, diagonals intersect at the midpoint, opposite angles are of equal measure and the sum of two angles at any side equals to 180°". A quadrangle must really have the above-listed properties, or it won't be a parallelogram. But how important is it to list all of the properties while introducing a concept? Which properties must be mentioned and which can be omitted and finally should alternative definitions of parallelogram be used?

To answer this question, let's create a hierarchical (causal – consequential) scheme of listed properties (there are numerous of variations of such schemes, but we will discuss just one of them):



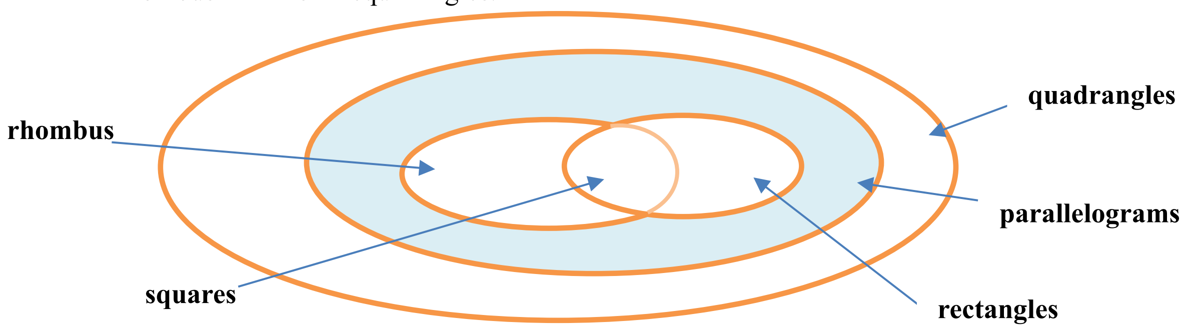
The scheme can be explained this way: if opposite sides of a quadrangle are parallel, then its opposite angles are equal to each other and the sum of any two angles will be 180°; besides that, the opposite sides are equal to each other and diagonals intersect at the midpoint.

Therefore, four properties from five are the result of one (of the sides being parallel). In such case we can say that parallel property of opposite sides is the main defining property and the necessary condition, or, in other words, a "sign of parallelogram". According to all these we can assume that "parallelogram is a quadrangle that has opposite parallel sides", while each of the other four facts is a result of determining property, or to say in other words is "a property of a parallelogram". If it's possible to select two defining properties for any concept, then it's obvious that we will be able to form an alternative definition. E.g., in case of a parallelogram we will get formulation: "a quadrangle, with equal opposite sides, is called a parallelogram". Thus, the number of defining properties (or defining groups of properties) in the content of a concept allows you to generate at least the same number of alternative definitions of a concept.

A so-called "concept map" shows a good result in the process of teaching as it makes a visible succession of properties. Concept map in mathematics, as a rule, is represented by Venn diagram. For instance, let's explain the scheme:

This map helps a student understand easier that all rectangles are parallelograms. Thus, each rectangle has all the properties of parallelograms and also its own defining property ("all the angles equal to each other") that makes its different from the other parallelograms; the same can be said about the rhombus — in multitude of parallelograms the defining feature of rhombus is that "all its sides are equal"; every square is a parallelogram, rhombus and rectangle at the same time — the content of this concept should contain contents of these three concepts; based on the above mentioned, there are different definitions of a square. E.g., a square is

- a parallelogram that has all equal sides and angles;
- a rectangle that has all equal sides;
- a rhombus that has all equal angles.



The most popular method in the process of teaching is "specification", that means the process of organizing concepts in a certain order "from general to specific". According to the presented example, firstly we teach about the concept of "quadrangle", then we add an appropriate property and get a concept "parallelogram", and move to the other concept by adding other properties ("rhombus" or "rectangle"), etc.

What is used more seldom is the method of generalization, which means: we subtract a subset from the content of a given concept (we "limit" it) and examine which multitude of an object is defined by the unity of these properties. The first difficult task that accompanies the usage of this method is subtraction of subsets from the content of a concept — the point is that if in process of separation one of the properties gets among the subsets (or a group of defining properties), then the volume of the concept won't change and the object will "keep" all former properties without the loss that was expected in the process of "limitation". Therefore, volume actually doesn't change; on the other hand, if subtracted sub-multitude doesn't include any "property", we will get a new group with content that will correspond to a new multitude of objects — the volume of a new concept (generalization of the given one), for which the previous volume represents a sub-multitude:

It's conspicuous that this way of teaching is inherently difficult, and that's why it should be used more carefully; though rejecting the method on behalf of its difficulty is not considered. For instance, in each school and each class there might be a student whose academic readiness exceeds the level of others. Such students shouldn't be given an opportunity to relax and get bored, but thinking of differentiated task that is in connection with current material is not an easy task. In such cases, the method of generalization can be used. E.g., in the process of teaching about quadrangles, the interested student can be offered such task: prove that if diagonals of a quadrangle are equal and intersect from a right angle, this quadrangle may not be a square. Such assignments are research-based and require the full involvement of a student. Method of generalization can be used for group projects, extracurricular club work and others.

3. Conclusion

There is a wide range of teaching methods, but what we must never forget is that their efficiency depends on our adequate approach and proper use of the methods. Especially cautious and attentive you need to be when teaching concepts, since concepts are the foundation of further scientific education and mistakes made at the initial stage of training in the future are very difficult, and sometimes simply impossible to fix.

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