Cubing and Think Dots

Revised Bloom's Taxonomy

The Taxonomy of Educational Objectives was created by Benjamin Bloom in the 1950's as a means of expressing qualitatively different kinds of thinking. Bloom's Taxonomy has since been adapted for classroom use as a planning tool and continues to be one of the most universally applied models across all levels of schooling and in all areas of study.

The Revised Bloom's Taxonomy

During the 1990's, Lorin Anderson (a former student of Benjamin Bloom) led a team of cognitive psychologists in revisiting the taxonomy with the view to examining the relevance of the taxonomy as we enter the twenty-first century.

As a result of the investigation a number of significant improvements were made to the existing structure. Before turning to examples of how the newly revised Taxonomy may be applied, it would be appropriate at this point to make both the revisions and reasons for the changes explicit.Figure1 below describes both the '*old*' and the '*new*' taxonomies:

REMEMBERING

Recognise, list, describe, identify retrieve, name ....

Can the student RECALL information?

UNDERSTANDING

Interpret, exemplify, summarise, infer, paraphrase .....

Can the student EXPLAIN ideas or concepts?

APPLYING

Implement, carry out, use ...

Can the student USE the new knowledge in another familiar situation?

ANALYSING

Compare, attribute, organise, deconstruct ...

Can the student DIFFERENTIATE between constituent parts?

EVALUATING

Check, critique, judge hypothesise ...

Can the student JUSTIFY a decision or course of action?

CREATING

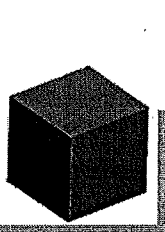
Design, construct, plan, produce ...

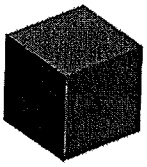
Can the student GENERATE new products, ideas or ways of viewing things ?

Bloom's Original Taxonomy	**Anderson's Revised Taxonomy**
Knowledge	Remembering
Comprehension	Understanding
Application	Applying
Analysis	Analysing
Synthesis	Evaluating
Evaluation	Creating

Figure 1 – The original taxonomy and the revised taxonomy

Cubing





Rolling for Success

What is "cubing"?

- Cubing is an instructional strategy that asks students to consider a concept from a variety of different perspectives.
- The cubes are six-sided figures that have a different activity on each side of the cube.
- A student rolls the cube and does the activity that comes up.

How is Cubing differentiated?

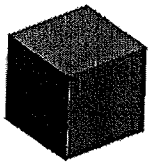
- Not all students receive the same cube.
- You can differentiate cubes according to readiness, learning profile, or interest (see differentiated cubing examples included).

How it works:

- Students can work alone, in pairs, or in small groups with the appropriate cube.
- In pairs or small groups, each student takes a turn rolling the cube and doing the activity that comes up. Students have the choice to roll again once if they don't like the activity that turns up.
- Students each roll the cube 2-4 times, depending on the magnitude of the assignments.

Using Cubing to Hone Thinking Skills

- Cubing originally was created to have students use a variety of thinking skills to consider a single concept.
- When used this way, each side of the cube has a different prompt: describe it, compare it, associate it, analyze it, apply it, evaluate it.



Cube Sides Suggestions...

Describe it * Compare it * Associate it * Analyze it * Apply it * Connect it * Illustrate it * Change it * Solve it* Question it * Rearrange it * Satirize it * Evaluate it * Relate it to something else * Contrast it * Investigate it * What is the significance of it? * Put it in historical perspective * What are the cause/effects of it * Cartoon it * Tell the parts of it * Argue for/against it *

Example: Onomatopoeia

Side One	Side Two	Side Three
Find an example of **onomatopoeia** in a poem from our anthology	Make a list of all the examples of **onomatopoeia** that you can think of in two minutes. Have your partner time you.	Write a letter to Webster's Dictionary from **onomatopoeia** on the topic, "We are words, too! Include us!"
Side Four	**Side Five**	**Side Six**
Write a limerick, concrete poem, or haiku using at least one example of onomatopoeia	Why do you think writers use onomatopoeia? What purpose does it serve?	Research the origin of the word "onomatopoeia." Where does it come from? What do its parts mean?

Example: Fractions

Side One: Locate It	Side Two: Define It	Side Three: Solve It
In two minutes, make a list of all of the places in which we find fractions in every day life. Have your partner time you.	What is a fraction? How would you explain what a fraction is to a first grader?	Complete fraction problems 1-10 on page 65. Have your partner check your work.
Side Four: Analyze It	**Side Five: Think About It**	**Side Six: Illustrate It**
What are the parts of a fraction? Define each part and describe their relationships to one another.	When dividing fractions, why do we have to "invert and multiply"? Show your thinking on paper.	Create a children's picture book about fractions. Use "Give Me Half!" as an example.

What is the point?

- Cubing gives students who like to use their hands and move around a chance to feel like they are "playing" while learning.
- Cubing gives students a chance to look at a concept from a series of different perspectives.
- Cubing allows the teacher to differentiate for readiness in a very un-obvious way. Since all students are working with cubes, students are not aware that their neighbors might be doing something a little different.

Concerns?

- Here is one… you may have more:
  - Cubes *can* turn into glorified worksheets– but not if all activities are *purposeful* and focused on getting students to understand a concept in a multitude of ways.

Cubing Fact Sheet

What is it? Cubing is a versatile strategy, similar to a contract, which allows you to plan different activities for different students or groups of students based on student readiness, learning style, and/or interests. You will create a cube-usually different colored cubes for different groups of students. On each of its six faces, you will describe a different task related to the subject and/or concept being learned.

Why use it? Cubing provides a way for all students to explore one important topic or idea but to accomplish tasks at their readiness levels, in their preferred learning styles, and/or in areas of personal interest. All students are working on activities dictated by their cubes; the activities are differentiated for individual students or groups of students. Groups are very flexible. One cubing activity might group gifted learners for more challenging, higher-level activities; another cubing activity might group gifted and non-gifted students alike according to their interests.

How to use it? Print out the blank cube template with these instructions. Then think of many different commands which might go on the faces of a cube (describe, diagram, apply, analyze, connect, argue, evaluate, and create, for example).

Example #1: To differentiate according to different levels of student readiness, two or more different cubes could be created with the same commands but with tasks at different levels of difficulty. Using "Describe" as the command, the task might be to describe the rainforest using as much information as you can and involving as many of your senses as possible in your description. Using the same command, you might ask the students to describe how their life would change if they moved to the canopy of the rainforest, using as many of their senses as possible in their description and being sure to explain why these changes would take place.

Example #2: To differentiate an activity according to interest or learning profile, you might set up several cubes for a single review activity. Two or three faces on all the cubes might be identical. The remaining faces on one of the cubes might contain tasks appropriate for students who enjoy writing (creating a poem, writing a journal entry, creating a pun). Another cube might

be better for oral learners, with tasks such as telling a story, presenting arguments for or against, or writing a song. You might create a third cube with activities which appeal to students with spatial strengths-making models, drawing or sketching, or making a Venn diagram with pictures rather than words.

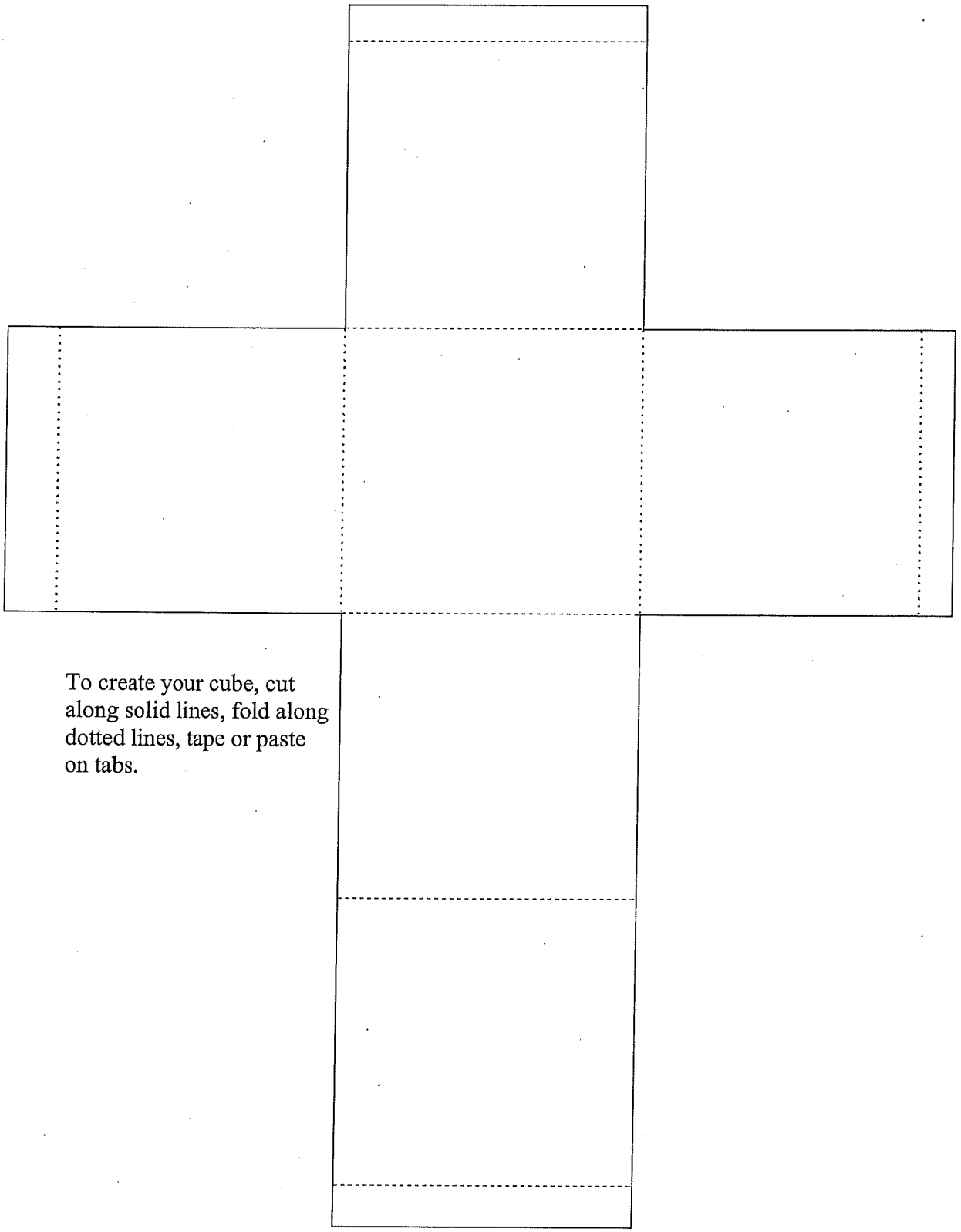
To differentiate instruction through the strategy of cubing, you will create different activities for different cubes. You would then assign students to tables with cubes that match their specific needs and abilities. Each student rolls a cube a specific number of times, and the face that points up on each roll becomes a task for a student to complete.

Where can I find more information about cubing?

How to Differentiate Instruction in Mixed Ability Classrooms, Carol Ann Tomlinson, ASCD.

http://www.mcps.k12.md.us/departments/eii/eiiscrapbook.html Photographs of differentiation strategies in use; look for cubing activities

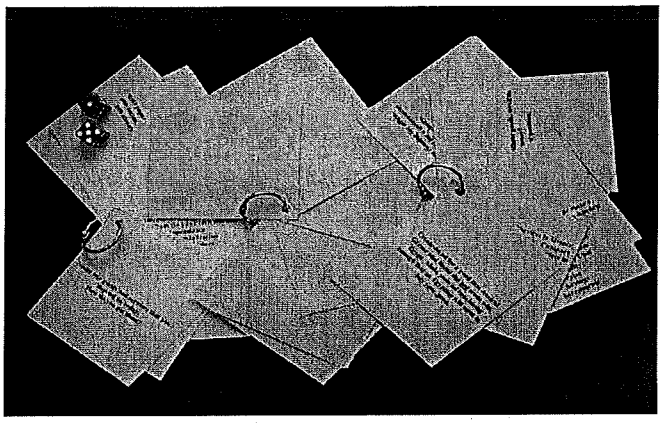
http://www.bsu.edu/teachers/services/ctr/javits/Instruction/Cubing.htm Examples of on-level cubing activities; you'll need to modify up and down; a template for making your cube.



To create your cube, cut along solid lines, fold along dotted lines, tape or paste on tabs.

ThinkDOTS©

A Versatile Strategy for Differentiation



ThinkDOTS©

- After a conceptual unit has been presented and students are familiar with the ideas and associated skills, "Think DOTS" is an excellent activity for students to construct meaning for themselves about the concept they are studying. The instructor first defines readiness levels, interests or learning styles in the class, using on-going assessment.
- Each student is given a set of activity cards on a ring, a die, and an activity sheet. Each student rolls the die and completes the activity on the card that corresponds to the dots thrown on the die (that is, if a student rolls a "three," she then finds the card with three dots on it and completes the activity written on that card). Each student then completes the activity on the activity sheet.

Materials:

1. 8 ½ x 11 inch paper or 5X7 index cards
2. Hole punch
3. Metal or plastic rings
4. Dice
5. Scissors
6. Markers or sticker dots
7. Laminating materials (optional)

Think Dots Activities

- The activities on the activity card should allow students to explore what they just learned from a variety of angles.
- You may consider having each activity card explore a concept or idea from a different level of Bloom's Revised Taxonomy*
- You can use the cards for a fun, engaging test review– put different formulas, important terms, or problems on each card

*Bloom's Revised Taxonomy is included in this packet.

ThinkDOTS ©

Construction:

1. **For each readiness level, six activities should be created.**
2. **On an 8 ½ x 11 inch page divided into six sections (this can be done easily on the computer by creating a 2 x 3 cell table and saving it as a template), the activities should be written or typed in each section.**
3. **On the back of each page, dots corresponding to the dots on the faces of a die should be either drawn or affixed (you can use Avery adhesive dots) on each of the six sections of the page.**
4. **The pages should be laminated for durability.**
5. **Then each page should be cut into the six sections.**
6. **Use a hole punch to make holes in one corner or in the top of each activity card.**
7. **Use a metal or plastic ring to hold each set of six cards together (you can get 100 metal rings from office supply stores for $9.00)**
8. **Create an Activity Sheet to correspond to the lesson for easy recording and management.**

ThinkDOTS ©

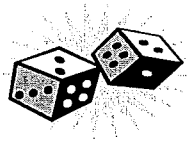
Suggestions:

1. **Use colored paper and/or colored dots to indicate different readiness levels, interests or learning styles.**
2. **Have students work in pairs.**
3. **Let students choose which activities – for example: roll the die and choose any three; create complex activities and have students choose just one to work on over a number of days.**
4. **After students have worked on activity cards individually, have them come together in groups by levels, interest or learning style to synthesize**

ThinkDOTS ©

Application:

1. **Use "ThinkDOTS" to lead students into deeper exploration of an idea.**
2. **Use "ThinkDOTS" for review before assessment.**
3. **Use "ThinkDOTS" as an assessment.**



Science Lesson
ThinkDOTS - Matter

How do the atomic numbers in the periodic table change from the top to the bottom? From left to right across the table?	Predict as many properties for potassium as you can. To make your predictions, look at the information in the box for this element and consider its location on the periodic table.	Carbon is atomic number 6. How are two carbon atoms with mass numbers of 12 and 14 different? Why are these atoms called isotopes?
Why do you think scientists used the term "cloud" to describe the position of electrons in an atom?	There are three jars in the front of the room. Each has a substance with a strong odor. One is a solid, one is a liquid, and one is a gas. Which odor would students in the back of the room smell first? Why?	Suppose you were given some sugar cubes, a grinder, some water, a pan, and a hot plate. What physical and chemical changes could you make in the sugar?

P. Goolsby & K. Brimljoin,
Amherst County Schools, 2000

High School English Unit: Prejudice

Kathy Pegues, 2000

Prejudice Discuss how prejudice and discrimination are not only harmful to the victim, but also to those who practice them.	**Scapegoating** Imagine a group of people that could be scapegoats. List and describe stereotypes of this group and the treatments they received because of them.
Articles Read the article. What could be reasons for the persecution? How can you justify and understand the minds of those responsible?	**Photography** Photographs tell stories. Write a caption for the photo and explain why you chose it.
Genetics Certain characteristics are blamed on genetics. Do genetics impact the characteristics of your group? Explain the reasoning behind your answer. Use your science knowledge.	**Stereotypes** Your group was persecuted. Identify a group who has been persecuted in more recent years. Compare the two and give reasons why.

ThinkDOTS: Vocabulary Review

Connect it ● An automobile manufacturer wants to use this word as the name for its newest car. They have asked you to design the car– if this word were a car, what would it look like? Draw a picture.	Define it ● ● What is this word's definition?
Use it ● ● ● Create a concrete poem using this word as the poem's subject.	Collage it ● ● ● ● Create a collage of words and images which represents this word. Do not put the word or the definition on the front of the collage; write them on the back.
Evaluate it In your opinion, is this word a "good" word or a "bad" word? In other words, is this word useful? Does it do a job that no other word can do? ● ● ●	● ● ● Personify it ● ● ● Give this word a personality-- what do you think this word would be like if it were a person? Find another word from our list that you think would either be this word's perfect match or worst enemy, and explain your rationale.

ThinkDOTS: Probability and Statistics

Argue it Make an argument for which graphing method is the easiest to read: pie charts, stem-and-leaf plots, bar graphs, or line graphs. Construct a visual model to show us why.	Conduct a survey Choose a **random sample** of n=15 students from this class and conduct a survey of their favorite sports team/food/rock star/ etc. (your choice!). Describe how you arrived at your random sample, and create a data display of your results.
Call it into question Is there such thing as a truly "random sample"?	Define it What is a random stratified sample? When would you use one?
Evaluate it Look at today's U.S.A Today opinion poll. What type of graph is it using to display its results? Do you feel that the data display is accurate or misleading?	Plot it Plot the distribution of scores from last year's final exam (Get the scores from the teacher-- sorry, all names have been removed!)

The "New Bloom's Taxonomy," Objectives, and Assessments

Prepared by Elizabeth Dalton
December 3, 2003

I.Overview

This document provides a review of the latest revision of the venerable "Bloom's Taxonomy," which combines aspects of the original taxonomy published by Bloom, Engelhart, Furst, Hill, and Krathwohl in 1956 with more recent taxonomy and framework research by others such as Merrill, Ausubel, Gagné, Romizowski, etc. David Krathwohl, one of the original contributing authors to Bloom's Taxonomy, was one of the two editors of the new version, published in *A Taxonomy for Learning, Teaching, and Assessing* in 2001. Unfortunately, when this revision was begun Benjamin Bloom was in advanced stages of Alzheimer's disease and unable to participate in the project. He died before the revision was published.

This document overviews the revised taxonomy in terms of types of objectives and learning activities, and particularly assessments, and where they fall in the two-dimensional taxonomy. A short review of other possible taxonomies or frameworks and comparable tools for selection of activities or assessments is also included.

II.Learning Objectives

What is meant by "levels" or "complexities" of learning objectives? Anderson, Krathwohl, et. al have updated the classic "Bloom's Taxonomy" to incorporate advances in learning theory and practice since its inception, and offer the following two-dimensional framework to describe learning objectives:

<table>
<tr><th></th><th>Remember</th><th>Understand</th><th>Apply</th><th>Analyze</th><th>Evaluate</th><th>Create</th></tr>
<tr><td>Fact</td><td>Remember Facts</td><td>Understand Facts</td><td>Apply Facts</td><td rowspan="3">Analyze using Facts, Concepts, Principles and Procedures</td><td rowspan="3">Evaluate using Facts, Concepts, Principles and Procedures</td><td rowspan="3">Create using Facts, Concepts, Principles and Procedures</td></tr>
<tr><td>Concept/ Principle</td><td>Remember Concepts</td><td>Understand Concepts</td><td>Apply Concepts</td></tr>
<tr><td>Procedure</td><td>Remember Procedures</td><td>Understand Procedures</td><td>Apply Procedures</td></tr>
<tr><td>Metacognitive</td><td>Remember Metacog. Strategies</td><td>Understand Metacog. Strategies</td><td>Apply Metacog. Strategies</td><td>Analyze Meta. Strategies</td><td>Evaluate Metacog. Strategies</td><td>Create Metacog. Strategies</td></tr>
<tr><td></td><td colspan="2">Knowledge</td><td>Skill</td><td colspan="3">Ability</td></tr>
</table>

This two-dimensional framework distinguishes between the type of knowledge being learned (e.g. Fact, Concept, Principle, Procedure, Metacognitive), and the type of

cognitive process being employed (Remember, Understand, Appy, Analyze, Evaluate, or Create). The horizontal dimension of cognitive process aligns with the original Bloom's Taxonomy categories, rewritten to active tense verb forms. (Evaluate and Create, formerly Synthesis and Evaluation, have also changed places to reflect meta-analysis the authors performed on various empirical studies of Bloom's Taxonomy in the intervening years.) The vertical dimension of type of knowledge aligns with other frameworks e.g. from the work of David Merrill or Ruth Clark.

In the left-most three columns, there is a strong correlation between the cognitive process and the type of knowledge content, as indicated by the shaded blocks. That is, most often we expect learners to remember facts, understand concepts, and apply procedures, though it is also possible to create learning objectives in the other cells, e.g. Apply Concepts. In the rightmost three columns, generally multiple types of knowledge content are employed in each of these more complex cognitive processes. Along the bottom we have also added another set of terms often used to characterize these objectives: knowledge, skill, and ability.

III.Learning Activities

Our intent, whether developing classroom-based instructor-led training, online training, or a blend of the two, is to include a rich environment of activities which promote learning and help our learners feel engaged with the content. However, we also want to ensure that the activities, including assessments, match with the objectives specified for the learning. To facilitate this, we provide a framework in which to define how the various activities apply to learning objectives of different types, based on the Anderson/Krathwohl revision of Bloom's. The activity types which we have identified include:

- Informational Documents
- Organizational Aids
- Diagrammatic Activities (e.g. flowcharts, information mapping)
- Discussions
- Collaborative Activities
- Authentic Practice
- Presentations
- Job Aids
- Demonstrations
- Drill/Practice
- Modeling

These learning activities are suitable to support different levels or complexities of learning objectives, as defined above in the revised Bloom's Taxonomy. Once we have used the two-dimensional taxonomy to classify learning objectives, we can then offer

instruction designers and course developers tools with which to select appropriate learning activities, including assessments, to match the type of learning objective.

With this in mind, we can see that we might present the following types of activities to support these areas of the Taxonomy:

	Remember	*Understand*	*Apply*	*Analyze*	*Evaluate*	*Create*
Fact	Presentation Informational Document Drill/Practice	Presentation Informational Document	Presentation			
Concept/ Principle	Presentation Informational Document Drill/Practice	Presentation Informational Document Organizational Aid Diagrammatic Activity Discussion Collaboration	Presentation Organizational Aid Diagrammatic Activity Discussion Authentic Practice	Presentation Diagrammatic Activity Discussion Collaboration Authentic Practice Job Aids Modeling	Presentation Discussion Collaboration Authentic Practice Job Aids Modeling	Presentation Collaboration Authentic Practice Modeling
Procedure	Presentation Informational Document Job Aids	Presentation Informational Document Organizational Aid Discussion Collaboration Job Aids	Presentation Organizational Aid Discussion Collaboration Authentic Practice Job Aids Modeling			

IV.Assessment Strategy

The taxonomy described above also applies directly to the realm of assessment. The following types of asessement activities have been identified:

Multiple Choice (Recall, Interpretations, Summaries, predictions, Best Answer, etc.)

Matching (concepts, cause & effect, etc.)

Sequencing

Multiple True/False

Short Answer Essay

Comprehension Item Set

Interlineal Item Set

Pictoral Item Set

Lab: High-Inference

Lab: Low-Inference

Interactive video/simulation

Instrumented lab

Visual observation/rating

Item set FIB

Project

Instrument-aided observation

Anecdotal (formative)

Demonstration with rating scale/checklist

Exhibition

Performance

Differentiation interlineal set

Knowledge mapping

Problem-solving item set

Discussion (formative)

Essay (rated on use of principles, procedures, etc.)

Review/critique

Constructed Response

Self-assessment (formative)

The items above are not presented in any particular order. They would be matched to the taxonomy as follows:

	Remember	*Understand*	*Apply*	*Analyze*	*Evaluate*	*Create*
Fact	Multiple Choice e.g. Recall definitions as taught	M/C M-T/F M/C - Interpretation short-answer essay	m/c - Apply memorized facts to simple authentic situations	m/c - best answer lab: high inference differentiation interlineal set knowledge mapping problem-solving item set	m/c: best answer discussion (formative) essay (rated on use of principles) essay (rated on use of procedures) review/critique	constructed response exhibition portfolio
Concept/ Principle	matching recall order e.g. concept, category, principle definitions	match cause-effect m/c predict using principles comprehension item set choose best (new) definition match classification m/c - examples and non-ex. m/c - summaries	lab: high-inference pictoral item set Apply concepts to solve an authentic problem			

	Remember	*Understand*	*Apply*	*Analyze*	*Evaluate*	*Create*
Procedure	recall steps of procedures recall sequencing	interlineal item set	lab: low-inference interactive video/simulation instrumented lab visual observation/rating item set FIB project pictoral item set instrument-aided observation anecdotal (formative) demonstration with rating scale/checklist exhibition performance			

Designing Effective Projects: Thinking Skills Frameworks

Bloom's Taxonomy: A New Look at an Old Standby

Traditional Hierarchy of Thinking Processes

In 1956, Benjamin Bloom wrote *Taxonomy of Educational Objectives: Cognitive Domain*, and his six-level description of thinking has been widely adapted and used in countless contexts ever since. His list of cognitive processes is organized from the most simple, the recall of knowledge, to the most complex, making judgments about the value and worth of an idea.

Bloom's Taxonomy of Educational Objectives (Traditional)

Skill	Definition	Key Words
Knowledge	Recall information	Identify, describe, name, label, recognize, reproduce, follow
Comprehension	Understand the meaning, paraphrase a concept	Summarize, convert, defend, paraphrase, interpret, give examples
Application	Use the information or concept in a new situation	Build, make, construct, model, predict, prepare
Analysis	Break information or concepts into parts to understand it more fully	Compare/contrast, break down, distinguish, select, separate
Synthesis	Put ideas together to form something new	Categorize, generalize, reconstruct
Evaluation	Make judgments about value	Appraise, critique, judge, justify, argue, support

Today's world is a different place, however, than the one Bloom's Taxonomy reflected in 1956. Educators have learned a great deal more about how students learn and teachers teach and now recognize that teaching and learning encompasses more than just thinking. It also involves the feelings and beliefs of students and teachers as well as the social and cultural environment of the classroom.

Several cognitive psychologists have worked to make the basic concept of a taxonomy of thinking skills more relevant and accurate. In developing his own taxonomy of educational objectives, Marzano (2000) points out one criticism of Bloom's Taxonomy. The very structure of the Taxonomy, moving from the simplest level of knowledge to the most difficult level of evaluation, is not supported by research. A hierarchical taxonomy implies that each higher skill is composed of the skills beneath it; comprehension requires knowledge; application requires comprehension and knowledge, and so on. This, according to Marzano, is simply not true of the cognitive processes in Bloom's Taxonomy.

The originators of the original six thinking processes assumed that complex projects could be labeled as requiring one of the processes more than the others. A task was primarily an "analysis" or an "evaluation" task. This has been proven not to be true which may account for the difficulty that educators have classifying challenging learning activities using the Taxonomy. Anderson (2000) argues that nearly all complex learning activities require the use of several different cognitive skills.

Like any theoretical model, Bloom's Taxonomy has its strengths and weaknesses. Its greatest strength is that it has taken the very important topic of thinking and placed a structure around it that is usable by practitioners. Those teachers who keep a list of question prompts relating to the various levels of Bloom's Taxonomy undoubtedly do a better job of encouraging higher-order thinking in their students than those who have no such tool. On the other hand, as anyone who has worked with a group of educators to classify a group of questions and learning activities according to the Taxonomy can attest, there is little consensus about what seemingly self-evident

terms like "analysis," or "evaluation" mean. In addition, so many worthwhile activities, such as authentic problems and projects, cannot be mapped to the Taxonomy, and trying to do that would diminish their potential as learning opportunities.

Revised Bloom's Taxonomy
In 1999, Dr. Lorin Anderson, a fromer student of Bloom's, and his colleagues published an updated version of Bloom's Taxonomy that takes into account a broader range of factors that have an impact on teaching and learning. This revised taxonomy attempts to correct some of the problems with the original taxonomy. Unlike the 1956 version, the revised taxonomy differentiates between "knowing what," the content of thinking, and "knowing how," the procedures used in solving problems.

The Knowledge Dimension is the "knowing what." It has four categories: *factual, conceptual, procedural,* and *metacognitive.* Factual knowledge includes isolated bits of information, such as vocabulary definitions and knowledge about specific details. Conceptual knowledge consists of systems of information, such as classifications and categories.

Procedural knowledge includes algorithms, heuristics or rules of thumb, techniques, and methods as well as knowledge about when to use these procedures. Metacognitive knowledge refers to knowledge of thinking processes and information about how to manipulate these processes effectively.

The Cognitive Process Dimension of the revised Bloom's Taxonomy like the original version has six skills. They are, from simplest to most complex: remember, understand, apply, analyze, evaluate, and create.

Remembering
Remembering consists of recognizing and recalling relevant information from long-term memory.

Understanding
Understanding is the ability to make your own meaning from educational material such as reading and teacher explanations. The subskills for this process include interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.

Applying
The third process, *applying*, refers to using a learned procedure either in a familiar or new situation.

Analysis
The next process is *analysis*, which consists of breaking knowledge down into its parts and thinking about how the parts relate to its overall structure. Students analyze by differentiating, organizing, and attributing.

Evaluation
Evaluation, which is at the top of the original taxonomy, is the fifth of the six processes in the revised version. It includes checking and critiquing.

Creating
Creating, a process not included in the earlier taxonomy, is the highest component of the new version. This skill involves putting things together to make something new. To accomplish creating tasks, learners generate, plan, and produce.

According to this taxonomy, each level of knowledge can correspond to each level of cognitive process, so a student can remember factual or procedural knowledge, understand conceptual or metacognitive knowledge, or analyze metacognitive or factual knowledge. According to Anderson and his colleagues, "Meaningful learning provides students with the knowledge and cognitive

processes they need for successful problem solving". The following charts list examples of each skill of the Cognitive and Knowledge Dimensions.

Cognitive Processes Dimensions

Cognitive Processes	Examples
Remembering—Produce the right information from memory	
Recognizing	• Identify frogs in a diagram of different kinds of amphibians. • Find an isosceles triangle in your neighborhood. • Answer any true-false or multiple-choice questions.
Recalling	• Name three 19th-century women English authors. • Write the multiplication facts. • Reproduce the chemical formula for carbon tetrachloride.
Understanding—Make meaning from educational materials or experiences	
Interpreting	• Translate a story problem into an algebraic equation. • Draw a diagram of the digestive system. • Paraphrase Jawaharlal Nehru's tryst with destiny speech.
Exemplifying	• Draw a parallelogram. • Find an example of stream-of-consciousness style of writing. • Name a mammal that lives in our area.
Classifying	• Label numbers odd or even. • List the events of the Sepoy Mutiny of 1857. • Group native animals into their proper species.
Summarizing	• Make up a title for a short passage. • List the key points related to capital punishment that the Web site promotes.
Inferring	• Read a passage of dialogue between two characters and make conclusions about their past relationship. • Figure out the meaning of an unfamiliar term from the context. • Look at a series of numbers and predict what the next number will be.
Comparing	• Explain how the heart is like a pump. • Compare Mahatma Gandhi to a present day leader. • Use a Venn diagram to demonstrate how two books by Charles Dickens are similar and different.
Explaining	• Draw a diagram explaining how air pressure affects the weather. • Provide details that justify why the French Revolution happened when and how it did. • Describe how interest rates affect the economy.
Applying—Use a procedure	
Executing	• Add a column of two-digit numbers. • Orally read a passage in a foreign language. • Have a student open house discussion.
Implementing	• Design an experiment to see how plants grow in different kinds of soil. • Proofread a piece of writing. • Create a budget.
Analyzing—Break a concept down into its parts and describe how the parts relate to the whole	
Differentiating	• List the important information in a mathematical word problem and cross out the unimportant information.

	• Draw a diagram showing the major and minor characters in a novel.
Organizing	• Place the books in the classroom library into categories. • Make a chart of often-used figurative devices and explain their effect. • Make a diagram showing the ways plants and animals in your neighborhood interact with each other.
Attributing	• Read letters to the editor to determine the authors' points of view about a local issue. • Determine a character's motivation in a novel or short story. • Look at brochures of political candidates and hypothesize about their perspectives on issues.
Evaluating—Make judgments based on criteria and syllabus guidelines	
Checking	• Participate in a writing group, giving peers feedback on organization and logic of arguments. • Listen to a political speech and make a list of any contradictions within the speech. • Review a project plan to see if all the necessary steps are included.
Critiquing	• Judge how well a project meets the criteria of a rubric. • Choose the best method for solving a complex mathematical problem. • Judge the validity of arguments for and against astrology.
Creating—Put pieces together to form something new or recognize components of a new structure.	
Generating	• Given a list of criteria, list some options for improving race relations in the school. • Generate several scientific hypotheses to explain why plants need sunshine. • Propose a set of alternatives for reducing dependence on fossil fuels that address both economic and environmental concerns. • Come up with alternative hypotheses based on criteria.
Planning	• Make a storyboard for a multimedia presentation on insects. • Outline a research paper on Mark Twain's views on religion. • Design a scientific study to test the effect of different kinds of music on hens' egg production.
Producing	• Write a journal from the point of view of mountaineer. • Build a habitat for pigeons. • Put on a play based on a chapter from a novel you're reading.

The Knowledge Dimension

Factual Knowledge—Basic information	
Knowledge of terminology	Vocabulary terms, mathematical symbols, musical notation, alphabet
Knowledge of specific details and elements	Components of the Food Pyramid, names of congressional representatives, major battles of WWII
Conceptual Knowledge—The relationships among pieces of a larger structure that make them function together	
Knowledge of classifications and categories	Species of animals, different kinds of arguments, geological eras

Knowledge of principles and generalizations	Types of conflict in literature, Newton's Laws of Motion, principles of democracy
Knowledge of theories, models, and structures	Theory of evolution, economic theories, DNA models
Procedural Knowledge—How to do something	
Knowledge of subject-specific skills and algorithms	Procedure for solving quadratic equations, mixing colors for oil painting, serving a volleyball
Knowledge of subject-specific techniques and methods	Literary criticism, analysis of historical documents, mathematical problem-solving methods
Knowledge of criteria for determining when to use appropriate procedures	Methods appropriate for different kinds of experiments, statistical analysis procedures used for different situations, syllabus guidelines for different genres of writing
Metacognitive Knowledge—Knowledge of thinking in general and your thinking in particular	
Strategic knowledge	Ways of memorizing facts, reading comprehension strategies, methods of planning a Web site
Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Different reading demands of textbooks and novels; thinking ahead when using an electronic database; differences between writing emails and writing business letters
Self-knowledge	Need for a diagram or chart to understand complex processes, better comprehension in quiet environments, need to discuss ideas with someone before writing an essay

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Costa, A. L. (Ed.). (2000). *Developing minds: A resource book for teaching thinking.* Alexandria, VA: ASCD.

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Revised Bloom's Taxonomy

Revised Bloom's Taxonomy (RBT) employs the use of 25 verbs that create collegial understanding of student behavior and learning outcome.

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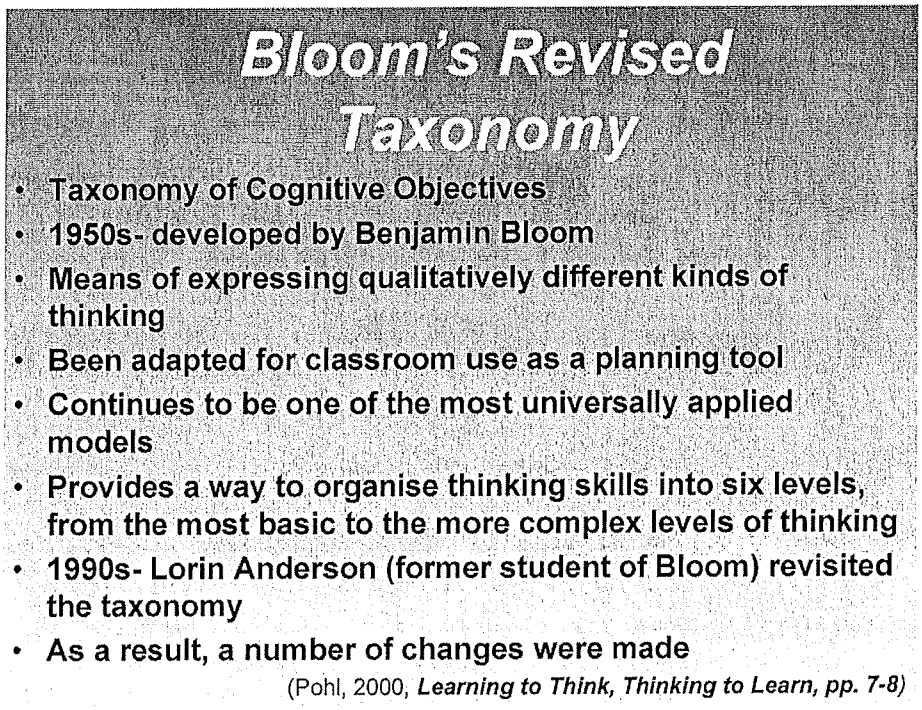

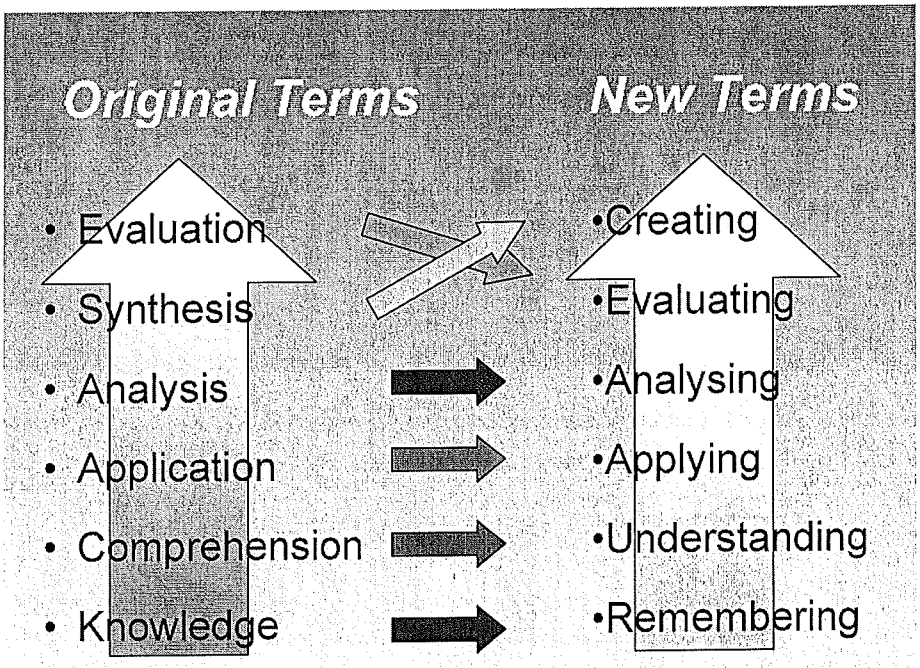

(Based on Pohl, 2000, ***Learning to Think, Thinking to Learn, p. 8***)

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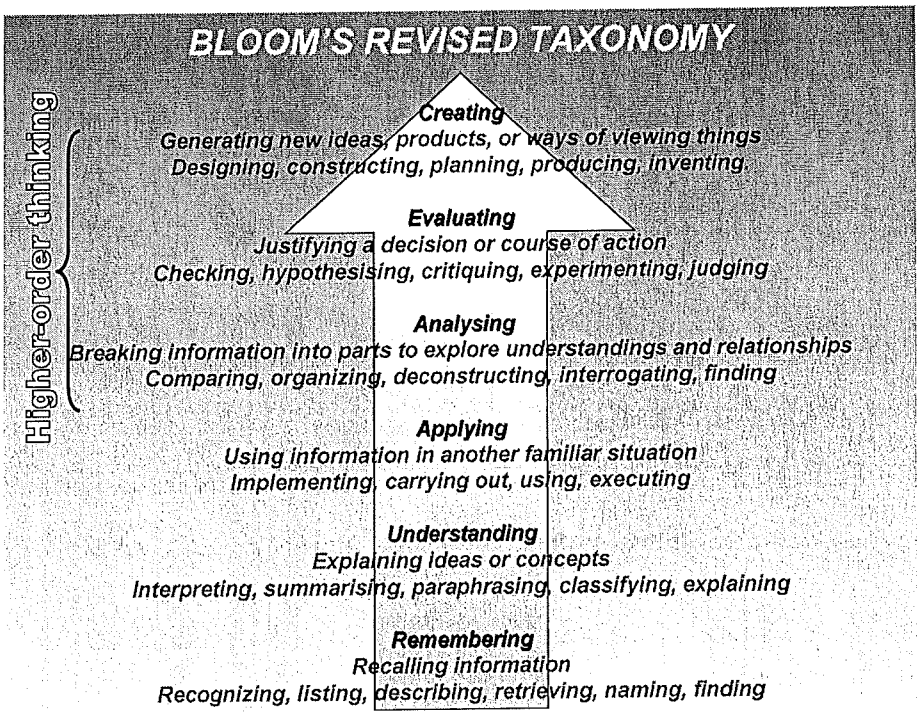
Change in Terms

- The names of six major categories were changed from *noun* to *verb* forms.
- As the taxonomy reflects different forms of thinking and thinking is an *active* process verbs were used rather than nouns.
- The subcategories of the six major categories were also replaced by verbs and some subcategories were reorganised.
- The knowledge category was renamed. Knowledge is an outcome or product of thinking not a form of thinking *per se*. Consequently, the word knowledge was inappropriate to describe a category of thinking and was replaced with the word *remembering* instead.
- Comprehension and synthesis were retitled to *understanding* and *creating* respectively, in order to better reflect the nature of the thinking defined in each category.

http://rite.ed.qut.edu.au/oz-teachernet/training/bloom.html



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The Cognitive Dimension Process

Level 1 - C1

Categories & Cognitive Processes	Alternative Names	Definition
Remember		**Retrieve knowledge from long-term memory**
Recognizing	Identifying	Locating knowledge in long-term memory that is consistent with presented material
Recalling	Retrieving	Retrieving relevant knowledge from long-term memory

Level 2 – C2

Categories & Cognitive Processes	Alternative Names	Definition
Understand		**Construct meaning from instructional messages, including oral, written, and graphic communication**
Interpreting	Clarifying Paraphrasing Representing Translating	Changing from one form of representation to another
Exemplifying	Illustrating Instantiating	Finding a specific example or illustration of a concept or principle
Classifying	Categorizing Subsuming	Determining that something belongs to a category
Summarizing	Abstracting Generalizing	Abstracting a general theme or major point(s)
Inferring	Concluding Extrapolating Interpolating Predicting	Drawing a logical conclusion from presented information
Comparing	Contrasting Mapping Matching	Detecting correspondences between two ideas, objects, and the like
Explaining	Constructing models	Constructing a cause and effect model of a system

Anderson, Lorin W. & Krathwohl, David R. (2001). *A Taxonomy for Learning, Teaching and Assessing: a Revision of Bloom's Taxonomy*. New York. Longman Publishing.

Level 3 – C3

Categories & Cognitive Processes	Alternative Names	Definition
Apply		**Applying a procedure to a familiar task**
Executing	Carrying out	Applying a procedure to a familiar task
Implementing	Using	Applying a procedure to an unfamiliar task
Analyze		**Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose**
Differentiating	Discriminating Distinguishing Focusing Selecting	Distinguishing relevant from irrelevant parts or important from unimportant parts of presented material
Organizing	Finding coherence Integrating Outlining Parsing Structuring	Determining how elements fit or function within a structure
Attributing	Deconstructing	Determine a point of view, bias, values, or intent underlying presented material
Evaluate		**Make judgments based on criteria and standards**
Checking	Coordinating Detecting Monitoring Testing	Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented
Critiquing	Judging	Detecting inconsistencies between a product and external criteria; determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem

Anderson, Lorin W. & Krathwohl, David R. (2001). *A Taxonomy for Learning, Teaching and Assessing: a Revision of Bloom's Taxonomy.* New York. Longman Publishing.

Categories & Cognitive Processes	Alternative Names	Definition
Create		**Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure**
Generating	Hypothesizing	Coming up with alternative hypotheses based on criteria
Planning	Designing	Devising a procedure for accomplishing some task
Producing	Constructing	Inventing a product

The Knowledge Dimension

Dimension	Definition
Factual Knowledge	The basic elements students must know to be acquainted with a discipline or solve problems in it
Conceptual Knowledge	The interrelationships among the basic elements within a larger structure that enable them to function together
Procedural Knowledge	How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods
Metacognitive Knowledge	Knowledge of cognition in general as well as awareness and knowledge of one's own cognition

Anderson, Lorin W. & Krathwohl, David R. (2001). *A Taxonomy for Learning, Teaching and Assessing: a Revision of Bloom's Taxonomy*. New York. Longman Publishing.

Potential Activities and Products

Remembering: Potential Activities and Products

- Make a list of the main events of the story.
- Make a time line of events.
- Make a facts chart.
- Write a list of any pieces of information you can remember.
- What animals were in the story?
- Make a chart showing...
- Make an acrostic.
- Recite a poem.

Understanding: Potential Activities and Products

- Cut out, or draw pictures to show a particular event.
- Illustrate what you think the main idea may have been.
- Make a cartoon strip showing the sequence of events.
- Write and perform a play based on the story.
- Retell the story in your own words.
- Write a summary report of the event
- Prepare a flow chart to illustrate the sequence of events.
- Make a coloring book.
- Cut out, or draw pictures to show a particular event. Illustrate what you think the main idea was.
- Make a cartoon strip showing the sequence of events.
- Write and perform a play based on the story.
- Retell the story in your own words.
- Write a summary report of the event
- Prepare a flow chart to illustrate the sequence of events.
- Cut out, or draw pictures to show a particular event. Illustrate what you think the main idea was.
- Make a cartoon strip showing the sequence of events.
- Write and perform a play based on the story.

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Applying: Potential Activities and Products

- Construct a model to demonstrate how it works
- Make a diorama to illustrate an event
- Make a scrapbook about the areas of study.
- Make a papier-mache map / clay model to include relevant information about an event.
- Take a collection of photographs to demonstrate a particular point.
- Make up a puzzle or a game about the topic.
- Write a textbook about this topic for others.
- Dress a doll in national costume.
- Make a clay model.
- Paint a mural using the same materials.
- Design a marketing strategy for your product using a known strategy as a model.

Analyzing: Potential Activities and Products

- Design a questionnaire to gather information.
- Write a commercial to sell a new product
- Make a flow chart to show the critical stages.
- Construct a graph to illustrate selected information.
- Make a family tree showing relationships.
- Devise a play about the study area.
- Write a biography of a person studied.
- Prepare a report about the area of study.
- Conduct an investigation to produce information to support a view.
- Review a work of art in terms of form, color and texture.

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Evaluating: Potential Activities and Products

- Prepare a list of criteria to judge...
- Conduct a debate about an issue of special interest.
- Make a booklet about five rules you see as important. Convince others.
- Form a panel to discuss views.
- Write a letter to. ..advising on changes needed.
- Write a half-yearly report.
- Prepare a case to present your view about...

Creating: Potential Activities and Products

- Invent a machine to do a specific task.
- Design a building to house your study.
- Create a new product. Give it a name and plan a marketing campaign.
- Write about your feelings in relation to...
- Write a TV show play, puppet show, role play, song ***or*** pantomime about..
- Design a record, book or magazine cover for...
- Sell an idea
- Devise a way to...
- Make up a new language and use it in an example.

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Assessment

Questions for Remembering

- What happened after...?
- How many...?
- What is...?
- Who was it that...?
- Can you name ...?
- Find the meaning of...
- Describe what happened after...
- Who spoke to...?
- Which is true or false...?

(Pohl, ***Learning to Think, Thinking to Learn***, p. 12)

Questions for Understanding

- Can you write in your own words?
- How would you explain...?
- Can you write a brief outline...?
- What do you think could have happened next...?
- Who do you think...?
- What was the main idea...?
- Can you clarify...?
- Can you illustrate...?
- Does everyone act in the way that ..... does?

(Pohl, ***Learning to Think, Thinking to Learn***, p. 12)

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Questions for Applying

- Do you know of another instance where...?
- Can you group by characteristics such as...?
- Which factors would you change if...?
- What questions would you ask of...?
- From the information given, can you develop a set of instructions about...?

(Pohl, ***Learning to Think, Thinking to Learn***, p. 13)

Question for Analysing

- Which events could not have happened?
- If...happened, what might the ending have been?
- How is...similar to...?
- What do you see as other possible outcomes?
- Why did...changes occur?
- Can you explain what must have happened when...?
- What are some or the problems of...?
- Can you distinguish between...?
- What were some of the motives behind..?
- What was the turning point?
- What was the problem with...?

(Pohl, ***Learning to Think, Thinking to Learn***, p. 13)

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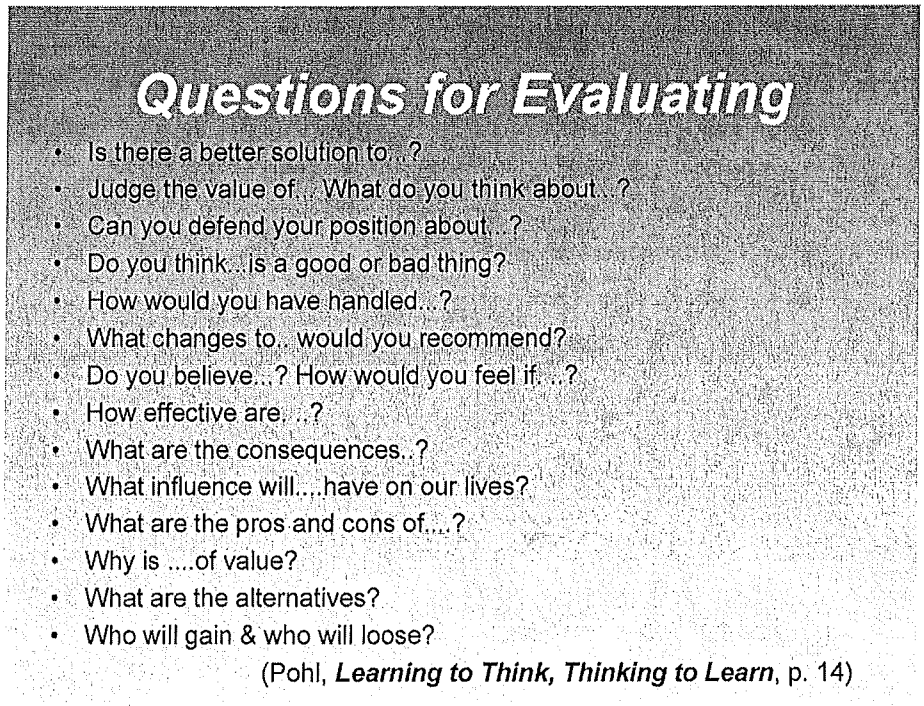

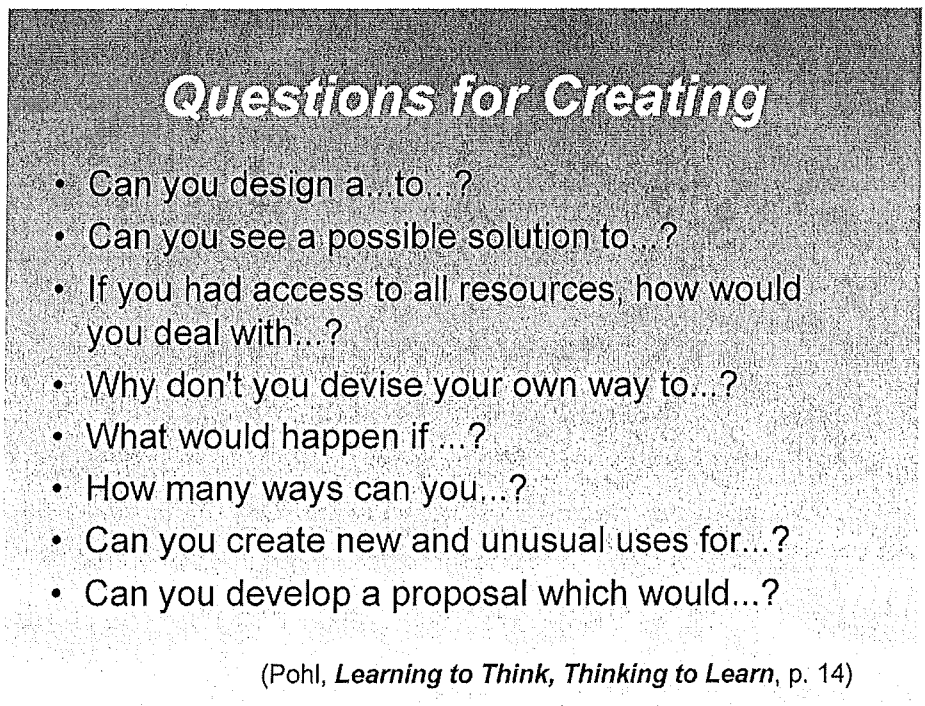

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