



Presentation for implementation of BLOOM'S TAXONOMY

Dr. L V Narasimha Prasad
Principal

26 – 28 February, 2020

Bloom's Taxonomy for Assessment

- ✓ Bloom's Taxonomy helps us in not only designing curriculum and teaching but also to design appropriate examination questions belonging to various cognitive levels.
- ✓ **Bloom's Taxonomy of Educational Objectives developed in 1956 by Benjamin Bloom** was widely accepted by educators for curriculum design and assessment.
- ✓ In 2001, Anderson and Krathwohl modified Bloom's Taxonomy to make it relevant to the present-day requirements.
- ✓ It attempts to divide learning into three types of domains (cognitive, affective, and behavioural) and then defines the level of performance for each domain.

Six Levels of Bloom's Taxonomy

- ✓ Revised Bloom's taxonomy in the cognitive domain includes thinking, knowledge, and application of knowledge.
- ✓ It is a popular framework in engineering education to structure the assessment as it characterizes complexity and higher- order abilities.
- ✓ It identifies six levels of competencies within the cognitive domain which are appropriate for the purposes of engineering educators.



Bloom's Taxonomy – Definition & Student Response



Level	Descriptor	Bloom's Definition	Student Response
1	Remembering	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Talent: in remembering previously learned material
2	Understanding	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Skill: to grasp the meaning of material
3	Applying	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Capability: to use learned material in new and concrete situations
4	Analyzing	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Aptitude: to deconstruct material into component parts to accurately understand its organizational structure

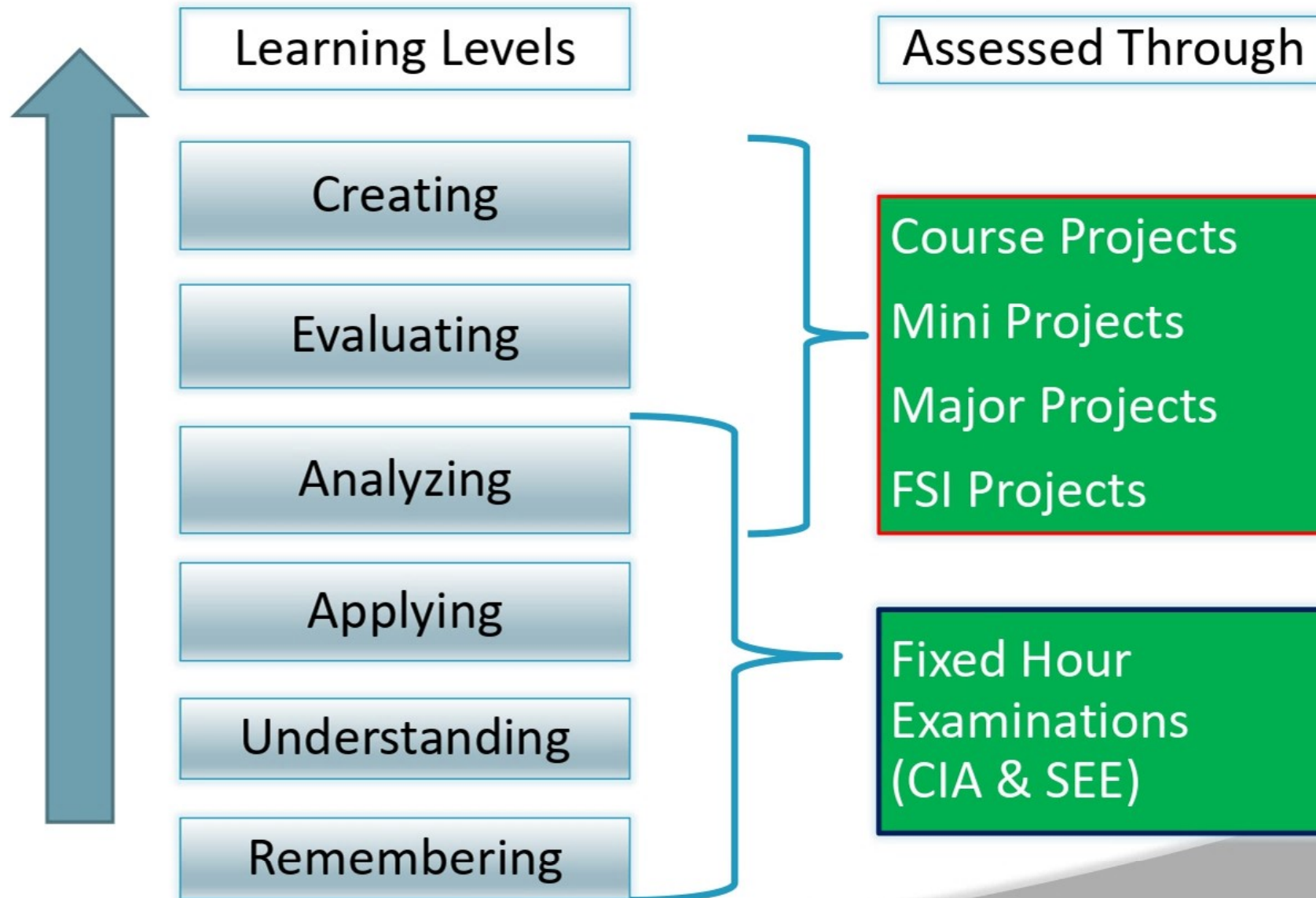
Bloom's Taxonomy – Definition & Student Response



Level	Descriptor	Bloom's Definition	Student Response
5	Evaluating	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Capacity: to assess effectiveness of whole concepts, in relation to values, outputs, efficacy, and viability.
6	Creating	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.	Knack: to develop new and unique structures, systems, models, approaches, and ideas, based from previous knowledge gains

Bloom's Taxonomy – Assessment Planning

Assessment methods for different Bloom's cognitive levels



Bloom's Taxonomy – Pattern of assessment

Pattern of assessment in each of the course in the program

- Alignment of assessment questions with course learning outcomes
- Whether all the learning outcomes are tested; sometimes some learning outcomes are over tested at the expense of others which may be not tested at all.
- Overall weightage in the assessment, to each of the Bloom's learning levels.

A good examination paper must consist of various difficulty levels to find different capabilities of students.

- Bloom's taxonomy helps the faculty to set examination papers that are well balanced, testing the different skills.
- It is recommended that at institution/University level, upper limit need to be arrived for lower order skills (for example, no more than 40% weightage for knowledge-oriented questions).
- As nature of every course is different, the weightage for different cognitive levels in the question papers can also vary from course to course.

Bloom's Taxonomy – Theory Course Assessment

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment				End Semester Examination (Theory) [70 marks] (in%)
	Theory			Practical	
	CIA – I [20 marks] (in%)	CIA – II [20 marks] (in%)	AAT [5 marks] (in%)	Rubric based CIA [30 marks] (in%)	
Remembering	30	30	0	10	20
Understanding	60	50	0	20	40
Applying	10	20	30	40	30
Analyzing	0	0	40	30	10
Evaluating	0	0	30	0	0
Creating	0	0	0	0	0

Bloom's Taxonomy – Laboratory Course Assessment

Assessment Methods & Levels (based on Bloom's Taxonomy)

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [30 marks] (in %)	End Semester Examination [70 marks] (in %)
Remembering	0	0
Understanding	0	0
Applying	30	30
Analyzing	30	20
Evaluating	20	10
Creating	20	30

Bloom's Taxonomy – Keyword Action Verbs



- Action verbs in preparing assessment questions are most important.
- Action verbs are indicators of the complexity (level) of the question.
- Educators have come up with taxonomy of measurable verbs corresponding to each of the Bloom's cognitive levels.
- These verbs help us not only to describe and classify observable knowledge, skills and abilities but also to frame the examination or assignment questions that are appropriate to the level.

Bloom's Taxonomy – Example 1 : Batteries

Level	Descriptor	Sample Question as per Bloom's Taxonomy
1	Remembering	<ul style="list-style-type: none">▪ List as many uses for household batteries as you can think of.▪ Name as many different sized batteries as you can.▪ Write down all the places where you can buy batteries.
2	Understanding	<ul style="list-style-type: none">▪ Describe the composition of a battery.▪ Draw and label the parts of a battery.▪ Describe how a battery works.
3	Applying	<ul style="list-style-type: none">▪ Draw a rough diagram illustrating how to properly insert a battery into a torch, a tape recorder or alarm clock.
4	Analyzing	<ul style="list-style-type: none">▪ Determine ways the battery has changed the following markets: toys, small appliances, and health aids.
5	Evaluating	<ul style="list-style-type: none">▪ What criteria would you set up to evaluate a particular brand of battery?▪ How would you use these criteria to select your next battery?
6	Creating	<ul style="list-style-type: none">▪ Invent a new toy that operates on batteries.▪ Draw your design and indicate how and where the batteries are to be installed.

Bloom's Taxonomy – Example 2 : Linear Equations

Level	Descriptor	Sample Question as per Bloom's Taxonomy
1	Remembering	▪ Define a linear equation
2	Understanding	▪ Explain why is $y=mx+b$ called a 'linear' equation
3	Applying	▪ Calculate the slope and y-intercept of the straight line shown in a graph
4	Analyzing	▪ A verbal problem like: A multiplex sold 500 tickets in a day. Adult tickets cost Rs 200...
5	Evaluating	▪ Decide which method (among elimination, substitution, graphical) is easier to solve simultaneous linear equation. Justify.
6	Creating	▪ Suppose you are given any two linear equations. Devise a rule to determine if there is a unique set of x,y values which satisfy both equations.

Bloom's Taxonomy – Example 3 : Basic Electronics & Logic Design

Level	Descriptor	Sample Question as per Bloom's Taxonomy
1	Remembering	▪ Draw logic symbol of "AND" gate
2	Understanding	▪ Write truth table for given combination of "AND" gates
3	Applying	▪ Apply truth tables and solve problems
4	Analyzing	▪ Realize a multiplexer by selecting optimum gates
5	Evaluating	▪ Compare and contrast two methods for implementing given function
6	Creating	▪ Design of counter/ state machine

Bloom's Taxonomy – Level 1: Remembering

Description	Recognize, recall facts
Example	Recalling Newton's laws of motion
Action verbs	list, recite, define, name, match, quote, recall, identify, label, recognize
Task using a Technology	Highlighting, Bookmarking, Flashcards, Searching / Googling

Bloom's Taxonomy – Level 1: Remembering

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to remember facts of the materials.</p> <p>The answer will deal with repeating precisely.</p>	<p>Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why</p>	<ol style="list-style-type: none"> 1. State Ohm's law 2. List the physical and chemical properties of silicon 3. List the components of A/D converter 4. Define the purpose of a constructor. 5. Define the terms: Sensible heat, Latent heat and Total heat of evaporation 6. List the assembler directives. 7. Describe the process of galvanization and tinning 8. Write truth table and symbol of AND, OR, NOT, XNOR gates 9. Define the terms; Stress, Working stress and Factor of safety. 10. What is the difference between declaration and definition of a variable/function? 11. List the different storage class specifiers in C. 12. What is the use of local variables? 13. What are the valid places for the keyword break to appear?

Bloom's Taxonomy – Level 2: Understanding

Description	Grasp meaning, explain, interpret, translate, paraphrase
Example	Describing the concept of uniform circular motion
Action verbs	describe, explain, paraphrase, restate, give original examples of, summarize, interpret, discuss
Task using a Technology	Summary writing in blog/wiki/journal, Explaining by Mind maps, categorizing, annotating

How does this subsume the level below (recall)?	This would require the learner to recall the concept of constant speed and tangential direction. Then explaining what happens when a body in constant speed changes its direction constantly.
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Bloom's Taxonomy – Level 2: Understanding

Demands	Action Verbs	Sample Questions
The questions are demanding from students to rephrase information and translate knowledge into new context and interpret. The answer will deal with demonstrating understanding of concepts.	Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate.	<ol style="list-style-type: none">1. Explain the importance of sustainability in Engineering design2. Explain the behaviour of PN junction diode under different bias conditions3. Describe the characteristics of SCR and transistor equivalent for a SCR4. Explain the terms; Particle, Rigid body and Deformable body giving two examples.5. Discuss the effect of Make in India initiative on the Indian manufacturing Industry.6. Summarize the importance of ethical code of conduct for engineering professionals7. Explain the syntax for 'for loop'.8. What is the difference between including the header file within angular braces < > and double quotes " "?9. What is the meaning of base address of the array?10. What is the difference between actual and formal parameters?11. Explain the different ways of passing parameters to the functions.12. Differentiate between entry and exit controlled loops.13. How is an Array different from Linked List?

Bloom's Taxonomy – Level 3: Applying

Description	Use knowledge in a new situation. Involves rules, methods, laws, principles
Example	Use the formula of $s = ut + \frac{1}{2}at^2$ to solve a problem
Action verbs	calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model
Task using a Technology	Creating presentations (Powerpoint, Zoho, Prezi), Play simulation/games, explain using screen capture

How does this subsume the level below (Understand)?	Assuming that the formula is not given, this would require the learner to recall the formula and its parameters. Then assigning correct values for the parameters and solving and converting units.
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Bloom's Taxonomy – Level 3: Applying

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to arrive at a solution and solve problems.</p> <p>The answer will deal with applying learned information to solve a problem.</p>	<p>Apply, Build, Choose, Construct, Develop, Experiment With, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize</p>	<ol style="list-style-type: none"> One of the resource persons needs to address a huge crowd (nearly 400 members) in the auditorium. A system is to be designed in such a way that everybody attending the session should be able to hear properly and clearly without any disturbance. Identify the suitable circuit to boost the voice signal and explain its functionality in brief. A ladder 5.0 m long rests on a horizontal ground & leans against a smooth vertical wall at an angle 20 with the vertical. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750 N stands on a rung 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder & the floor. An electric train is powered by machine which takes the supply from 220 V DC rail running above the train throughout. Machine draws current of 100 A from the DC rail to account for high torque during starting and runs at 700 r.p.m initially. Calculate the new speed of the train once it picks up the speed where the torque output required is only 70% of starting torque. Assume the motor has a resistance of 0.1Ω across its terminals. Write an algorithm to implement a stack using queue. A single array $A[1..MAXSIZE]$ is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables top1 and top2 ($top1 < top2$) point to the location of the topmost element in each of the stacks. What is the condition for “stack full”, if the space is to be used efficiently. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation lookaside buffer (TLB) which can hold a total of 128-page table entries and is 4-way set associative. What is the minimum size of the TLB tag?

Bloom's Taxonomy – Level 4: Analyzing



Description	Separate whole into parts until structure of whole and relationship between parts is clear.
Example	Analyze a physical scenario and find the relative magnitude of forces acting upon the object in the scenario
Action verbs	classify, outline, break down, categorize, analyze, diagram, illustrate
Task using a Technology	Organizing using (database, MS Excel), analyze & explain graphs(excel, draw.io, graphsketch.com), Mashups
How does this subsume the level below (Apply)?	This would require the learner to: Understand what forces are acting Recall their formulae Apply those formulae to find the relative magnitude

Bloom's Taxonomy – Level 4: Analyzing

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to separate an idea into its parts and demonstrate the relationship of the parts to the whole.</p> <p>The answer will deal with breaking things down into their elements, and formulating theoretical explanations.</p>	<p>Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test For, Theme</p>	<ol style="list-style-type: none"> 1. A class of 10 students consists of 5 males and 5 females. We intend to train a model based on their past scores to predict the future score. The average score of females is 60 whereas that of male is 80. The overall average of the class is 70. Give two ways of predicting the score and analyze them for fitting model. 2. Suppose that we want to select between two prediction models, M1 and M2. We have performed 10 rounds of 10-fold cross-validation on each model, whereas the same data partitioning in round one is used for both M1 and M2. The error rates obtained for M1 are 30.5, 32.2, 20.7, 20.6, 31.0, 41.0, 27.7, 26.0, 21.5, 26.0. The error rates for M2 are 22.4, 14.5, 22.4, 19.6, 20.7, 20.4, 22.1, 19.4, 16.2, 35.0. Comment on whether one model is significantly better than the other considering a significance level of 1%. 3. Return statement can only be used to return a single value. Can multiple values be returned from a function? Justify your answer. 4. Bob wrote a program using functions to find sum of two numbers whereas Alex wrote the statements to find the sum of two numbers in the main() function only. Which of the two methods is efficient in execution and why? 5. Carly wants to store the details of students studying in 1st year and later on wishes to retrieve the information about the students who score the highest marks in each subject. Specify the scenario where the data can be organized as a single 2-D array or as multiple 1-D arrays.

Bloom's Taxonomy – Level 4: Analyzing (Cont.)

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to separate an idea into its parts and demonstrate the relationship of the parts to the whole.</p> <p>The answer will deal with breaking things down into their elements, and formulating theoretical explanations.</p>	<p>Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test For, Theme</p>	<ol style="list-style-type: none"> 6. Dave is working on a Campus Management Software but is unable to identify the maximum number of students per course. He decided to implement the same using arrays but discovered that there is memory wastage due to over provisioning. Which method of memory storage should be used by Dave and how it can be implemented using C? 7. Albert is working on a 32-bit machine whereas Julie is working on a 64-bit machine. Both wrote the same code to find factorial of a number but Albert is unable to find factorial of a number till 9 whereas Julie is able to find the factorial of higher number. Identify the possible reason why Albert is unable to find the factorial. Suggest some changes in the code so that Albert can handle bigger inputs. 8. While writing a C code, the problem faced by the programmers is to find if the parenthesis is balanced or not. Write an algorithm to check if the parenthesis in C code are balanced. Initially your code should work for balanced { and } braces. 9. Swapping of the data in a linked list can be performed by swapping the contents in the linked list. Can the contents of a linked list be swapped without actually swapping the data?

Bloom's Taxonomy – Level 5: Evaluating



Description	Judge value based on criteria, decision making.
Example	Evaluate a given free body diagram for a given physical scenario
Action verbs	choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select, evaluate
Task using a Technology	Create argumentation maps (Mind map, compendium), Writing summary (Wiki, blog, journal), Writing review/critique/conclusions (Comments, wikis)
How does this subsume the level below (Analyze)?	This would require: Analyze the physical scenario to find objects and forces present Remember relevant concepts Apply the procedure to write free body diagrams Compare the two free body diagrams

Bloom's Taxonomy – Level 5: Evaluating

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to make judgments about the value or merits of an idea, purpose, and solution to a problem, procedure, method or product.</p> <p>The answer deal with justifying value judgments.</p>	<p>Agree, Appraise, Assess, Award, Choose, Compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify, Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value</p>	<ol style="list-style-type: none"> 1. Appraise the weight of packaging sugar industry within last six months. 2. Assess the influence of environmental policies for capital city. 3. Compare between first sampling plan with second sampling plan in quality control. 4. Explain the decrease of efficiency rate of network of water distribution in new opened project. 5. Justify the increase of carbon monoxide in middle of the city during midday. 6. Measure the time heating of water in connected pipes. 7. Prioritize the extra energy costs into included values by probability of mathematical relations. 8. Prove mathematically the correctness of the following algorithm. 9. How would you rank quality of goods or how disprove against other claims? 10. The vehicle electronics today play a key role in all comfort and safety features; support this by sensors which assist intelligent data communication of the electronic vehicle systems. 11. Value last testing of benzene and ratio of octane.

Bloom's Taxonomy – Level 6: Creating

Description	Combine parts to make (new) whole, creative behaviours, propose plans
Example	Create working models to demonstrate Newton's laws of motion
Action verbs	design, formulate, build, invent, create, compose, generate, derive, modify, develop
Task using a Technology	Write a program(IDEs) ,Plan an activity (planners), create models (Blender, Sketchup), create blog, vlog, podcast
How does this subsume the level below (Evaluate)?	This would require the learner to: Analyze real world examples of Newton's laws Explain how Newton's laws in the context of those examples Identify objects and forces Calculate relative magnitude / momentum / final velocity etc

Bloom's Taxonomy – Level 6: Creating

Demands	Action Verbs	Sample Questions
<p>The questions are demanding from students to design experiments and test hypotheses. The answer will deal with constituting something and Combining elements.</p>	<p>Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory</p>	<ol style="list-style-type: none"> 1. Add methanol to gasoline to clean about surrogate compensation. 2. Combine the grinding steel with band saw at the end of technical workshop. 3. Delete statement in oracle SQL developer to install other programs. 4. Design the Zinc-coated or galvanized steel to give a unique combination of high strength, formability, light weight, and corrosion resistance. 5. How to formulate a research question in qualitative scientific research? 6. Integrate between quality and safety concepts according to international standards. 7. How you make up brushes for painting of iron produced in the factory? 8. Modify the rate of temperature increase in gas tube in refrigeration. 9. Prepare a project on components of disaster and evacuation management. 10. Rearrange the equation by subtracting what is to the right of the equal sign from both sides of the equation: $\frac{4}{5}x - (3) \cdot \frac{3}{4}x - [(2x) \cdot \frac{1}{2}] = 0.$

The Cognitive Process Dimension – categories, cognitive processes (and alternative names)

Cognitive processes that further clarify the bounds of the six categories

Remember	recognizing (identifying)	recalling (retrieving)		
Understand	interpreting (clarifying, paraphrasing, representing, translating)	classifying (categorizing, subsuming)	inferring (concluding, extrapolating, interpolating, predicting)	comparing (contrasting, mapping, matching)
	exemplifying (illustrating, instantiating)	summarizing (abstracting, generalizing)		explaining (constructing models)
Apply	executing (carrying out)	implementing (using)		
Analyze	differentiating (discriminating, distinguishing, focusing, selecting)	organizing (finding, coherence, integrating, outlining, parsing, structuring)		attributing (deconstructing)
Evaluate	checking (coordinating, detecting, monitoring, testing)		critiquing (judging)	
Create	producing (construct)	planning (designing)	generating (hypothesizing)	



Thank you