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THE LOGICAL MODEL FOR MATHEMATICS PROBLEM FORMULATION AND SOLUTION

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The structure of problem formulation and solution essence

In accordance with E. Krik [2] suggested formulation, the essence of problem and its solution is the transition from one state to another, i.e., the initial conditions form the state A - entrance, but state B - exit is formed by problem solution result, reaching of which is defined in problem formulation.

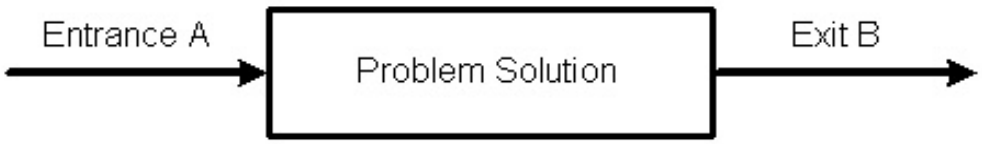

Figure 1.

Solving problem means moving from entrance state A to exit state B. This kind of problem formulation and its solution essence understanding requires isolating the following elements: entrance A, exit B, transition R from state A to state B, as well as transition justification T - the theory information element E_I, for acquisition of which the problem is compiled.

Apart from nature of problem objective, the authors suggest regarding entrance A as information element E_I structure separate subtree conjunction, i.e., as a concrete information element A_I which is correspondent to information element E_I, terms of which are either concrete real objects, mathematics theory applied science concepts, concepts examined earlier in study course, or their special cases. Exit B is suggested to be regarded as special case B_I for information element E_I. If the terms of B_I are replaced by respective terms of E_I, the information element E_I itself is obtained at a certain degree of abstraction. Under these conditions the transition R from state A to state B can be regarded as a chain of implications with premise A_I and conclusion B_I. The transition R realizes separate information element E_I subtree A_I supplement with missing peaks and links, and realizes its structure in conformance with E_I hierarchy.

***Identification* problems and their solutions**

Every mathematics study course contains indefinable concepts or concepts defined axiomatically, as well as concepts that are defined with text or formula, i.e., directly or indirectly indicating the set where the respective mathematical object belongs and its specific characteristics. Considering all above mentioned, *identification* problem entrance A structure A_I matches with information element E_I structure fully or it is its substructure conjunction. Solving *identification* problem means expanding problem structure A_I to structure B_I and establish unambiguous representation R between structure B_I and information element structure E_I. The formulated unambiguous representation R establishment envisages: *simplification, classification, synthesis, modification, estimation and*

inclusion.

The subject (problem solver) while solving the problem not always performs the all the listed steps in the listed order consciously. If the student education level is sufficiently high and he has understood the essence of the information element to be acquired, the problem solution reduces to *inclusion* stage.

***Property or operation usage by sample* problems and their solutions**

After the concept definition the formulation of properties or definitions of the operations which are performed with the respective concept usually follow. As the properties of mathematics concept or operations with them are formulated with text or formulas, the information element structure that is developed earlier based on definition, can be expanded with newly established formula structure. The number of peaks, links and hierarchy rank of information element E_I increases and the structure becomes more complicated. It is evident, that it is possible to construct list of identification problems for understanding this more complicated structure E_I, but it is methodologically well-founded that it is useful to include concept properties and operation usage samples, respective for information element R_I, in the theory explanation.

Problem on *property or operation usage by sample* in its information element A_I, corresponding to formulation A, contains usage sample P_I structure fully or its subtree conjunction. Solving *property or operation usage by sample* problem means expanding problem structure A_I to structure B_I and establish unambiguous representation R between result structure B_I, sample structure P_I and in theory newly established information element structure E_I. The establishment of the formulated unambiguous representation R this time foresees: *analysis, classification, synthesis, modification, estimation and inclusion*. Hence, *identification* problem solution contains the same steps as *property or operation usage by sample* problem with the only difference that the structure has become more complicated and the solution starts with new step - *analysis*.

Also this time the subject (problem solver) while solving the problem not always performs the all the listed steps in the listed order consciously. If the student's education level is already sufficiently high, he recognizes the formulated problem as a standard problem and in the course of solution after the *analysis* moves directly to *inclusion*.

Problem on *usage of information element compilation or single information element multiple property or operation compilation usage by previously acquired algorithm*

With development of study process the mathematics course information capacity sharply increases. Due to the tight links between different concepts, the structure of the information element E_I, which is correspondent to theory, is expanded with new peaks, links and levels. To ensure understanding of the connection between separate subtrees of this structure, certain algorithms are necessary to connect separate information elements or different properties and operations of an information element. An information element G_I can be constructed for these algorithms that differs from concept property or operation usage sample P_I by with the information capacity. Therefore from the point of view of the logical model, there is no fundamental difference between *property or operation usage by sample* problem solutions and problems on *usage of information element compilation or one information element multiple property or operation compilation usage by previously acquired algorithm* solutions.

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