Computing Verbs to Enhance Bloom's Revised Taxonomy

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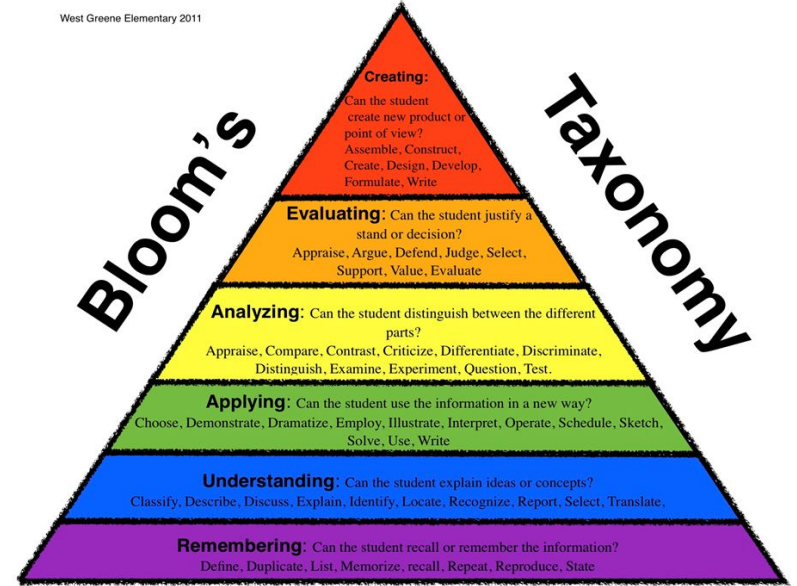Christian Servin, El Paso Community College

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Bloom's Revised Taxonomy

6 levels of cognition

- Creating   Ex: *Develop*
- Evaluating   Ex: *Assess*
- Analyzing   Ex: *Distinguish*
- Applying   Ex: *Illustrate*
- Understanding   Ex: *Explain*
- Remembering   Ex: *List*

Verbs associated with each level, used in crafting learning outcomes and competencies

West Greene Elementary 2011

Bloom's   **Taxonomy**

Creating: Can the student create new product or point of view? Assemble, Construct, Create, Design, Develop, Formulate, Write

Evaluating: Can the student justify a stand or decision? Appraise, Argue, Defend, Judge, Select, Support, Value, Evaluate

Analyzing: Can the student distinguish between the different parts? Appraise, Compare, Contrast, Criticize, Differentiate, Discriminate, Distinguish, Examine, Experiment, Question, Test.

Applying: Can the student use the information in a new way? Choose, Demonstrate, Dramatize, Employ, Illustrate, Interpret, Operate, Schedule, Sketch, Solve, Use, Write

Understanding: Can the student explain ideas or concepts? Classify, Describe, Discuss, Explain, Identify, Locate, Recognize, Report, Select, Translate,

Remembering: Can the student recall or remember the information? Define, Duplicate, List, Memorize, recall, Repeat, Reproduce, State

Bloom's Verbs for Computing - Project Overview

Goal: Enhance the verb lists with verbs to support computing disciplines

- Project conceived Summer 2020
- StrawDog: First round of proposed verbs (~90) presented at SIGCSE 2021 & other venues
- Feedback incorporated into next round

IronDog: report with 76 verbs, just released

- Available for public review and comment
- Seeking feedback from all computing disciplines

Proposed New Verbs (Selected)

Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Enumerate Reference	Annotate Comment Follow	Backup Compile Connect Deploy Document Encourage Encrypt Hash Install Measure …	Articulate Automate Correlate Detect Facilitate Predict Promote Simulate Trace …	Adapt Administer Balance Debug Delegate Hack Prioritize Propose …	Collaborate Compose Reengineer Refactor Secure Visualize …

Proposed New Verbs (Selected)

Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Enumerate Reference	Annotate Comment Follow	**Backup** Compile Connect Deploy Document Encourage Encrypt Hash Install **Measure** …	Articulate Automate Correlate Detect Facilitate Predict Promote Simulate **Trace** …	Adapt Administer Balance Debug Delegate Hack Prioritize Propose …	Collaborate Compose Reengineer **Refactor** Secure Visualize …

Sample Learning Outcomes

Backup: *Common computing task, especially in system administration and data security*

1. Backup multiple local or remote files and folders to a backup volume.
2. Backup marked data to a remote location using an automation script.

Trace: *Tracing code, and can also be used more generally*

1. Trace a variable's value as it changes throughout a code module.
2. Trace an activity to detect the condition that creates a deadlock.
3. Trace a list attached or linked to personnel who are not allowed access to any part or function of the system.

Reformulating Learning Outcomes

Learning outcomes from **CS2013** and reformulated learning outcomes with one of the proposed new verbs

Example 1:

- ORIGINAL: Use refactoring in the process of modifying a software component.
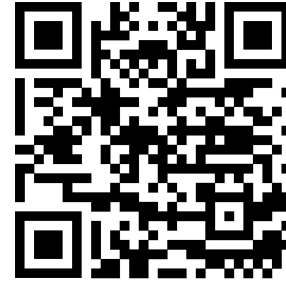- NEW: **Refactor** a software component.

Example 2:

- ORIGINAL: Explain what is meant by "best", "expected", and "worst" case behavior of an algorithm.
- NEW: **Measure** "best", "expected", and "worst" case behavior of a given algorithm.

Call to Action

Review the IronDog draft and provide your feedback!

Bloom's Verbs for Computing IronDog Draft:

    ccecc.acm.org/BloomsIronDog

IronDog Draft

Feedback Survey:

    forms.gle/cmcSegnRAXJnHx3V9

Survey