

A silver metal spiral binding is visible on the left edge of the notebook cover, consisting of a series of loops that hold the pages together.

Diagnostic, Summative and Formative Assessments in Math

Lecture 19 – 14th December 2023

Overview

- How do we design effective assessments?
- Purpose of Assessments
- Types of Assessments
- How to give Effective Feedback to enhance student learning.
- Useable Examples





EFFECTIVE
ASSESSMENTS



CONSTRUCTIVE
FEEDBACK



HIGHER STUDENTS
SUCCESS



**Why Do We Assess?
How Do We Assess?
What Do We Assess?
When Do We Assess?**

How to design effective assessments

- *Learner assessment* follows from the **objectives**.
- Based on the principles of *backward design* developed by Wiggins and McTighe (1998), instructors identify the lesson objective or desired results and then decide what they will accept as evidence of learners' knowledge and skills.
- The concept of *backward design* holds that the instructor must begin with the end in mind (i.e., *what the student should be able to know, understand, or do*) and then map *backwards* from the desired result to the current time and the students' current ability/skill levels to determine the best way to reach the performance goal.



What is Assessment?

"Assessment is today's means of understanding how to modify tomorrow's instruction."

- Carol Tomlinson

GOALS vs OBJECTIVES

GOALS

- General expectations of student outcomes.
- The OVERALL description and purpose of the unit/lesson/etc.

Can be broad and vague

Example:

Students will understand analytical properties of simple function

OBJECTIVES

- Statement of what students should be able to do, or how they should change developmentally, as a result of instruction.

Much more specific and MEASURABLE

Example:

Students will be able to describe the properties of parabolic function



Four components of an objective

A – AUDIENCE

- The Student

B – BEHAVIOR

- What the student will do?

C – CONDITION

- Under what circumstance will the task be accomplished?

D – DEGREE (Criteria)

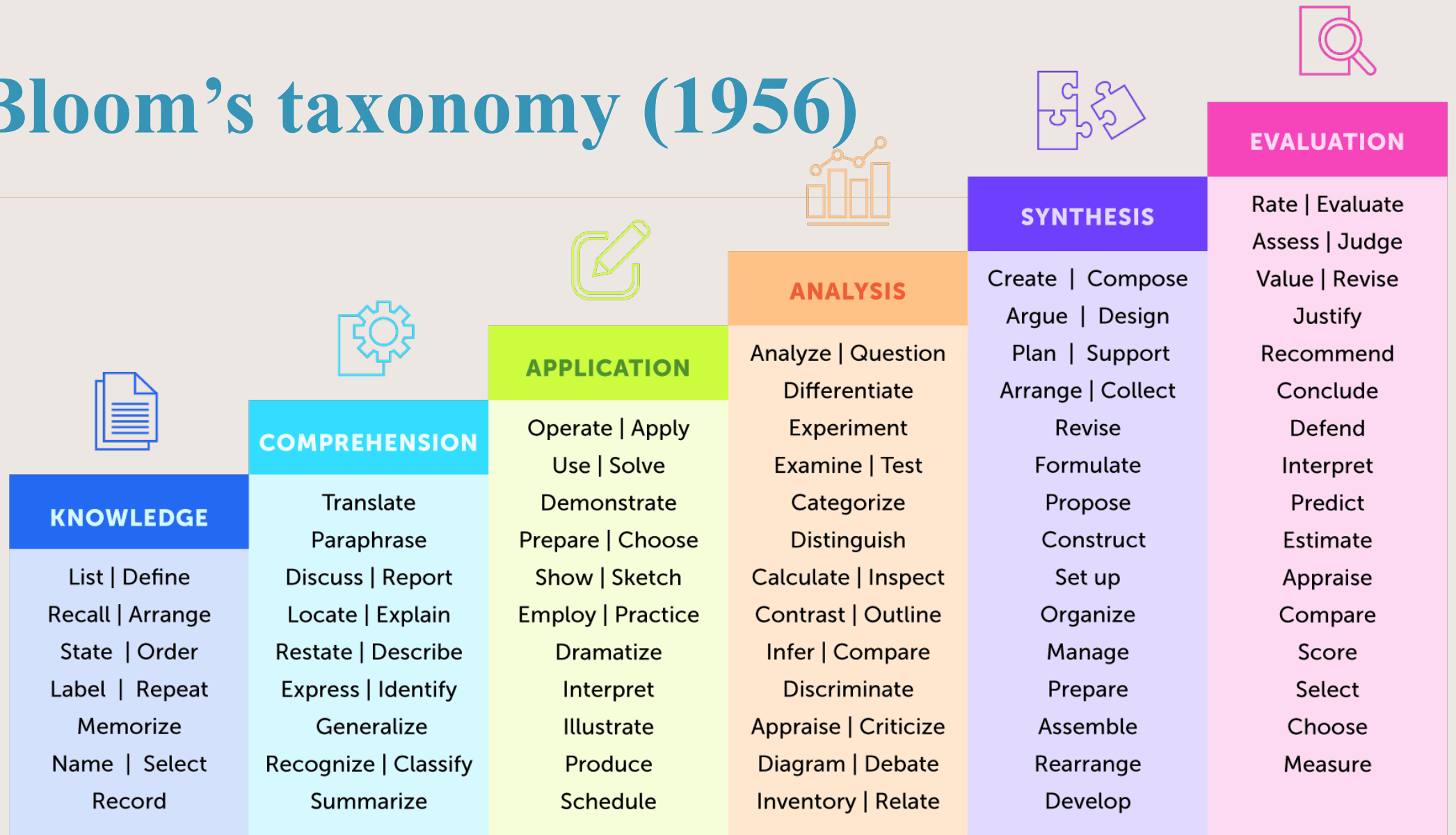
- Percent correct

Learning outcome format



WHICH VERBS?

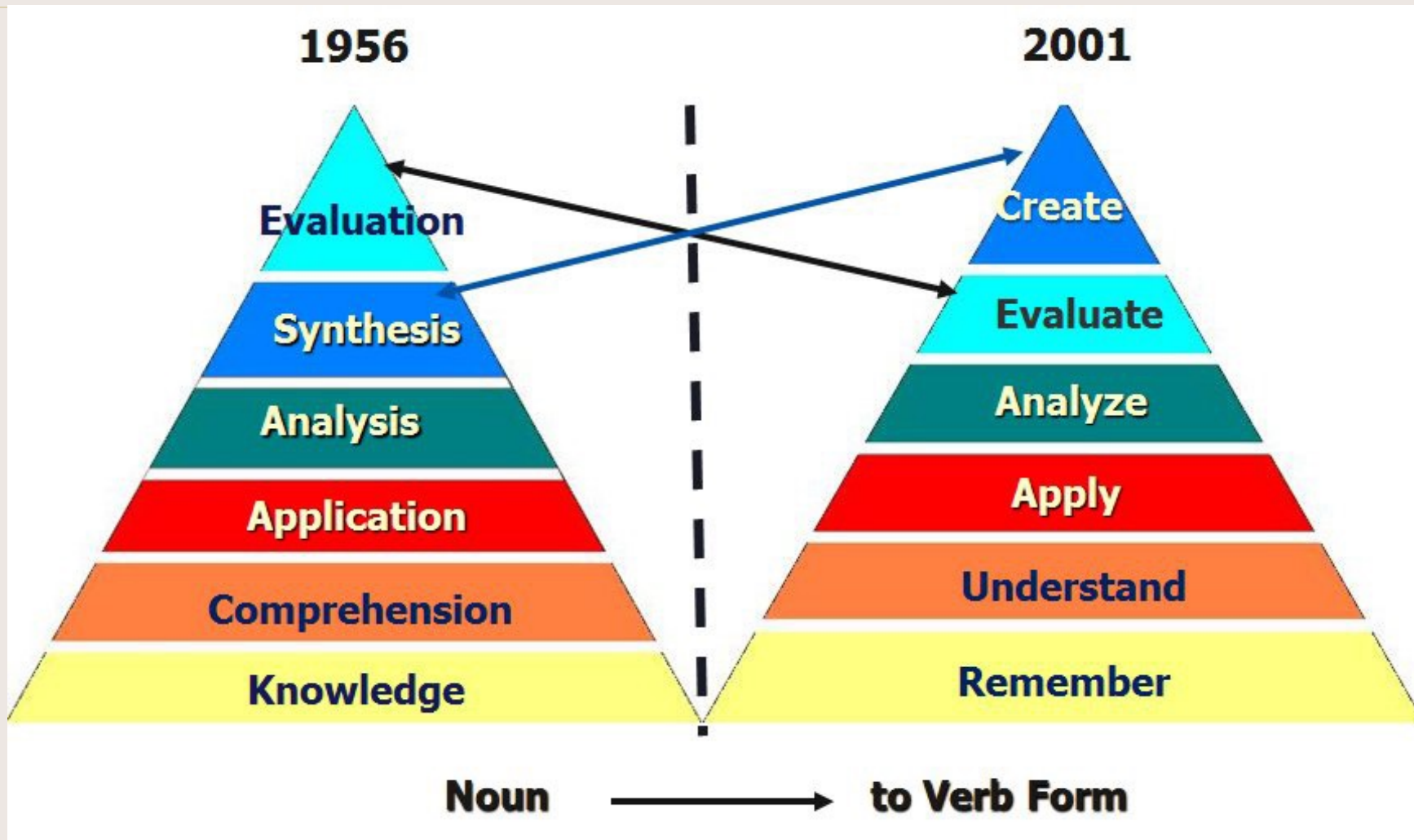
Bloom's taxonomy (1956)

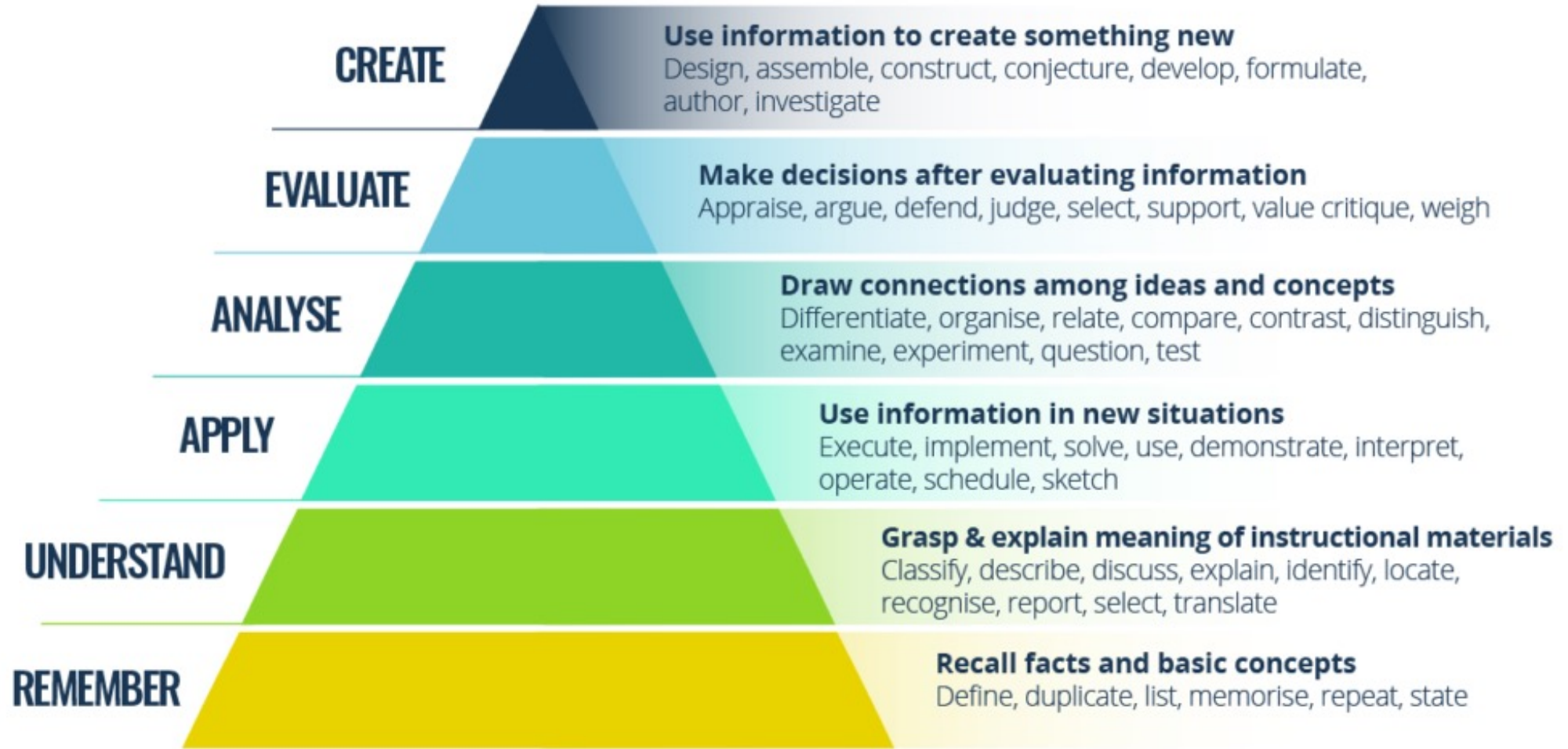


← LOWER ORDER THINKING SKILLS

HIGHER ORDER THINKING SKILLS →

Bloom's taxonomy revised (2001)





The Knowledge Dimension

(Bloom's Revised Taxonomy)



Factual Knowledge

The basic elements that students must know to be acquainted with a discipline or solve problems in it.

- Knowledge of **terminology**
- Knowledge of specific **details** and **elements**



Conceptual Knowledge

The interrelationships among the basic elements within a larger structure that enable them to function together.

- Knowledge of **classifications** and **categories**
- Knowledge of **principles** and **generalizations**
- Knowledge of **theories, models** and **structures**

the kind of knowledge to be learned



Procedural Knowledge

How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.

- Knowledge of subject-specific **skills** and **algorithms**
- Knowledge of subject specific **techniques** and **methods**
- Knowledge of **criteria** for determining when to use appropriate **procedures**



Metacognitive Knowledge


Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

- **Strategic knowledge**
- **Knowledge about cognitive tasks**, including appropriate contextual and conditional knowledge
- **Self-knowledge**

Conceptual
Mathematics

Procedural
Mathematics

Bloom's taxonomy revised towards the knowledge dimension (2002) - example



Cognitive Process Dimension ↓	Knowledge Dimension →	FACTUAL The basic elements a student must know to be acquainted with a discipline or solve problems in it.	CONCEPTUAL The interrelationships among the basic elements within a larger structure that enable them to function together.	PROCEDURAL How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.	METACOGNITIVE Knowledge of cognition in general as well as awareness and knowledge of one's own cognition
REMEMBER Retrieve relevant knowledge from long-term memory.	List primary and secondary colors	Recognize the symptoms of exhaustion	Recall how to perform CPR.	Identify strategies for retaining information.	
UNDERSTAND Construct meaning from instructional messages, including oral, written, and graphic communication.	Summarize the features of a new product	Classify adhesive by toxicity	Clarify assembly instructions	Predict one's response to culture shock	
APPLY Carry out or use a procedure in each situation.	Respond to frequently asked questions	Provide advice to novice	Carry out pH tests of water sample	Use techniques that math one's strength	
ANALYZE Carry out or use a procedure in each situation	Select the most compels list of activities	Differentiate between writing registers	Integrate compliance with regulations	Deconstruct one's biases	
EVALUATE Make judgments based on criteria and standards.	Check for consistently among sources	Determine relevance of results	Judge efficiency of sampling technique	Reflect on one's progress	
CREATE Put elements together to form a coherent whole; reorganize into a new pattern or structure.	Generate a log of daily activities	Assemble a team of experts	Design efficient project workflow	Create a learning portfolio	

Note: These are **learning objectives** – not **learning activities**. It may be useful to think of preceding each objective with something like, "students will be able to...:"

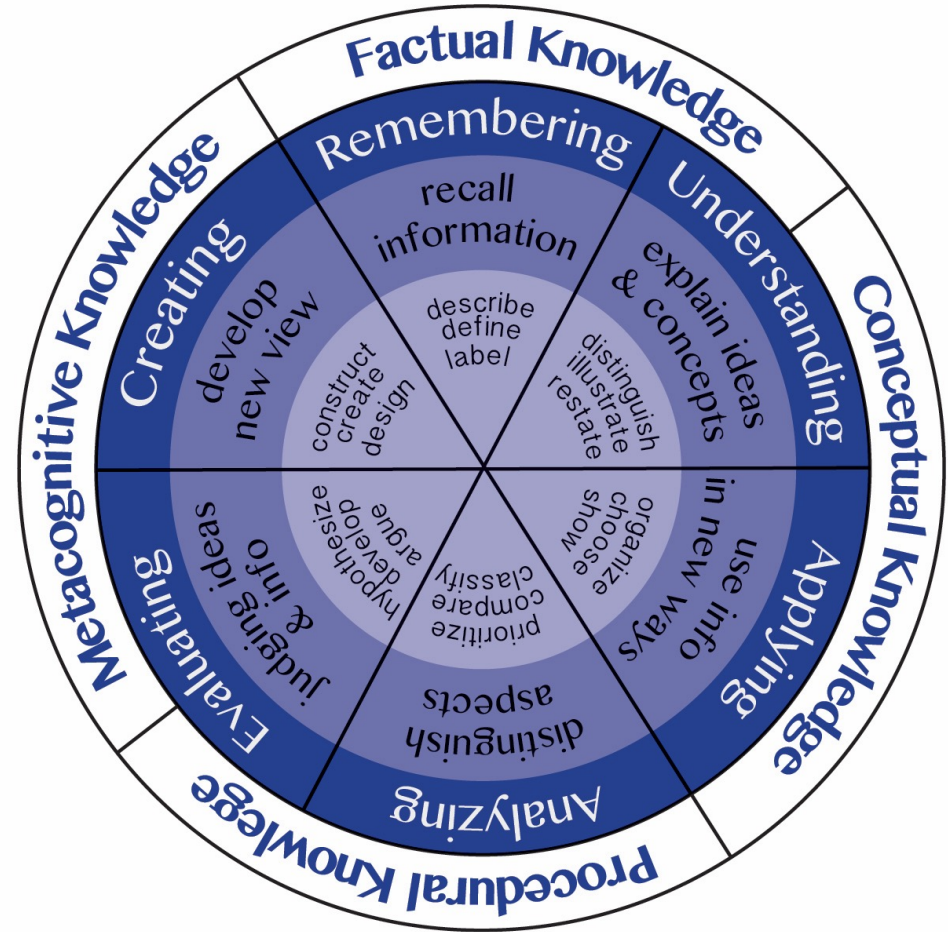
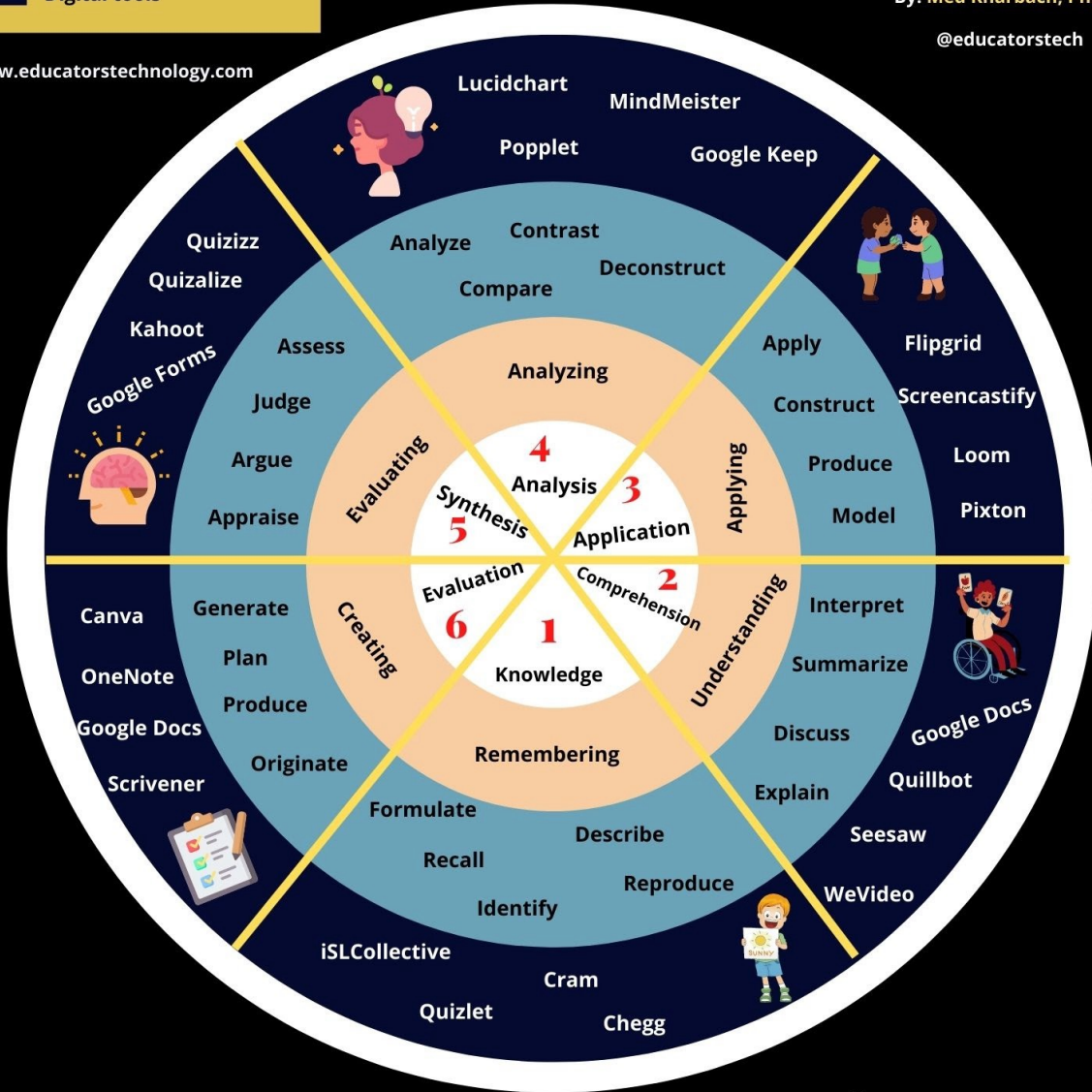
Bloom's Taxonomy Wheel

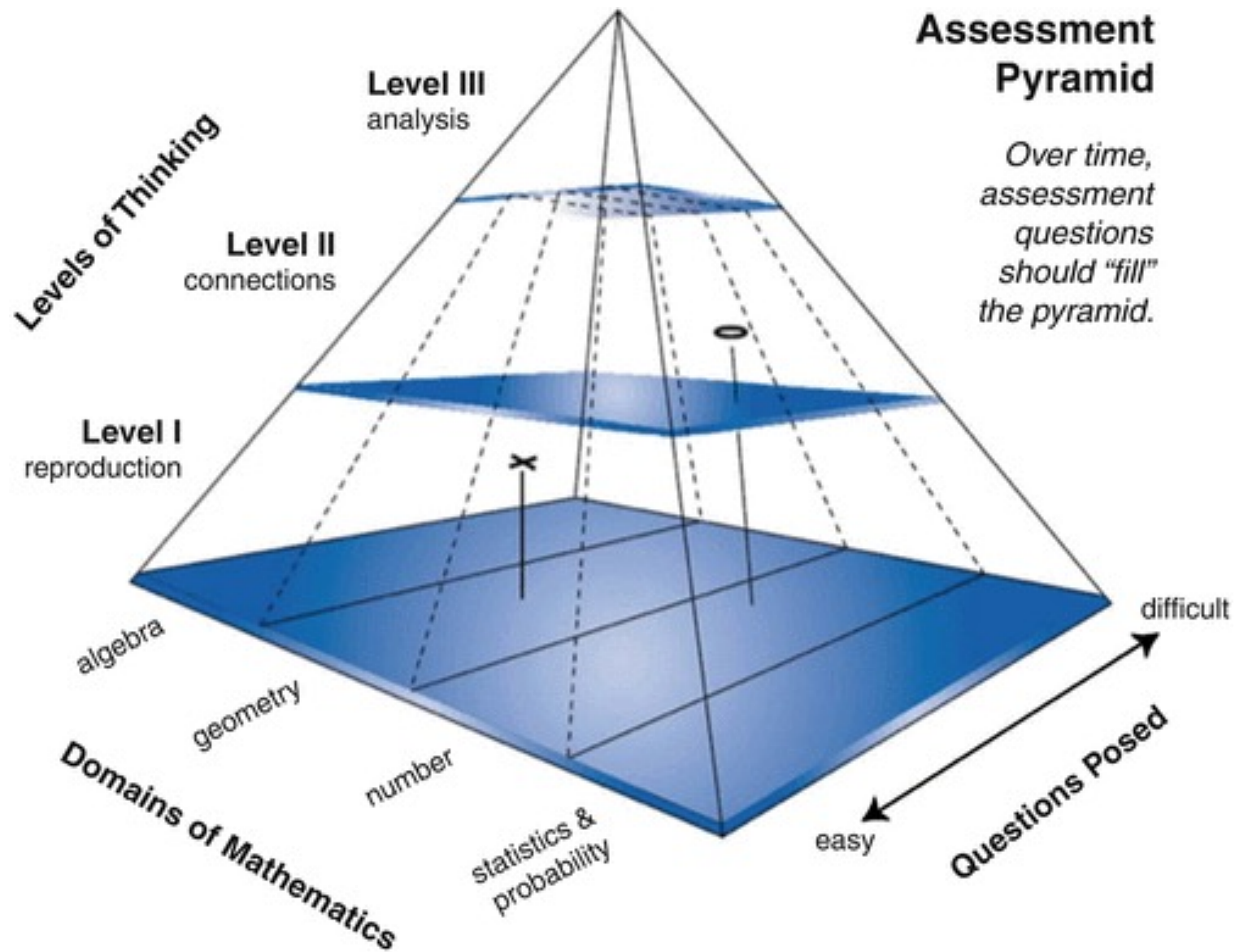
- Bloom's original taxonomy
- Revised taxonomy
- Verbs
- Digital tools

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Assessment is a Process



Step 1: Establishing learning objectives



Step 2: Provide learning opportunities that relate to the objectives



Step 3: Determine if learning has occurred



Step 4: Make revisions and improvements based on determinations of student learning

Evaluations are Judgments based on performance.

Judgments about performance.
Evaluation mostly refers to the assignment of grades based on student performance.

Examples: tests and papers

Thus, evaluation can be part of the assessment,
but it is not an assessment in and of itself.

HOW

Observations

Essays

Interviews

Performance
tasks

Exhibitions
and
demonstrations

Portfolios

Journals

Teacher-
created tests

Rubrics

Self- and peer-
evaluation

End-of-
Course/Grade
Tests

Maps

Questioning

Others?

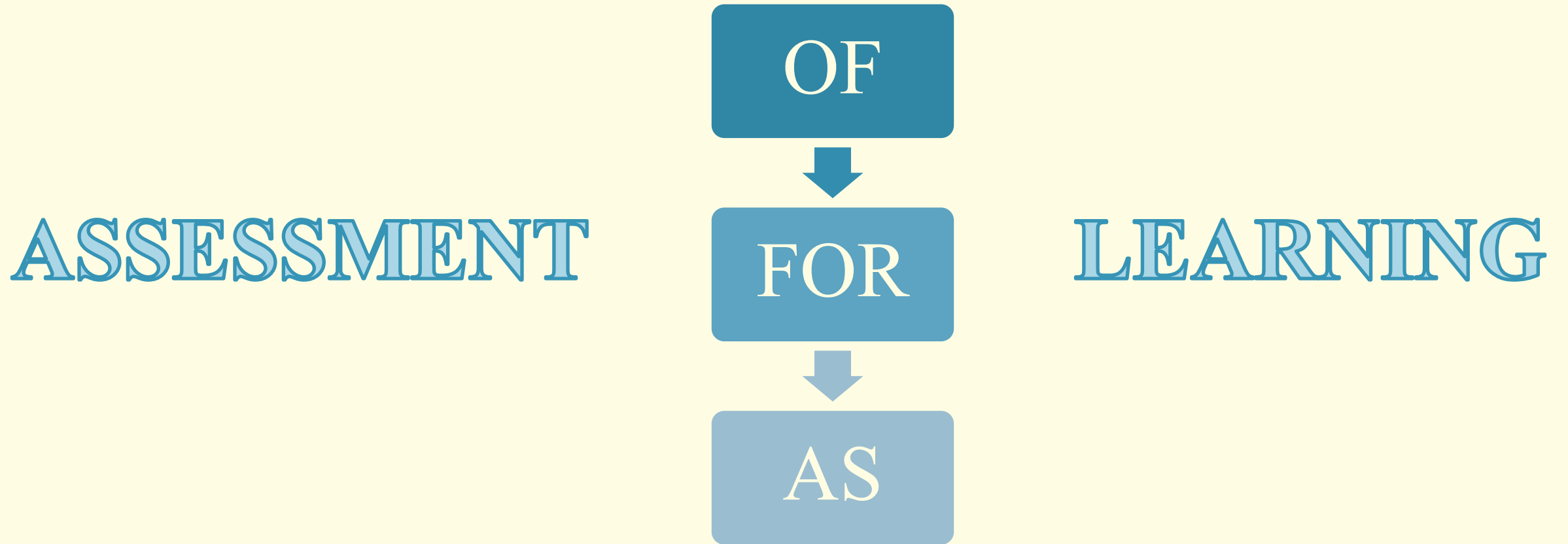
Some teachers talk about...

WHY



Assessment Debate

Purpose of assessment



ASSESSMENT OF LEARNING



SUMMATIVE
ASSESSMENTS



NORM-REFERENCED
ASSESSMENTS



CRITERION-REFERENCED
ASSESSMENTS

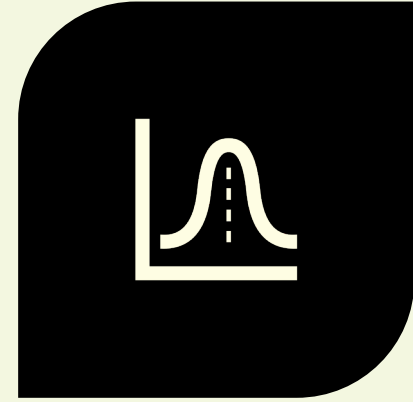
ASSESSMENT FOR LEARNING



DIAGNOSTIC
ASSESSMENTS



FORMATIVE
ASSESSMENTS



CONFIDENCE
ASSESSMENTS

ASSESSMENT AS LEARNING



IPSATIVE
ASSESSMENTS

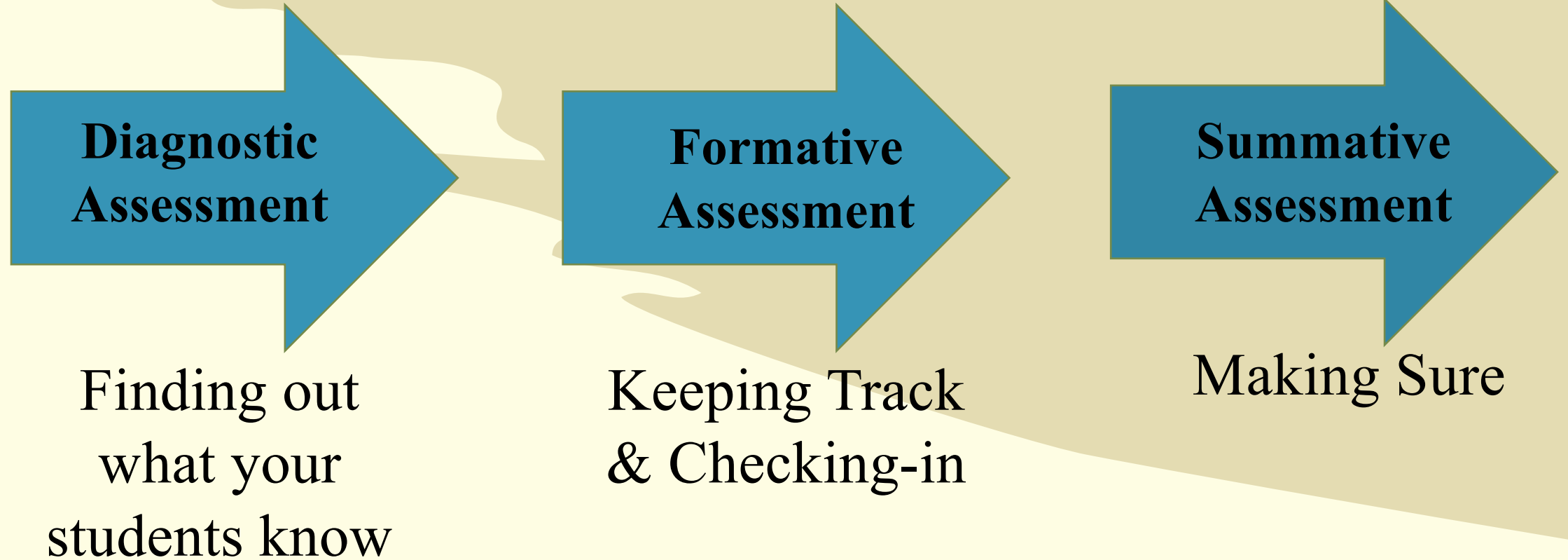


SELF-ASSESSMENTS



PEER-ASSESSMENTS

On-Going Assessments



Diagnostic assessment

- Diagnostic Assessment can help you identify your students' current knowledge of a subject, their skill sets and capabilities, and to clarify prior conceptions before teaching takes place.

Knowing your students' strengths and weaknesses can help you better plan what to teach and how to teach it.

- Pre-tests (on content and abilities)
- Self-assessments (identifying skills and competencies)
- Discussion board responses (on content-specific prompts)
- Interviews (brief, private, 10-minute interview of each student)

When you structure **diagnostic assessments** around your lesson, **you'll get the information you need to understand student knowledge and engage your whole classroom.**

Diagnostic assessments can also help benchmark student progress. Consider giving the same assessment at the end of the unit so students can see how far they've come!



Comparing assessments

Characteristics	Formative	Summative
PURPOSE	To provide ongoing feedback and adjustment to instruction	To document student learning at the end of an instructional segment.
WHEN CONDUCTED	During instruction and after instruction	After instruction
STUDENT INVOLVEMENT	Encouraged	Discouraged
STUDENT MOTIVATION	Intrinsic, mastery-oriented	Extrinsic, performance- oriented

Comparing assessments

Characteristics	Formative	Summative
TEACHER ROLE	To provide immediate, specific feedback and instructional correctives.	To measure student achievement and give grades.
LEARNING EMPHASIZED	Deep understanding, application, and reasoning	Knowledge and comprehension
LEVEL OF SPECIFICITY	Highly specific and individual	General and group oriented
STRUCTURE	Flexible, adaptable	Rigid, highly structured

Comparing assessments

Characteristics	Formative	Summative
IMPACT ON LEARNING	Strong, positive, long-lasting	Weak and fleeting



Formative Assessments

- Formative assessment provides feedback and information during the instructional process, while learning is taking place, and while learning is occurring.
- Formative assessment measures student progress but it can also assess your own progress as an instructor.
 - Observations during in-class activities; of students' non-verbal feedback during lecture
 - Homework exercises as a review for exams and class discussions)
 - Reflections journals that are reviewed periodically during the semester
 - Question and answer sessions, both formal—planned and informal—spontaneous
 - Conferences between the instructor and student at various points in the semester
 - In-class activities where students informally present their results
 - Student feedback is collected by periodically answering specific questions about the instruction and their self-evaluation of performance and progress.



Summative Assessments

- ❖ Summative assessment takes place **AFTER** the learning has been completed.
- ❖ Provides information and feedback that sums up the teaching and learning process.
- ❖ Should match the material taught and reflect the formative assessments.

Rubrics

- ❖ Often developed around a set of standards or expectations, it can be used for summative assessment.
- ❖ It can be given to students before they begin working on a particular project so they know what is expected of them (precisely what they have to do) for each of the criteria.
- ❖ Help you to be more objective when deriving a final, summative grade by following the same criteria students used to complete the project.

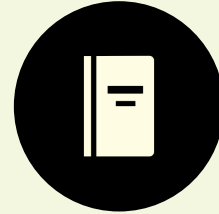
Types of Summative Assessments



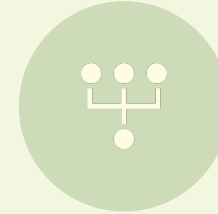
EXAMINATIONS
(MAJOR, HIGH-STAKES
EXAMS)



FINAL EXAMINATION (A
TRULY SUMMATIVE
ASSESSMENT)



TERM PAPERS (DRAFTS
SUBMITTED
THROUGHOUT THE
SEMESTER WOULD BE A
FORMATIVE
ASSESSMENT)



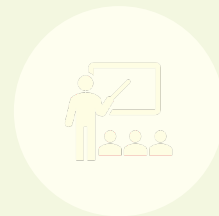
PROJECTS (PROJECT
PHASES SUBMITTED AT
VARIOUS COMPLETION
POINTS COULD BE
FORMATIVELY
ASSESSED)



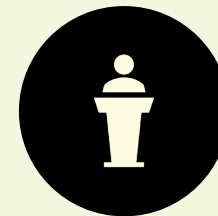
PORTFOLIOS (COULD
ALSO BE ASSESSED
DURING ITS
DEVELOPMENT AS A
FORMATIVE
ASSESSMENT)



PERFORMANCES



STUDENT EVALUATION
OF THE COURSE
(TEACHING
EFFECTIVENESS)



INSTRUCTOR SELF-
EVALUATION

What is the Difference?

“Summative assessment is more product-oriented and assesses the final product, whereas formative assessment focuses on the process toward completing the product. Once the project is completed, no further revisions can be made. If, however, students are allowed to make revisions, the assessment becomes formative, where students can take advantage of the opportunity to improve.”

EFFECTIVE FEEDBACK



1. It **MUST** be timely.



2. It **MUST** be SPECIFIC.



3. It **MUST** be understandable to the student.



4. It **MUST** allow the student to act on feedback

Refine, Revise, Practice, and Retry

EVALUATIVE FEEDBACK

Evaluative feedback involves a judgment by the teacher based on implicit or explicit norms.

Evaluative feedback may take the form of:

Approval: “That’s a good resolution.” “You’ve done well.” “Good job!”

Disapproval: “That’s not good enough.” “Not your best.”

Reward: Gold stars/😊/10/Stickers

Punishment: “Write it out again.”

DESCRIPTIVE FEEDBACK

Descriptive feedback:

focuses on identified learning outcomes and makes specific reference to the student's achievement.

Looks towards improvement.

An example of descriptive feedback:

“That’s a good introduction because you have covered the main points we discussed at the beginning. Now ... which points do you think you should expand on?”