

## Creativity for teachers

Creating a program for teachers that introduces creative thinking to their other thinking skills (critical thinking, reflection, questioning)

**Definition:** Developing an idea that is something original and of value.

Creative thinking is a set of skills that can be learned, developed, and utilized in daily problem solving. The idea must be useful in that it solves the problem but could be magical in its development.

Creativity, or the production of change, is a result of both thinking and emotion; it is a matter of both the head and the heart. To create positive change, you must marry clear thinking with such emotional states as courage, risk taking, and tolerance for ambiguity.

**Innovation** is the practical application of the creative idea into a process or product.

**Entrepreneur:** Create value where there was none.

### Don't believe the experts:

*"That's an amazing invention, but who would ever want to use one of them?"* (US President Rutherford B. Hayes, after participating in a trial telephone conversation between Washington and Philadelphia in 1876).

*"Television won't be able to hold onto any market it captures after the first six months. People will soon get tired of staring into a box every night"* (Darryl F. Zanuck, Head of 20<sup>th</sup> Century Fox, 1946)

*"The horse is here to stay, but the automobile is only a novelty, a fad"* (President of Michigan Savings Bank, 1903, advising Henry Ford's lawyer not to invest in the Ford Motor Company – disregarding the advice, he invested \$ 5,000 in stock, which he sold several years later for \$ 12,5 million).

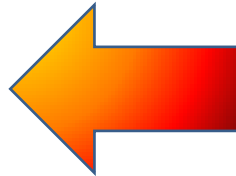
*"I think there is a world market for about five computers"* (Thomas J. Watson Sr., Chairman of IBM, 1943)

## What are some of the traits of creative thinkers?

### Traits of the Creative Person

#### *Qualities of Creative People*

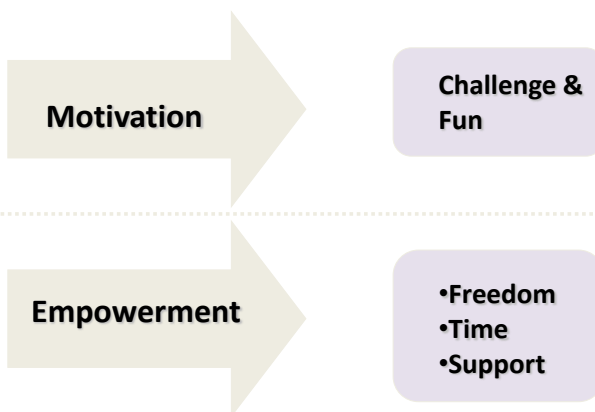
- Curious
- Energetic
- Experimenting
- Independent
- Industrious
- Flexible
- Open-minded
- Original
- Playful
- Perceptive
- Persevering
- Questioning
- Risk taker
- Self-aware
- Sensitive



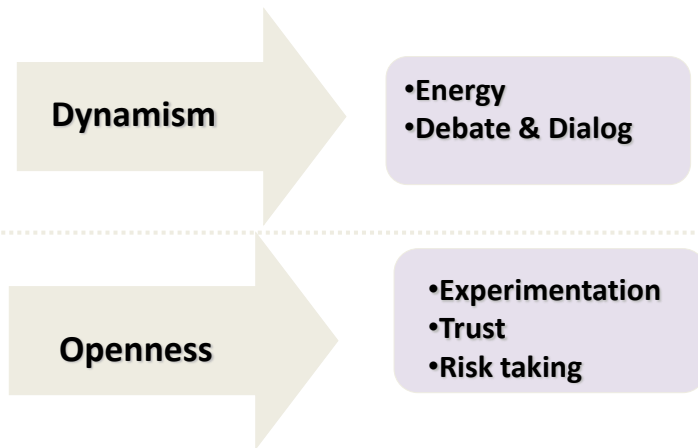
SOURCE: Davis (1986).

## Setting the environment of the classroom

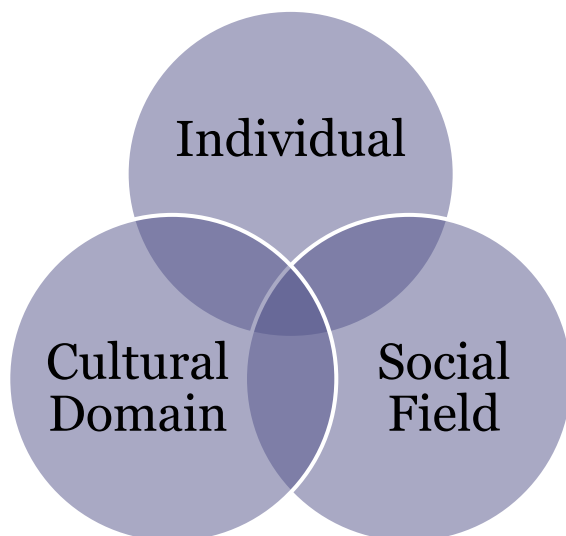
### Creating a Creative Climate



## Creating a Creative Climate



Mihaly Csikszentmihalyi .. Creativity is the intersection of three anonymous areas.



**Cultural Domain is the area where the person is working**

**Social Field is the Institution that pass judgment on the idea.**

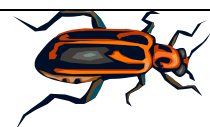
We need to create a school based DNA so it can be carried to each successive class. We need to honor risk taking, looking for different ways to do things, content knowledge, curiosity and the synthesizing mind.

Using creativity in all disciplines of learning:

Discipline	Method
Literature / Literacy	Find design challenges in stories
Social studies/ History	Find design challenges from the history or social studies that is happening at that time or place.
Science	Do engineering designs based on the science
Math	Take a design challenge and look for the math that can we utilize to make the design better or for it to work
Art	Take design and use art to improve the design

## Creative Exercise

### Bug List Exercise



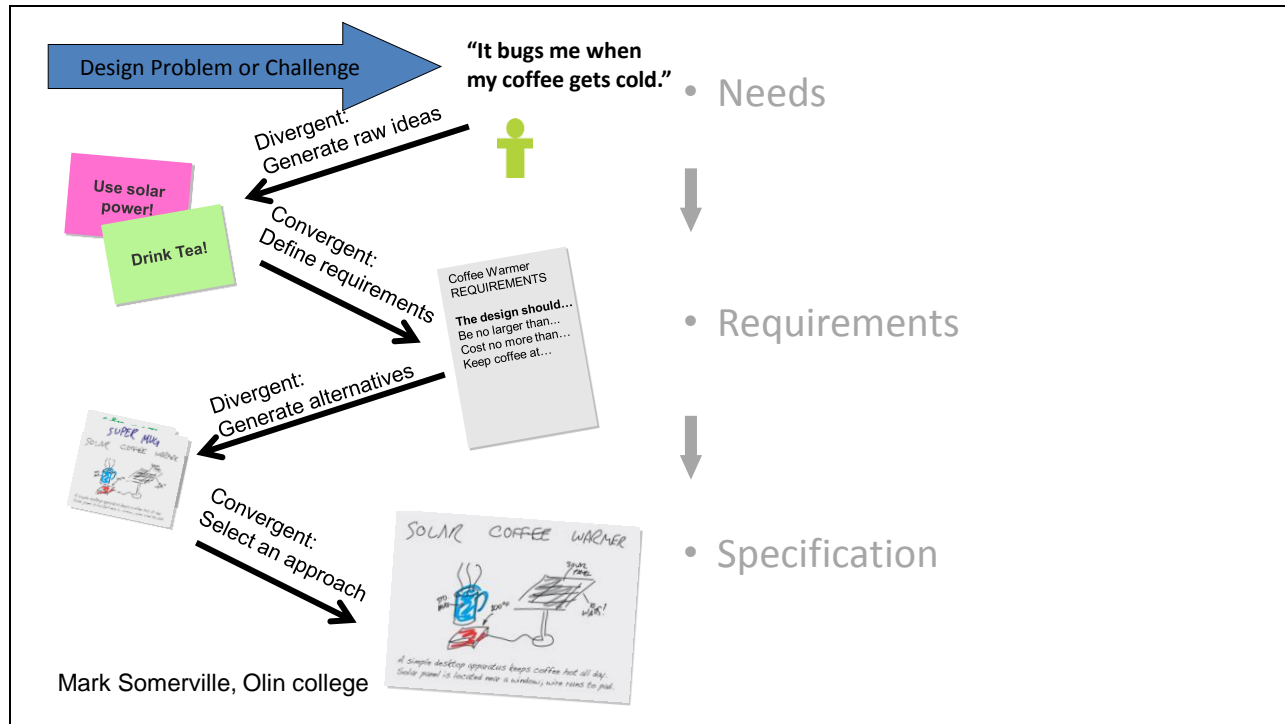
Purchase a small notepad, and carry it with you throughout the next few weeks.

Every time you observe something that “bugs you” – something that doesn’t work right, or that you think could be improved – jot it down in your notepad. You don’t need to limit this to technological artifacts.

For example, you might jot down “I never know if my alarm clock is actually set”, but you might also jot down “My son never tells me when he is coming home”, or “Wet newspaper this morning!”.

Your objective here is to become more conscious of the things around you that could be improved.

**Take the “Bug” and use it as the problem to solve or fix**



## Thinking Skills



- Questioning
- Creative and Critical thinking
- Meta-cognitive reflection
- Strategies

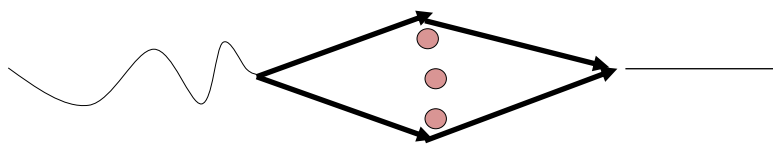
Learning environment

Can someone give examples of these?

[www.engineeringlens.org](http://www.engineeringlens.org)

<b>Critical Thinking</b> * Analyzing the past * What evidence? * What is the author's purpose? * Convergent thinking * Skepticism is a virtue	<b>Creative Thinking:</b> Creativity improves pupils' self-esteem, motivation and achievement * Brain storming * Divergent thinking * Exploring your environment & testing many options * Stimulate curiosity * Innovation & entrepreneurship
<b>Meta-cognitive reflection</b> * What do I want to understand? * What have I learned? * What do I still need to learn? * Provide feedback for reflection * Regulate ones behavior	<b>Questions ... Engaging the student</b> * Logical Sequential * Open ended * Listening is the first step in good questioning * Provocative * Engage * Encourage higher order thinking

### Summary Process



Priming	Generative	Convergent	Defining
Story Mapping	Brain Writing	Discussion of Pro/Con	Gallery Sketches
Needs	Morphological Analysis	Shaping	Modeling/Building
Problem Framing	Shaping	Requirements	Posters
Values	Brain Storming	Decision Matrix	Presentation
OTHERS ( science constraint)			→

↑  
**Listen to the needs and values of the customers**

- ↑
- Generate raw ideas for a given challenge
  - Select an idea that is particularly interesting
  - Identify the requirements for that concept
  - Come up with multiple solutions that meet the requirements
  - Select a solution, based on the requirements



<p>Janet L. Kolodner Interactive Computing</p> <p>Georgia Institute of Technology</p>	<h2 style="text-align: center;">Claim: You don't need to be Einstein to reason creatively</h2> <ul style="list-style-type: none"><li>• <b>Rather</b><ul style="list-style-type: none"><li>- Notice unstated problems (poor texture)</li><li>- Stretch applicability (redefine "easy to prepare")</li><li>- Try out non-obvious ideas (different food)</li><li>- Consider more alternatives</li><li>- Accept inconsistencies for a while (the powers that be might not like this)</li><li>- Become bored with repetition</li></ul></li></ul> <p style="text-align: center;">May 2010                      FLAIRS, Daytona Beach                      6</p>
	<h2 style="text-align: center;">What is Creative Reasoning?</h2> <ul style="list-style-type: none"><li>• Having a <u>disposition</u> toward using one's reasoning capabilities to the utmost<ul style="list-style-type: none"><li>- Beyond the obvious</li><li>- Beyond the easiest</li><li>- Addressing a challenge or problem<ul style="list-style-type: none"><li>- Sometimes by changing it (being subversive?)</li><li>- Without relaxing constraints too much, but possibly by manipulating them a lot</li></ul></li></ul></li><li>• And having the competence and knowledge to carry through with one's intentions</li></ul> <p style="text-align: center;">May 2010                      FLAIRS, Daytona Beach                      10</p>

## How Can we Promote a Creative Reasoning?

1. What do we know about creative reasoning and creative design (the cognitive)?
2. What do we know about how to help people learn complex skills and practices?
3. What do we know about how to help people develop attitudes and disposition?  
(ask me if I don't say enough about this)
4. How can AI help?

All from a mile high  
May 2010 FLAIRS, Daytona Beach

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### Tools to get better at being creative:

- Learners need help reflecting on their achievements so as to recognize what they are doing, what they know, what they need to learn to do better, and how valuable the successful reasoning they are doing.



- To help kids (or anyone) become successful in creative reasoning , they need to regularly engage successfully in creative reasoning and come to appreciate its usefulness in achieving their personal goals.



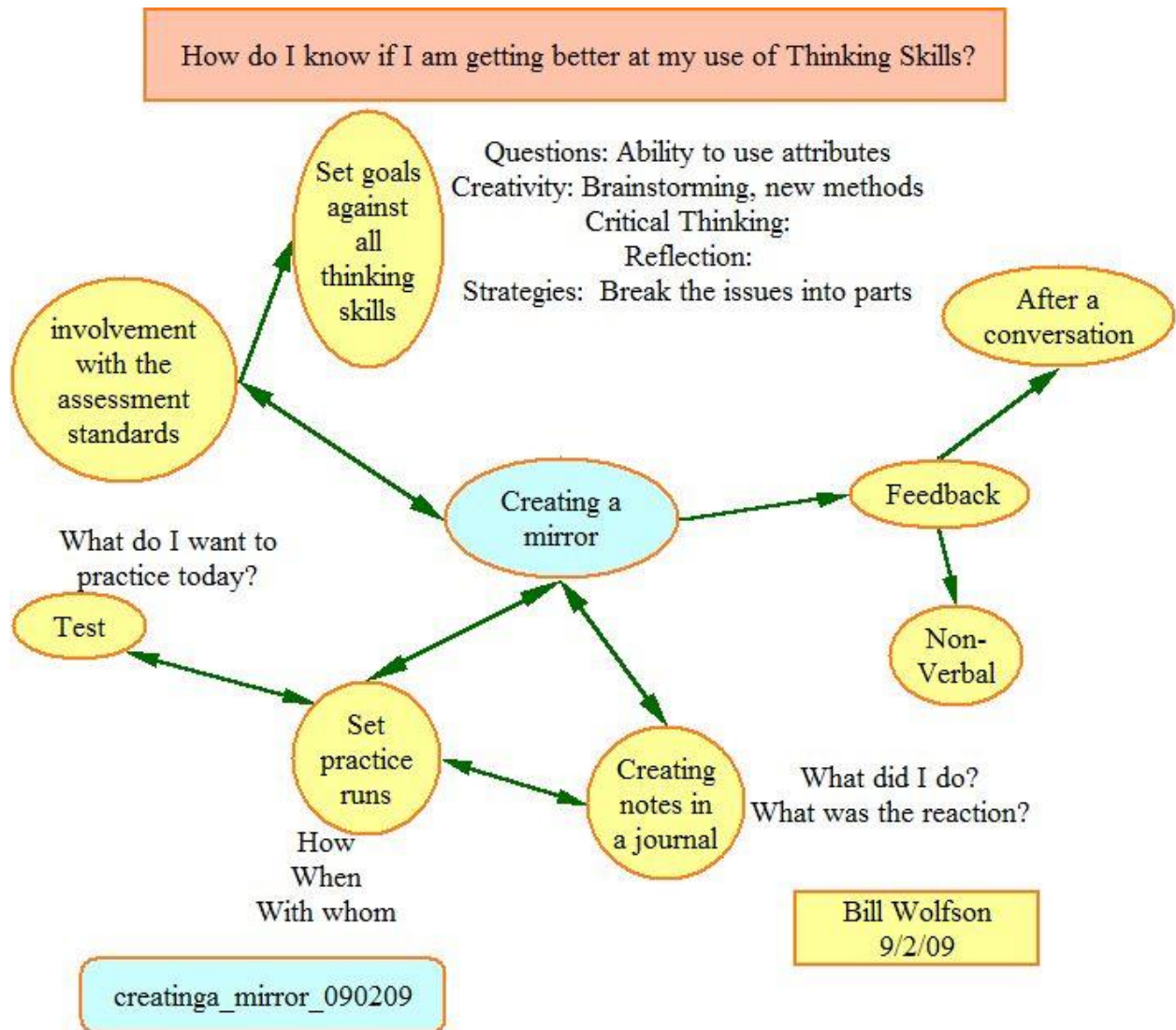
- Have them address challenges requiring creativity.
- Help them address those challenges “creatively.”
- Foreground and discuss skills, practices, tactics, and attitudes that make someone creative
  - Iteration toward solutions
  - Consideration of alternatives
  - Deliberation about goal adoption
  - Generation of evaluation criteria
  - Preparing for and recognizing opportunities
  - Synergy between multiple endeavors
  - Habits of reflection that will lead towards effective representations
- Provide a mirror for feedback

**What about developing a creative “mindset”?**

- Notice unstated problems
- Stretch applicability
- Try out non-obvious ideas
- Consider more alternatives
- Accept inconsistencies for a while
- Become bored with repetition
- Go beyond what’s required
- Treat it as a personal challenge
- A lot of hard work is required

When the tactics/ideas come up, discuss them. Help learners experience and recognize the value of each.

How do we get better at our creative process?



## Example of using 5 Why's

Bright moon in the forest, makes the forest lighter with the bright moon

1 Why do I want to make it lighter?

So we can see better

2 Why do I want to see better

So I can see the animals

3 Why do I want to see the animals?

So I can learn more about them

4 Why do I want to learn more about them

So I can understand their life

5. Why do I want to understand their life

So I can document their lives... create a light that allows seeing the animals without disturbing them

Using DeVinci method of associating words from the original problem to find solutions

**Provide a light that won't disturb the animals**

Science	Math	Light	Animals	Provide
Life Science	Number sense	visible	Small	Hand held
Physical/chemistry	Algebra	Inferred	Birds	Strapped on the head
Earth/Space	Geometry	Strobe	Large	Located in the forest trees
Simple machines	Data	flash	Insects	Walking stick

# Using questions in the engineering design process

Engineer design process* / Thinking skills	Questions
<b>Identify the need or problem</b> <ul style="list-style-type: none"> <li>• Compare / Contrast</li> <li>• Decision process</li> <li>• Drawing Conclusions</li> <li>• Analysis</li> </ul>	What are we looking to do? How would we judge success? What do we have to design to solve this issue? What is the purpose of this design? What would the goals and objectives be? Can we break the problem/design into parts?
<b>Research the need or problem</b> <ul style="list-style-type: none"> <li>• Classification</li> <li>• Sequencing</li> <li>• Critical Thinking</li> <li>• Compare / Contrast</li> <li>• Root Cause</li> <li>• Synthesis</li> </ul>	What do we know? Any similar circumstance from the past that we can build on? Who are the stakeholders and their needs? What outside factors will affect this problem/need/design? What questions do we need to ask? How do we know the facts are true? What evidence do we have? What science do we need to understand to implement this design? How would we use the science?
<b>Develop possible solution (s)</b> <ul style="list-style-type: none"> <li>• Brainstorm</li> <li>• Critical Thinking</li> <li>• Root Cause</li> <li>• Evaluation</li> </ul>	What concepts, definitions, and principles do we need to utilize? Have we taking all assumptions, thoughts into consideration? What facts, data, observations and experiences are available? Can we combine elements into a novel design?
<b>Select the best possible solution(s)</b> <ul style="list-style-type: none"> <li>• Compare / Contract</li> <li>• Classification</li> <li>• Drawing Conclusions</li> <li>• Problem Solving</li> </ul>	What interpretation and inferences can we make? How does it meet all the requirements of the design? How would we test the solution so we can provide information about the design?
<b>Construct a prototype</b> <ul style="list-style-type: none"> <li>• Classification</li> <li>• Drawing Conclusions</li> <li>• Problem Solving</li> </ul>	Do we need to build it or can we simulate it? What materials, skills & tools do we need? What plans are necessary to document the design? Can we break of the construction into modules?
<b>Test and evaluate the solution(s)</b> <ul style="list-style-type: none"> <li>• Compare / Contract</li> <li>• Classification</li> <li>• Drawing Conclusions</li> <li>• Problem Solving</li> </ul>	What test plan do we need to evaluate the design? What tools do we need to test it? How can we design this solution so we can easily reproduce it?
<b>Communicate the solution(s)</b> <ul style="list-style-type: none"> <li>• Compare / Contract</li> <li>• Classification</li> <li>• Drawing Conclusions</li> </ul>	Who are our audience and what are they expecting to hear? Have we testing all our conclusions and facts? Have we presented it in a way people can understand it? How can we present the information in clear and concise graph ?
<b>Redesign</b> <ul style="list-style-type: none"> <li>• Brainstorm</li> <li>• Compare / Contract</li> <li>• Classification</li> <li>• Drawing Conclusions</li> </ul>	What have we learned & what would we do differently? What was our thought process?

# Learning to Think

Critical Thinking <a href="http://www.criticalthinking.org">www.criticalthinking.org</a>	Science Method The art of making sense ... Ruby	Engineering Process* From Framework page 53 May 2001	Mathematical Problem Solving Modified from George Polya's four step method in his book How to Solve it, by Pat Davidson
What's the author's purpose?	Define the situation <b>Develop a Hypothesis</b>	Identify the need or problem	Understand the problem
What key questions or problems does the author raise?	The precise formulation of the problem <b>Design an Experiment</b>	Research the need or problem	List the key facts given and questions to be answered
What information, data and evidence does the author present	<b>Perform the experiment</b> Observation of the relevant facts	Develop possible solutions	Devise a plan or strategy such as: -Look for a pattern -Look at the basic foundation -Draw a picture or diagram
What key concepts guide the author's reasoning?	The use of previous knowledge	Select the best solutions	Solve the problem
What key conclusion is the author coming to? Are they justified?	Formulation of the explanatory hypothesis	Construct a prototype	Check the results and examine the solution
What is the primary assumption?	Deductions from the hypothesis <b>Form a Conclusion</b>	Test & Evaluate the solution	Communicate the complete solution with proper units and labels
What is the author's viewpoint?	Testing	Communicate the solution	Look back to reflect on the process and other strategies that could have been used
What are the implications of the author's reasoning?	Conclusion: <b>Write a report</b>	Redesign & Renewal	Look ahead to think about how the problem could be extended

***"Children must be taught how to think, not what to think."* Margaret Mead**

billwolfson

What makes some people innovative? HBR.org/ Dec.2009 ... The innovator's DNA by Jeff Dyer, Ha Greersen and Clayton Christensen

Five "Discovery skills" separate true innovators from the rest of us. These three studied 25 entrepreneurs and surveyed 3,000 executives who have started innovative companies or invented new products. What was different about them? Could this be learned or are you born with it?

They have something different called creative intelligence which enables discovery yet differs from other intelligence. Innovators engage both sides of the brain as they leverage 5 discovery skills to create new ideas.

Skills	Attributes
<p><b>Associating</b> Steve Jobs has frequently observed, "Creativity is connecting things"</p>	<p>The ability to successful connect seemingly unrelated questions, problems or ideas from different fields, is central to the Innovator's DNA</p> <p>The Medici effect caused the explosive growth in Florence in creativity by bring together Sculptors, Scientists, Poets, Philosophers, Painters and Architects.</p>
<p><b>Questioning</b> Its asking the right question ... Peter Drucker</p>	<p>Innovators constantly ask questions that challenge common wisdom</p> <p>"If we did this, what would happen?" Ask "Why" and "Why not" and "What if?"</p> <p>Imagine opposites ... in his book "The opposable Min", Roger Martin writes that innovative thinkers have the capacity to hold two diametrically opposing ideas in their head. Embrace constraints ... great questions actively impose constraints on our thinking and serve as a catalyst for out-of-the-box-insights</p> <p>One of <b>Google's</b> nine innovation principles is "Creativity loves Constraints"</p>
<p><b>Observing</b> ... Behaving like</p>	<p>Observers try all different techniques</p>

<p>anthropologists and social scientists</p>	<p>to see the world in a different light.</p> <p>Akio Toyoda regularly practices Toyota’s philosophy of “genchi genbutsu – “going to the spot and seeing yourself”</p> <p>Frequent direct observation is baked into the Toyota culture.</p>
<p>Experimenting ..</p>	<p>Like scientists, innovators actively try out new ideas by creating prototype and launching pilots. Bezo (Amazon) sees experimentation as so critical to innovation that he has institutionalized it at Amazon. “I encourage our employees to go down blind alleys and experiment” Bezo says. “ if we can get processes decentralized so that we can get a lot of experiments without it being very costly, we’ll get a lot more innovation”.</p>
<p><b>Networking</b> Devoting time and energy to finding and testing ideas through a network of diverse individuals gives innovators a radically different perspective.</p>	<p>They attend idea conferences to get ideas. “The insights required to solve many of our most challenging problems come from outside our industry and scientific field. We must aggressively and proudly incorporate into our work finding and advances which were not invented here” ... Kent Bowen ... Found of CPS technologies</p>

How do you do this;

Practice, Practice, Practice

The most important skill to practice is questioning. Asking “Why” and “Why not” can help turbo-charge the other discovery skills.

Rehearing over and over the behaviors described, to the point that they become automatic. This requires putting aside time for you and your team to actively cultivate more creative ideas.

To strengthen experimentation consciously approach work and life with a hypothesis-testing mind-set. Attend seminars or executive education courses on topics outside your area of expertise; take apart a product or process that interests you; read books that purport to identify emerging trends.

Develop new hypothesis for the knowledge you’ve acquired and test them in the search for new products or processes.

Openly acknowledging that leaning through failure is valuable goes a long way toward making an innovative culture.

#### “ACT DIFFERENTLY”

Howard Gardner, Hobbs Professor of Cognition and Education at the Harvard Graduate School of Education, is a psychologist and author known for his theory of multiple intelligences. Application of his theory, especially for education, has been controversial. But I think his latest book, *Five Minds for the Future*, is a must read for technology professionals.

His thesis is that, "...vast changes that include accelerating globalization, mounting quantities of information, the growing hegemony of science and technology, and the clash of civilizations," requires, "capabilities that, until now, have been mere options." He describes "Five Minds," or cognitive abilities that will command a premium in the years ahead:

1. The Disciplinary Mind -- the mastery of major schools of thought (including science, mathematics, and history) and of at least one professional craft.
2. The Synthesizing Mind -- the ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.
3. The Creating Mind -- the capacity to uncover and clarify new problems, questions and



phenomena.

4. The Respectful Mind -- awareness of and appreciation for differences among human beings and human groups.

5. The Ethical Mind -- fulfillment of one's responsibilities as a worker and as a citizen.

While the book is not directed specifically at technology professionals, I found much of what he said echoed characteristics of the most effective people I know: deep domain expertise, intellectual curiosity, creativity, global perspective, knowledge of and respect for diverse cultures, and teamwork. It is and will continue to be possible for anyone with a few of these characteristics to succeed in technology, but I believe those who excel and assume positions of leadership will exhibit all of these abilities.

### IBM CEO creativity

**ARMONK, NY, - 18 May 2010:** According to a major new IBM (NYSE: [IBM](#)) survey of more than 1,500 Chief Executive Officers from 60 countries and 33 industries worldwide, chief executives believe that -- more than rigor, management discipline, integrity or even vision -- successfully navigating an increasing complex world will require creativity.

Conducted through in-person interviews with senior leaders and consultants from IBM's Global Business Services division, less than half of global CEOs believe their enterprises are adequately prepared to handle a highly volatile, increasingly complex business environment. CEOs are confronted with massive shifts -- new government regulations, changes in global economic power centers, accelerated industry transformation, growing volumes of data, rapidly evolving customer preferences -- that, according to the study, can be overcome by instilling "creativity" throughout an organization.

## The CEOs Speak



In surveying more than 1,500 Chief Executive Officers from around the world, the IBM 2010 Global CEO Study found that chief executives believe successfully navigating an increasing complex world will require creativity.

More than 60 percent of CEOs believe industry transformation is the top factor contributing to uncertainty, and the finding indicates a need to discover innovative ways of managing an organization's structure, finances, people and strategy.

The study also uncovers starkly divergent strategic concerns and priorities among CEOs in Asia, Japan, Europe or North America – the first time such clear regional variations have appeared in this biennial survey of private and public sector leaders.

"Coming out of the worst economic downturn in our professional lifetimes -- and facing a new normal that is distinctly different -- it is remarkable that CEOs identify creativity as the number one leadership competency of the successful enterprise of the future," said Frank Kern, senior vice president, IBM Global Business Services "But step back and think about it, and this is entirely consistent with the other top finding in our Study -- that the biggest challenge facing enterprises from here on will be the accelerating complexity and the velocity of a world that is operating as a massively interconnected system."

### **Managing complexity**

The CEOs interviewed told IBM that today's business environment is volatile, uncertain and increasingly complex. Eight in ten CEOs expect their environment to grow significantly more complex but only 49 percent believe their organizations are equipped to deal with it successfully – the largest leadership challenge identified in eight years of research.

The CEOs said that the complexity of an interconnected world is aggravated by a number of factors. For example, CEOs expect revenue from new sources to double over the next five years and 76 percent of CEOs foresee the shift of economic power to rapidly developing markets.

Over the last four studies, the expected impact of technology on organizations has risen from 6<sup>th</sup> to 2<sup>nd</sup> place in importance, revealing that CEOs understand that technology and the interconnection of the world's infrastructures is

contributing to the complexity they face, and also reveals that they need more technology-based answers to succeed in a world that is massively interconnected.

The study highlights the attributes of top-performing organizations based on revenue and profit performance during the past five years, including the economic downturn.

- Top performing organizations are 54 percent more likely than others to make rapid decisions. CEOs indicated they are learning to respond swiftly with new ideas to address the deep changes affecting their organizations.
- 95 percent of top performing organizations identified getting closer to customers as their most important strategic initiative over the next five years – using Web, interactive, and social media channels to rethink how they engage with customers and citizens. They view the historic explosion of information and global information flows as opportunities, rather than threats.
- Organizations that have built superior operating dexterity expect to capture 20 percent more of their future revenue from new sources than their more traditional peers.

### **One World, Diverging Views**

Vast complexity is further intensified by regional differences. The study noted that perspectives varied with geography – differences of opinion about what changes to make, what new skills will be needed and how to succeed in the new economic environment. These regional variations also compound the complexities with which CEOs must contend.

China proved much more resilient than the developed nations during the economic downturn. So, CEOs in China are, understandably, less concerned about volatility than CEOs in other regions. In fact, they are becoming increasingly confident of their place on the world stage.

But if China is to fulfill its global aspirations, it will need a new generation of leaders with creativity, vision and international management experience. Many of the country's CEOs recognize this; 61 percent believe “global thinking” is a top leadership quality. Most companies will also need new industry models and skills. They cannot simply replicate the models they have used in their domestic market, which has a completely different cost structure. CEOs in China are also devoting far more energy to building new skills and capabilities than their peers in the West.

In North America, which faced a financial crisis that led to governments becoming major stakeholders in private enterprise, CEOs are more wary of “big government” than CEOs elsewhere. A full 87 percent anticipate greater government intervention and regulation over the next five years, compounding their sense of uncertainty.

In Japan, 74 percent of CEOs expect the shift of economic power from mature to rapidly developing markets to have a major impact on their organizations. By contrast, the European Union is less concerned about this shift, with only 43 percent of CEOs expecting to be impacted.

Understanding these and other sharp differences emerging by region is increasingly important as economies and societies become more closely linked. Organizations confront these differences as they increasingly operate across boundaries and across different regions.

### **About the IBM 2010 Global CEO Study**

This study is the fourth edition of IBM's biennial Global CEO Study series. To better understand the challenges and goals of today's CEOs, IBM consultants met face-to-face with the largest-known sample of these executives.

Between September 2009 and January 2010, IBM interviewed 1,541 CEOs, general managers, and senior public sector leaders who represent different sizes of organizations in 60 countries and 33 industries.

For access to the full study findings and case studies, please visit: <http://www.ibm.com/ceostudy>

To join the conversation about smarter leadership, please visit: <http://smarterleaders.tumblr.com/>

## Summary of future needs of Society around Thinking Skills

of Society		by Daniel Pink	Howard Gardner
		Design ... creating something	<b>The Creating Mind</b> -- the capacity to uncover and clarify new problems, questions and phenomena
		Stories .. fashion a compelling narrative	<b>The Ethical Mind</b> -- fulfillment of one's responsibilities as a worker and as a citizen.
		Symphony ... putting the pieces together	<b>The Synthesizing Mind</b> -- the ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.
		Empathy .. walk in someone else's shoes	<b>The Respectful Mind</b> -- awareness of and appreciation for differences among human beings and human groups
		Play	
Meaning ...pursue more significant desires; purpose, fulfillment		<b>The Disciplinary Mind</b> -- the mastery of major schools of thought (including science, mathematics, and history) and of at least one professional craft.	

**HOW:** What makes some people innovative? HBR.org/ Dec.2009 ... The innovator's DNA by Jeff Dyer, Hal Greersen and Clayton Christensen



### Creative Reasoning:

<b>Associating</b> ... Steve Jobs has frequently observed, "Creativity is connecting things"	<b>Observing</b> ... Behaving like anthropologists and social scientists
<b>Questioning</b> ... Its asking the right question ... Peter Drucker	<b>Networking</b> ... Devoting time and energy to finding and testing ideas through a network of diverse individuals gives innovators a radically different perspective.
<b>Experimenting</b> ... Like scientists, innovators actively try out new ideas by creating prototype and launching pilots. <b>Failure is learning</b>	