SAMR, STEM and Assessment

Ruben R. Puentedura, Ph.D.

Redefinition

Tech allows for the creation of new tasks, previously inconceivable

Modification

Tech allows for significant task redesign

Transformation

Augmentation

Tech acts as a direct tool substitute, with functional improvement

Substitution

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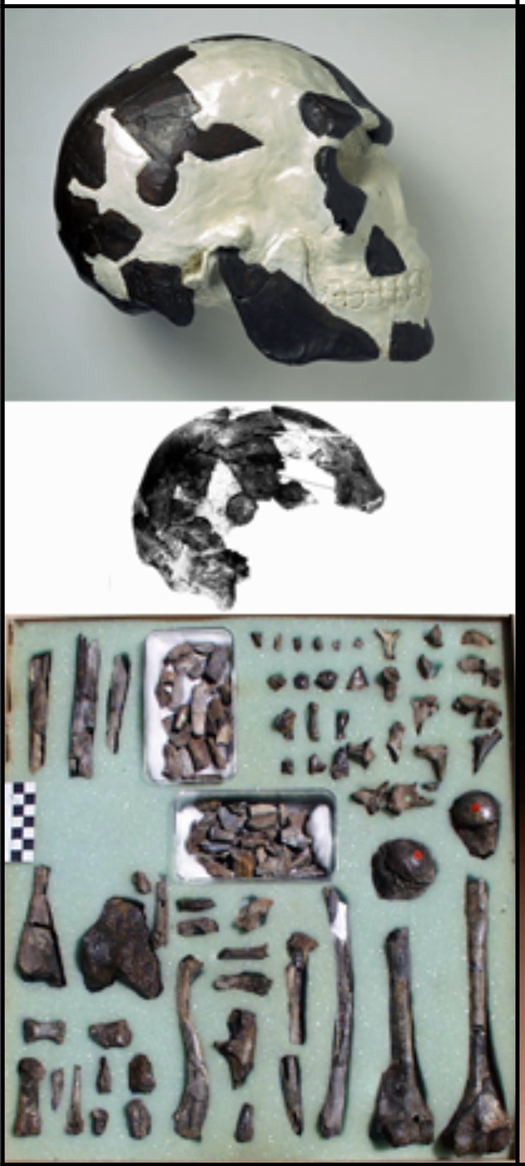
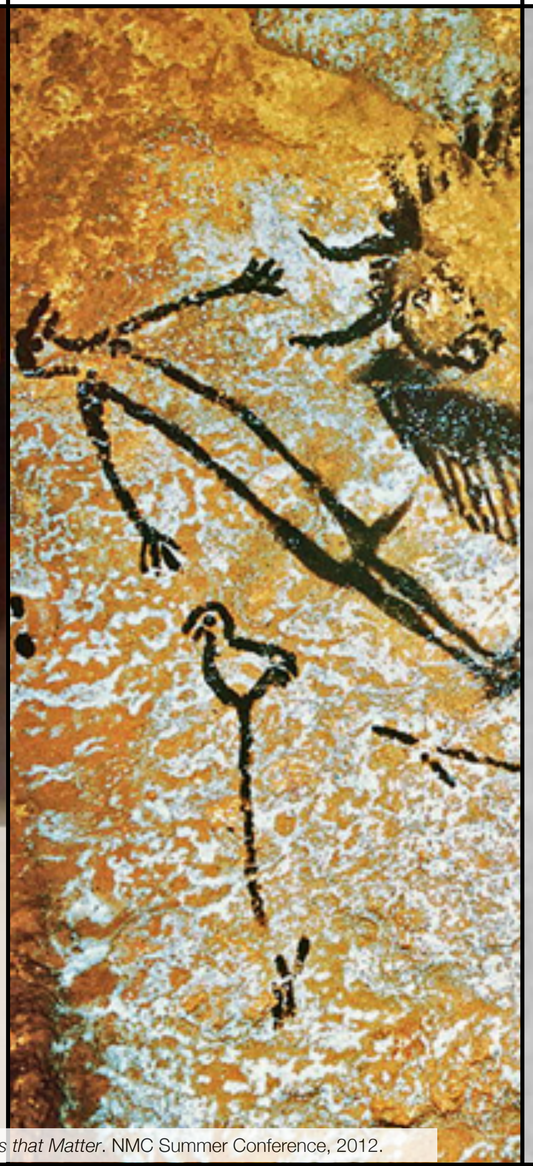
Enhancement

Ruben R. Puentedura, *As We May Teach: Educational Technology, From Theory Into Practice*. (2009)

Social	Mobility	Visualization	Storytelling	Gaming
200,000 years	70,000 years	40,000 years	17,000 years	8,000 years





Ruben R. Puentedura, “Technology In Education: The First 200,000 Years” *The NMC Perspective Series: Ideas that Matter*. NMC Summer Conference, 2012.

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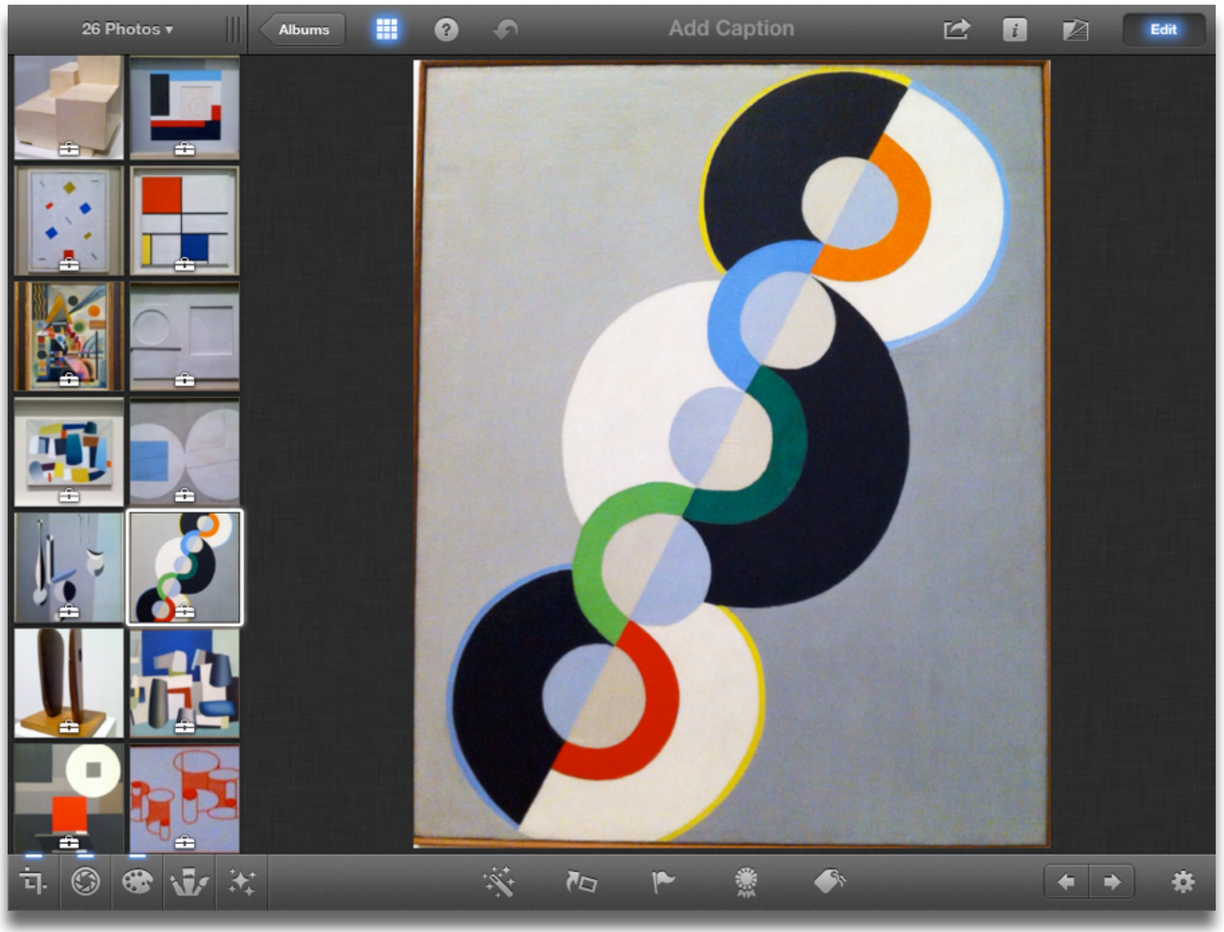

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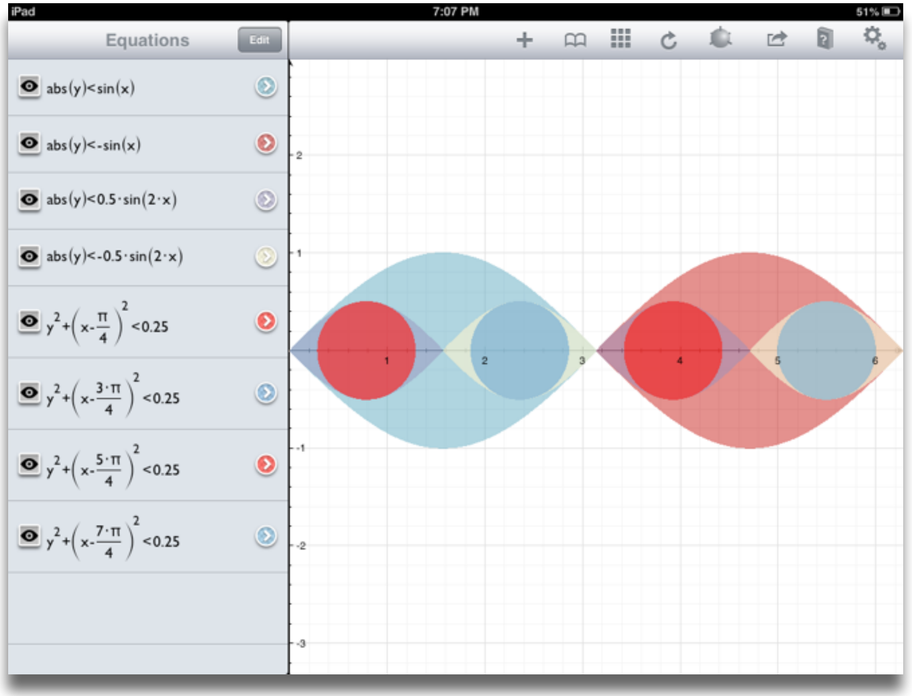

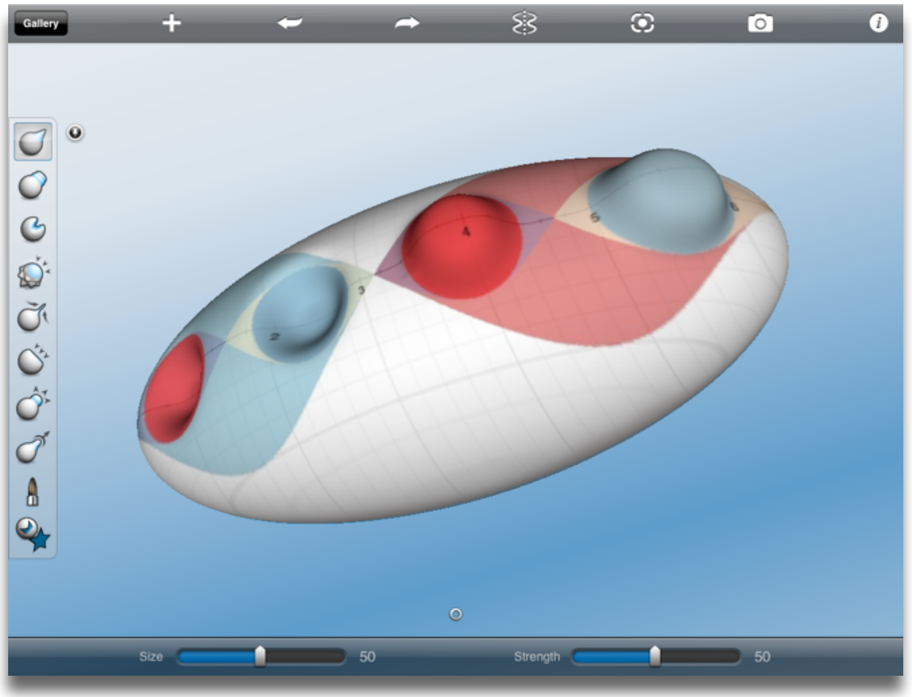

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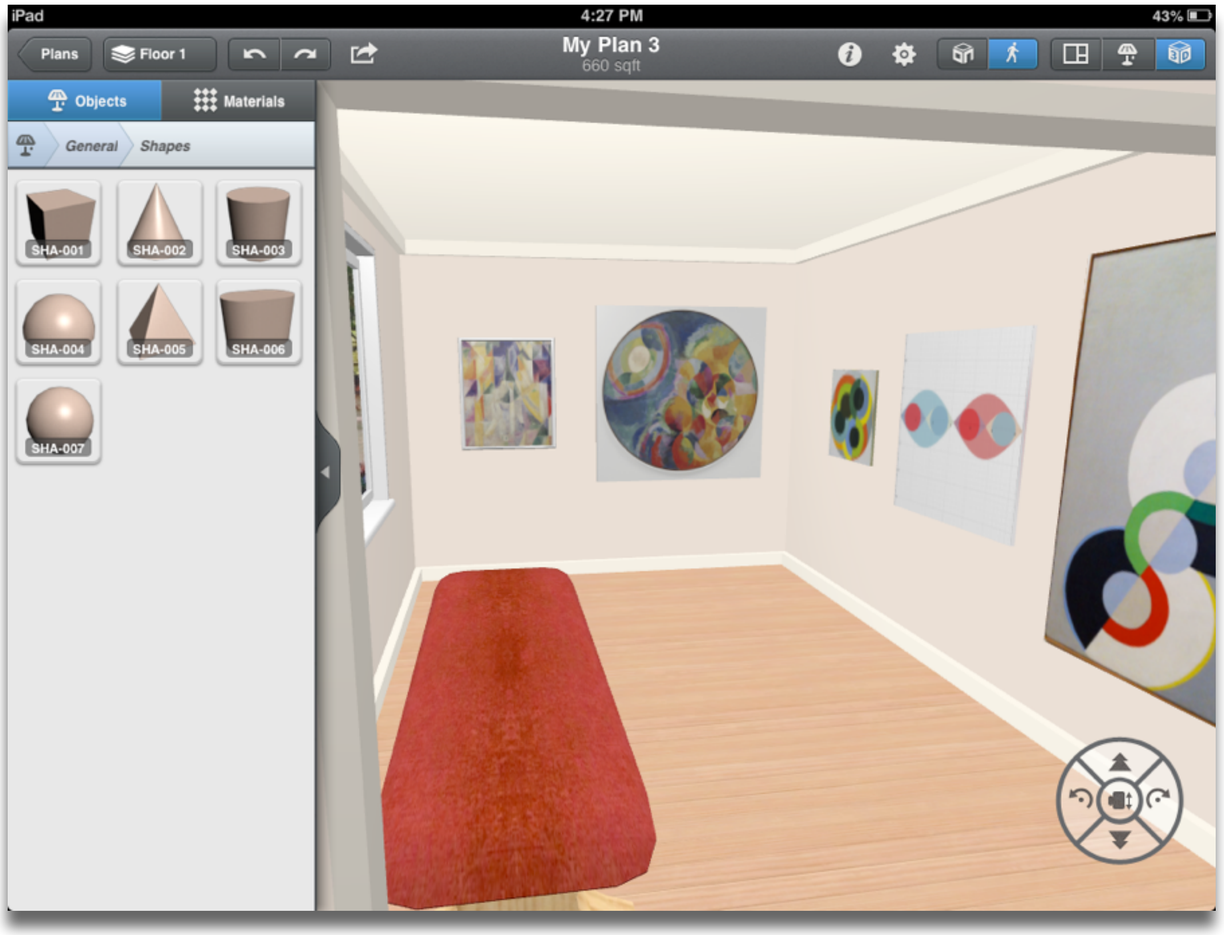
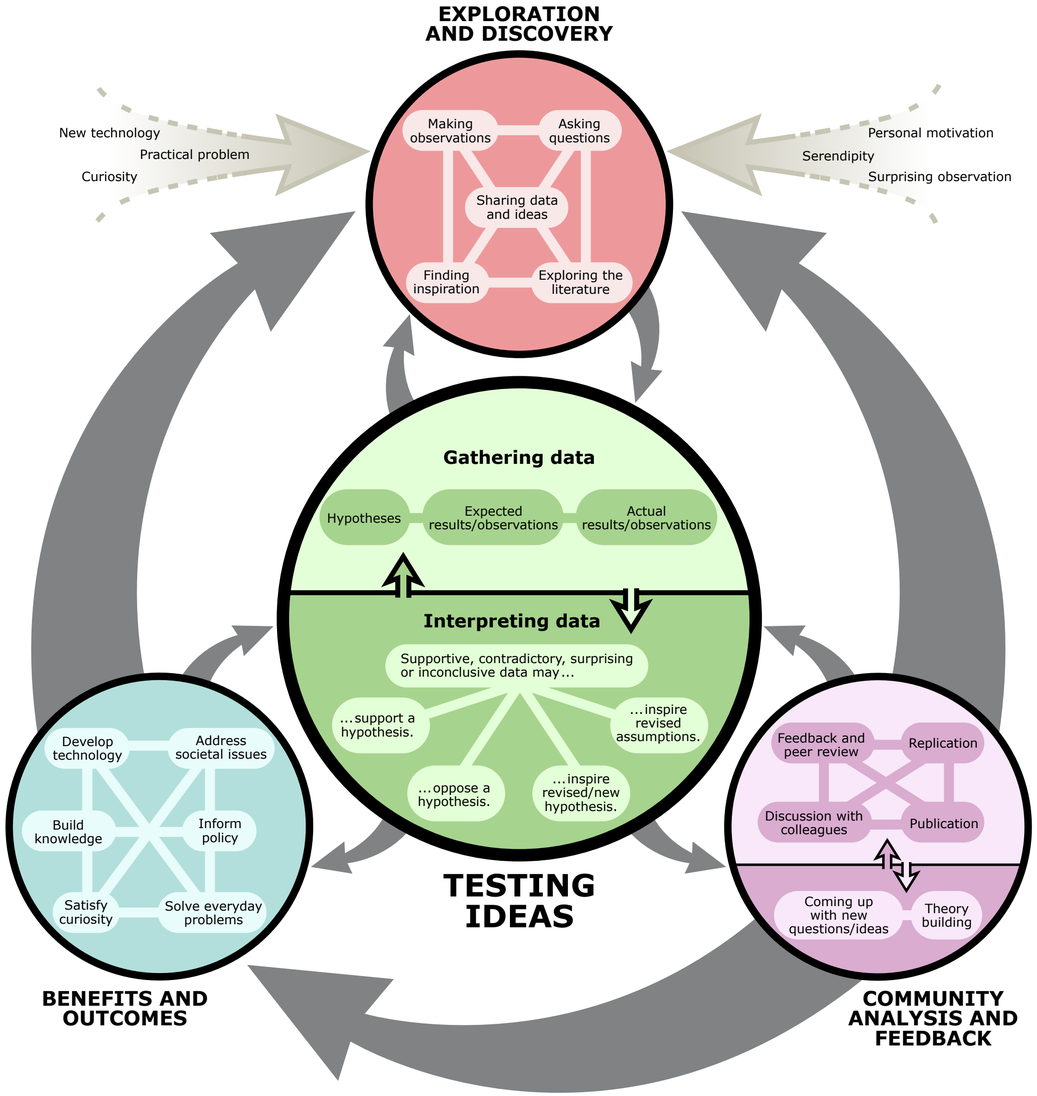


1. SAMR and STEM

Understanding Science:
How Science Works



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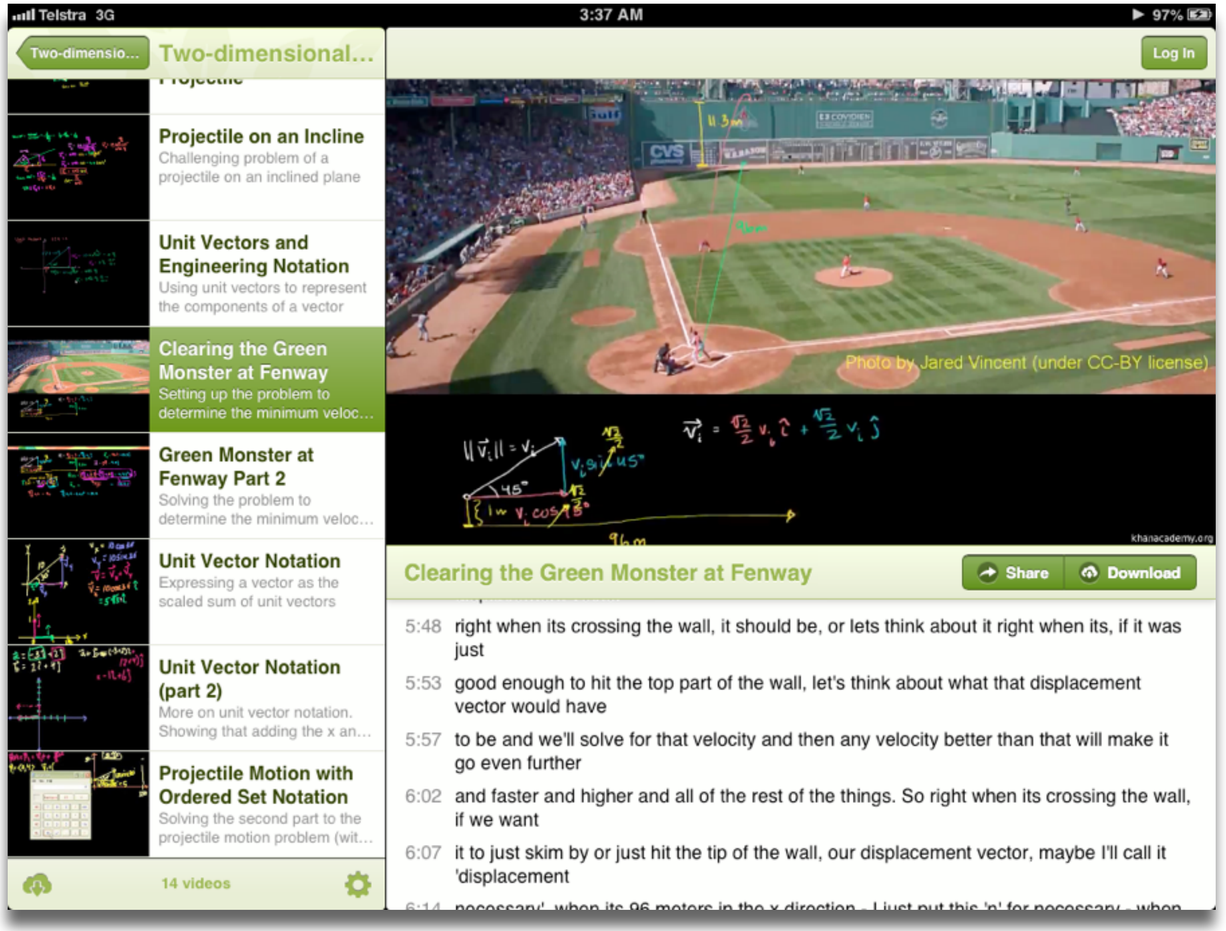

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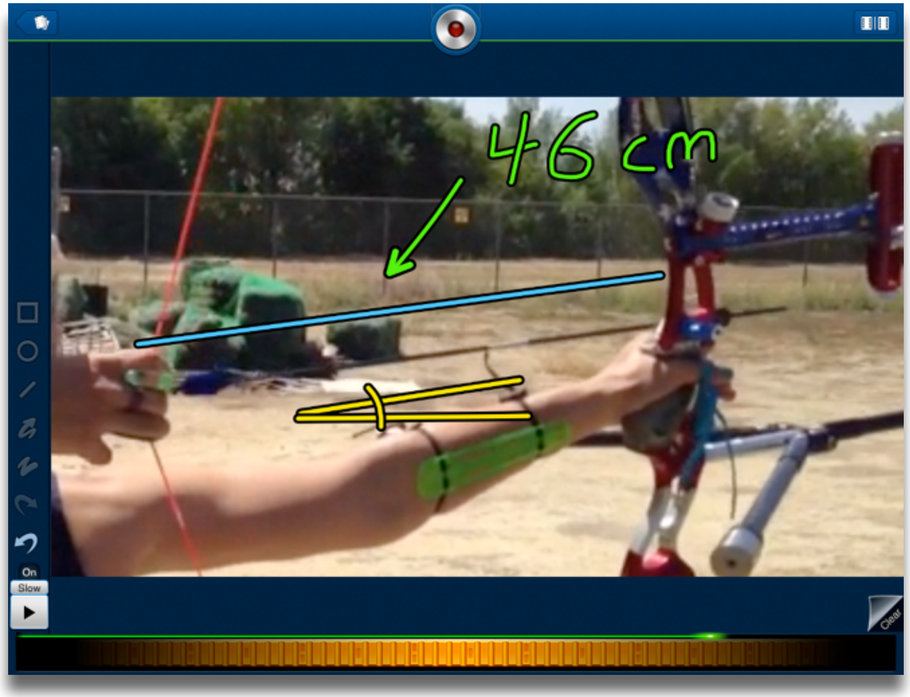

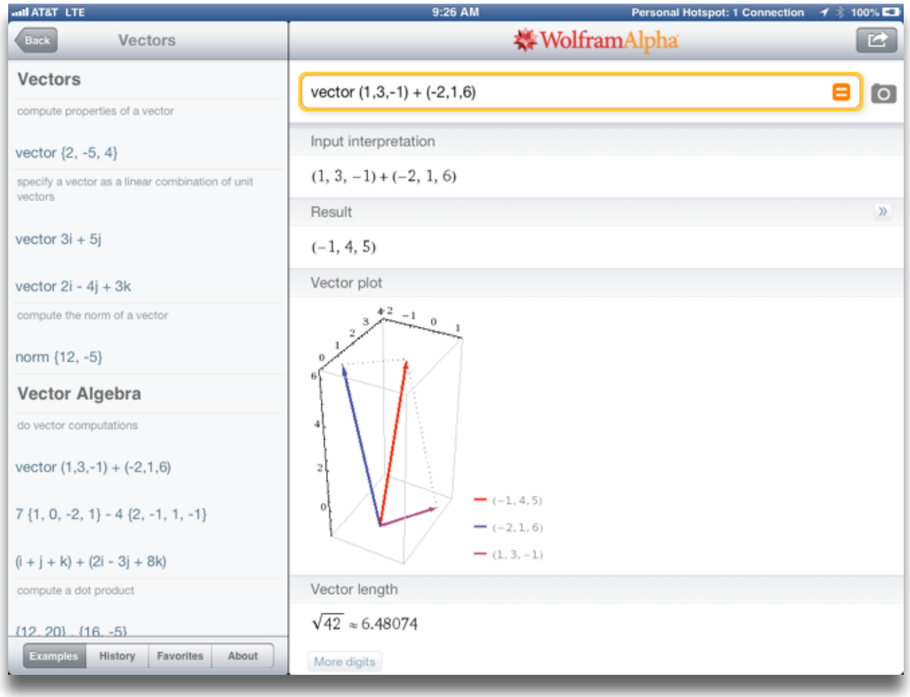

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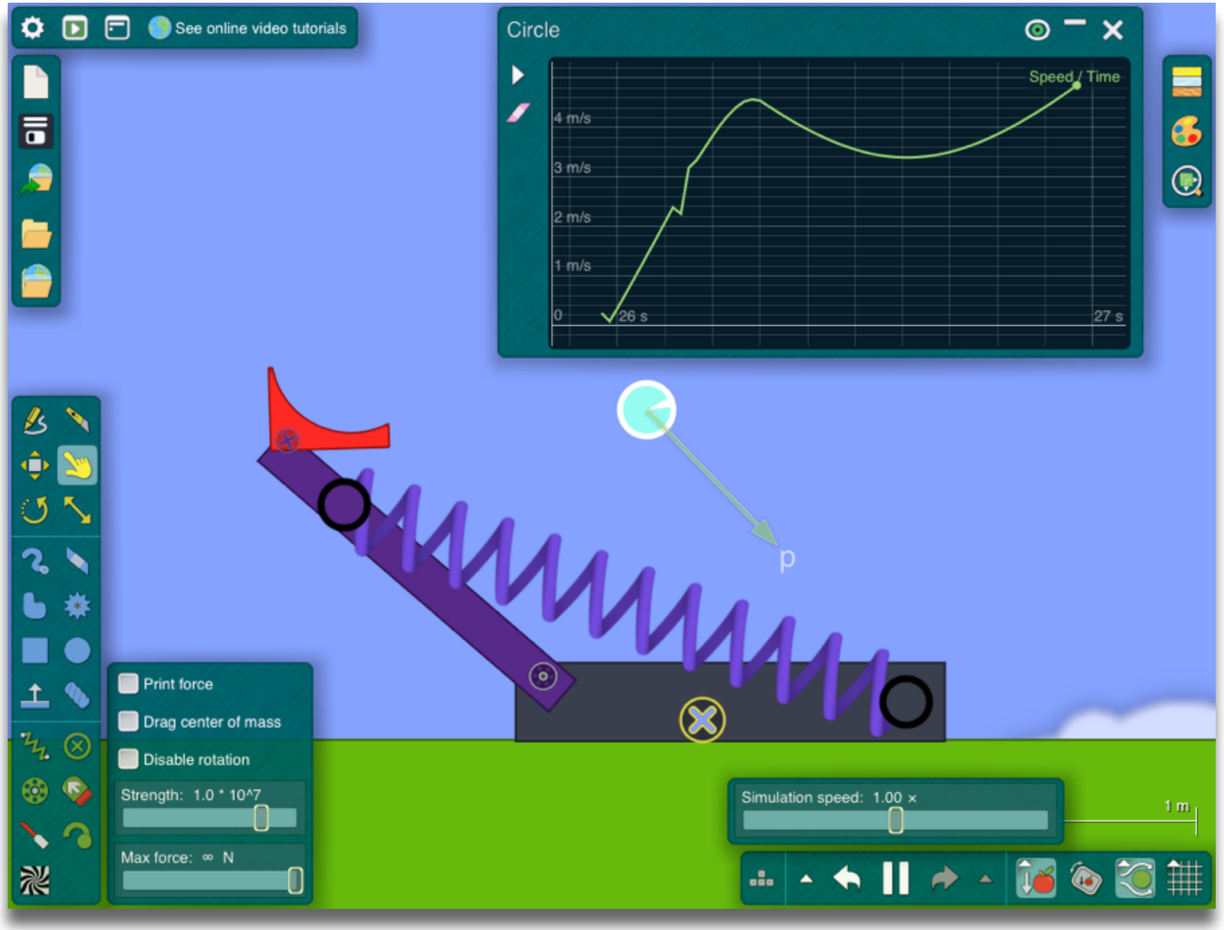

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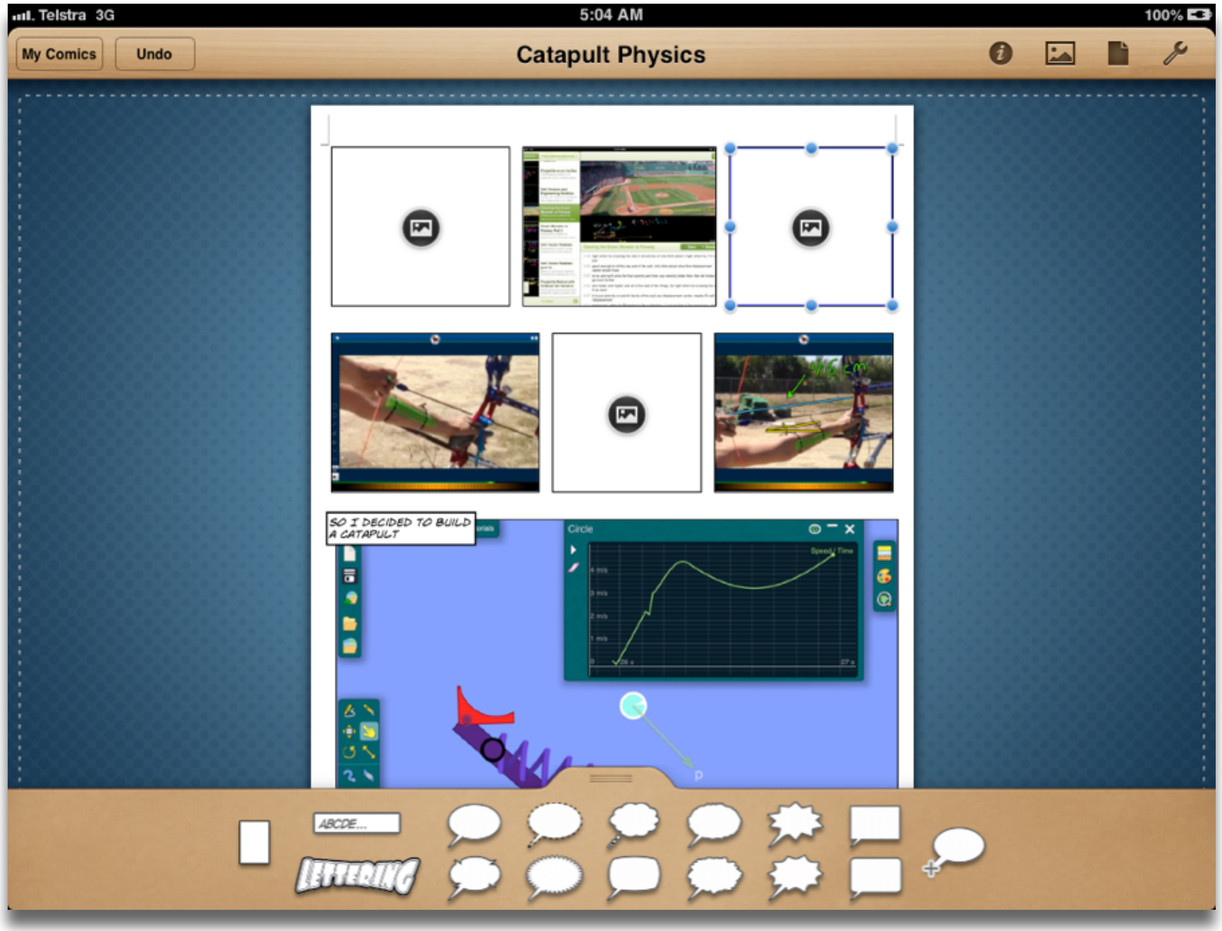
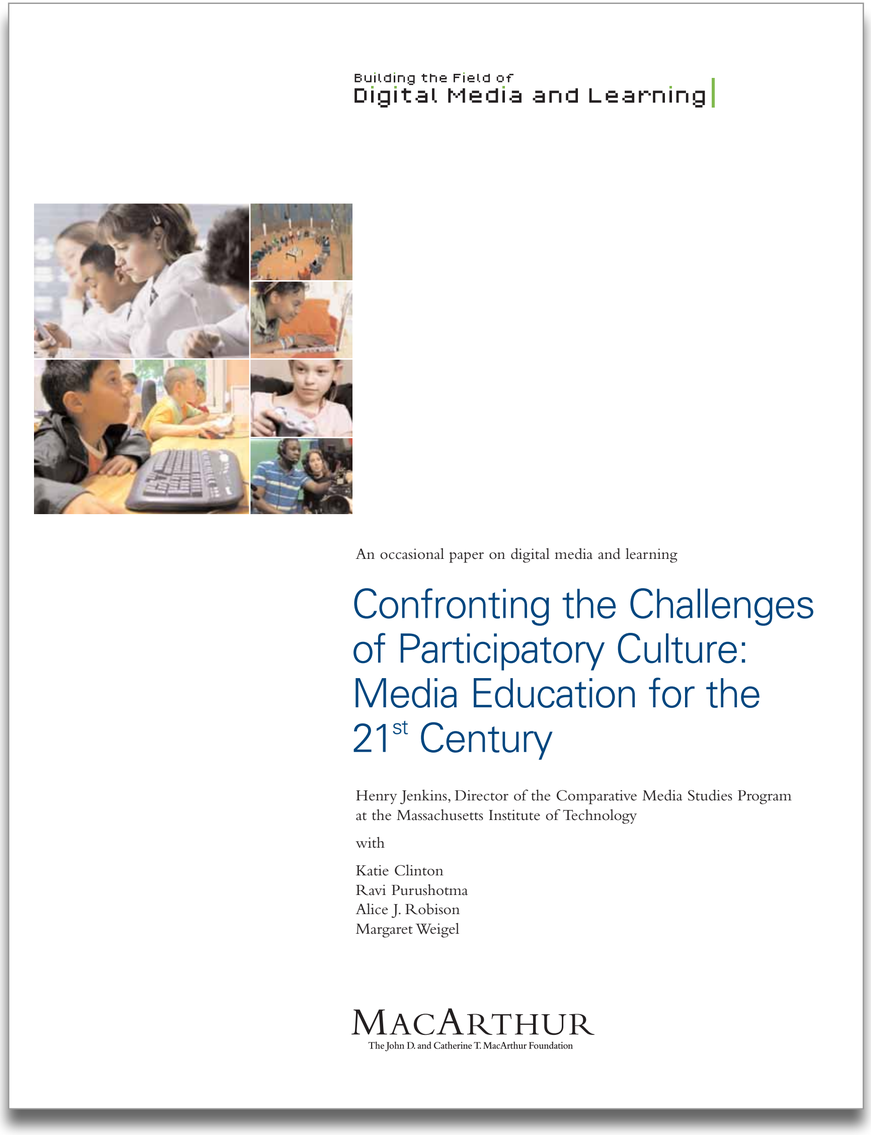


Confronting the Challenges of Participatory Culture: Media Education for the 21st Century



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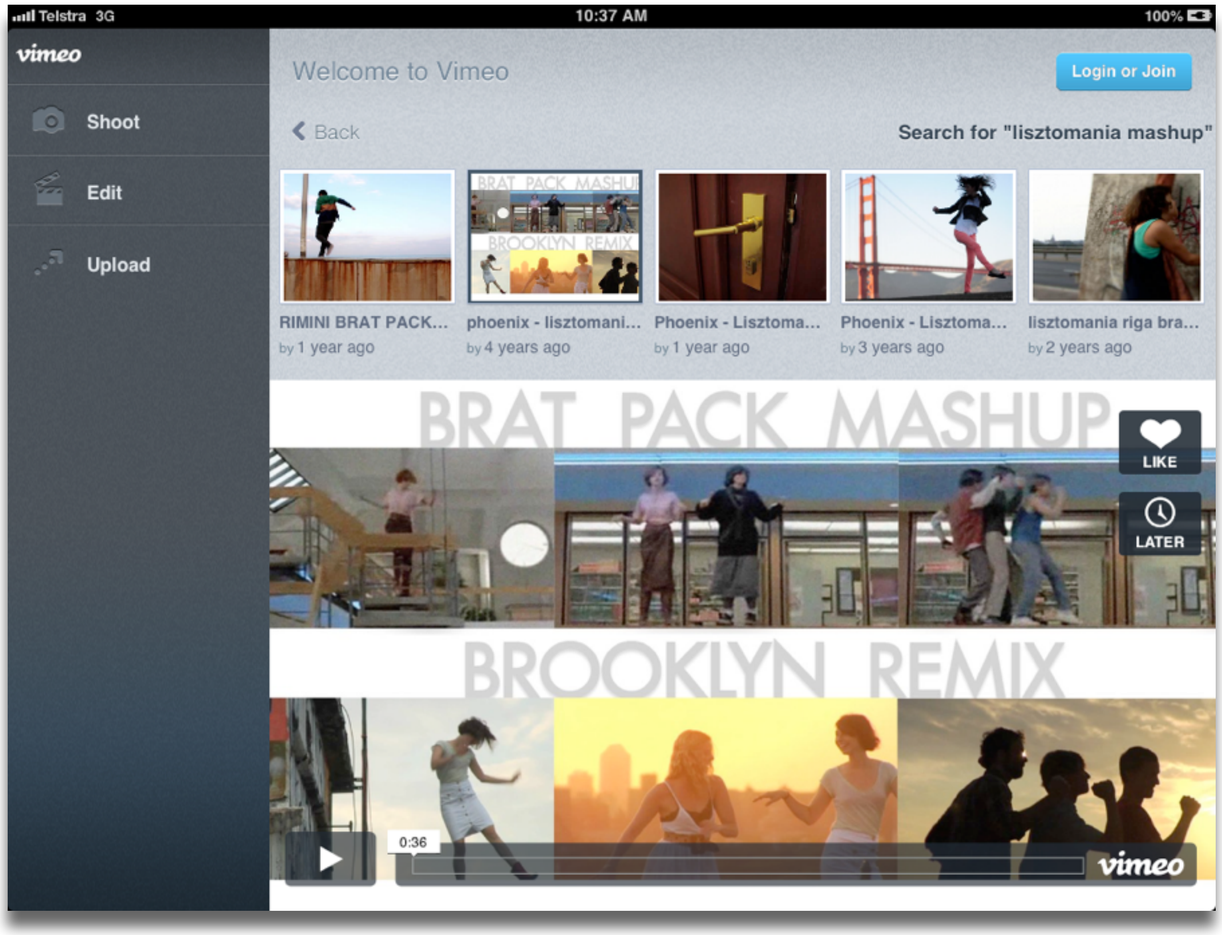

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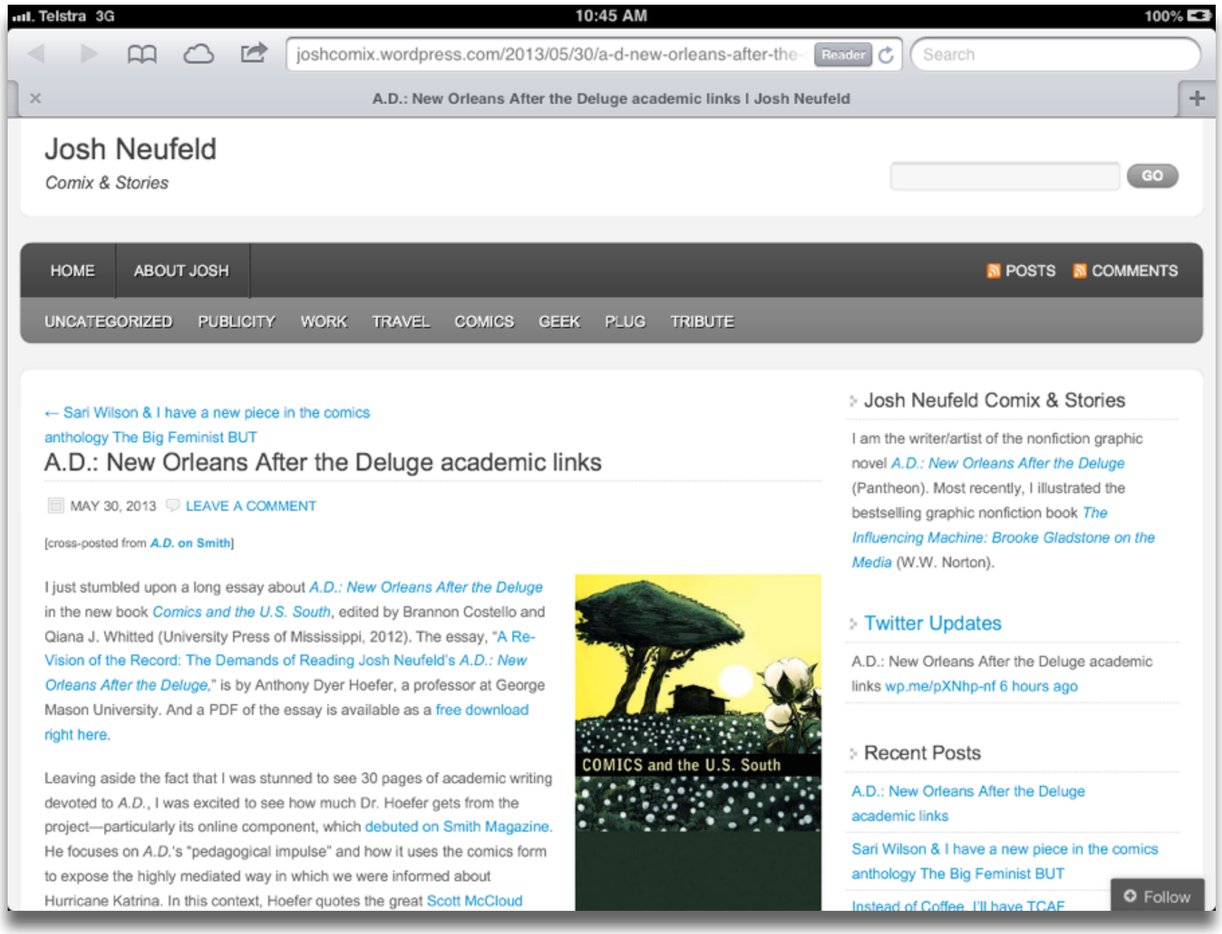

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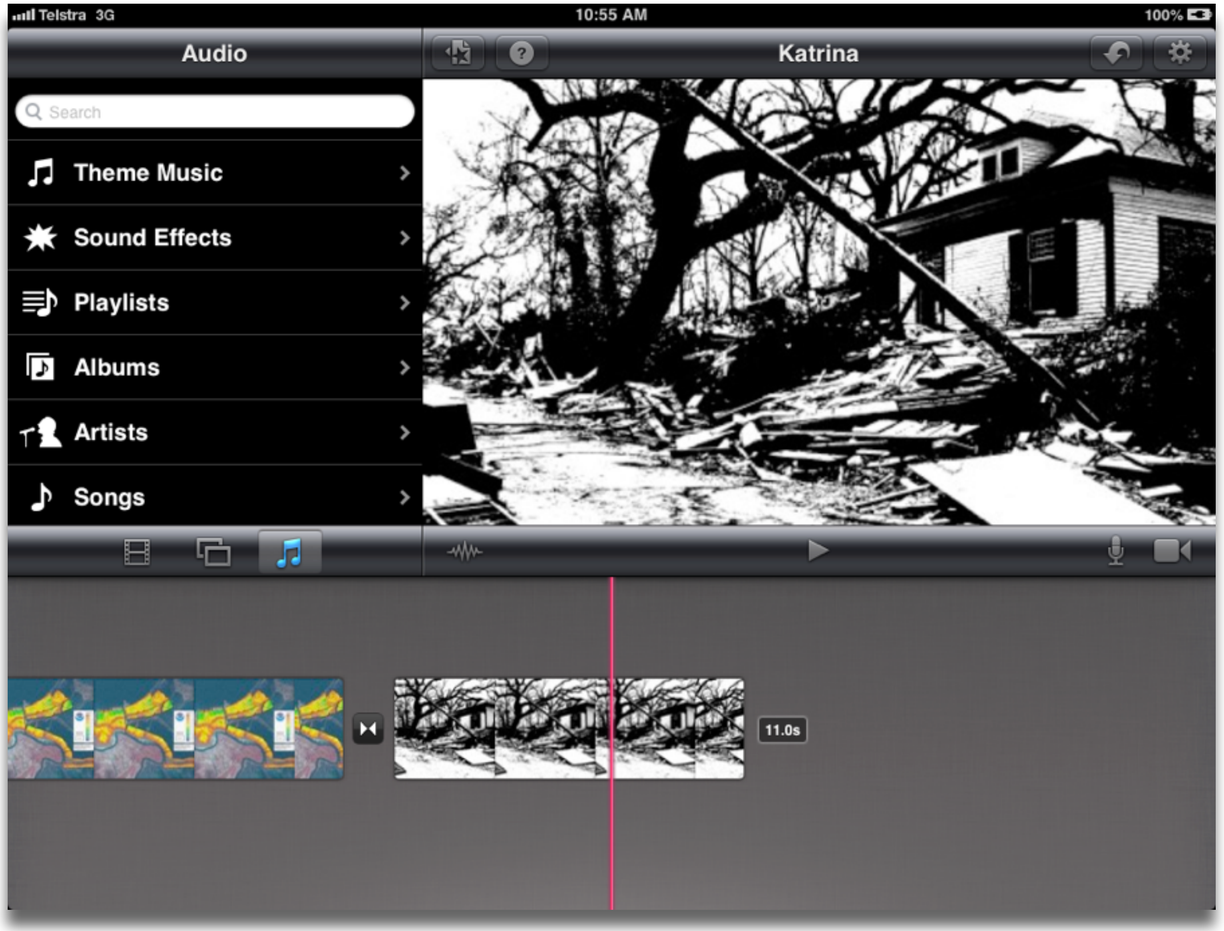

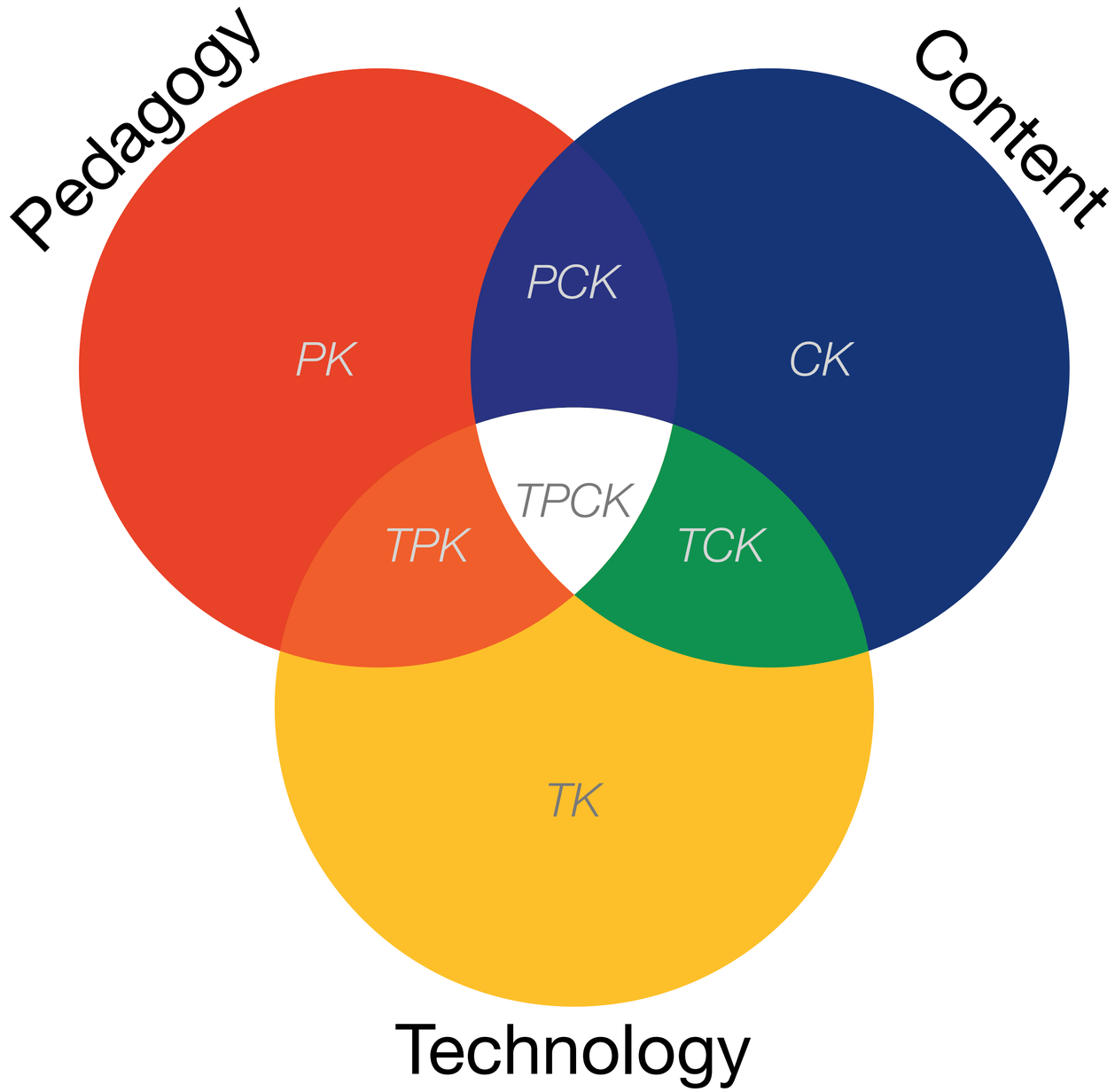

Punya Mishra & Matthew J. Koehler, “Technological pedagogical content knowledge: A framework for teacher knowledge”. *Teachers College Record, 108*(6). (2006)

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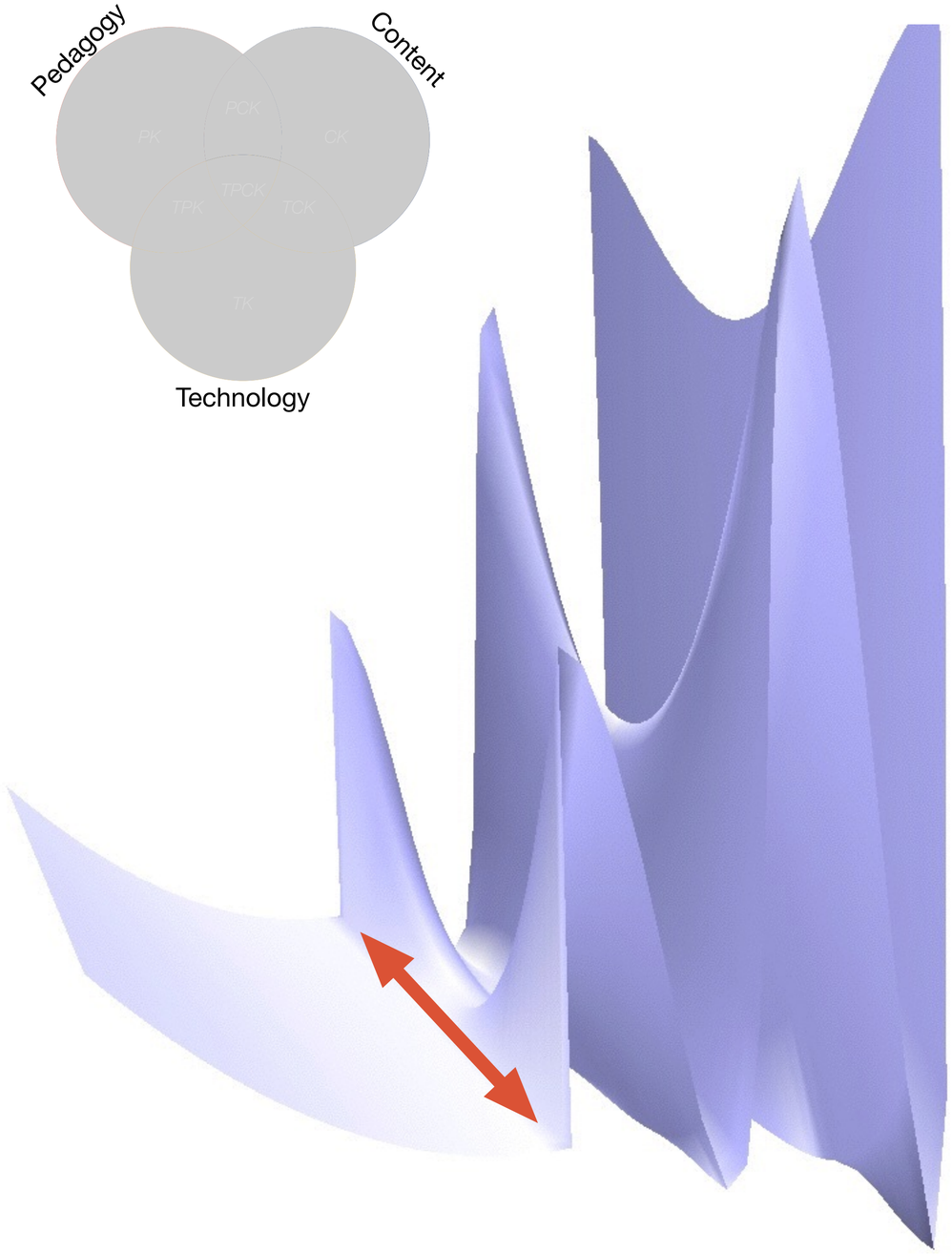

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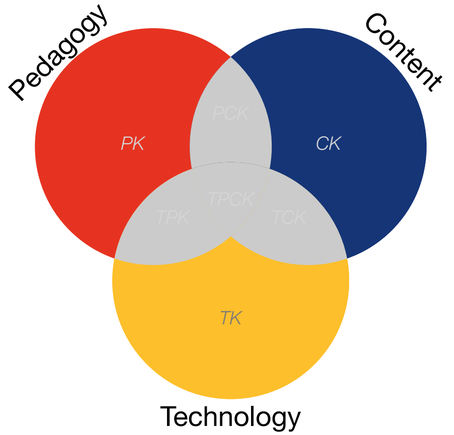

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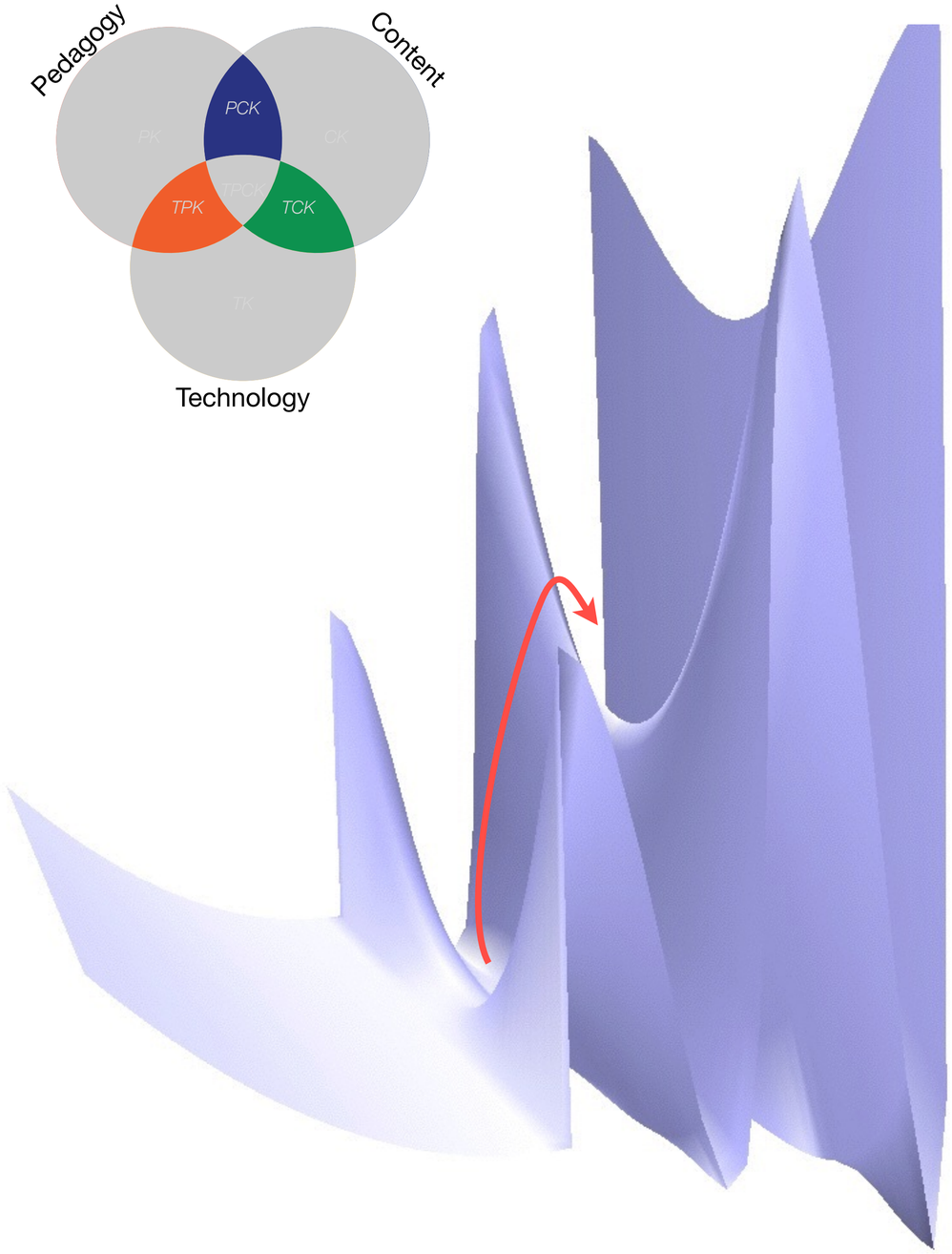

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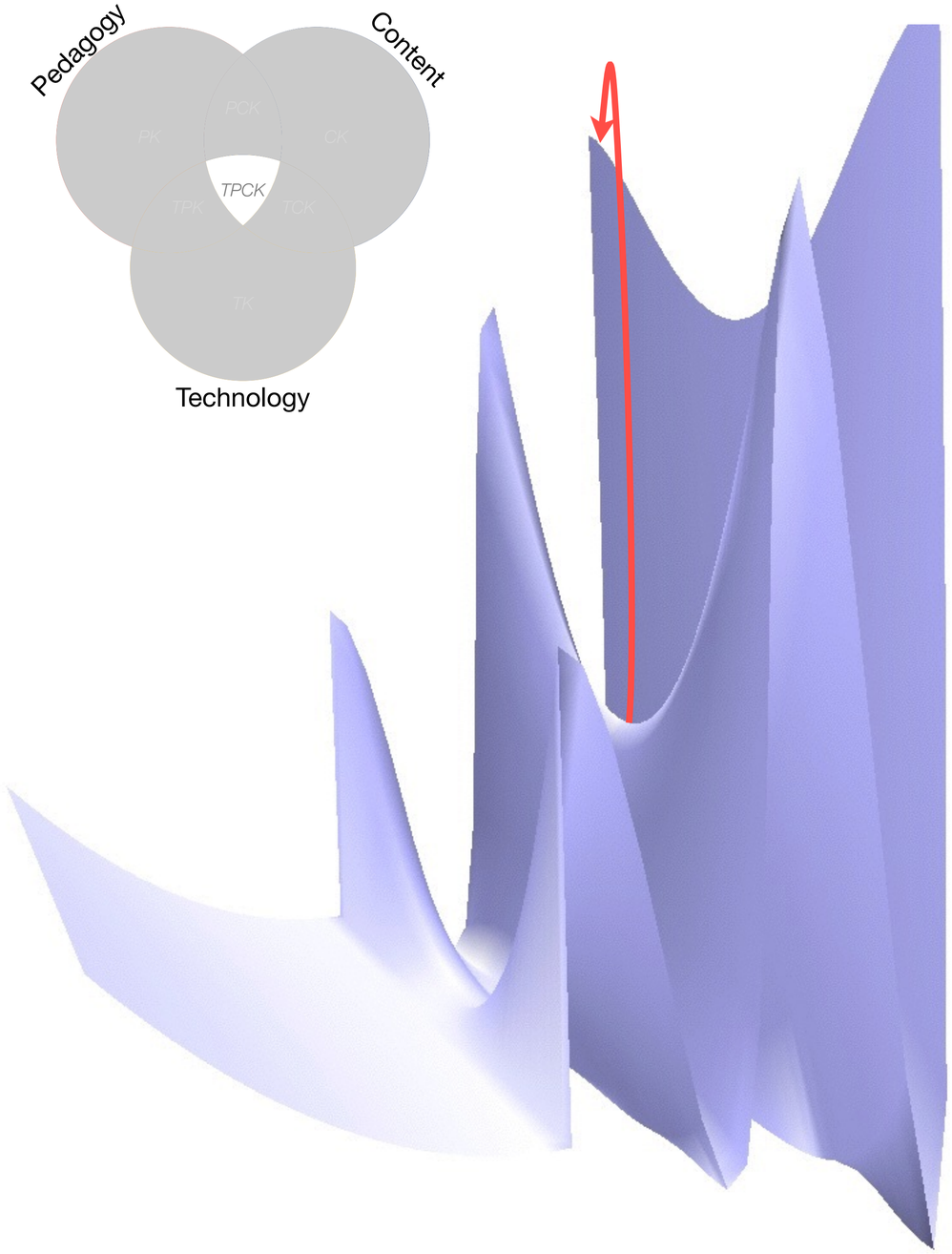

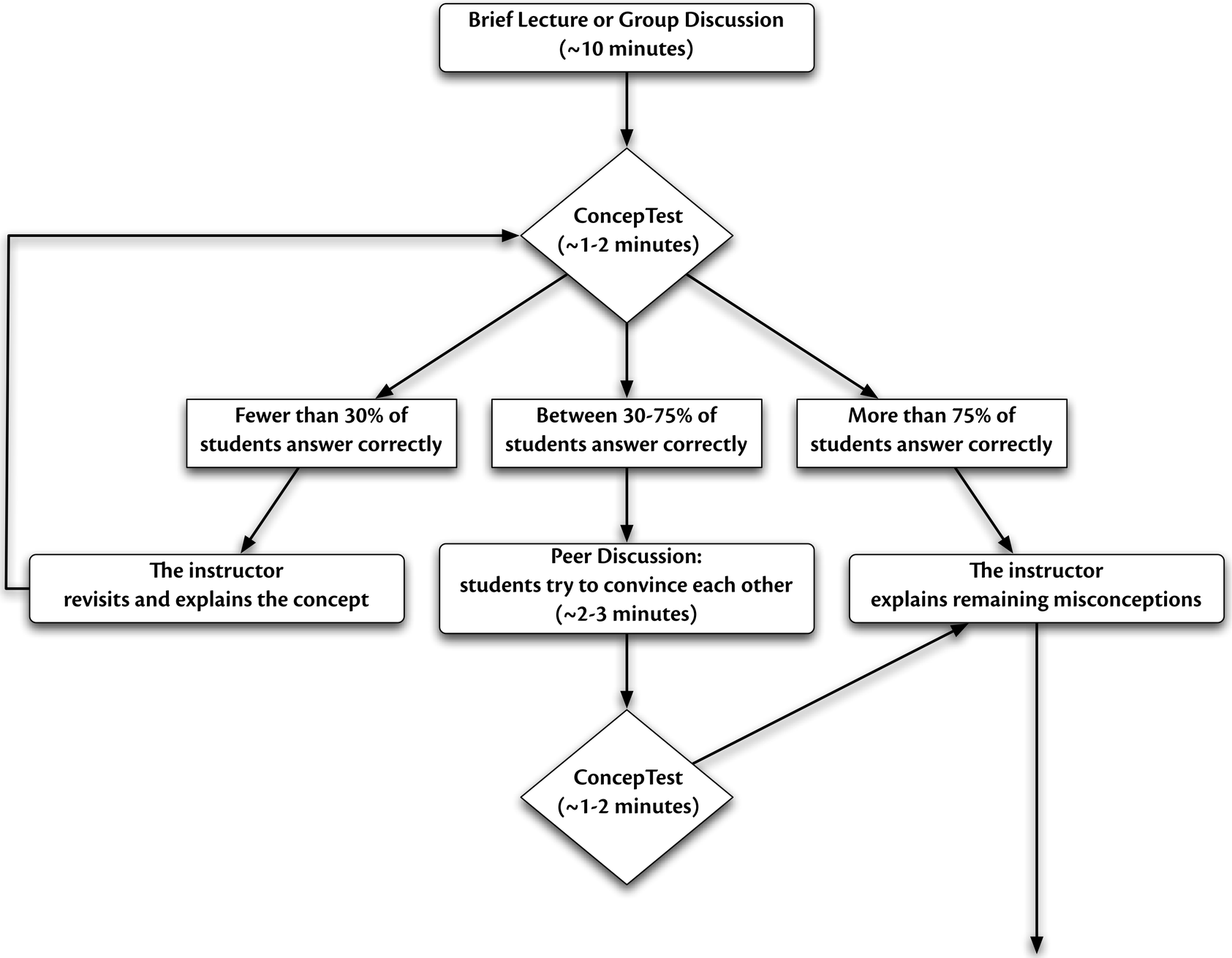

Mazur, E. *Peer Instruction - A User's Manual*. Prentice Hall (1997)

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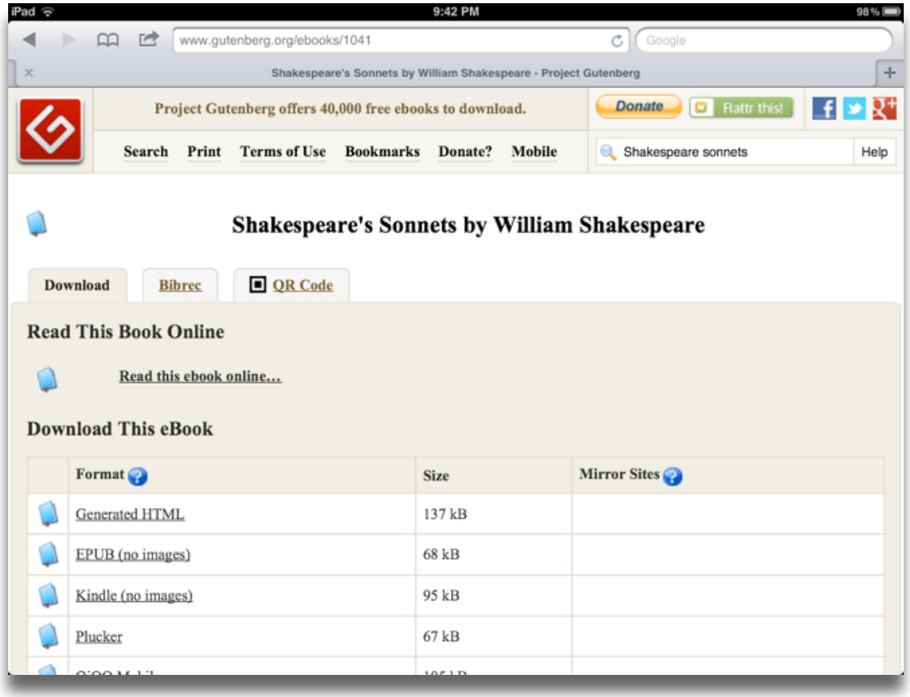

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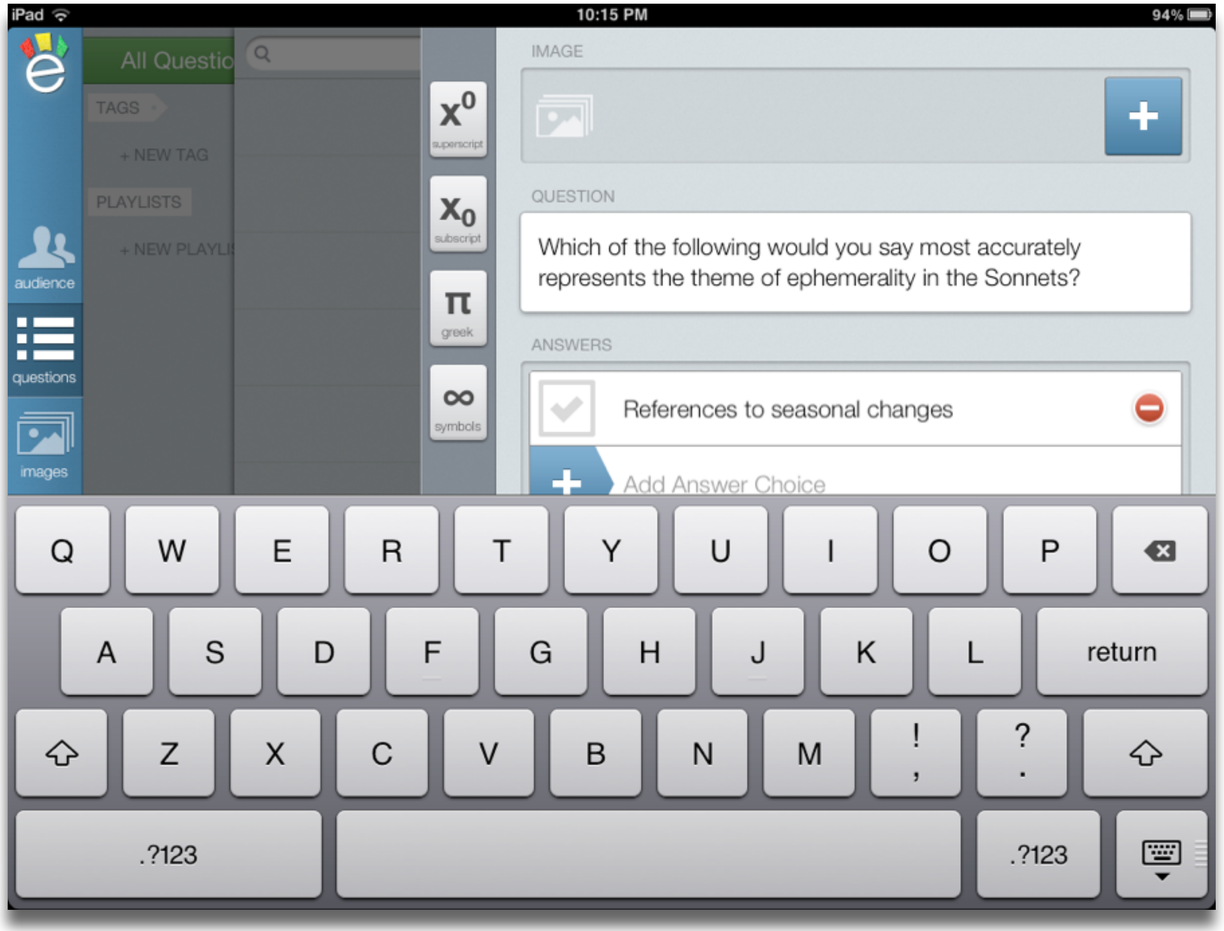

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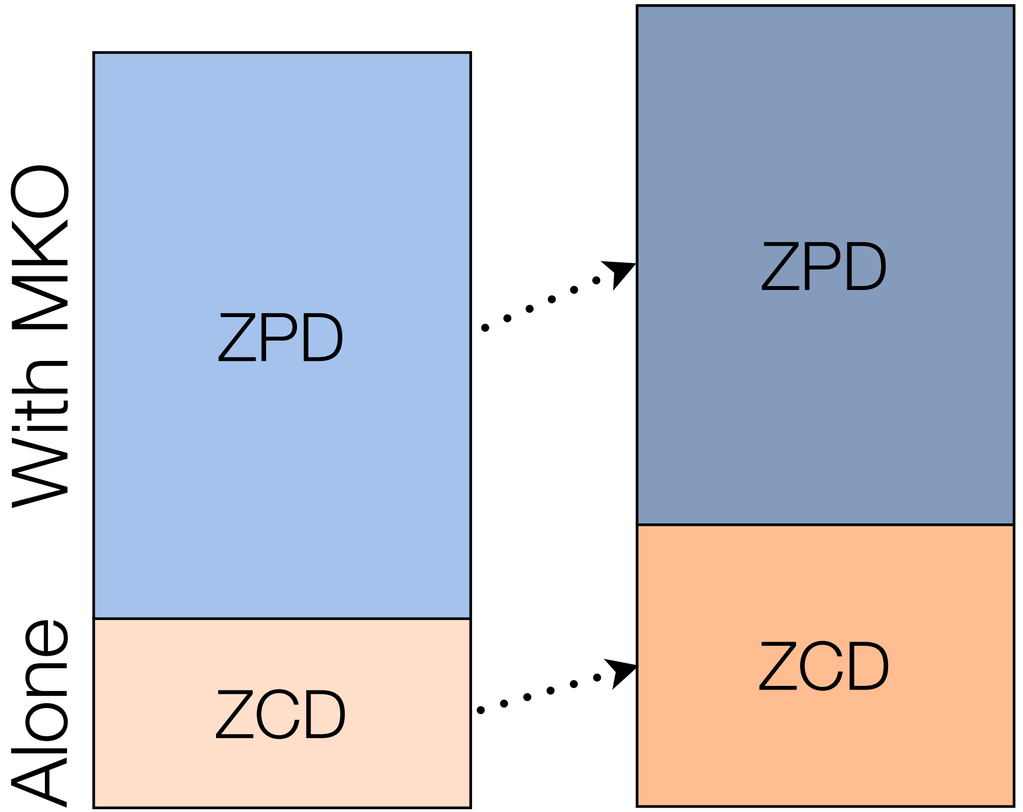
2. Informing Design and Assessment



- Zone of Proximal Development (ZPD):
  - Region between:
    - what a learner can accomplish independently (the Zone of Current Development, ZCD)
    - what they can accomplish with assistance from a “more knowledgeable other” (MKO)
- *“…what a child can do with assistance today she will be able to do by herself tomorrow.”*
- This is an iterative process:
  - The ZCD and ZPD change over time;
  - Independent practice is required to close the loop.

Lev Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press. (1978)

Consolidating

Consolidating understanding refers to a solid, confident facility with a given concept or skill. A consolidating learner produces exemplary work to reflect her growth. She demonstrates consistent, independent success.

Formulating

Formulating understanding represents meaningful steps forward as a learner builds upon her basic grasp of a concept or skill. A formulating learner is achieving a greater degree of independent achievement than when her understanding was first emerging.

Emerging

Emerging understanding is a good beginning. It indicates a learner who is working to establish her basic grasp of the concept or skill being addressed. An emerging learner may be encountering an idea or skill that is relatively new to her.

Expanding

Expanding understanding indicates a learner who has consolidated her understanding, and in addition to this, also demonstrates a capacity to reach beyond by generating unique insights and original connections. An expanding learner demonstrates novel thinking and individual initiative in exploring and using complex, interrelated ideas.

Surveying Seymour Papert’s Four Expectations

- **Expectation 1:** suitably designed formative/summative assessment rubrics will show improvement when compared to traditional instruction.
- **Expectation 2:** students will show more instances of work at progressively higher levels of Bloom's Taxonomy.
- **Expectation 3:** student work will demonstrate more – and more varied – critical thinking cognitive skills, particularly in areas related to the examination of their own thinking processes.
- **Expectation 4:** student daily life will reflect the introduction of the technology. This includes (but is not limited to) directly observable aspects such as reduction in student attrition, increase in engagement with civic processes in their community, and engagement with communities beyond their own.

S. Papert. *An Evaluative Study of Modern Technology in Education*. MIT Artificial Intelligence Laboratory Memo No. 371. (June, 1976)

Black and Wiliam: Defining Formative Assessment

"Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited."

Black, P. and Wiliam D. "Developing the theory of formative assessment." *Educational Assessment, Evaluation and Accountability*. 21:5-31 (2009)

Bloom's Taxonomy: Cognitive Processes

Anderson & Krathwohl (2001)	Characteristic Processes	
Remember	• Recalling memorized knowledge • Recognizing correspondences between memorized knowledge and new material	
Understand	• Paraphrasing materials • Exemplifying concepts, principles • Classifying items • Summarizing materials	• Extrapolating principles • Comparing items
Apply	• Applying a procedure to a familiar task • Using a procedure to solve an unfamiliar, but typed task	
Analyze	• Distinguishing relevant/irrelevant or important/unimportant portions of material • Integrating heterogeneous elements into a structure • Attributing intent in materials	
Evaluate	• Testing for consistency, appropriateness, and effectiveness in principles and procedures • Critiquing the consistency, appropriateness, and effectiveness of principles and procedures, basing the critique upon appropriate tests	
Create	• Generating multiple hypotheses based on given criteria • Designing a procedure to accomplish an untyped task • Inventing a product to accomplish an untyped task	

Lorin W. Anderson and David R. Krathwohl (Eds.), *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives, Complete Edition*. Longman. (2000)

Facione: Critical Thinking – Cognitive Skills and Subskills

Skill	Subskills
Interpretation	Categorization Decoding Significance Clarifying Meaning
Analysis	Examining Ideas Identifying Arguments Analyzing Arguments
Evaluation	Assessing Claims Assessing Arguments
Inference	Querying Evidence Conjecturing Alternatives Drawing Conclusions
Explanation	Stating Results Justifying Procedures Presenting Arguments
Self-Regulation	Self-examination Self-correction

Peter Facione, *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction - Executive Summary*. "The Delphi Report". American Philosophical Association, Committee on Pre-College Philosophy. California Academic Press, 1990

Wiliam: A Framework for Formative Assessment

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1 Clarifying learning intentions and criteria for success	2 Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3 Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4 Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	5 Activating students as the owners of their own learning	

Dylan Wiliam, *Embedded Formative Assessment*. Solution Tree (2011)

1. Clarifying, Sharing, and Understanding Learning Intentions and Criteria for Success

- Rubric Dichotomies:
  - Task-specific *vs*. generic rubrics
  - Product-focused *vs*. process-focused
  - Official *vs*. student-friendly Language
- Rubric Design:
  - Three key components in presenting learning intentions and success criteria to students:
    - WALT: we are learning to
    - WILF: what I'm looking for
    - TIB: this is because
  - Make explicit progressions within rubrics, and progressions across rubrics
- Students and Rubrics:
  - Have students look at samples of other students' work, then rank them by quality
    - Students become better at seeing issues in their own work by recognizing them in others' work
    - Not a "somebody wins" exercise, but rather a quality exercise that engages students
  - Have students design test items, rubrics

2. Eliciting Evidence of Learners' Achievement in the (Extended) Classroom

- Asking questions in class:
  - Chosen to act as a discussion/thinking trigger
  - Should provide info for varying instruction on the fly and in the long term
  - Examples:
    - ConcepTest
    - POE (Predict-Observe-Explain)
    - TPS (Think-Pair-Share)
    - Virtual Whiteboard

3. Providing Feedback that Moves Learners Forward

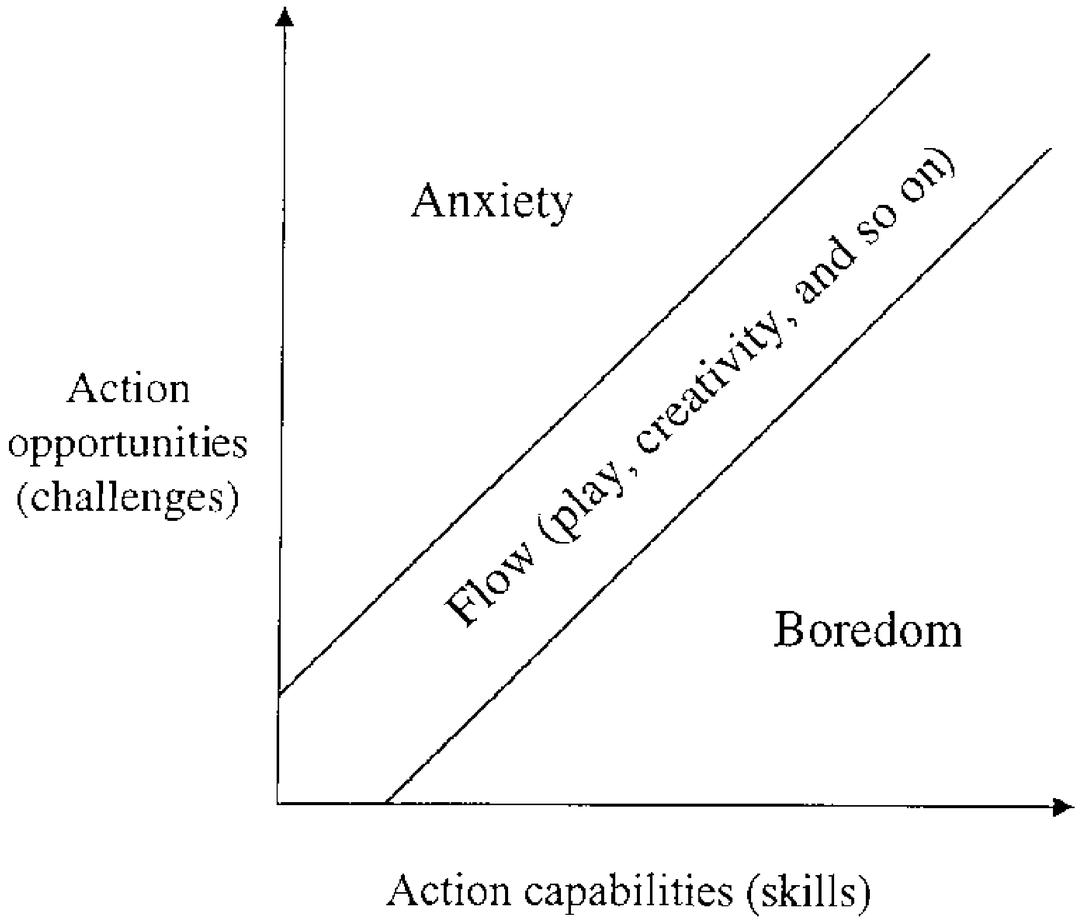
- The feedback process must provide a recipe for future action
- Feedback should:
  - Be more work for the recipient than the donor, i.e., not just right/wrong – make them think about what did not work
  - Be focused: less is more
  - Relate explicitly to goals/rubrics
- How:
  - Scores or praise alone do not provide this; comments do
  - Supplying minimal scaffolded responses (i.e., where the student got stuck) >> supplying a full response to the problem
    - This emphasizes the crucial role of the draft object and process
  - Oral feedback >> written feedback
    - Consider using recordings
  - Create (sometimes together with students) process rubrics that embody this scaffold
  - Provide time for students to use this feedback
- Minimize grading:
  - Avoid false stopping points
  - Avoid ratchet effect

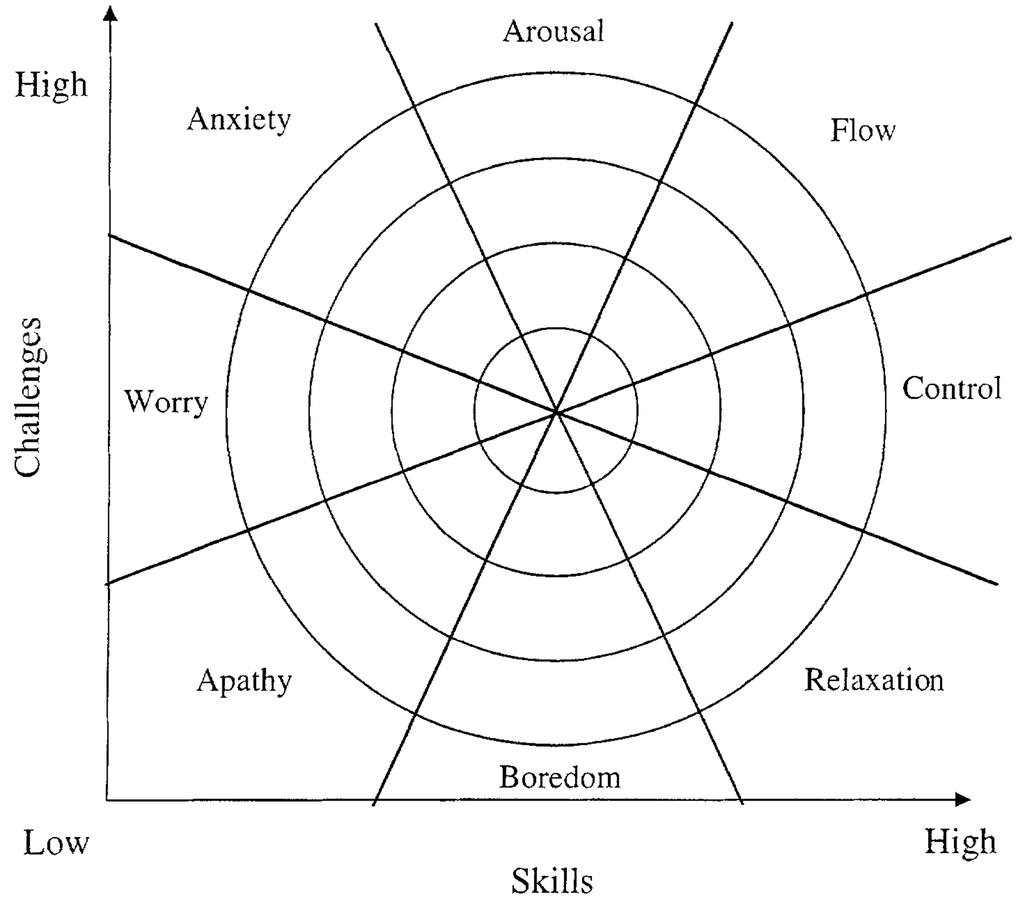
4. Activating Students as Instructional Resources for One Another

- Two key elements:
  - Group goals
  - Individual accountability
- Effectiveness due to (in order of importance):
  - Personalization
  - Cognitive Elaboration
  - Motivation
  - Social Cohesion
- Reciprocal help only works when it takes the form of elaborated explanations:
  - Not simple answers or procedures
  - Looks to the upper levels of Bloom for both participants
- Reciprocal help is more effective (by a factor of up to 4) if the product being assessed is the result of the aggregate of individual contributions, rather than just one group product

5. Activating Students as Owners of their Own Learning

- Effective self-assessment is up to twice as effective as other-assessment
- Two key components:
  - Metacognition:
    - Metacognitive knowledge: know what you know
    - Metacognitive skills: what you can do
    - Metacognitive experience: what you know about your cognitive abilities
  - Motivation:
    - Traditionally viewed as a cause (intrinsic/extrinsic), but is better viewed as an outcome:
      - Flow (M. Csikszentmihalyi): the result of a match between capability and challenge
        - Students are motivated to reach goals that are specific, within reach, and offer some degree of challenge
- Three sources of info for students to decide what they will do:
  - Perceptions of the task and its context
  - Knowledge about the task and what it will take to be successful
  - Motivational beliefs
- The role of the draft process and object resurfaces as a crucial component here
- Important Tools:
  - Learning logs and journals
  - Learning portfolios





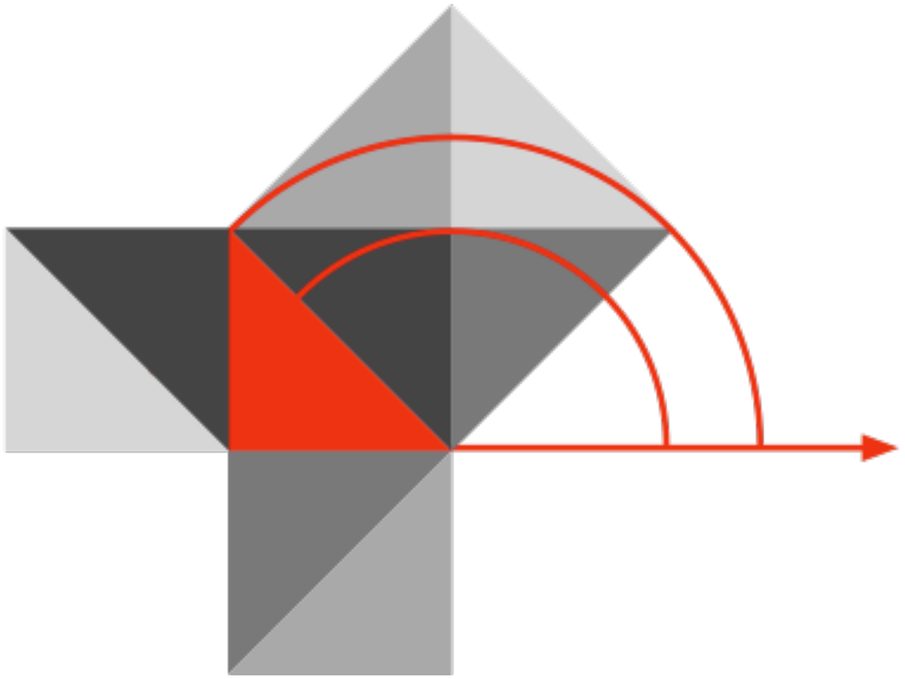
Jeanne Nakamura & Mihaly Csikszentmihalyi, “The Concept of Flow” in: *Handbook of Positive Psychology* (C. R. Snyder and Shane J. Lopez, Editors). Oxford University Press. (2002)

3. Starting Points

Choosing the First SAMR Ladder Project: Three Options

- **Your Passion:**
  - If you had to pick one topic from your class that best exemplifies why you became fascinated with the subject you teach, what would it be?
- **Barriers to Your Students' Progress:**
  - Is there a topic in your class that a significant number of students get stuck on, and fail to progress beyond?
- **What Students Will Do In the Future:**
  - Which topic from your class would, if deeply understood, best serve the interests of your students in future studies or in their lives outside school?

Hippasus



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