

# Study and practice for the strategy of higher education reform based on TRIZ theory

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## Abstract:

Most college students in China lack the ability of innovation. The author of this paper made a long-term research around the cultivation of students' innovation ability and engineering consciousness. With TRIZ education theory as the instruction, the northeast DianLi University students' innovation practice has been conducted. During the process, the author analyzed the problems and defects existing in the education system in this school, found solutions to the main contradiction of the scientific theory of solution. This aims to build college students' innovative curriculum system, as well as for the cultivation of innovative talents to provide beneficial exploration and try.

**Key words:** TRIZ; education reform; practice

## 1. INTRODUCTION

Classroom teaching is the basic form of teaching, is the student to obtain information, improve skills, and form the main channel of ideological concept. Classroom teaching time is limited, however, to achieve the least amount of time to obtain the biggest progress and development of the students, the new curriculum reform of primary and secondary schools have to face a problem is how to maximize the classroom teaching efficiency. Effectiveness is an important way to improve the classroom teaching. Effective teaching under the background of pushing forward quality education in our country is more and more attention.

Engineering college is known as "the cradle of cultivating engineers". It undertakes a glorious mission of training engineers. Cultivating the innovation spirit and ability of engineering students is of important for engineering university. Although technological innovation must be based on the enterprise as the main body, it is conducive to satisfy the needs for technological innovation on engineering practice of company quickly, and college students who equipped with innovation ability will be the impetus of enterprise technology innovation inevitably. And it is benefit to improve innovation ability to master innovation methodologies for the

students, even though innovation is hard to schedule and cannot be taught as well [1].

Various famous innovation methodologies used including creativity methods such as Brainstorming, Six Thinking Hats, Mind Map, Brinnovation, Benchmarking, and TRIZ, etc. These can provide a dialectical mode of thinking, and will be useful for developing thinking, and finding a shortcut and identify the method for solving the invention issues. At present, TRIZ is considered to be the theory of inventive problem solving in the innovation methodologies [2].

In this paper, the theory of TRIZ will be simply introduced and then the necessity of using TRIZ theory teaching in colleges and universities be discussed. A kind of effective innovative ability cultivation mode, that is 5-minute educational model: one lesson, one principle, one method, an example, will be provided and the results be given.

## 2. TRIZ THEORY

TRIZ is a theory of invention problem solving in Russian prefixes. The theory was found by the former Soviet union Altshuler · G · S and their leading researchers. And through the analysis and study of nearly 2.5 million pieces of high levels of invention patents in the world, they sum up out the theory of creative problem solving and method. its purpose is to study human inventions, solution definitely technical problems produced in the process of scientific principles, methods and rules[3]. TRIZ means "the theory of inventive problem solving (TIPS)".

TRIZ is specializing in innovative design theory, has established a series of general tools, the model and indicate the problem solving countermeasures to solve the problem of exploration direction. TRIZ theory is used to solve the problem of invention patent analysis proposed methodology, has been fruitful results in the field of engineering technology. Penetration and expansion has been gradually to other areas. It is to guide people's creative problem solving and provide the scientific method, rule.

The core idea of TRIZ theory is mainly manifested in three aspects: (1) whether it is a simple product or complex technical system, the development of its core technology is to follow the objective law of evolution, namely has objective evolutionary laws and mode; (2) all kinds of technical problems, conflicts and contradiction solving, is the power of

driving this process; (3) the ideal state of the development of the technology system, the maximum function is implemented with the least amount of resources.

There are two kinds of problems, with generally known or unknown solutions, people have to face. The issues with known solutions can usually be

addressed by information found in books, technical journals, or with subject matter experts. Altshuller maintains that an acceptable theory of invention should be familiar enough to inventors by following the general approach for problem solving shown in figure.1 [4]. A theoretical system was constructed as shown in figure.2 [5].

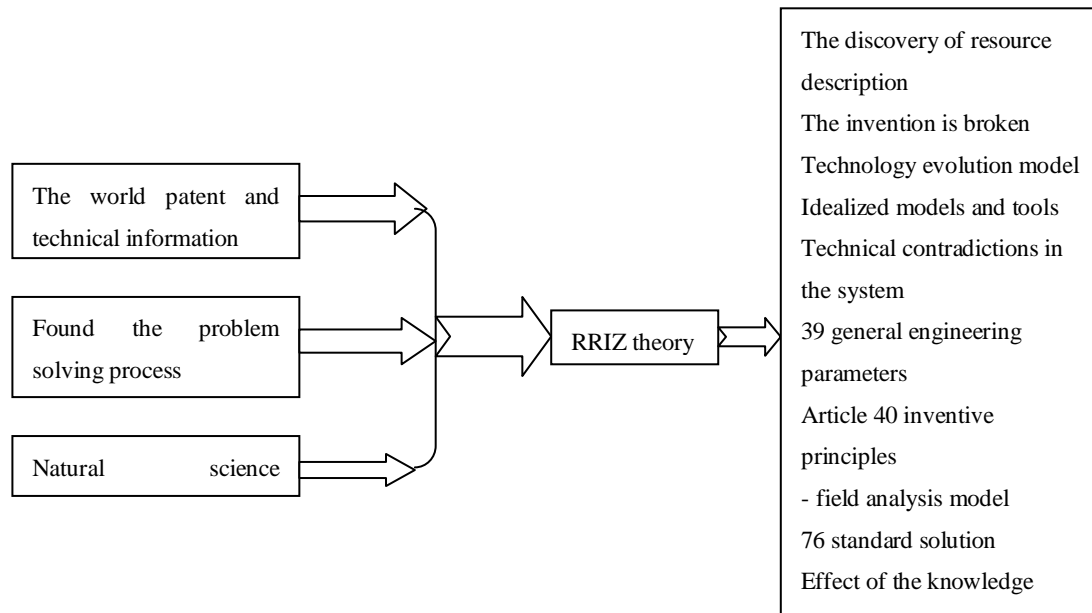


Figure 1. TRIZ approach to problem solving

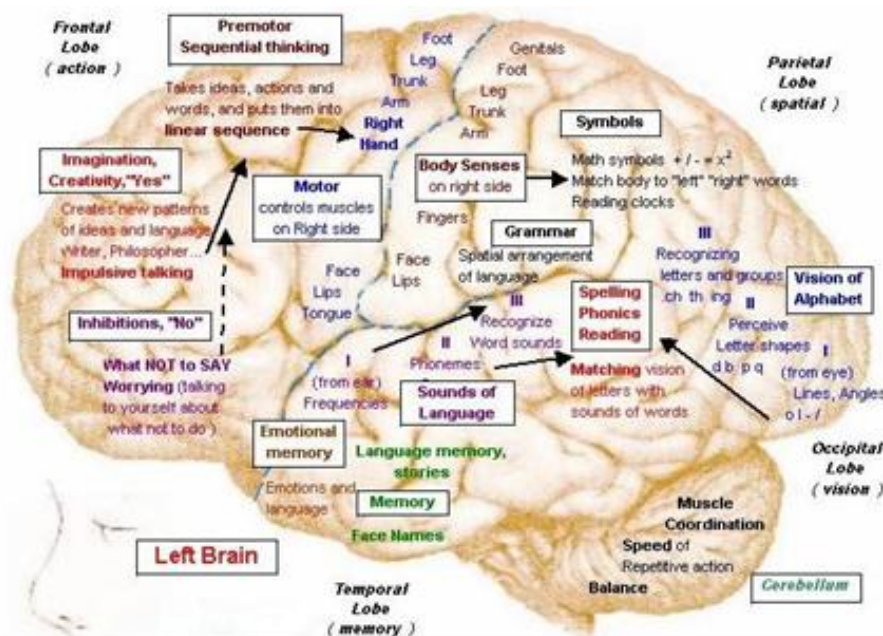


Figure 2. The brain functional partition

### 3. NECESSITY OF USING TRIZ THEORY TEACHING IN COLLEGES AND UNIVERSITIES

TRIZ is a kind of improve creativity, leads people innovative theory, therefore, TRIZ teaching of the non-computer majors not appropriate knowledge of

the traditional teaching method, should be the focus fell on the training of innovative thinking and innovative ability, in the selection of teaching organization form, teaching content and curriculum evaluation should have innovation on the way.

1. The small class system, interactive, discussion-based teaching restricted by teachers, at

present, most of the courses in TRIZ related colleges and universities are of large amount of teaching, with teaching style is given priority to, the lack of interaction and discussion. And the cultivation of innovative thinking and innovative ability, like learning to ride a bike, teachers' teaching methods and techniques, students must go through their own practice can truly grasp the riding skills, otherwise just theoretical.

TRIZ course appropriate teaching organization form is small, can give students more opportunities to participate in the teaching process, help teachers understand the students' feedback in time, strengthen the interaction between teachers and students. Can also study group as the unit the classroom layout, upper and lower limits of dilute platform, through the analysis of the division of labor cooperation and common group students and discussion, students mutual promotion and competition between team, formed a lively classroom atmosphere, in imparting knowledge and cultivate the students' communication ability and team cooperation spirit. In courses in TRIZ, the teacher wants to clear the teaching main line, clear the teaching plan, improve the teaching design, teaching method, discussion method, competition method, practical teaching methods, such as combination type training methods, guide the student to carry on the inquiry learning based on problem, based on the case discussion-based learning and participatory learning based on project, only let the student become the protagonist of the classroom, to make students understand the real meaning of creative thinking and thinking.

2. Choose target-oriented teaching focus and teaching cases

For students majoring in engineering, the teaching content with technical and physical contradictions, field analysis, HOWTO TRIZ tools to solve problems such as system model, and TRIZ innovative thinking as the key point, supplemented by system function analysis, resource analysis, causal analysis method and technology system evolution laws of TRIZ systematic method to analyze the problem, such as case teaching should be combined with professional is given priority to with practical cases in the field of engineering technology, pay attention to the application scope of rigid, to grasp the method of the invention can enable students to master practical operation innovation tools.

#### **4. A KIND OF EFFECTIVE INNOVATIVE ABILITY CULTIVATION MODE**

Take the student as the main body, teacher as the leading, independent innovation learning combined with guidance, to grasp the method of advanced innovation, innovation, build an open mind, open field of vision, open thought innovation, create a platform. To strengthen the construction of college students' innovation base, and promote the teaching mode reform, gradually implement for the entire

school, all-round open innovation practice teaching base.

- (1) Courses in innovation action classes
- (2) To strengthen teachers team construction
- (3) Build a diversified innovation practice teaching platform

(4) Explore the efficient operating mode  
Methods training: to master the advanced innovative thinking and innovative ability, break through mindset, open.

Practical training: combined with professional knowledge and practical life, practice and practice.

Summarize the method to improve: conclusion, summarize the practical experience, seminars, BBS, improve ability.

Feedback loop: promote innovative teaching content, teaching method and teaching mode.

5 minutes education model: a class, a principle, a method and an example

#### **5. EFFECT AND CHARACTERISTIC**

Feature 1: the innovative methods, improve the ability of invention

Creative innovation to create "wash brain" practice method is proposed, and applied to the practice in the base of the method of "training".

Feature 2: relying on the advantage of, build a four-step innovation practice system

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Summarize the method to improve: conclusion, summarize the practical experience, seminars, BBS, improve ability.

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Feature 3: prominent industry characteristics, strengthen the discipline overlapping fusion

As the "green energy, energy conservation and emission reduction" as the main line, strengthen and applied mathematics, mechanical, electrical, electronic and other disciplines of crossover and integration, focus on training students' energy integration technology innovation and application ability.

In other to overcome the above mentioned problems, a four-line TRIZ innovation education mode has been presented by us.

1) Curriculum construction: In early 2006, an elective course named creativity psychology was set up. A variety of innovative methods including TRIZ were introduced to the students. The aim is to train students' awareness and interest in science and technology innovation and enlarge their innovative knowledge and methods.

2) Platform construction: A scientific and technological innovation platform called the students practical and innovative demonstration base of TRIZ and Mindmap has been built since 2009 based on 2

provincial laboratories, 4 provincial-level engineering research center and 5 college laboratories. The platform provides practical and innovative base for students and it is open all year round, in which large laboratory instrument is open daily for more than 16 hours.

3) Open training seminars: In order to make innovative education universal and to strengthen the understanding of TRIZ, there will be 6 times open training seminars per year held in our university. Some experts and scholars will be invited to give lectures to students.

4) Effective innovative ability cultivation mode. This is the most innovative education mode presented by us. TRIZ consists of 40 principles, 11 transformers, 76 standard rules, and 40-step problem solving program, and requires about 200-300 hours to master. It is not enough to make the students master TRIZ theory only depend on one elective course and several lectures. In order to strengthen long-term innovative education, a 5-minute educational mode, that is one lesson, one principle, one method, an example, has been presented. The educational mode is that the teacher will spend almost 5 minutes telling the students one TRIZ principle, one TRIZ method with an example before teaching any other course each time. The aim is to maintain students' interest in science and technology innovation and get more innovative knowledge and methods[6].

In brief, the presented innovative education and training programs can provide students the mode including methods training and practical training to promote the innovative ability.

In recent three years, students received various types of innovation and competition awards on more than 100 times involving 500 people. The more important point is that the students' operational ability and problem-solving ability has been greatly improved.

## 6. CONCLUSIONS

TRIZ theory itself is a kind of method of innovation theory, and it has not only confined to the guidance of the application of technological innovation itself, in the education innovation,

improve the classroom efficiency, and other areas of the service, also has good prospects. Through the research and application of TRIZ theory, students' innovative ability can be improved, logical thinking can be strengthened, the classroom efficiency of campus service level can also be improved. Through the combination of technological innovation process and the curriculum reform, will greatly enhance the school innovation efficiency, highlights the practical value of the TRIZ. The author in this topic, and will do the further research in the future.

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## 8. REFERENCES

- [1] Qiao Haishu, Li Yuanhang. "Sum up the Training of the Creative Ability of College Student". *University Education Science*, 2008, (1): 20-23. (In Chinese)
- [2] Terninko, J, Zusman, A., & Zlotin, B. "Systematic Innovation: An introduction to TRIZ". *FL: CRC, Press*. 1998.
- [3] Tan RunHua, "Invention of Problem-solving Theory" [M]. *Beijing: science press*, 2004. 97-99.
- [4] Theory of Inventive Problem Solving (TRIZ). <http://www.mazur.net/triz/>
- [5] Cheng Ruxiang. "Winning innovation". *Aerospace China Press*. 2007. (In Chinese)
- [6] Qing Wang, Jingru Bai, Zhang Bai, Chunxia Jia, "Training methods of theory of TRIZ for engineering college students" [J]. *Energy Education Science and Technology Part B: Social and Educational Studies*. 2012 Volume (issue) Special Issue 2:49-54