U-SIT And Think News Letter - 52

Updates and Commentary

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Unified **S**tructured **I**nventive **T**hinking is a problem-solving methodology for creating unconventional perspectives of a problem, and discovering innovative solution concepts, when conventional methodology has waned.

Dear Readers:

. To readers of newsletter mini-lecture translations in Spanish: backissues are now available in a single bundle. Register for free copies on the website: go to **www.u-sit.net** click on **Registration;** scan down the page **Back issues of Spanish translations** and then to **NL_01-51** and check its box. Note that the file size is shown as 2.6 MB – a condensed pdf file. The file arrives in your email moments after you click to **submit** your request.

3. Mini USIT Lecture – 52 USIT – a Method for Solving Engineering-Design Type Problems

Where and how do we learn heuristics?

Learning to solve problems is an intellectual pleasure for everyone.
Learning how one solves problems is an intellectual exercise for the curious.

Everyone enjoys having solved a problem. They don't necessarily go looking for problems to solve, and they may be terrified if faced with a problem they must solve. But once it is recognized that one has solved a problem without assistance there is immediate satisfaction and perhaps a tinge of pride.

Professional problem solvers come early to the training that builds their skills. An innate interest and satisfaction in problem solving motivates them. Where we learn these skills is mostly evident. Obviously our academic training prepares us with specific and specialized problem-solving skills. And there are skills we acquire in association with others who have learned to solve problems. Then there are those skills we teach ourselves. The most interesting of these are the ones we simply discover by paying attention to how we process information and assemble solution concepts, seemingly out of nowhere. Personal introspection is a powerful technique for evaluating, criticizing, perfecting, and developing reliable problem-solving skills. A key to this process is learning to analyze our personal problem-solving methodology in terms of heuristics – the "tricks" or mental tools we apply over and over in defining, analyzing, and solving problems.

Do you recall the earliest heuristic you learned? The first fascinating heuristic I remember learning was the trick of "casting out nines" to check answers for arithmetic problems. (See for example

http://www.jimloy.com/number/nines.htm.) Over time some of our heuristics become such a natural part of our thinking we may not even be aware we still use them. This makes introspection of the problem-solving process the more interesting. What heuristics do we favor? Which do we choose to use more often?

A favorite heuristic of mine is "to simplify". This came to mind a couple of weeks ago when my son emailed me a problem to solve that he had heard on the radio. I enjoyed this problem very much because in the process of solving it I discovered a property of numbers I had never been aware of before. Here's the problem in case you would like to solve it.

> In a long hall are 20,000 electric lights that are operated each by a pull-chain. Initially all lights are turned off. A person walks through the hall and pulls every chain, thus turning on each light. A second person walks through and pulls every other chain – #2, #4, #6, etc. up to, and including, #20,000 – thus turning off those lights. The next person walks through and pulls every third chain – #3, #6, #9, etc. – thus turning off some lights and turning on others. The next person pulls every 4^{th} chain, the next every 5^{th} chain, and so on until the $20{,}000^{th}$ person passes through and pulls the chain of #20,000. The question is, after the $20{,}000^{th}$ person has pulled the last chain, how many lights remain on? (The answer is not a trivial one.) [I don't know to whom credit for this problem belongs. If you do, please let me know.]

I'll discuss this problem in the next newsletter and the insight I gained in working it.

Another heuristic I favor is "to challenge every assumption by examining its opposite"; also knows as the "contrarian" view. An example of applying the contrarian view that comes to mind is in trying to solve a mechanical wire puzzle. You know, those metal contraptions that you have to figure out how to take apart or to free a seemingly trapped ring, for example. When totally flummoxed, I have resorted to the following contrarian view. I have the person challenging me to solve the puzzle, to free the captured component, while out of my sight, and then let me try to reassemble it. (Also known as working a problem backwards.)

This "contrarian view" and to "simplify" seem to become involved in my own problem-solving process without consciously calling for them. I don't know where I learned either one. There are, of course, many others that come into play by consciously applying them. However, to do this requires remembering a useful one when needed. At my age, I need a heuristic for remembering good heuristics!

Try it. See how many heuristics you can list in 60 seconds that you know and use.
(Need a heuristic for this?)

When I tried this exercise I was able to name a dozen heuristics. However, I felt during the exercise that there must be many more that I know and use. And there are. The easiest way for me to bring a useful heuristic to mind is to work a problem. Something happens subconsciously in this process that brings a heuristic to the conscious for its inspection and use if appropriate. In this case, some are useful heuristics and others are not. Furthermore, many others don't come to mind. This makes me wonder what are the cues in a problem that spark recall of the heuristics that do come to mind? As I tried to answer this question, it occurred to

me that it is quite possible that the cues lie in the type of mental questioning that is evolving as I work on an unsolved problem.

It seems evident to me that some cues indeed are imbedded in the problem statement and others in the thinking process. Note that I am not referring to "clues" as are included in textbook problems to point a student to a particular algorithm to apply or how to define useful variables. I am referring to conscious cues that seed the subconscious and bring to the conscious, from that database of experience, a useful heuristic. Thus, "seeding" becomes a heuristic for recalling heuristics.

Since becoming involved with USIT, I have learned that there are words in problem statements that act as such cues. They consist of the objects, attributes, and effects that are verbally and graphically expressed. However, a single word does not do the trick. Other features are required. Herein lies the heart or secret of tying a heuristic to a problem. I don't have a full answer to this concept yet, not even close. But I'll list some of my observations and hope you can add more. (Any feedback from readers on this phenomenon of problem solving will be appreciated.)

Features of a problem statement, and of one's mental process of examining a problem, that cue for useful heuristics include the following and many more: (mental processes are shown in parentheses)

	Cue	Recalled heuristics
1	Complexity of size	Simplify; Reduce to zeorth order; Minimize the number of objects
	Patterns; including	
2	Symmetry	Use symmetry; Remove symmetry; Take symmetry to the extreme
3	Repetition	Simplify
4	Complementariness	
5	(lack of)	(Introduce symmetry)
	Contradiction	
6	Self contradiction	Search root causes; Search multiple effects
7	Contradiction with known fact	Search root causes
8	Familiarity	Search known solutions
9	Analogy with past experience	Reword for ambiguity
10	(Metaphor)	(Reword for ambiguity)
11	Specificity	Generalize; Remove metrics; Take to extremes
12	(No cues)	Look for effects at points of contact; (Reword problem statement)
13	Root causes	(Encourage intuitive response)

These brief statements may or may not have meaning to you. They do to me. And herein, I think, is the main key for applying heuristics. They are language and visual metaphors that expand our thinking as we mentally use language and simple sketches to inspire insight as we work our way through a problem solving exercise. A mathemathics teacher taught us to write and sketch the information of a problem before trying to solve it. This heuristic is golden.

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Happy Holidays

6. Feedback

7. Papers and essays

The following materials can be read by clicking on their titles. Links are also available on the USIT website (www.u-sit.net/Publications)

1. "Injecting Creative Thinking Into Product Flow"
2. "Problem Statement"
3. "Metaphorical Observations"

8. Other Interests

1. Have a look at the USIT textbook, "Unified Structured Inventive Thinking – How to Invent", details may be found at the Ntelleck website: www.u-sit.net (*Note*; not at www.ic.net)
2. USIT Resources Visit www.u-sit.net and click on Registration.

Publications	Language	Translators	Available at …
1. Textbook: **Unified Structured Inventive Thinking – How to Invent**	English	Ed Sickafus (author)	www.u-sit.net
2. eBook: **Unified Structured Inventive Thinking – an Overview**	English	Ed Sickafus (author)	www.u-sit.net
	Japanese	Keishi Kawamo, Shigeomi Koshimizu and Toru Nakagawa	www.osaka-gu.ac.jp/php/nakagawa/TRIZ/
	Korean	Yong-Taek Park	www.ktriza.com/www/usit/register_form.htm
"**Pensamiento Inventivo Estructurado Unificado – Una Apreciación Global**"	Spanish	Juan Carlos Nishiyama y Carlos Eduardo Requena	www.u-sit.net
3. eBook "**Heuristics for Solving Technical Problems – Theory, Derivation, Application**" -- **HSTP**	English	Ed Sickafus (author)	www.u-sit.net
"**Heurísticas para Resolver Problemas técnicos – Teoría Deducción Aplicación**"	Spanish	Juan Carlos Nishiyama y Carlos Eduardo Requena	www.u-sit.net
4. **U-SIT and Think Newsletter**	English	Ed Sickafus (Editor)	www.u-sit.net
	Japanese	Toru Nakagawa and Hideaki Kosha	www.osaka-gu.ac.jp/php/nakagawa/TRIZ/
	Korean	Yong-Taek Park	www.ktriza.com.
Mini-lectures from NL_01 through NL_51	Spanish	Juan Carlos Nishiyama y Carlos Eduardo Requena	www.u-sit.net click on Registration

Please send your feedback and suggestions to Ntelleck@u-sit.net and visit www.u-sit.net

To be creative, U-SIT and think.