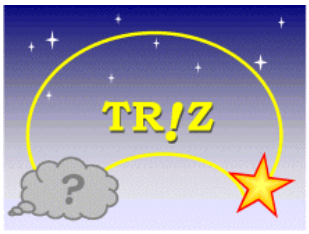

Education and Training of Creative Problem Solving Thinking with TRIZ/USIT

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(Osaka Gakuin Univ., Japan)
http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/eTRIZ/

ETRIA TRIZ Future Conference 2007
IHK, Frankfurt am Main, Germany
November 6 - 8, 2007

Outline of my Talk:

I will report my experiences of
training industrial engineers and
teaching under-graduate students
on 'how to think creatively in problem solving'.

for Engineers

What to teach:
based on TRIZ
reorganized and unified into USIT (Unified Structured Inventive Thinking)
for easier to learn and apply,
together with wider background

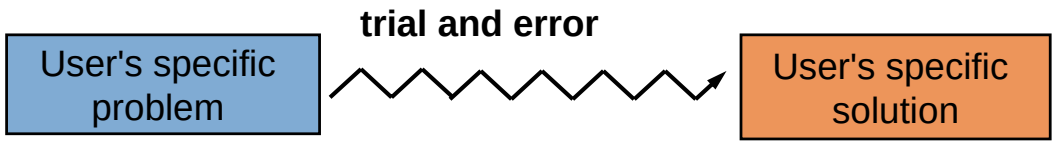
for Students

Activities:
2-Day USIT Training Seminar with real problem solving
Lecture classes (1 semester) + Seminar classes (2 years)

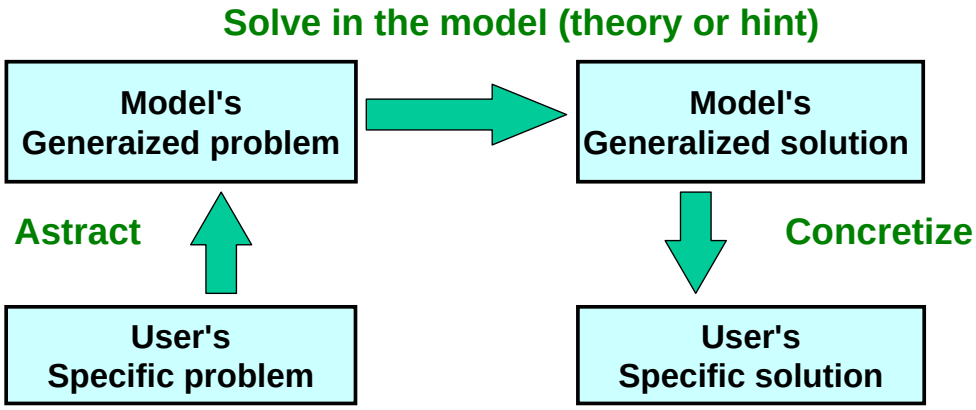
Case studies of real engineering problems
Case studies of everyday-life problems are useful.

What to teach
on 'How to think creatively in problem solving'

Trivial approach



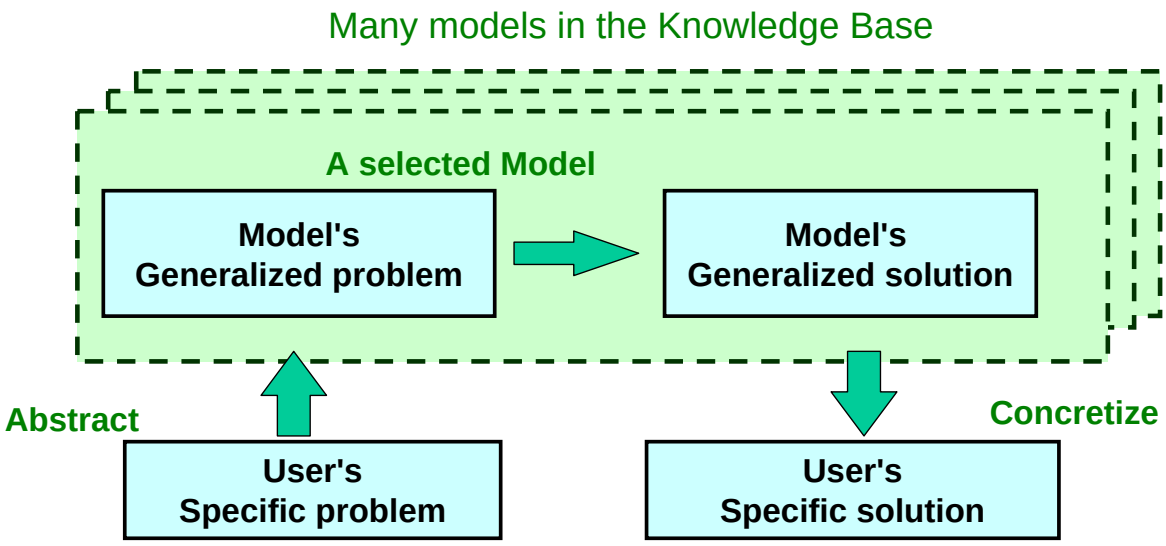
Four Box Scheme



Four Box Schemes, Accumulated:

Science & Technologies (Many models, specialized in areas)

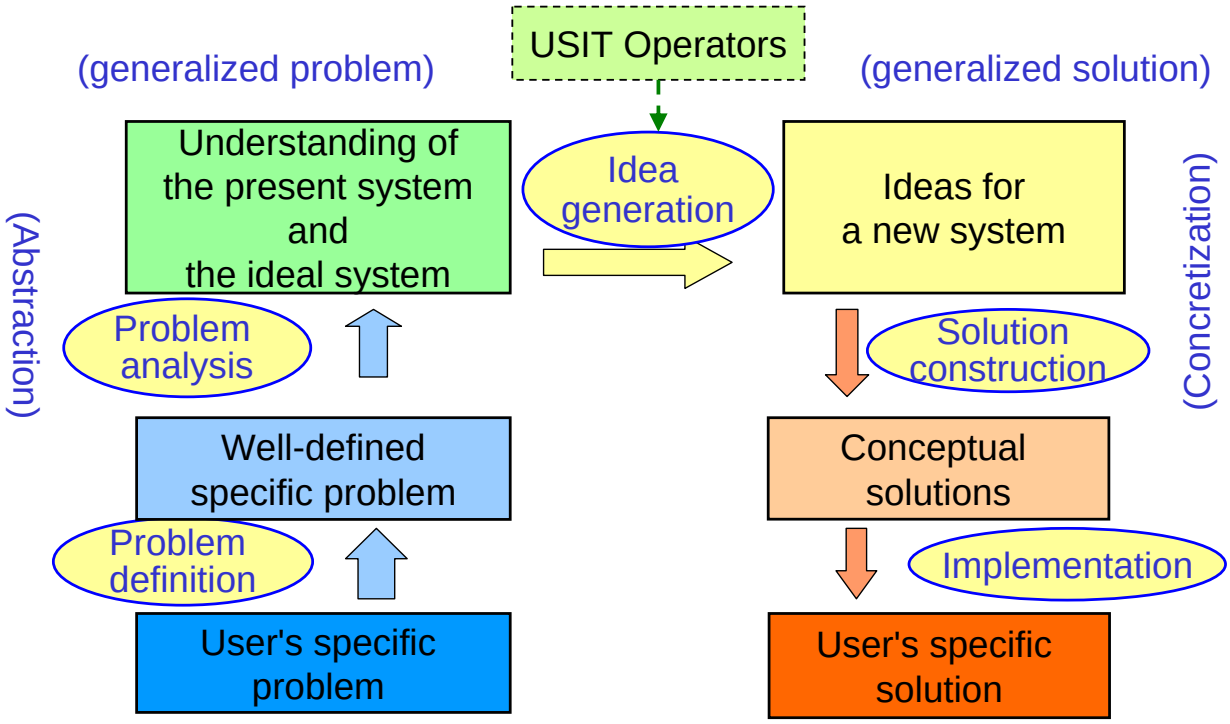
--> (Traditional) TRIZ (Across areas, but many separate tools)



Many models ==> How to choose one ? How to abstract ?

Six-Box Scheme in USIT

A New Paradigm for Creative Problem Solving
A standard set of tools for any problem



T. Shimoda and T. Nakagawa (2006)

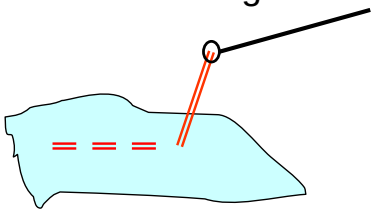
Everyday-life Case Study in USIT:
How to fix a string shorter than the needle at the end of sewing

Define the Problem:

(a) Undesirable effect: The string is shorter than the needle and prohibit applying the standard way of making a knot.

(b) Task statement: Devise methods for fixing the string left shorter than the needle.

(c) Sketch:



by Students

(d) Plausible root causes:

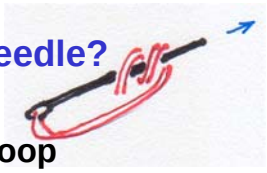
The standard way of making a knot is applicable only when the string left is longer than the needle.

(e) Minimum set of relevant objects:

Cloths, string (already sewn), string (left), the needle

Problem Analysis (1): Understanding the present system

(1) Functional analysis: What is the function of the Needle?



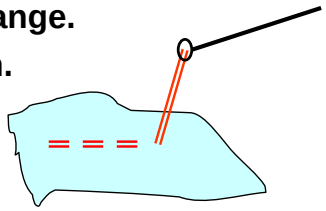
A base for making a loop of the string;

A guide for passing the end of the string through the loop

(2) Attribute analysis: Properties taken for granted form the Constraints:

The string does not expand = Its length does not change.

The needle is hard = No change in shape and length.



When any of these constraints is lifted, there appears a novel solution.

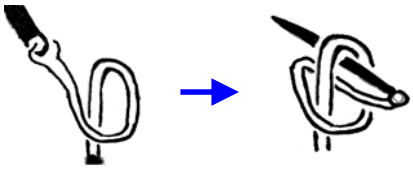
(3) Analysis of time characteristics: Processes of sewing:

Solutions at the final stage and solutions at any earlier stage.

(4) Analysis of space characteristics: A knot makes the string thick at the end.

Watch out about the topology in making a knot and in the 'hole and string' .

Several known solutions:



A well-known technique.
Difficult to make the loop of string in the space; need some practices

The hole of the needle has a slit, thus the string can be passed and removed without cutting the loop of the string. (a commercial product)

Problem Analysis (2) : Understanding the Ideal system

Ideal arrangement of a sting in space for making a knot

It should be nice if we could hold the string in this arrangement in the space.

Solution Generation:
Generate Ideas and Construct Solutions

Known technique

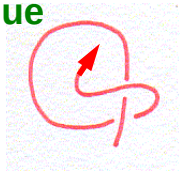
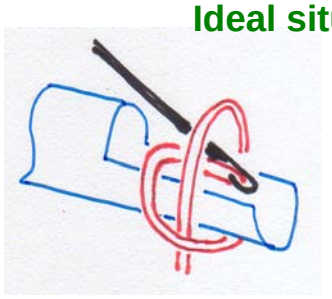
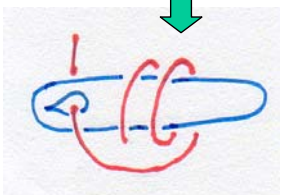


Image of
Ideal situation



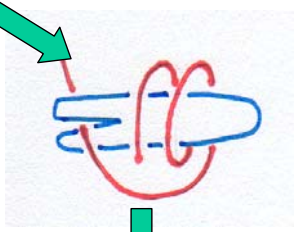
A novel tool
made of a straw

A ridiculous idea

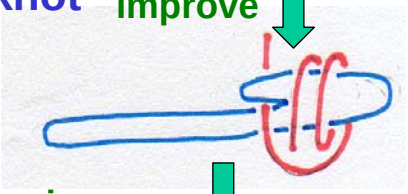


A novel needle
specialized for
making a knot

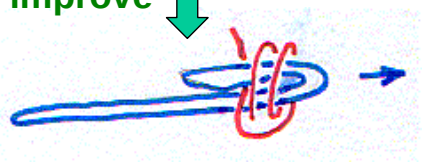
improve



improve



improve



USIT Procedure [Flowchart]

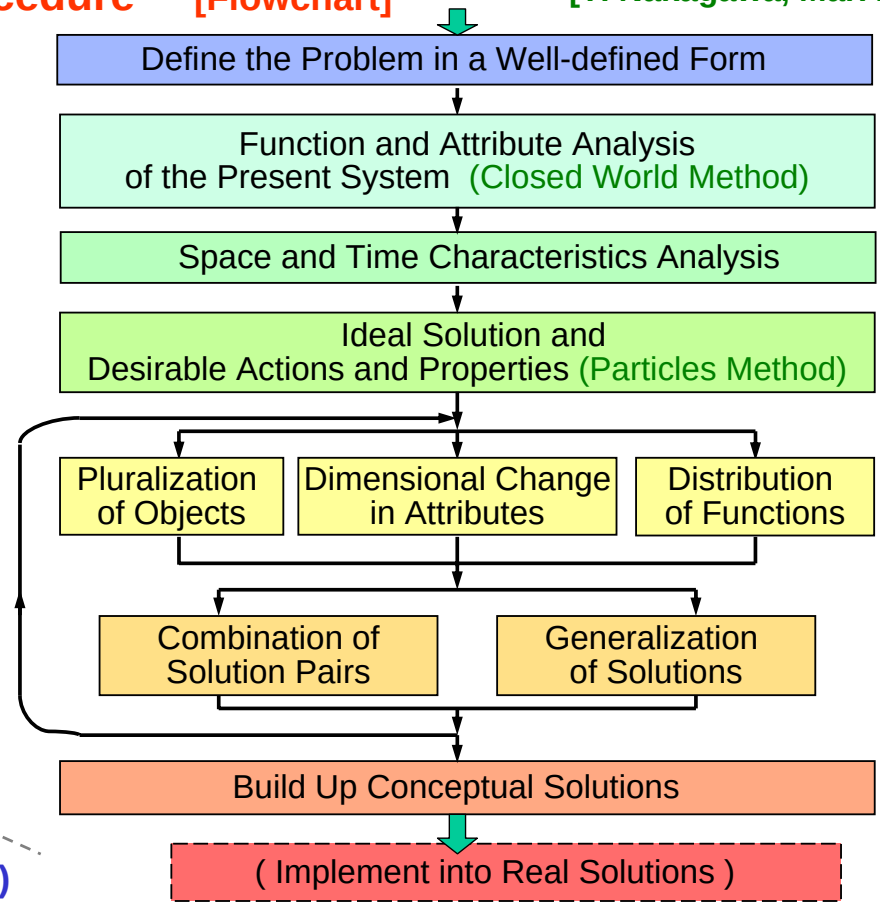
[T. Nakagawa, Mar. 2005]

Problem Definition

Problem Analysis

Solution Generation

After USIT (Implementation)



Training of Engineers

2-Day USIT Training Seminar (<-- 3 days)

for Engineers

Introduction to TRIZ & USIT
Full lecture on USIT procedure
with case study examples
Group practice of solving 3 real problems

In-company training
Open, multi-company members <-- special Agreement

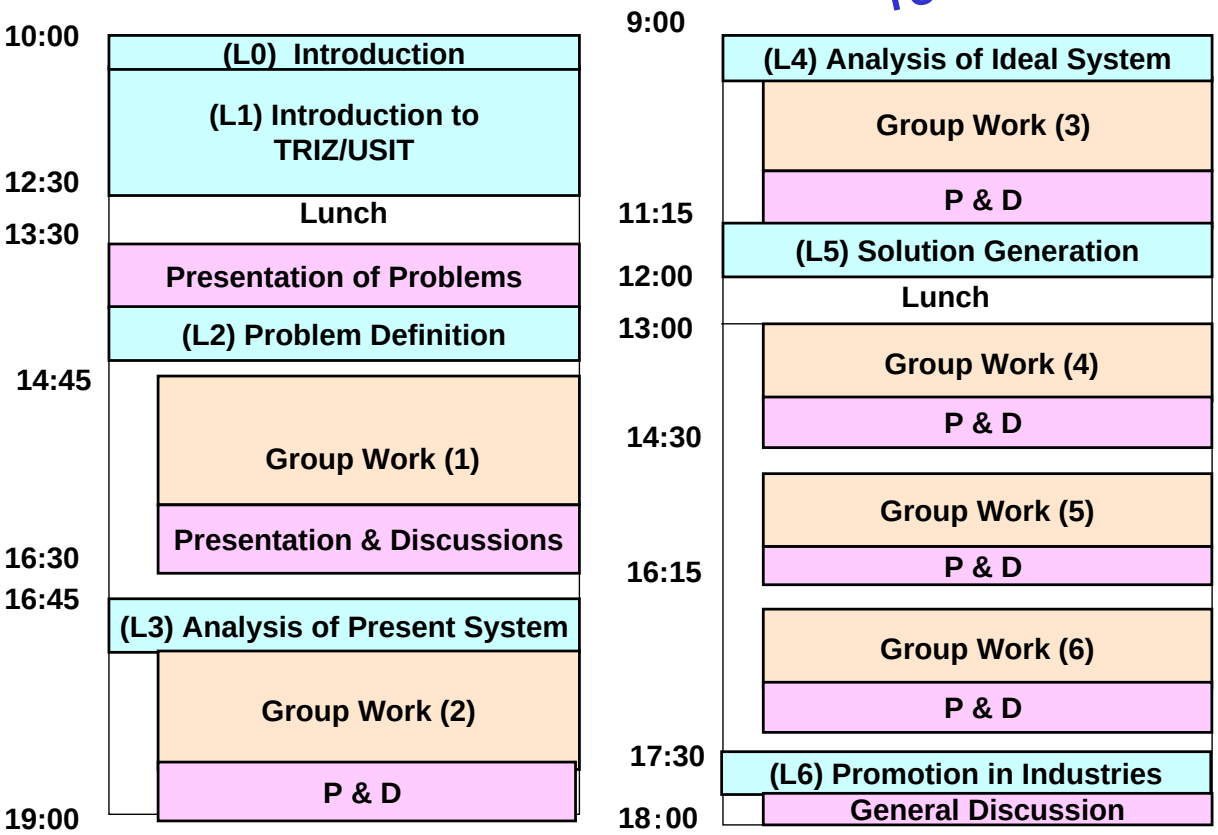
Successful with 30-50 ideas and 5-10 solution concepts for each problem

<-- High motivation, good background knowledge

Practices of Training/Applying USIT

2-Day USIT Training Seminar (Nakagawa)

for Engineers



Education of Undergraduate Students

No experiences of working in technology, in industries
Not high motivation in the topic at first

for Students

Need to teach them, step by step,
- Basic concepts of creative thinking,
- Basic concepts of systems, functions, causality, etc.
- Basic concepts of planning, designing, development, etc.
- Basic mechanism relevant to each problem
  - before handling specific technical problems

Thus,
- Specific technical problems are not suitable.
- Textbooks and Web articles addressed to engineers are not suitable (at first).

==> Solving practices of everyday-life problems

3 Classes I am teaching on TRIZ/USIT at OGU

	Lecture class	Seminar Class	Thesis Class
Semester	**2nd yr (or over) Fall**	**3rd yr Spring and Fall**	**4th yr Spring and Fall**
Hours	**1.5 hr × 13-15**	**1.5 hr × 26-28**	**1.5 hr × 26-28**
Students	**40 - 60 (Selective)**	**1 - 5 (Mandatory)** ⇨	**1 - 5 (Mandatory)**
Theme	**Methodologies of creative problem solving**	**Creative problem solving thinking**	
Teaching style	**Lecture**	**Group training**	**Group training and individual thesis work**
Task	**a report**	**reports**	**preliminary reports and a thesis**

Lecture Class: 'Methodologies of Creative Problem Solving'

15 Lectures (for 90 minutes each) to 2nd(+) year students:

(1) An easy introduction with simple case studies

(2) Three principal approaches in science & technology
third approach: Problem Solving.

(3) Finding the problem and its focus

(4) How come up with ideas? Enlightenment, Brainstorming.

(5) What are 'Systems'

for Students

-- Problem Analysis --

(6) Finding root causes of the problem

(7) Analyzing functions and attributes of the system

(8) Extra: How to construct and write a report.

(9) Analyzing space/time characteristics and ideal solution
(Particles Method)

-- Solution Generation --

(10) Fully utilizing knowledge bases: TRIZ Knowledge bases

(11) How to break through the barriers:
Physical Contradictions and TRIZ Separation Principles

(12) A system of solution generation operators:
USIT Operators

-- Summing Up of the Class --

(13) Case studies of everyday-life problem solving

(14) Creative problem solving with USIT

(15) Creative problem solving with TRIZ

-- Conclusion of the Class--

Seminar and Thesis Classes (Nakagawa)

Practices of Training/Applying TRIZ/USIT

for Students

Seminar Class (A small group of 3rd yr students)

- Most Textbooks on TRIZ for engineers are not suitable for students to study.
- Studying case studies and working on them again are useful.
- Group practices of solving various everyday-life problems
  -- with explanation of the problem solving methods TRIZ/USIT.

Thesis Class (the same students who are now 4th yr)

- Continuation of group practices on various everyday-life problems
- Finding a problem for individual thesis work
- Student's presentation and group discussion on each student's thesis problem
- Writing a thesis (Abstract in two pages is mandatory.)
- Presentation/defendence of the thesis work in a joint-Lab meeting
- Building a Students' Web site and posting the thesis works publicly.

Results posted in "TRIZ Home Page for Students by Students"

"TRIZ Home Page for Students by Students"

http://www.osaka-gu.ac.jp/php/nakagawa/TRIZ/TRIZ-st/index.htm

Mizuo Omori **Naoya Hayashi**

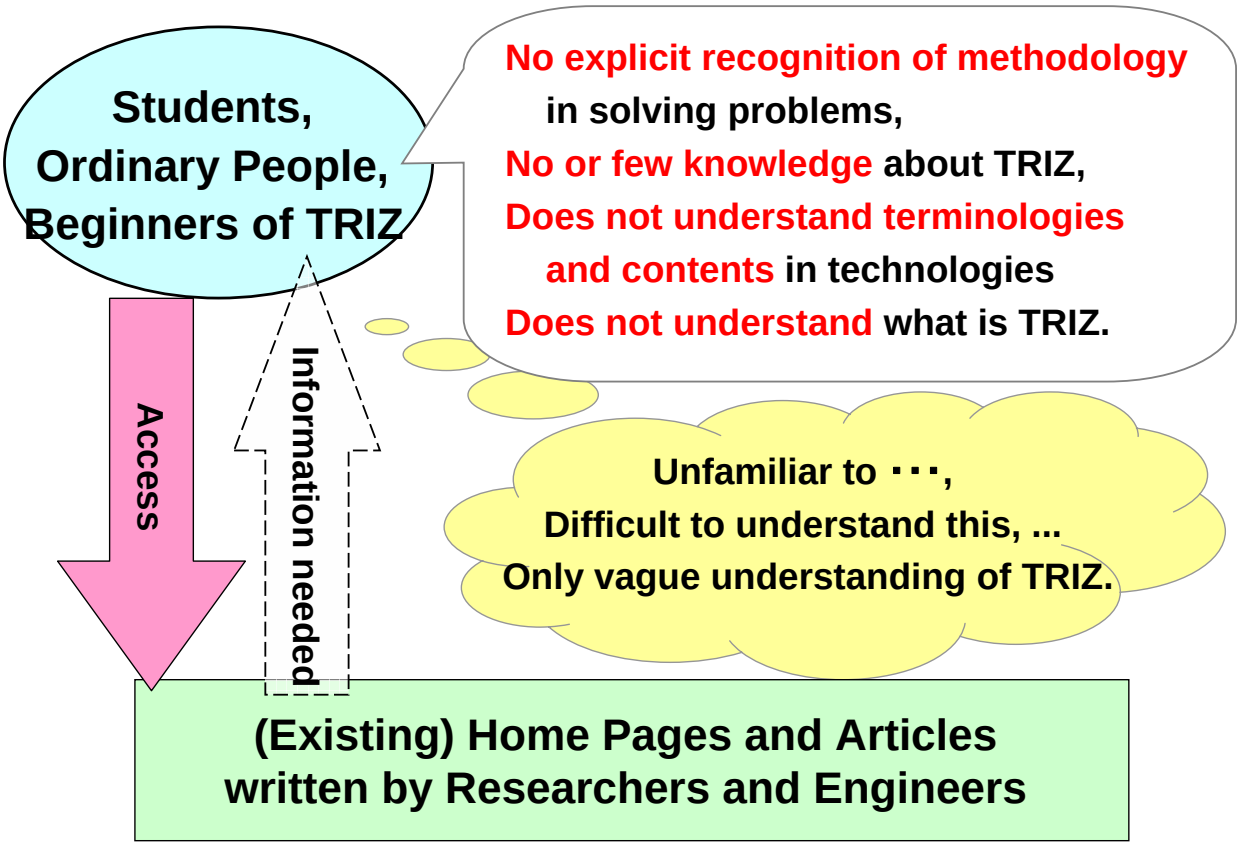
Tsubasa Shimoda **Toru Nakagawa** **Masayuki Hida**

Faculty of Informatics, Osaka Gakuin University

Nakagawa's Seminar Class for the Thesis Work

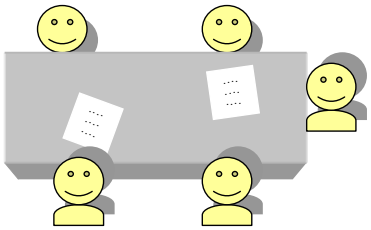
Graduated in March, 2006 **(Photo taken on the day of Graduation Ceremony)**

Needs for a TRIZ Home Page for Students

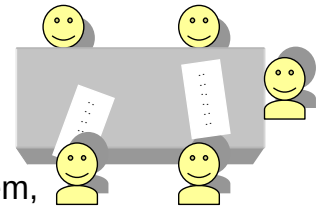


A Record of Students' Discussion just before their graduation

"What we think we obtained by studying TRIZ/USIT"



- **At first** we did not have much interests in it;
  we started to learn it without knowing what it is.
- **By the experiences of practices of solving problems**,
  we have been attracted with TRIZ little by little.
- **Collaborative Thinking:** I have found that rather than thinking alone,
  thinking in collaboration with my Seminar group members brings us
  new findings and new ideas and hence much better solutions.
- **Analytical thinking:** When we analyze problems from various viewpoints, we
  come to see their solutions. Thorough analyses are essential for problem solving.
- **Ideas have come up to my mind more often** than before.
  The experiences of studying to slove a number of problems
  have led us to find solutions of different poblems.



- **Confidence:** Though I was poor at making ideas, I now feel that I myself is able to think of something new.
- **TRIZ thinking:** In my everyday life, when I meet some problem, I now find myself trying to analyze the problem and to figure out solutions
- **Influence:** By solving every-day life problems with TRIZ/USIT, we became familiar with TRIZ and received the influence of TRIZ on our own life style, feeling it pleasant and interesting.
- **Limitations:** It is often impossible to really make prototypes and to examine the solutions due to lack of technologies and practical environment.

Examples of Case Studies Achieved by the Students:

- 'How to fix a string shorter than the needle' (Shimoda, 2006)
- 'How to prevent from shoplifting in a book store' (Hayashi, 2006)
- 'How to prevent unauthorized persons from entering the auto-locking door of apartment building' (Fujita, 2007)
- 'Methods of preventing cords and cables from getting entangled/messy' (Ito, 2007)

Concluding Remarks: Education and Training of Creative Problem Solving Thinking with TRIZ/USIT

(1) **The contents of my teaching have shifted**
from TRIZ (separated big tools with huge knowledge bases)
to USIT (a standard thinking procedure in group collaboration)

(2) **For training engineers in industries:**
2-Day USIT Training Seminar with real problem solving practice.
Case studies of real industrial problems and easy everyday-life problems are useful.

(3) **For educating undergraduate students:**
Giving motivation and introductory guidance is essential.
Lecture course (1 semester) is established.
Seminar + thesis classes (2 years) are used for practice.
Group practices on everyday-life problems are useful.
Students have generated several nice case studies.

(4) Training and Education are reflected in my understanding of TRIZ/USIT.