

Research Methodology

Selecting and Defining a Research
Problem

Selecting and Defining a Research Problem

- Be CREATIVE
- Identifying and stating the problem
- Identifying and defining the variables in the problem
- Evaluating the problem for its research ability
- Reviewing the literature related to the problem

Be CREATIVE

- <http://www.creativeeducationfoundation.org/>
- <http://new.odysseyofthemind.org>
- <http://www.academia.edu>
- <http://www.asee.org>
- [http:// www.polymathlectures.org](http://www.polymathlectures.org) (free creativity course)
- <http://www.successfuleducation.us>

Be CREATIVE

- <http://education.engineering.uga.edu>
- [http:// www.ctechinnovation.com](http://www.ctechinnovation.com)
- <http://www.waseda.jp/eng/academics2/cse.html> (School of Creative Science and Engineering)
- <http://www.eeic.osu.edu> (The **Engineering Education** Innovation Center)

Be CREATIVE

- North Carolina State University
- Cambridge University
- Northampton University (UK)

- “Creativity as the production of something that is both new and truly valuable”--
Rothenberg
- “It would seem to be our responsibility to produce some creative engineers or at least not to extinguish the creative spark in our students.”—Richard Felder

Be CREATIVE

- Creativity in Engineering, needs
 - Immerse yourself in a domain or problem
 - Be prolific—generate lots of ideas
 - Use tools for representations and thoughts
 - Play with ideas
 - Avoid premature closure

- Don't be afraid to be different
- Be open and receptive to new ideas
- Do it—practice your craft
- Maintain a product orientation
- Relax—indulge your diversions
- Reflect—review what you have done
- Have fun!

Be Creative

- Seltzer and Bentley (1999)
- Creativity is the application of knowledge and skills in new ways to achieve a valued goal.
 - The ability to identify new problems, rather than depending on others to define them
 - The ability to transfer knowledge gained in one context to another in order to solve a problem

Be Creative

- A belief in learning as an incremental process, in which repeated attempts will eventually lead to success
- The capacity to focus attention in the pursuit of a goal, or set of goals

Be Creative

- Creativity is a process of generating and manifesting a new idea
- Innovation is taking creative ideas into reality and implementation to produce a new product or system

Factors That Boost Creativity

- Record your creative ideas
- Take a walk!
- Travel!
- Practice 1: randomly select a word and then try to formulate ideas incorporating this word

Factors That Boost Creativity

- Practice 2: Open a scientific journal, choose an article of interest then apply creative thinking approaches such as “applied imagination” or “ask questions” to formulate a new solution to accomplish the same goal.
- Practice 3: Go to an international patent site on the web and choose a patent of interest. Think how to apply creative thinking approaches to improve the patent or find another solution to accomplish the same goal.

Factors That Boost Creativity

- Practice 4: Define your problem, then ask six questions: What? Where? When? Why? Who? and How?
- Exercise your brain by talking to educated people, being a member in a scientific society, reading scientific papers and patents of interest

Factors That Boost Creativity

- Writing
- Be healthy
- Be happy
- Be confident
- Playing imagination games, have fun and play
- Brainstorming

Factors That Limit Creativity

- TV/Drug addiction
- Fear of criticism
- Lack of confidence
- State of mind/body and general health
- Being too busy causes stress and reduces creativity
- Conflicting goals and objectives

Factors That Limit Creativity

- Not allowing oneself enough time to relax
- Ego
- Demands for quick production of results
- Harsh words from others may destroy one's creativity
- Routines and setting specific ways of doing things generate a rigid mind

Factors That Limit Creativity

- Self-criticism
- Rigid rules and barriers limit creativity

Creative Thinking Techniques

- Applied Imagination
 - Put to other uses?
 - Adapt?
 - Modify?
 - Magnify?
 - Minify?
 - Substitute?
 - Rearrange?

Creative Thinking Techniques

- Reverse?
- Combine?

Creative Thinking Techniques

- Ask Questions
 - Ask WHY five times
 - Ask six universal questions (What, Who, When, Where, Why, How)

Creative Thinking Techniques

- Brainstorming
 - Generating ideas process in a group of people
- Brainstorming properties
 - Have a well-defined and clearly stated problem.
 - Have someone assigned to write down all the ideas as they occur.
 - Have the right number of people in the group.

Creative Thinking Techniques

- Have someone in charge to help enforce the following guidelines:
 - Suspend judgment
 - Every idea is recorded and accepted
 - Encourage people to build on ideas of others
 - Encourage way out and odd ideas

Creative Thinking Techniques

- TRIZ (Theory of Inventive Problem Solving)
- By Genrich Altshuller
- Tree search for the best solution
- ARIZ
- USIT

Creative Thinking Techniques

- Attribute Listing
 - Breaking down the problem into smaller bits
 - Looking for a replacement for every bit to produce a new product or system

Any Question?

THANKS FOR YOUR ATTENTION

