

Bloom's Revised Taxonomy: Mathematics

Taxonomy of Cognitive Objectives -1950s-developed by Benjamin Bloom 1990s-Lorin Anderson (former student of Bloom) revisited the taxonomy. 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 more accurate.

A mathematics teacher found that by using Bloom's higher levels --analyzing, evaluating and creating --when questioning students during Math, helps them become better problem solvers. Asking students to explain their Math answers, using words, drawings or diagrams and numbers (equations), is an excellent way to assess if they truly understand the concept taught. Having students extend and explain a number pattern engages them in higher level thinking skills, too. I also have my students come up with their own questions about a lesson to help each other. This is difficult at first and they usually just ask knowledge questions. But with practice, students begin to ask better questions --questions to which they can explain the answers.

Questioning should be used purposefully to achieve well-defines goals. Typically a teacher would vary the level of questions within a single lesson.

Usually questions at the lower levels are appropriate for: <ul style="list-style-type: none">• evaluating students' preparation and comprehension.• diagnosing students' strengths and weaknesses.• reviewing and/or summarizing content.	Questions at higher levels of the taxonomy are usually most appropriate for: <ul style="list-style-type: none">• encouraging students to think more deeply and critically.• problem solving, encouraging discussions.• stimulating students to seek information on their own.
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The new terms are defined as:

Remembering: Retrieving, recognizing, and recalling relevant knowledge from long-term memory. eg. find out, learn terms, facts, methods, procedures, concepts

Understanding: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. Understand uses and implications of terms, facts, methods, procedures, concepts.

Applying: Carrying out or using a procedure through executing, or implementing. Make use of, apply practice theory, solve problems, use information in new situations.

Analyzing: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing. Take concepts apart, break them down, analyze structure, recognize assumptions and poor logic, evaluate relevancy.

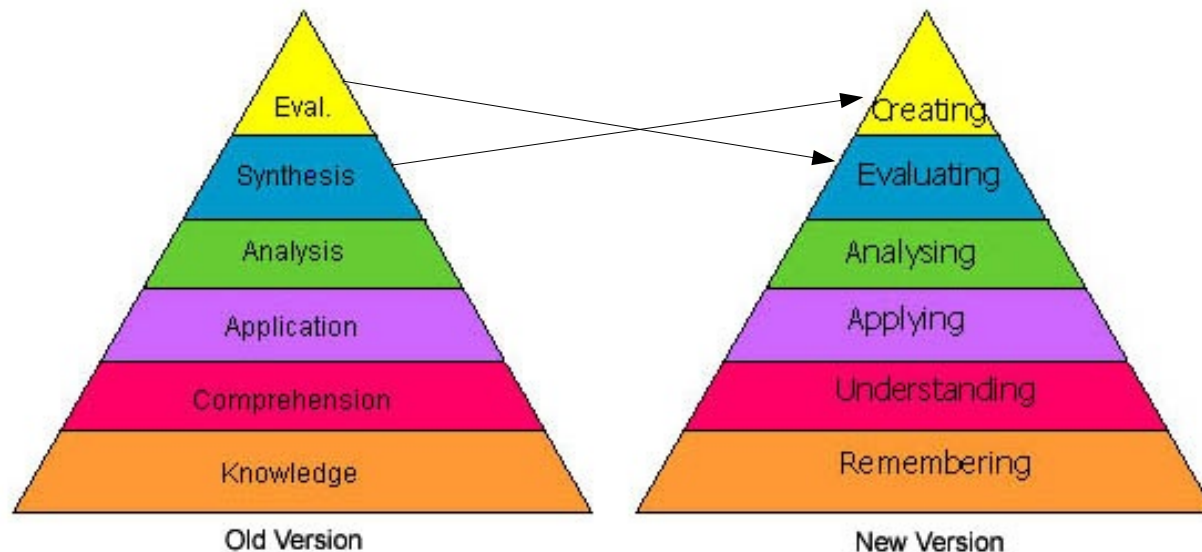
Evaluating: Making judgments based on criteria and standards through checking and critiquing. Set standards, judge using standards, evidence, rubrics, accept or reject on basis of criteria.

Creating: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing. Put things together; bring together various parts; write theme, present speech, plan experiment, put information together in a new & creative way

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	New Terms	Actions	Learning Activities
Higher-order thinking	<p><u>Creating</u></p> <p>(Putting together ideas or elements to develop an original idea or engage in creative thinking).</p>	<p>Designing Constructing Planning Producing Inventing Devising Making</p>	<p><i>Creating:</i> (Generating new ideas, products, or ways of viewing things) <i>How could we determine the number of pennies in a jar without counting them? Apply and integrate several different strategies to solve a mathematical problem. Design a new monetary system or an experiment for establishing ...</i></p> <p>Designing, constructing, planning, producing, inventing. <i>Invent a machine to do a specific task. Develop a menu for a new healthy foods restaurant.</i></p>
	<p><u>Evaluating</u></p> <p>(Judging the value of ideas, materials and methods by developing and applying standards and criteria).</p>	<p>Checking Hypothesizing Critiquing Experimenting Judging Testing Detecting Monitoring</p>	<p><i>Evaluating:</i> (Judging the value of a product for a given purpose, using definite criteria) <i>Develop a proof ... and justify each step ..., Using a definition ... determine ...</i> Justifying a decision or course of action, checking, hypothesizing, critiquing, experimenting, judging</p> <p><i>What criteria would you use to evaluate if your answer is correct? Prepare a list of criteria to judge... Evaluate expressions.</i></p>
	<p><u>Analyzing</u></p> <p>(Breaking information into its component elements to explore relationships).</p>	<p>Comparing Organizing Deconstructing Attributing Outlining Structuring Integrating</p>	<p><i>Analyzing:</i> (Breaking information into parts to explore understandings and relationships) <i>Given a math word problem, determine the strategies that would be necessary to solve it. Write a paragraph describing the relationship ..., How does ... compare to ...</i></p> <p>Comparing, organizing, deconstructing, interrogating, finding <i>Design a survey to find out ... Graph your results. Use a Venn Diagram to show how two topics are the same and different. Translate between visual representations, sentences, and symbolic notation. Make predictions based on experimental or statistical data.</i></p>
Lower-order thinking	<p><u>Applying</u></p> <p>(Using strategies, concepts, principles and theories in new situations).</p>	<p>Implementing Carrying out Using Executing</p>	<p><i>Applying:</i> (Using information in concrete situations) <i>Compute the area of actual circles. Use the given graph to ..., Choose and describe the best method to ...</i></p> <p>Using information in another familiar situation, implementing, carrying out, using, executing <i>Draw a diagram which shows these fractions or take photographs of the fractions. Determine measures of central tendency and dispersion Write a journal entry. Write an explanation about this topic for others.</i></p>
	<p><u>Understanding</u></p> <p>(Understanding of given information).</p>	<p>Interpreting Exemplifying Summarizing Inferring Paraphrasing Classifying Comparing Explaining</p>	<p><i>Understanding:</i> (Grasping the meaning of material) <i>Given the mathematical formula for the area of a circle, paraphrase it using your own words. Select the graph that illustrates</i></p> <p>Explaining ideas or concepts Interpreting, summarizing, paraphrasing, classifying, explaining <i>Find items that you can use to show the fractions. Retell or write in your own words... Report to the class... Write a summary report of the event.</i></p>
	<p><u>Remembering</u></p> <p>(Recall or recognition of specific information).</p>	<p>Recognizing Listing Describing Identifying Retrieving Naming Locating Finding</p>	<p><i>Remembering:</i> (Remembering previously learned material) <i>State the formula for the area of a circle. State the rule of ..., Explain and use the procedure for ...</i></p> <p>Recalling information, recognizing, listing, describing, retrieving, naming, finding, locating <i>List the fractions you know and can show. List the attributes of your shape. Make a concept map of the topic. Make a chart showing...</i></p>

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Fractions with Bloom's Revised Taxonomy	3D shapes with Bloom's Revised Taxonomy
<p>Remembering List the fractions you know and can show.</p> <p>Understanding Find items that you can use to show the fractions.</p> <p>Applying Draw a diagram which shows these fractions or take photographs of the fractions.</p> <p>Analysing Design a survey to find out which fractions are easy and which are hard. Graph your results.</p> <p>Evaluating Choose a diagram or picture to represent the hardest fractions to use in a game.</p> <p>Creating Create a power point presentation game for others to play.</p>	<p>Remembering List the attributes of your shape.</p> <p>Understanding Find items that you can use to show the shape.</p> <p>Applying Draw a diagram or take a photograph of the shape.</p> <p>Analysing Identify where the shape is found in the classroom and school.</p> <p>Evaluating Tell why your shape is used in the places it is.</p> <p>Creating Create an item that includes all or part of your shape. Draw and label your design.</p>