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A Study on Thinking Tools or Problem Solving Tools

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0. Preface

After "TRIZ"(the acronym for "Theory of Inventive Problem Solving" in Russian) was developed, many articles have been issued [1] and many improvements including "ASIT (Advanced Systematic Inventive Thinking)" [2,3,4] have been made on "TRIZ".

But not sufficient theoretical grounds are given in these articles until now.

Thus I give a very brief outline of background and framework to problem solving tools or thinking tools.

1. System Object and Process Object

Among other creatures the human being is characterized as having the indirect way of recognition and operation via medium. Thus until now we have had the vast accumulated indirect media called "culture" that is born by the "technical means" or "common concept" in the area of recognition and operation. In the area of operation on the outside world "technology" born by the technical means and "institution" born by common concept are made and made use of. [5,6]

Characterizing the ability of the human being is the ability of solving the problem or design which is to decide the image of contents of "object" before their realization in the real world in advance. We must think "object" is everything to be selected and decided to solve a problem or to design something. Thus we grasp that "object" is not only "system object" consisting of the element of technical system or institutional system to make but also "process object" consisting of the element of process of system action or human action. [6]

2 Structure and Function

Next I give the outline of "structure" and "function" considering the formal contents of "object" which have statics and dynamics. [7,8]

A "structure" is the whole things that consist of elements and relations between them. A set of "object", either it is "system object" or "process object", has structure of "object".
A "function" is a "positive meaning" of "object", either it is "system object" or "process object", to the outside world.
"Object" has a "positive meaning" to outside world when its action itself is useful, its action makes a useful "attribute" or interaction between its attribute and the other attribute make up a useful attribute.
Action is "process object" itself or is taken by "system object" via process. And both "system object" and "process object" have attributes.

3   Design or Solving the Problem

"System design" and "process design" is to decide the contents of "system object" and "process object" respectively to achieve the required functions.

Thinking logically and dealing explicitly with ''process object'' brings us to the following examination.

To design or to reach a solution of the problem, "object", "structure", "function"("action" and "attribute") can be operated as follows.

"Object" itself can be added or removed.

"Structure" of "objects" can be changed.

"Action" as a "function" can be added or removed.

"Attributes" as a "function" can be added/activated, removed/deactivated or changed.

According to these preparations I propose tentative tool "THE TOOL" of which operations is as follows and shown in Table 1 as compared with ASIT. "THE TOOL" is the framework of the thinking tools or the problem solving tools to which all kinds of operations can apply.

The terms of "THE TOOL" are following that of ASIT when possible.

Table 1 Operation of Tools

Operation	Tool		ASIT	THE TOOL
Add	Object Using Multiplication Tool *1		X	X
Add	Function Using Unification Tool *2		X	X
Remove	Object Using Object Removal Tool *3		X	X
Remove	Function of Existing Object Using Function Removal Tool *3+			X
Change	Object Using Division Tool *4		X	X
Replace	Existing Object using Object Replace Tool *4+			X
Change	Attribute of Object	Using Uniform Attribute Change Tool *5+		X
		Using Breaking Symmetry Tool *5 (Symmetry in Space)	X	X
		(Symmetry in Time)	X	X
		(Group Symmetry)	X	X

x   available

In Table 1 we can

#1 add "object" using multiplication tool *1,

#2 add "function" of existing "object" using unification tool *2,

#3 remove "object" using object removal tool *3 or remove "function" of existing "object" using function removal tool *3+,

#4 change "object" using division tool(including the case of changing "object" using breaking symmetry tool) *4 or replace or substitute existing "object" using object replace tool *4+, and/or

#5 change "attribute" of "object" using uniform attribute change tool *5+ or change "attribute" of "object" using breaking symmetry tool *5.

*1: <u>Multiplication</u>: Solve a problem by introducing a slightly modified copy of an existing "object" into the current system or process. [2,3,4] (I slightly changed that of [3,4])

*2: <u>Unification</u>: Solve a problem by assigning a new use to an existing "object" [2,3,4].

*3: <u>Object Removal</u>: Solve a problem by removing an "object" from the current system or process. [2,3,4] (I slightly changed that of [3,4])

*3+:<u>Function Removal</u>: Solve a problem by removing "function" of the existing "object".

*4: <u>Division</u> : Solve a problem by dividing an "object" and reorganizing "structure" (including the case of changing "object" using <u>breaking symmetry</u> tool). [2,3,4]

*4+:<u>Object Replace</u>: Solve a problem by replacing or substituting the existing "object" with the adding "object" obtained by <u>multiplication</u> tool.

*5+:<u>Uniform Attribute Change</u>: Solve a problem by changing "attribute" uniformly.

*5: <u>Breaking Symmetry</u>: Solve a problem by changing a symmetrical situation into an asymmetrical one. [2,3,4]

(Hatched parts are newly added to ASIT)

"THE TOOL" can be extended to be more generic, but in this article it keeps strict restriction of ASIT [9] (ASIT's "The Closed World Condition" ("The inventive solution world does not introduce new kinds of objects that do not appear in the problem world." [2]) is very strict and powerful, therefore it is maintained here); at the same time it obtain logical exactness.

4   Conclusion

I took a brief outlook of "process object" and "structure and function" and proposed the outline of "THE TOOL" which was a framework of thinking tools or problem solving tools.

References

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