Going beyond the basics of Critical Thinking: Teaching high ability students the principles of Inventive Problem-Solving

Presented by
Suzanna J. Ramos, Ph.D.
Hector Ramos, Ph.D.

Assistant Lecturers
Department of Educational Psychology
College of Education and Human Development
Texas A&M University
suzannaramos@tamu.edu
hreina@tamu.edu
Introduction to TRIZ

- TRIZ is the theory of inventive problem solving.

- Systematic approach for understanding and solving problems which allows for clear thinking and generation of innovative ideas.

- Beginning in 1946 and still evolving, TRIZ was developed by Soviet inventor, Genrich Altshuller and his colleagues.

- Received his first Russian patent in the ninth grade.

- Came up with 40 principles of inventive thinking based on thousands of patents.

Although TRIZ is used in technical areas, this session shares tips on how to use basic principles of TRIZ in the classroom.
Foundation 1: Ideal Final Result (IFR)

- It describes the solution to a problem free of any constraints and/or assumptions from the original problem or issue.

- Example: Design a survival kit during times of natural disasters

- Constraints/Assumptions:
  - Handle
  - Container
  - Zipper
  - Pocket
  - Pouch

<table>
<thead>
<tr>
<th>Constraints/Assumptions</th>
<th>IFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle</td>
<td>0</td>
</tr>
<tr>
<td>Container</td>
<td>0</td>
</tr>
<tr>
<td>Zipper</td>
<td>0</td>
</tr>
<tr>
<td>Pocket</td>
<td>0</td>
</tr>
<tr>
<td>Pouch</td>
<td>0</td>
</tr>
</tbody>
</table>

- The survival kit must not have any of those elements.
**Use of IFR in the Classroom**

- In what ways might students conduct a presentation without PowerPoint slides or any other electronic media?

- In what ways might students assess their own understanding of a topic without any sort of grading by the teacher? Example: Activities for self-assessment e.g. sketching, explain in your own words

- In what ways might students design a pen without ink, plastic tube, stem, and nib? Hint: Think function, not object!

**Foundation 2: Contradictions**

- Occurs when a desired state cannot be reached because something else in the system prevents it.

1) **Train students to visualize the increased positive effects and the consequent negative effects and list those situations.**

   - The vehicle has high horsepower but uses more fuel.
   
   - Service is customized to each client but the service delivery system gets complicated.
   
   - Software has many applications for classroom use but it is difficult to learn.
Use of Contradictions in the Classroom

2) Challenge students to find ways to solve the contradictions.

- In what ways might we increase horse power with less fuel consumption?

- In what ways might we have customized service using a simple delivery system?

- In what ways might we learn to use software with several applications easily?

More examples:
- In what ways might an umbrella be large enough to keep the rain away but small enough to carry?
- In what ways might I increase the number of pages in a book and make it lighter?

Earlier, we introduced you to the chart on the TRIZ principles. We will look at a few of them.

TRIZ Principle 1: Segmentation

- Divide an object into independent parts.
- Make an object sectional
- Increase the degree of fragmentation or segmentation.
TRIZ Principle 1: Segmentation...Con’t

Students:

- In what ways might students segment content learned during independent study to enhance understanding?
  - Pause and ponder questions e.g stop and reflect
  - What are 3 insights you have learned at this point in time?
  - How will you apply what you have learned in a real-life situation?

Teachers:

- Create flexible groupings
- Break down teaching goals into sub-goals
- Offer separate programs to meet diverse needs of students
- Use partitions to create sectional classrooms
- Create individual standards-based modules
TRIZ Principle 2: Extraction

- Extract only the necessary part or property from an object.
- Extract the “disturbing” part or property from an object.

Students:

- In what ways might students’ boredom motivate others to overcome it?
  - Get students to become aware of their boredom and generate solutions to overcome it.

- In what ways might students extract a necessary part of an object to create something new? Example: a table

Teachers:

- Enable testing-out for students who have met learning objectives for a particular topic for the week.

- The school librarian is an in-class resource person for students who are doing independent studies.
TRIZ Principle 6: Universality

- An object can perform several different functions; therefore, other elements can be removed.

Students:

- Apart from its intended use, what are the other uses of___?:
  - A hat
  - A clock
  - A candle
  - A pair of spectacles
  - A pair of mittens

Teachers:

- Multidisciplinary teams to create standardized tests
- Employ “Lunch and Learn” events
- Create new ways of collaboration among different departments
- Recruit and employ teachers with dual/multiple areas of certification.
Final Thoughts

- TRIZ is a highly technical process but the ideas presented are simply triggers for deeper thinking.
- Can be used in conjunction with creative problem solving, depth and complexity, lateral thinking, etc.