SAMR, Learning, and Assessment

Ruben R. Puentedura, Ph.D.

Part 1: PCK and SAMR

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

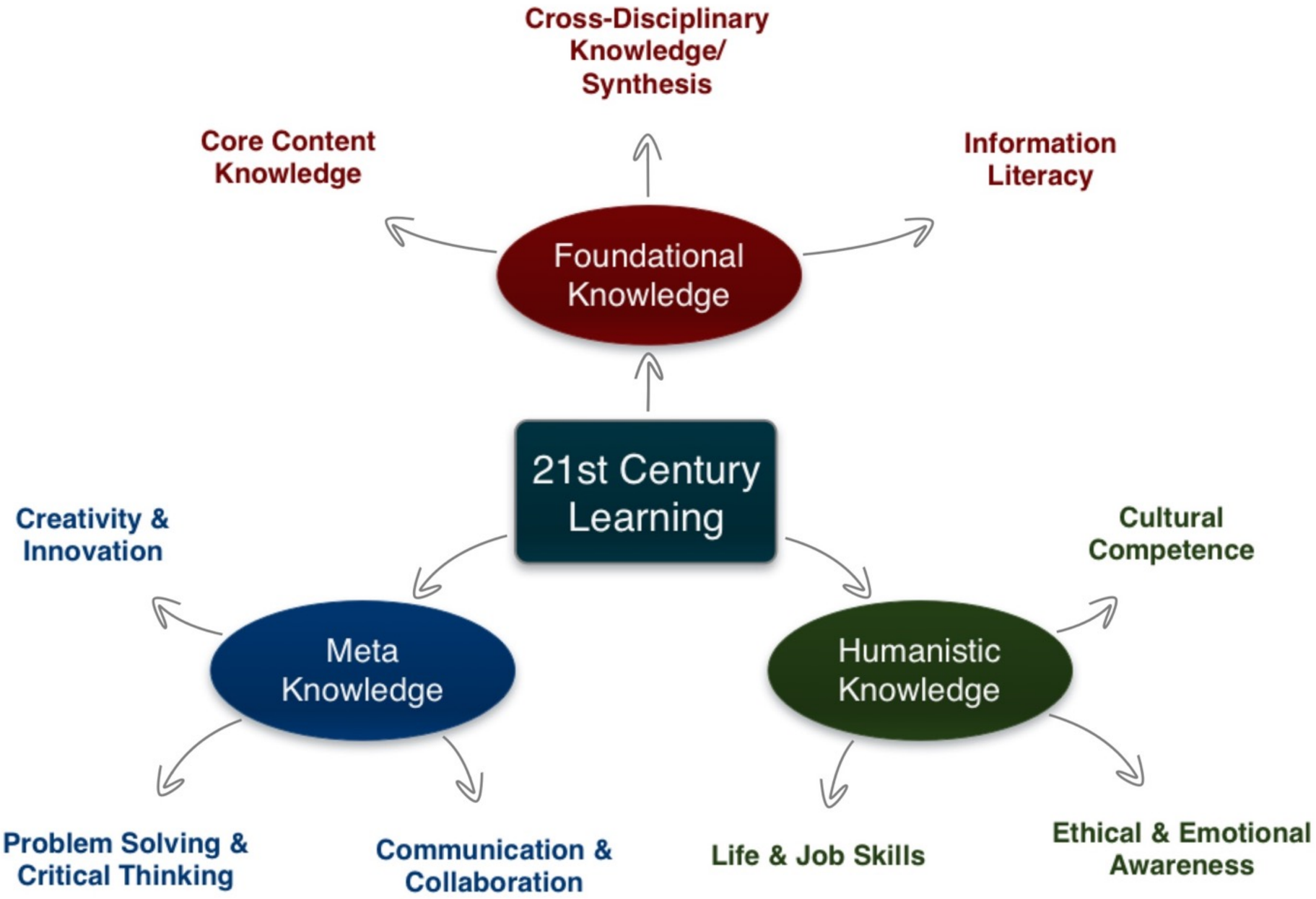
Tech acts as a direct tool substitute, with no functional change

Enhancement

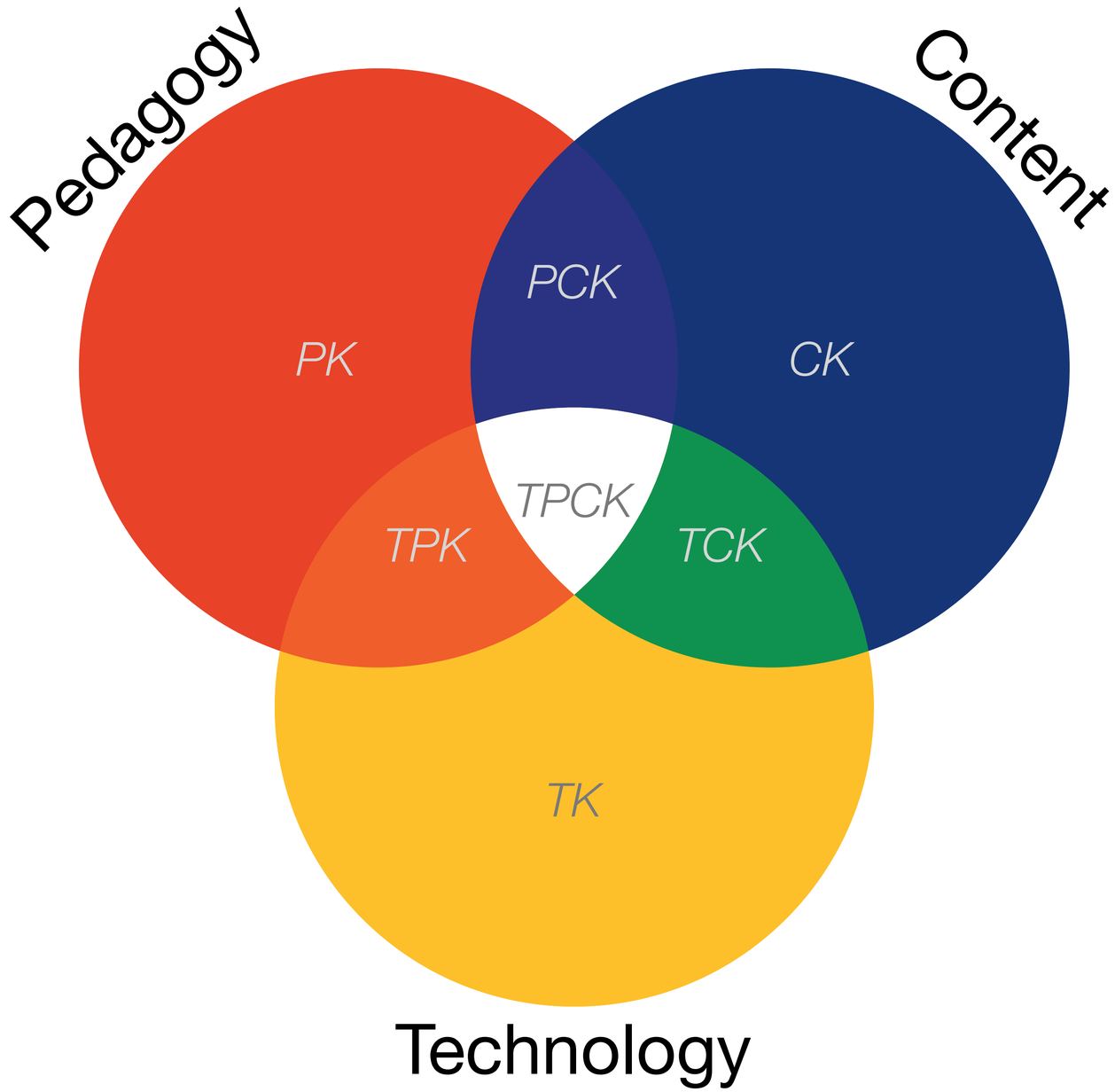
Ruben R. Puentedura, *As We May Teach: Educational Technology, From Theory Into Practice*. (2009)

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

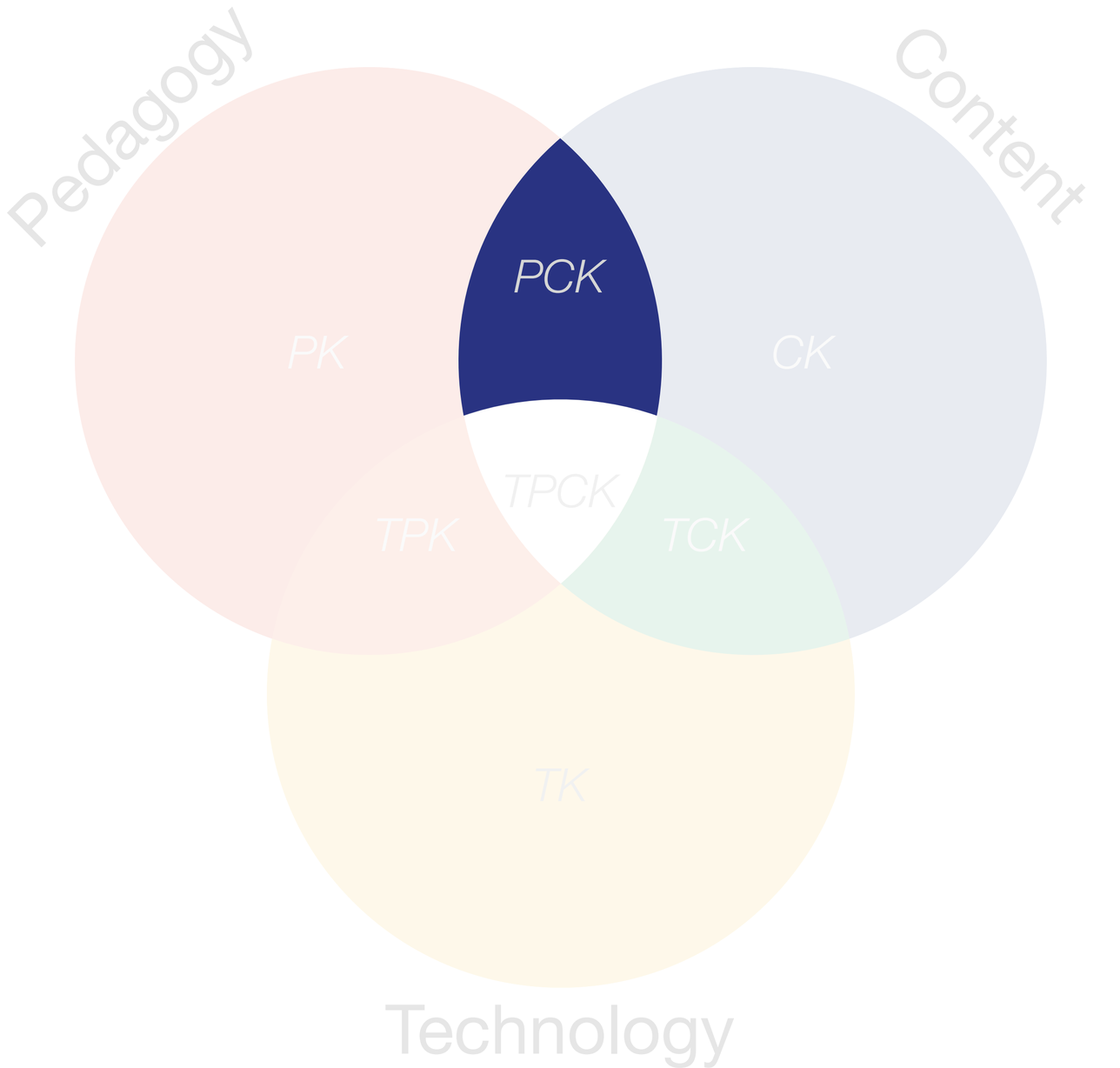
Ruben R. Puentedura, “Technology In Education: The First 200,000 Years” *The NMC Perspective Series: Ideas that Matter*. NMC Summer Conference, 2012.



Kristen Kereluik, Punya Mishra, Chris Fahnoe, and Laura Terry, “What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning”. *Journal of Digital Learning in Teacher Education (29)* 4 (2013)

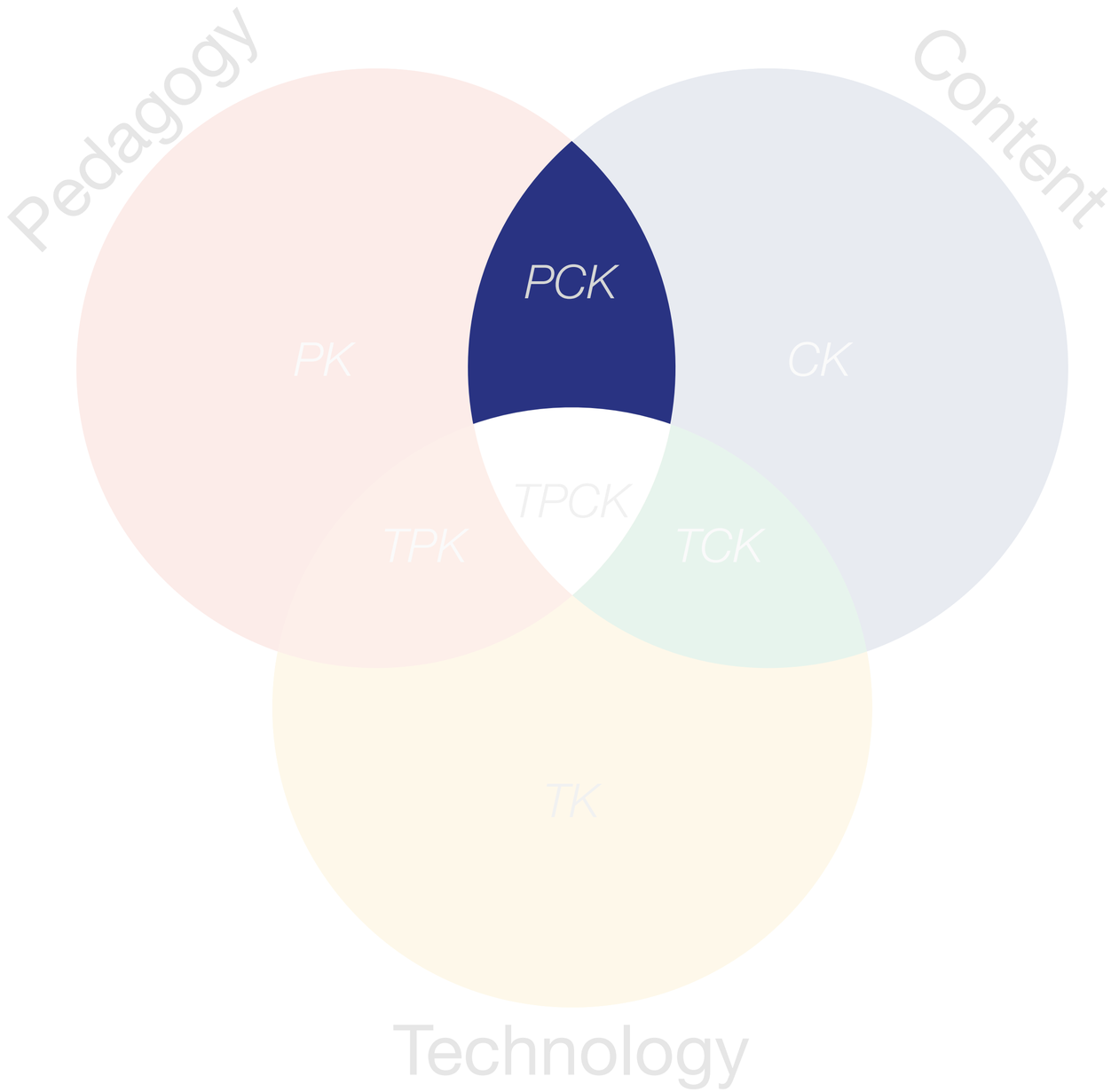


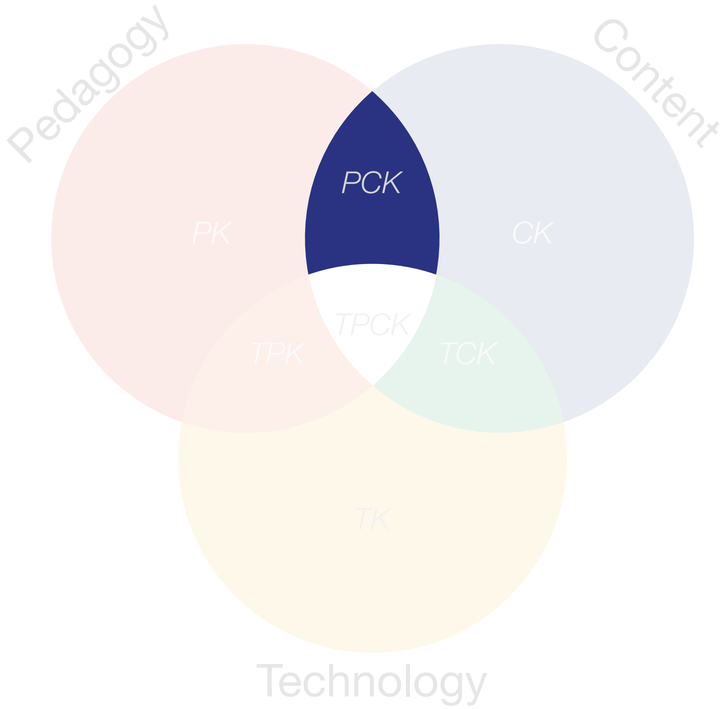
Punya Mishra & Matthew J. Koehler, “Technological pedagogical content knowledge: A framework for teacher knowledge”. *Teachers College Record, 108*(6). (2006)



Lee S. Shulman, "Those Who Understand: Knowledge Growth in Teaching." *Educational Researcher*, Vol. 15, No. 2 (Feb., 1986)

History & Geography


Pedagogy
Content
PCK
PK
CK
TPCK
TPK
TCK
TK
Technology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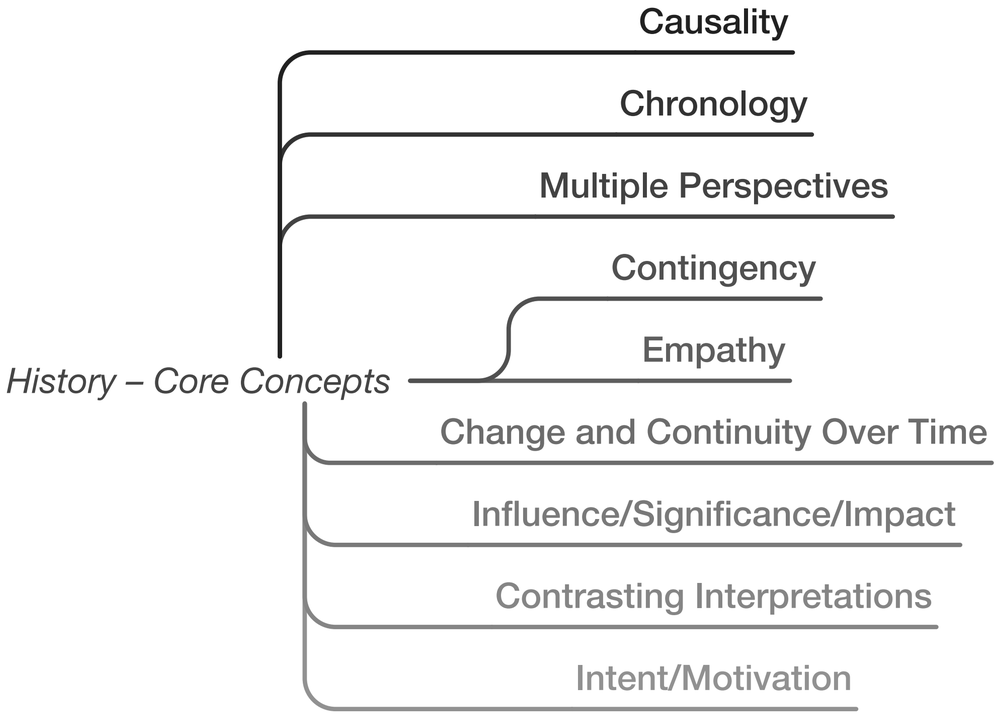
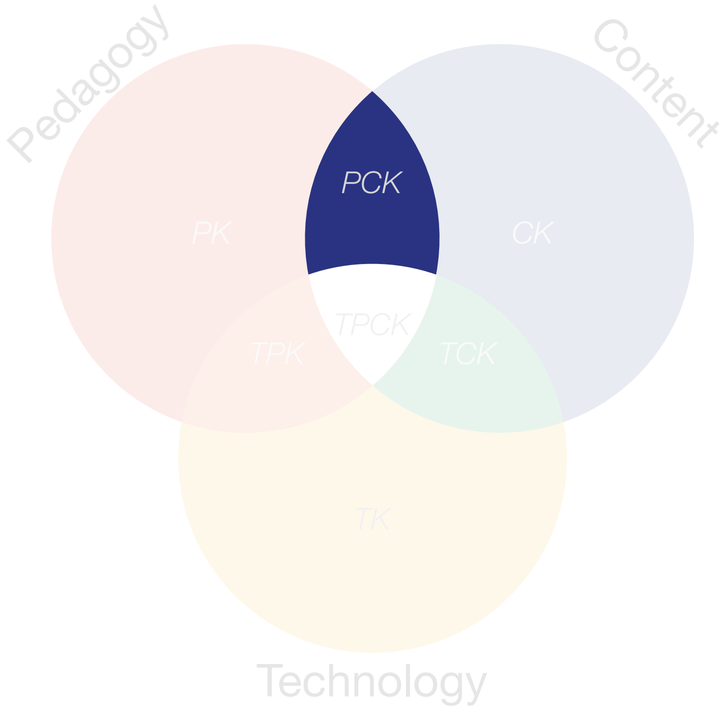

Causality
Chronology
Multiple Perspectives
Contingency
Empathy
History – Core Concepts
Change and Continuity Over Time
Influence/Significance/Impact
Contrasting Interpretations
Intent/Motivation



- *History – Core Concepts*
  - Causality
  - Chronology
  - Multiple Perspectives
  - Contingency
  - Empathy
  - Change and Continuity Over Time
  - Influence/Significance/Impact
  - Contrasting Interpretations
  - Intent/Motivation

- *History – Guiding Criteria*
  - Does the question represent an important issue to historical and contemporary times?
  - Is the question debatable?
  - Does the question represent a reasonable amount of content?
  - Will the question hold the interest of students?
  - Is the question appropriate given the materials available?
  - Is the question challenging for the students you are teaching?
  - What organizing historical concepts will be emphasized?

Bruce Lesh. ''*Why Won't You Just Tell Us the Answer?*'' *Teaching Historical Thinking in Grades 7-12*. Stenhouse Publishers. (2011)

Location
Position in space

Condition
Mix of natural & artificial features that give meaning to a location

Links
Connections between places

Formal Region
Group of places with similar conditions

Functional Region
Group of places linked together by a flow

Phil Gersmehl. *Teaching Geography*. The Guilford Press. (2005)

Spatial Thinking Skills	
Comparison	How are places similar or different?
Aura	What is this place’s influence on nearby places?
Region	What nearby places are similar to this one?
Transition	How do things change between two places?
Hierarchy	What larger area is this area inside? What smaller areas are inside it?
Analogy	What places have similar conditions?
Pattern	What distinctive arrangements can you see on a map?
Association	Are these patterns similar?

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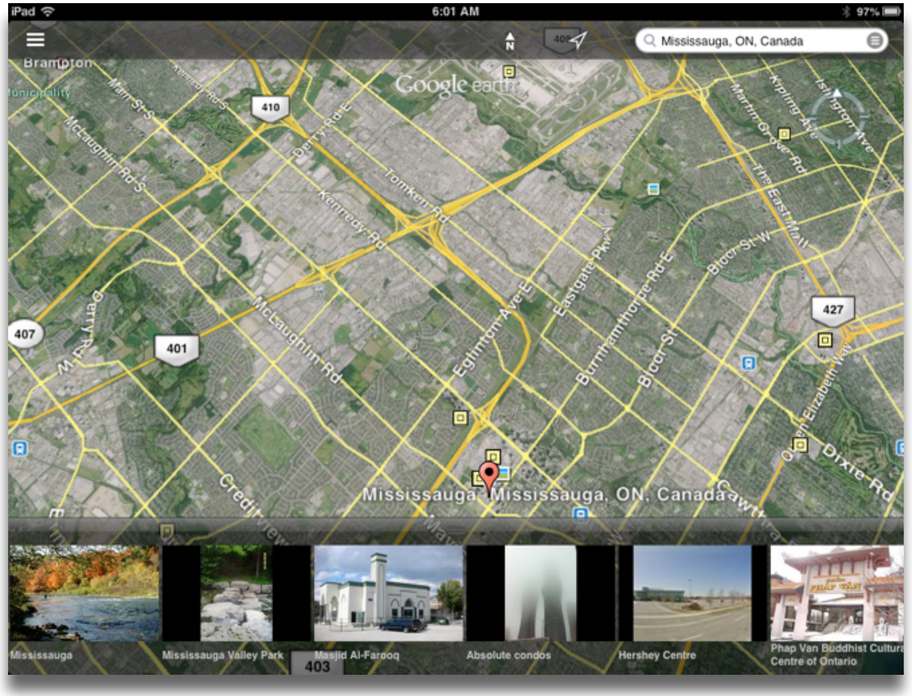

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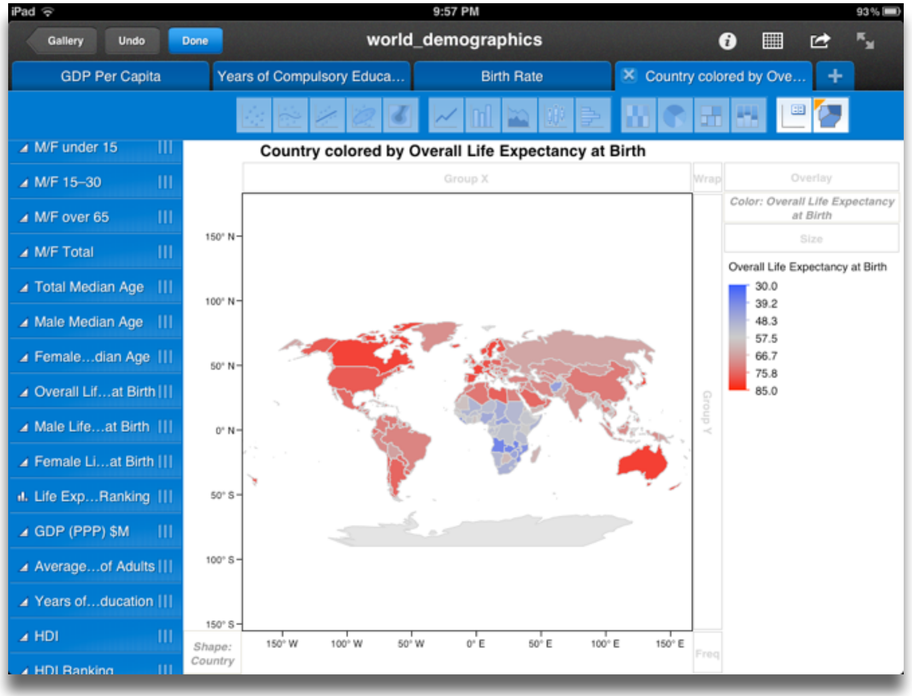

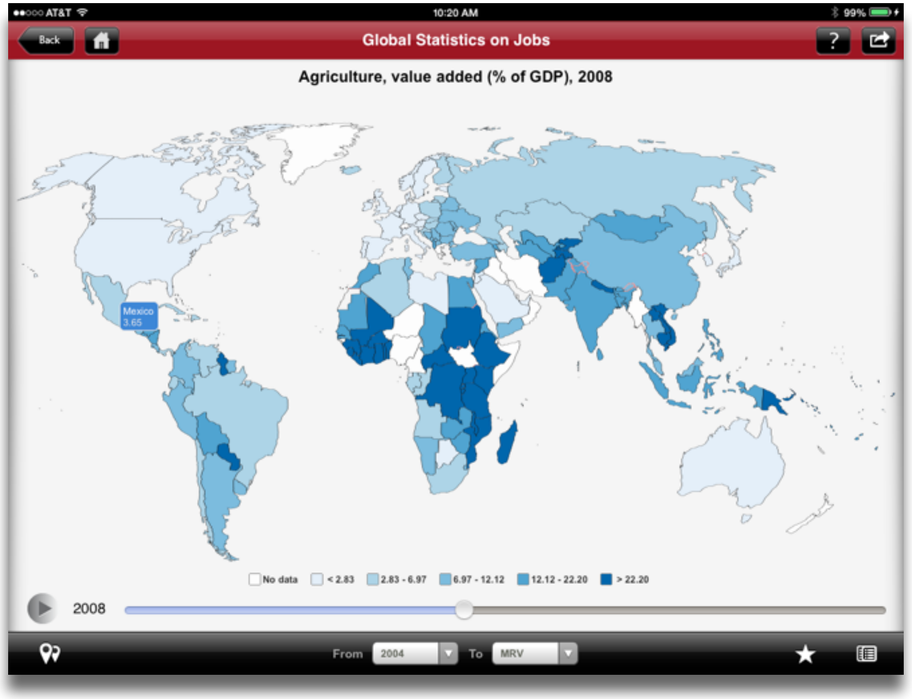

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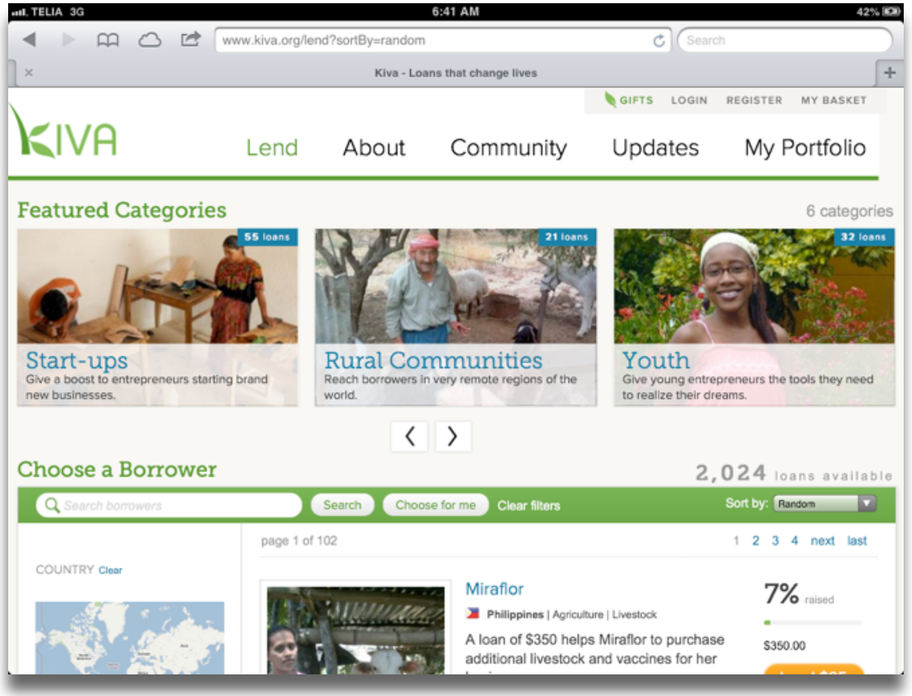
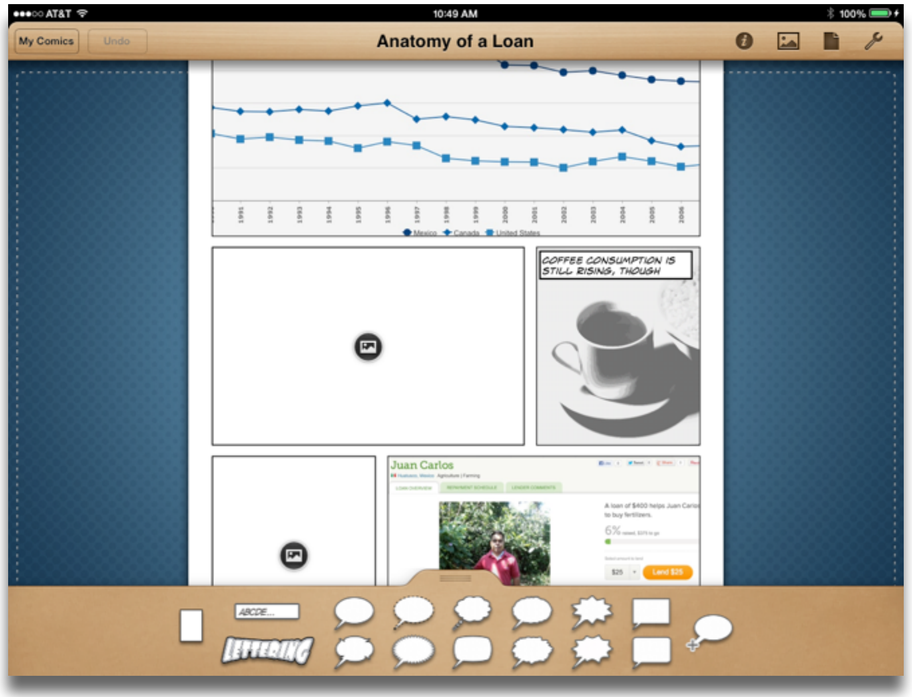
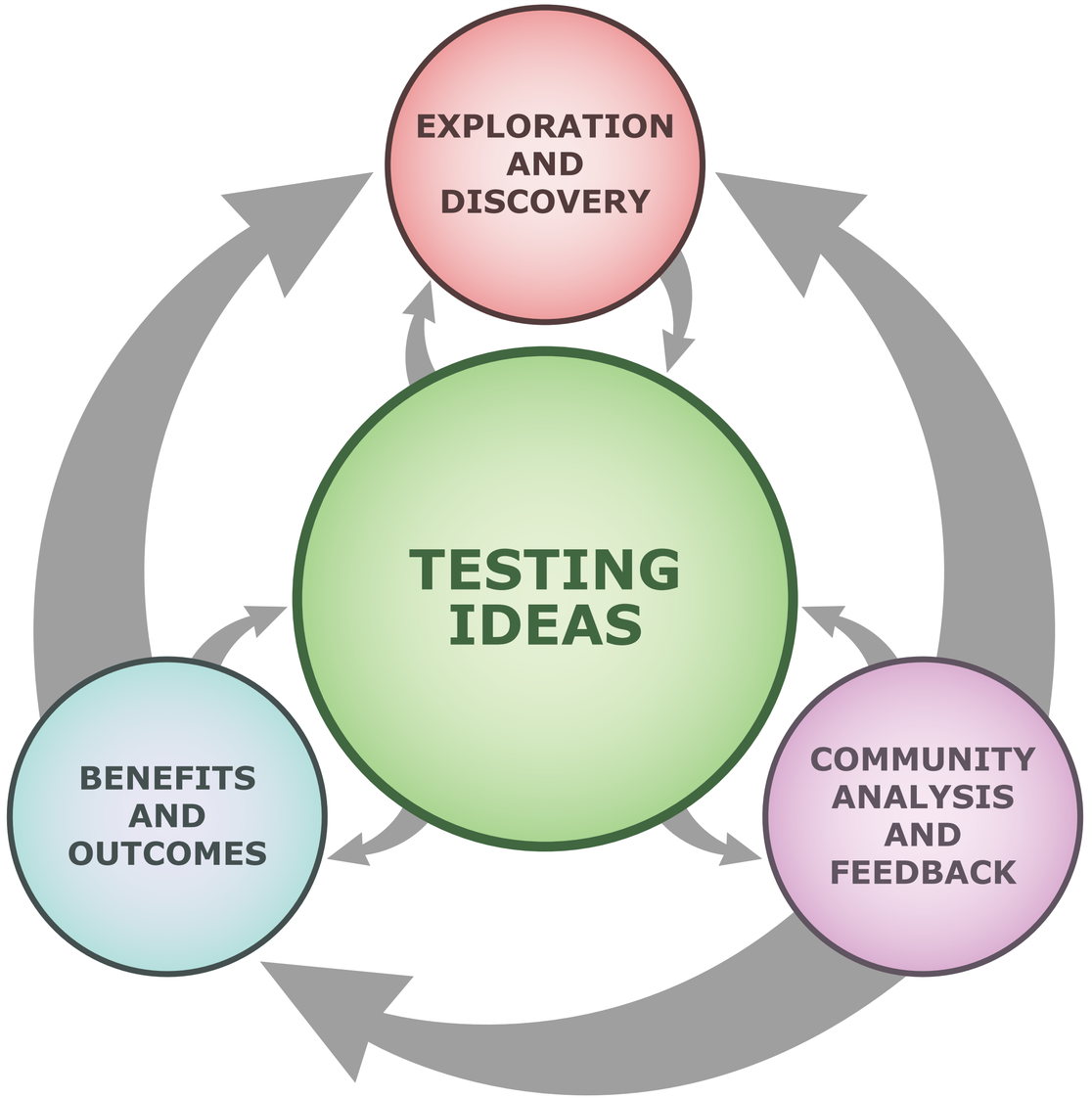




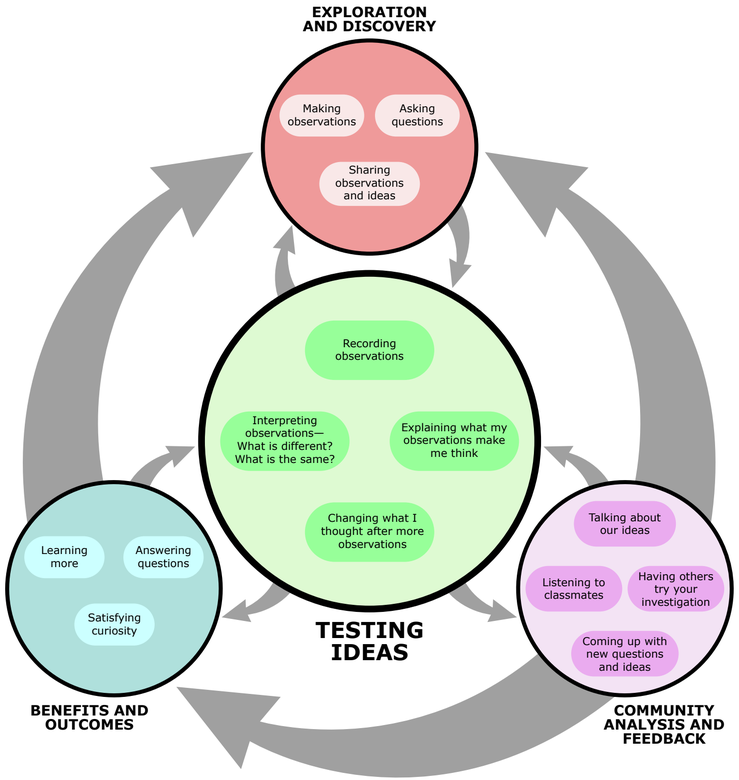
Science & Mathematics

Understanding Science: How Science Works

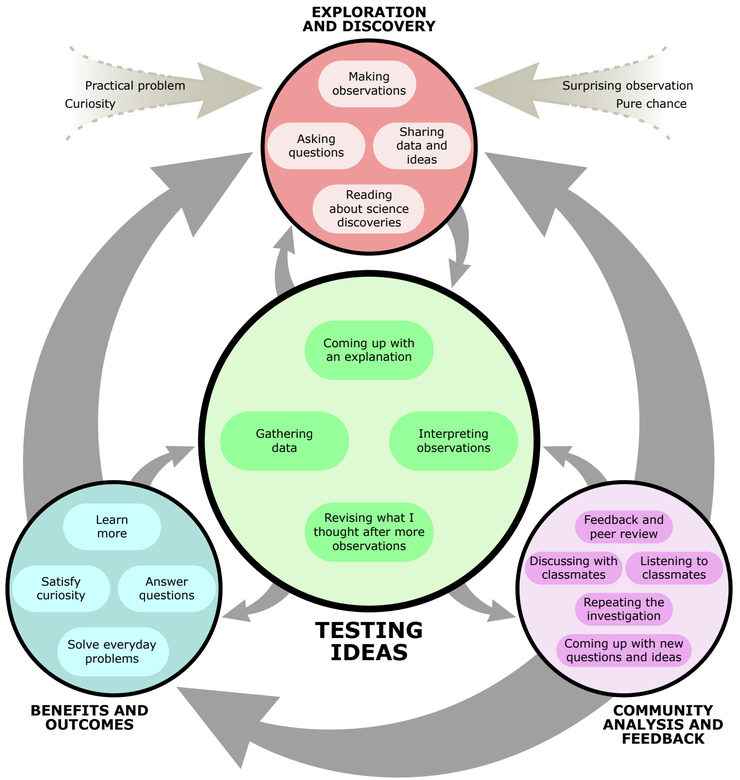


"Understanding Science." Understanding Science. N.p., n.d. Web. 5 Jan. 2014. <http://undsci.berkeley.edu>

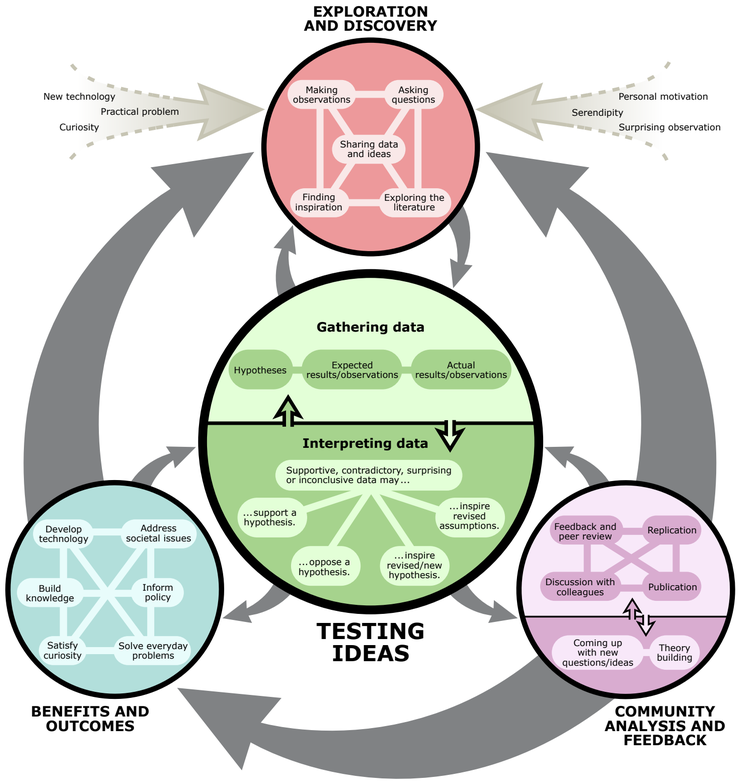
Understanding Science: How Science Works



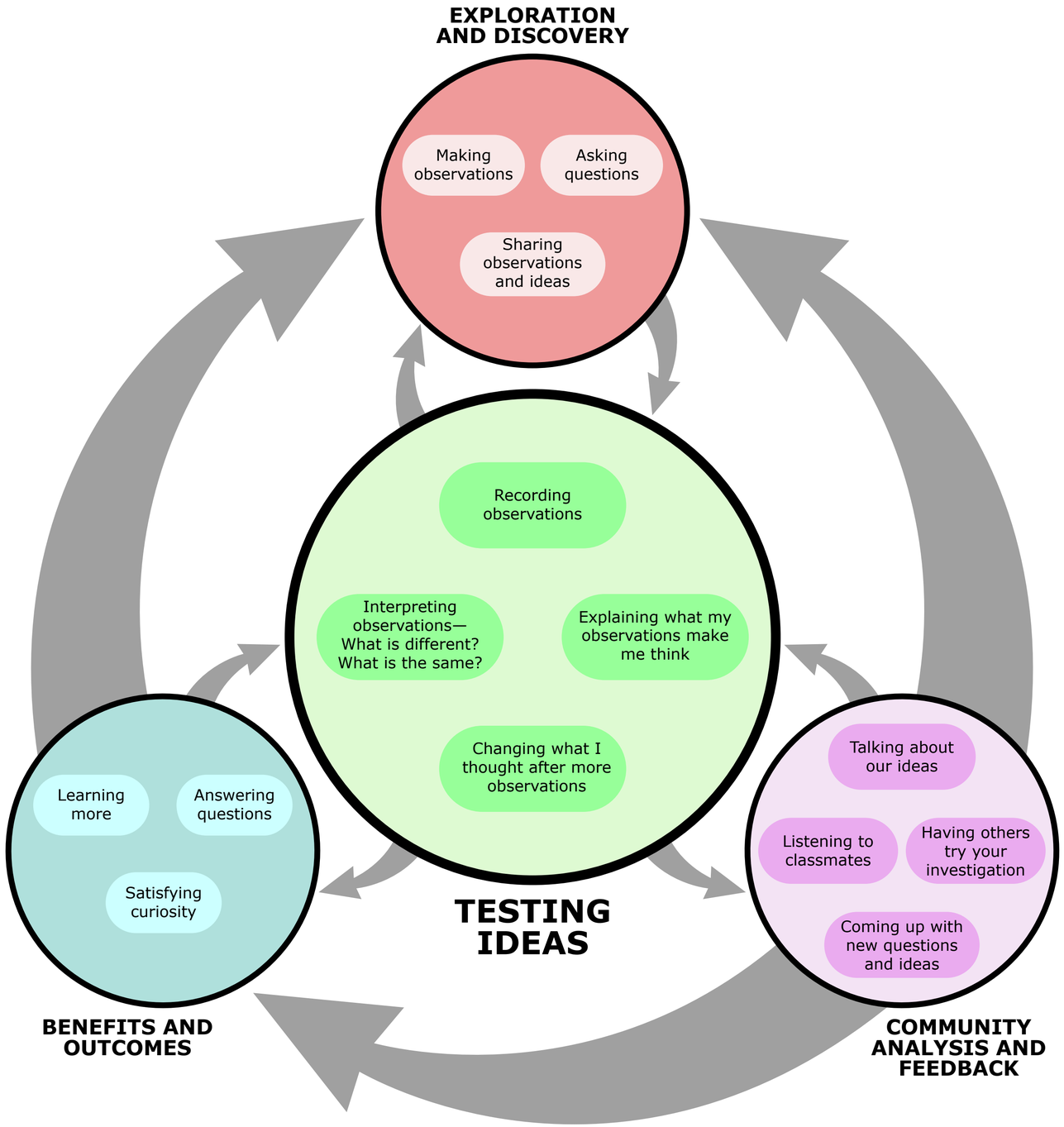
K–2

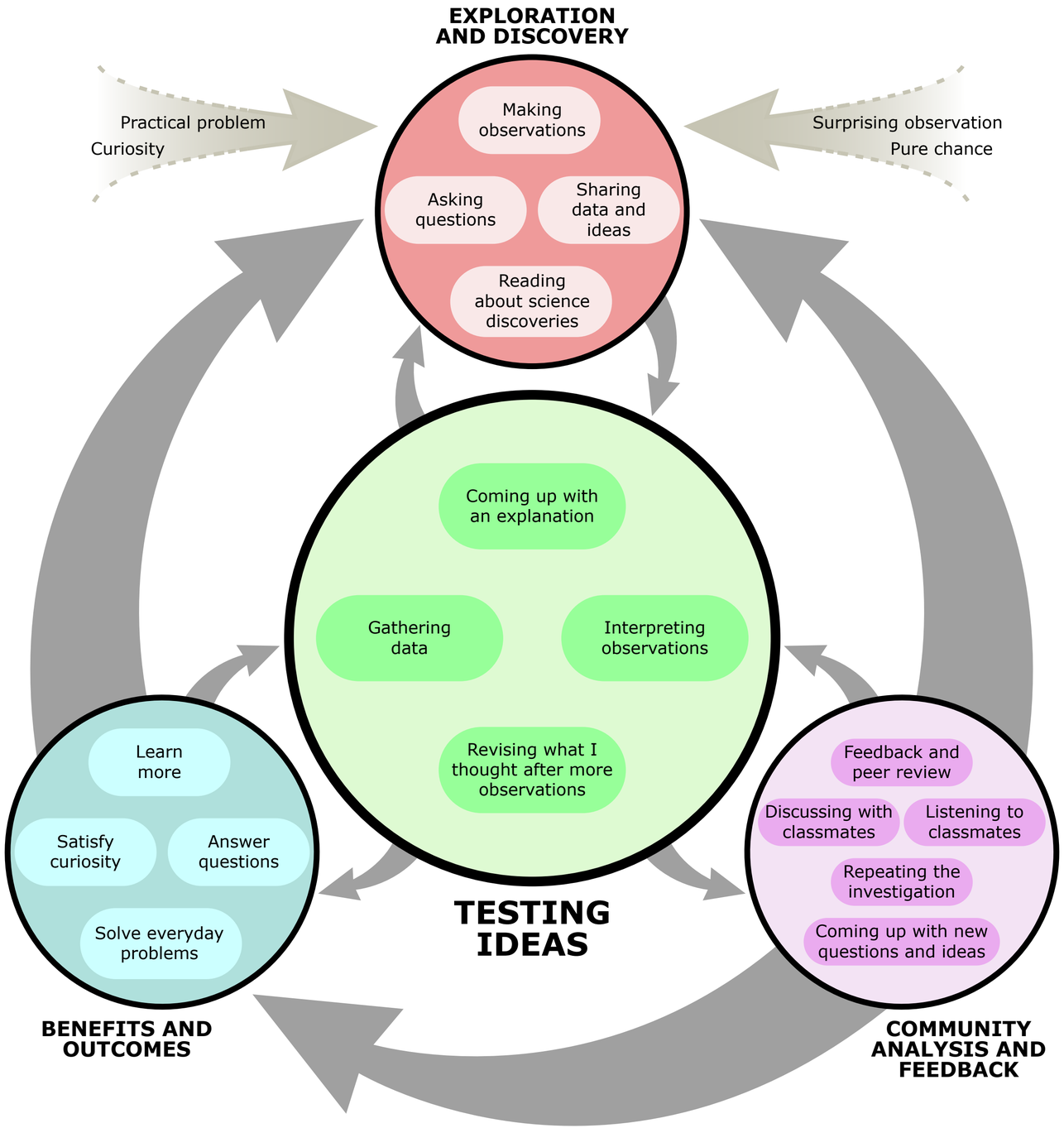


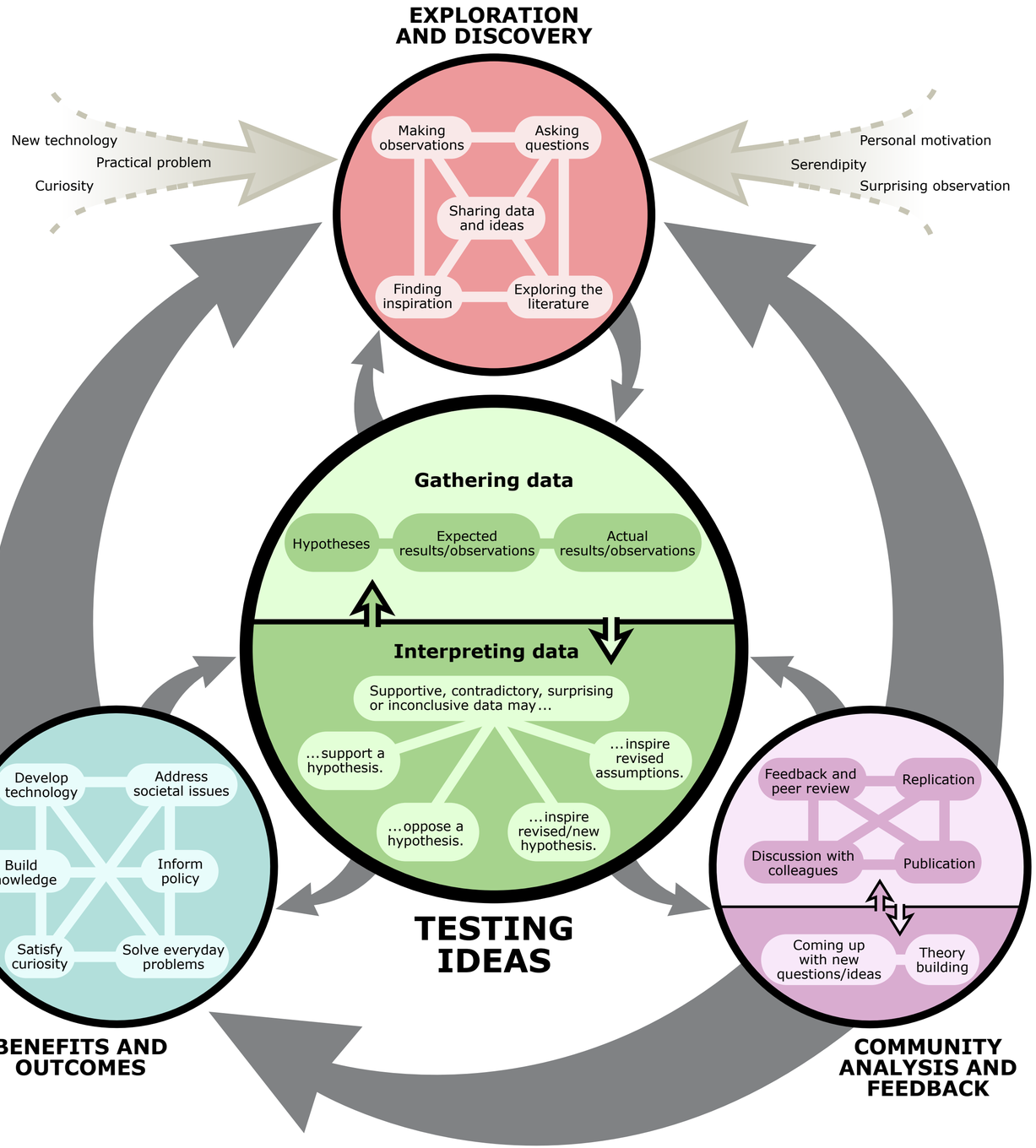
3–5



6–16


EXPLORATION AND DISCOVERY
Making observations
Asking questions
Sharing observations and ideas
Recording observations
Interpreting observations— What is different? What is the same?
Explaining what my observations make me think
Changing what I thought after more observations
TESTING IDEAS
Learning more
Answering questions
Satisfying curiosity
BENEFITS AND OUTCOMES
Talking about our ideas
Listening to classmates
Having others try your investigation
Coming up with new questions and ideas
COMMUNITY ANALYSIS AND FEEDBACK


EXPLORATION AND DISCOVERY
Practical problem
Curiosity
Surprising observation
Pure chance
Making observations
Asking questions
Sharing data and ideas
Reading about science discoveries
Coming up with an explanation
Gathering data
Interpreting observations
Revising what I thought after more observations
TESTING IDEAS
Learn more
Satisfy curiosity
Answer questions
Solve everyday problems
BENEFITS AND OUTCOMES
Feedback and peer review
Discussing with classmates
Listening to classmates
Repeating the investigation
Coming up with new questions and ideas
COMMUNITY ANALYSIS AND FEEDBACK

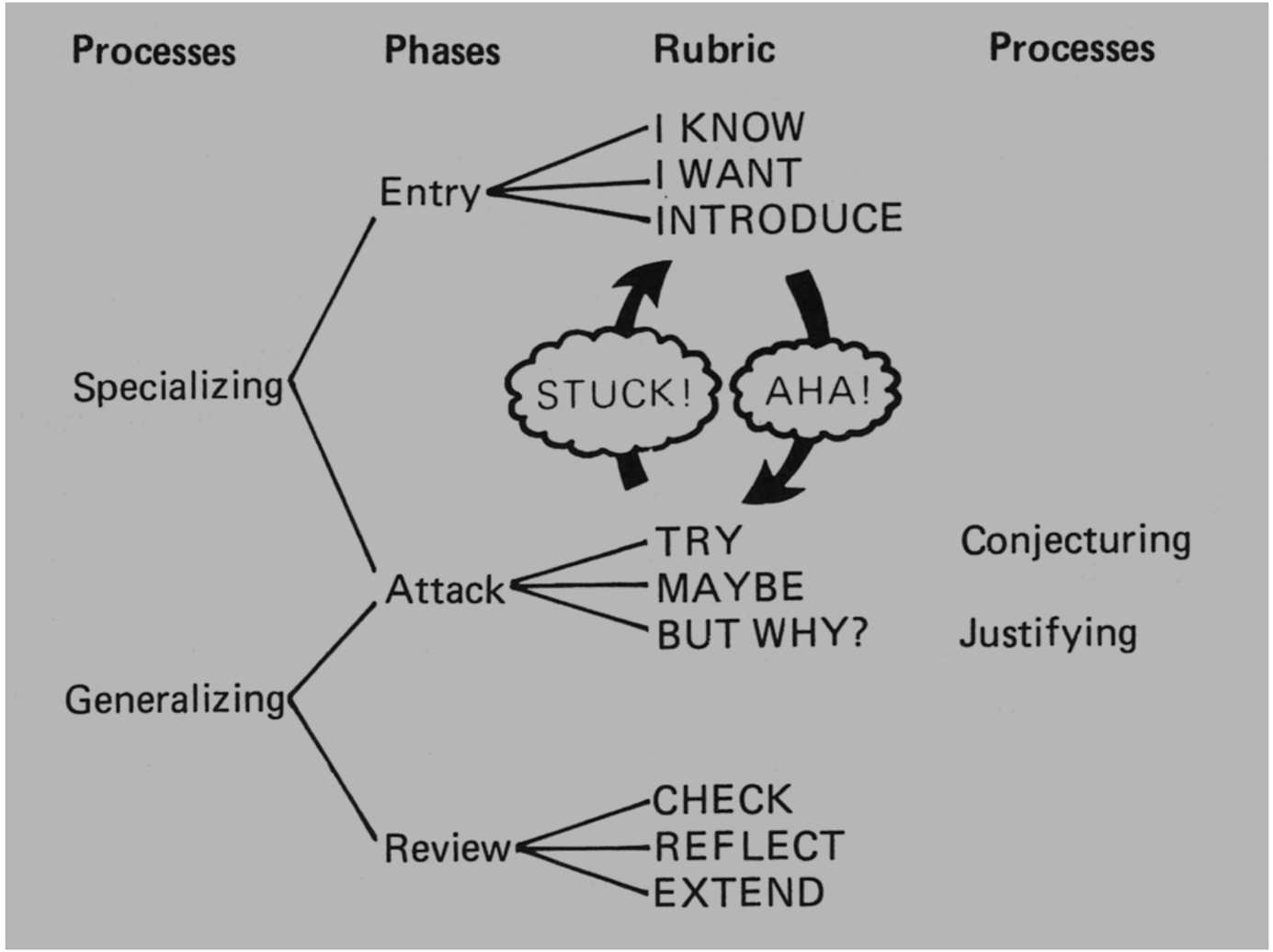

EXPLORATION AND DISCOVERY
New technology
Practical problem
Curiosity
Personal motivation
Serendipity
Surprising observation
Making observations
Asking questions
Sharing data and ideas
Finding inspiration
Exploring the literature
Gathering data
Hypotheses
Expected results/observations
Actual results/observations
Interpreting data
Supportive, contradictory, surprising or inconclusive data may…
…support a hypothesis.
…inspire revised assumptions.
…oppose a hypothesis.
…inspire revised/new hypothesis.
TESTING IDEAS
Develop technology
Address societal issues
Build knowledge
Inform policy
Satisfy curiosity
Solve everyday problems
BENEFITS AND OUTCOMES
Feedback and peer review
Replication
Discussion with colleagues
Publication
Coming up with new questions/ideas
Theory building
COMMUNITY ANALYSIS AND FEEDBACK

The Art of Problem Posing: the What–If–Not Strategy

- **Level 0: Choosing a Starting Point**
  - This could be an object, a concrete scenario, or a theorem.
- **Level I: Listing Attributes**
  - What are all the key components involved in this starting point?
- **Level II: What-If-Not-ing**
  - What if each attribute were not so - what could it be then?
- **Level III: Question Asking or Problem Posing**
  - What new questions can we ask using these new alternatives?
- **Level IV: Analyzing the Problem**
  - We select some of these questions and try to analyze or answer them.

Stephen I. Brown and Marion I. Walter. *The Art of Problem Posing, Third Edition*. Psychology Press. (2005)

Thinking Mathematically



J. Mason, L. Burton, and K. Stacey. *Thinking Mathematically, Second Edition*. Prentice Hall. (2011)

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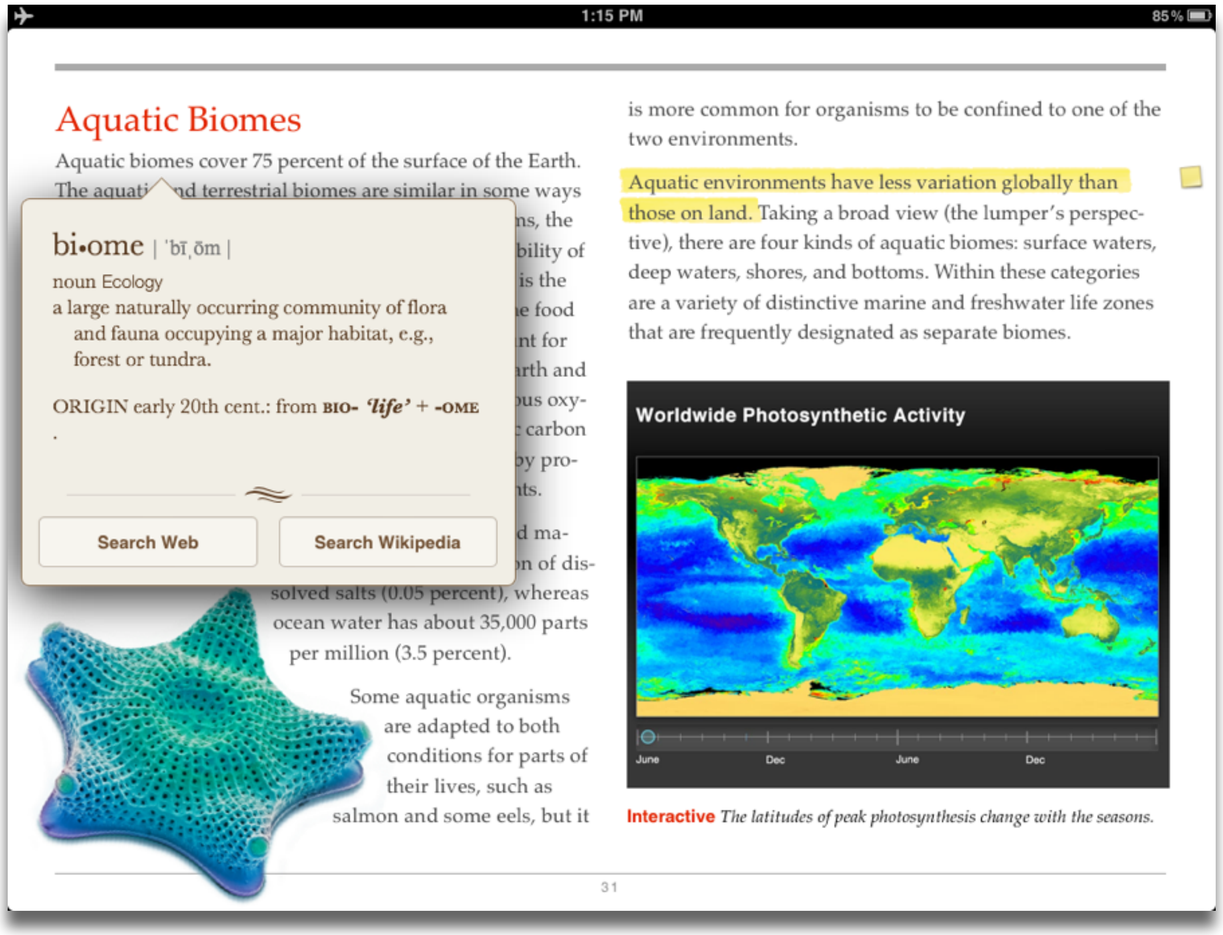

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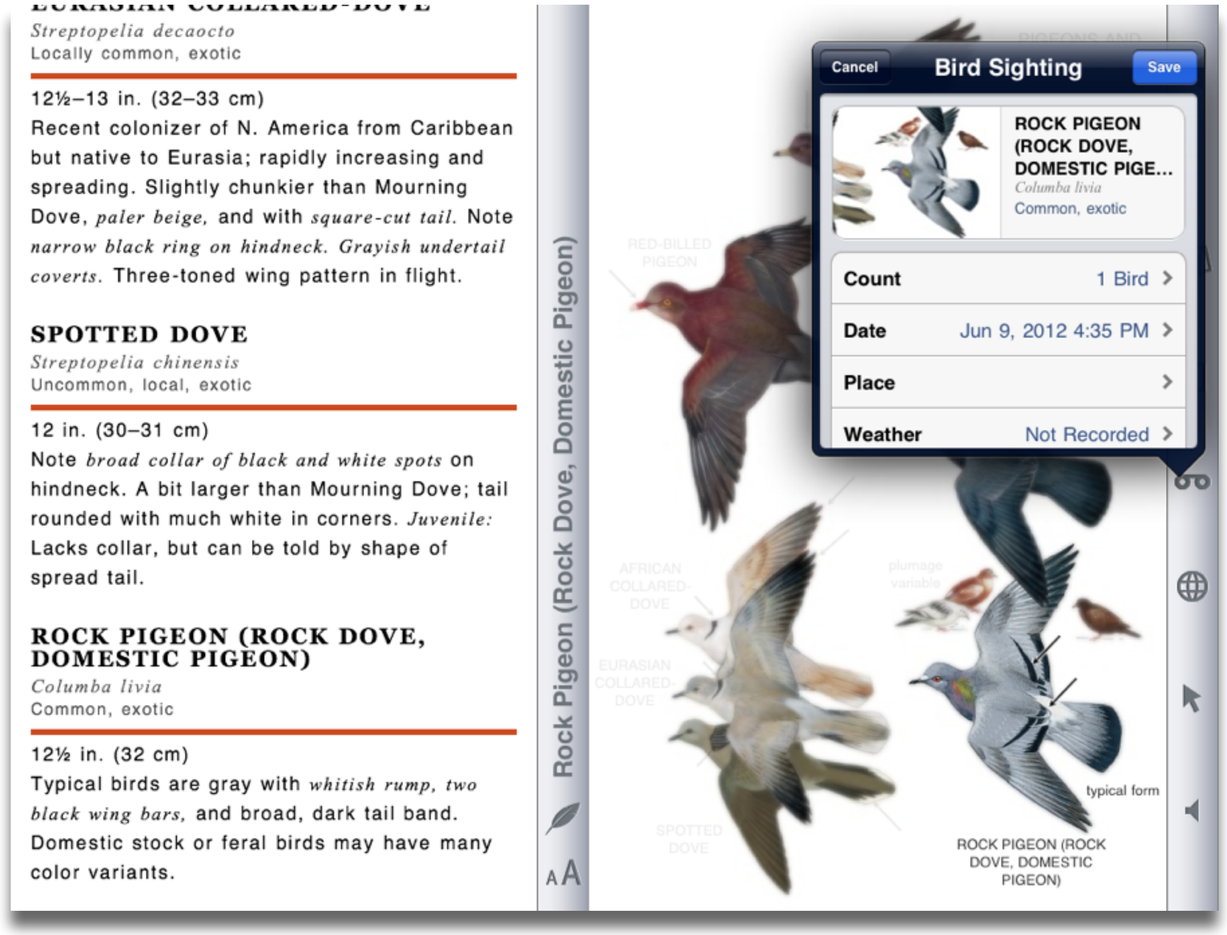

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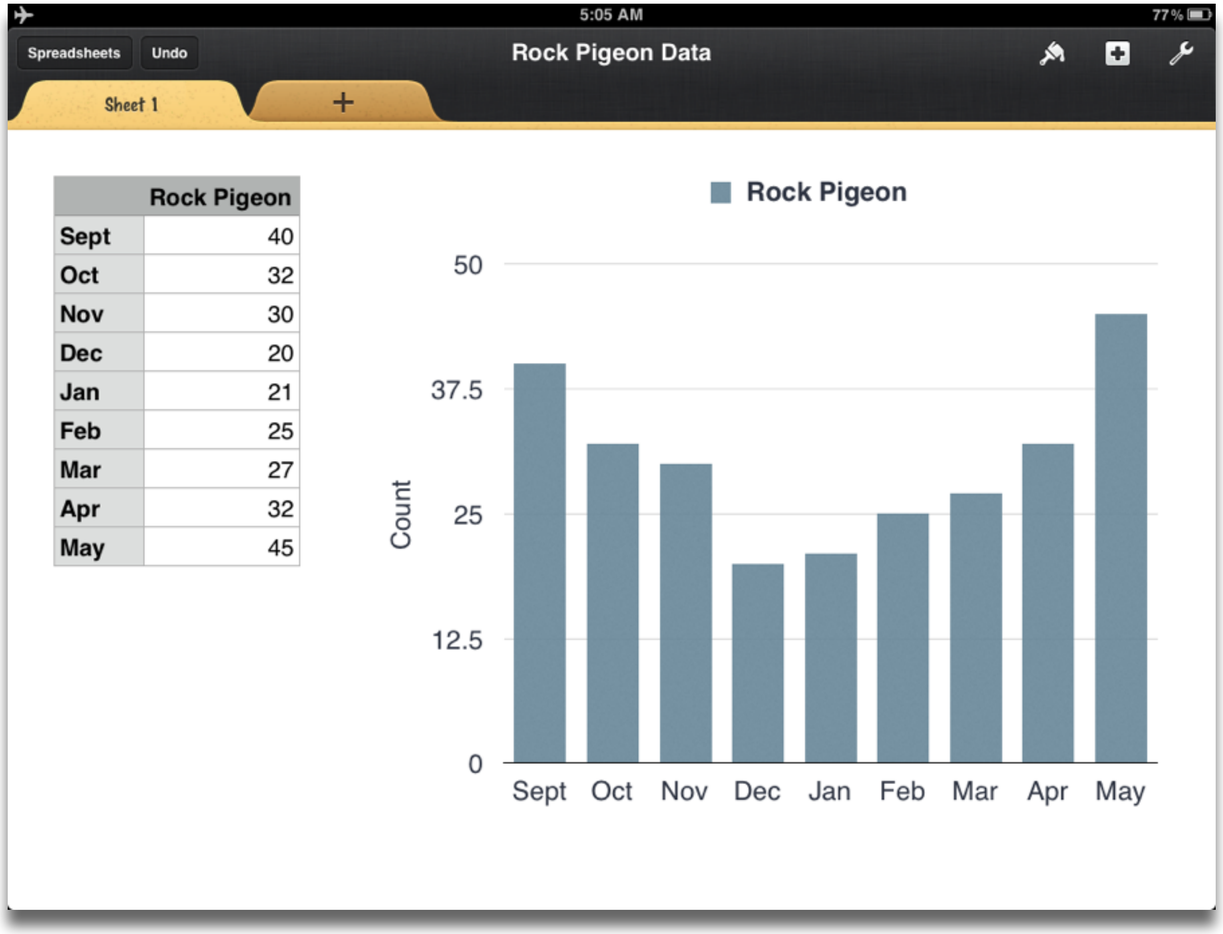

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English Language Arts & Foreign Languages

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

Ten Strategies for Designing Critical Thinking Tasks

- Tasks linking course concepts to students' personal experience or previously existing knowledge
- Explanation of course concepts to new learners
- Thesis support assignments
- Problem-posing assignments
- Data-provided assignments
- Template assignments
- Assignments requiring role-playing of unfamiliar perspectives or imagining "what if" situations
- Summaries or abstracts of articles or course lectures
- Dialogues or argumentative scripts
- Cases and simulations

John C. Bean. *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom, Second Edition*. Jossey-Bass. (2011)

ACTFL Proficiency Guidelines (2012)

	Speaking	Writing	Listening	Reading
Novice	short messages, everyday topics, isolated words/phrases	lists and notes, formulaic information, words and phrases	key words, expressions, simple statements, recognize known phrases	key words, expressions, predictable texts, recognize known text
Intermediate	recombine material, simple questions, sentence-level language	simple messages, simple facts, ideas, connected sentences	sentence-length speech, everyday topics, controlled environment	loosely connected texts, basic information, straightforward texts
Advanced	participatory dialogue, broader topics, paragraph-level	routine texts, factual narratives, paragraph structures	connected discourse, general interest topics, straightforward discourse	main idea of narratives, real-world topics, concrete texts
Superior	accuracy and fluency, abstract elaboration, extended discourse	research texts, complex topics, extended narrative	extended discourse, less familiar topics, specialized narrative	broad range of texts, wide range of subjects, stylistic awareness
Distinguished	articulate users, wide range of concepts, sophisticated discourse	full formal writing, wide range of topics, sophisticated discourse	rich cultural discourse, wide range of topics, sophisticated discourse	wide range of genres, complex topics, sophisticated discourse

ACTFL Proficiency Guidelines. (2012)

Designing Successful Fluency & Accuracy Activities

- **Characteristics of Successful Fluency Activities:**
  1. Comprehensible input (reading and/or listening texts)
  2. Culturally authentic and personalized information gap:
     a. Genuine (students share authentic information, e.g. their own life experiences)
     b. Contrived (students share information assigned to them, e.g. roleplaying someone else's experiences)
  3. Strategy Instruction
  4. Targeted language functions (e.g. narration, persuasion), text types, modes of language use (e.g. interpretive, interpersonal, presentational)
  5. Accountability phase (demonstration of mastery of skills, concepts, or information via multiple formats, e.g. oral presentation, written report, charts, graphs, digital storytelling)
- **Key Accuracy Components:**
  - Grammatical/Syntactical
  - Pronunciation/Intonation/Spelling
  - Lexicon
  - Sociolinguistic

Benjamin Rifkin. "Guidelines for Foreign Language Lesson Planning." *Foreign Language Annals*, Vol. 36 (2), pp 167-179. (2003)

A Five-Phase Lesson Plan

- **Overview**
  - Statement of goals, learning objectives
- **Preparation**
  - Presentation of listening, reading texts
  - Language processing tasks
  - Cultural context and background
  - Discussion of learning, language processing strategies
- **Drill and Practice**
  - Opportunities for discourse, spoken or written, interpersonal or presentational
  - Drill: teacher-centered
  - Practice: learner-centered
- **Check**
  - Demonstration of mastery of skills, concepts
- **Follow-up**
  - Discussion of outcomes, current and future strategies
  - Larger cultural comparisons, analysis

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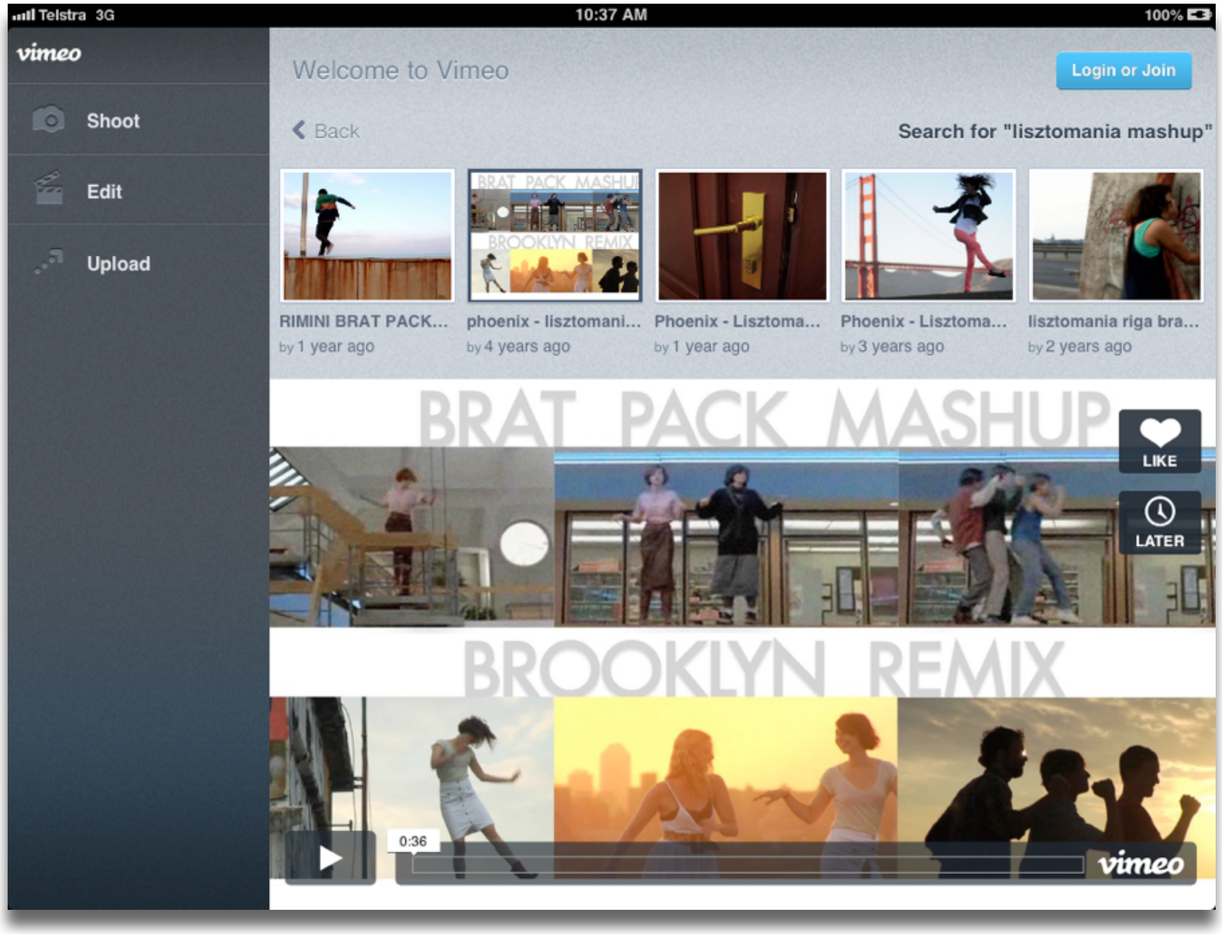

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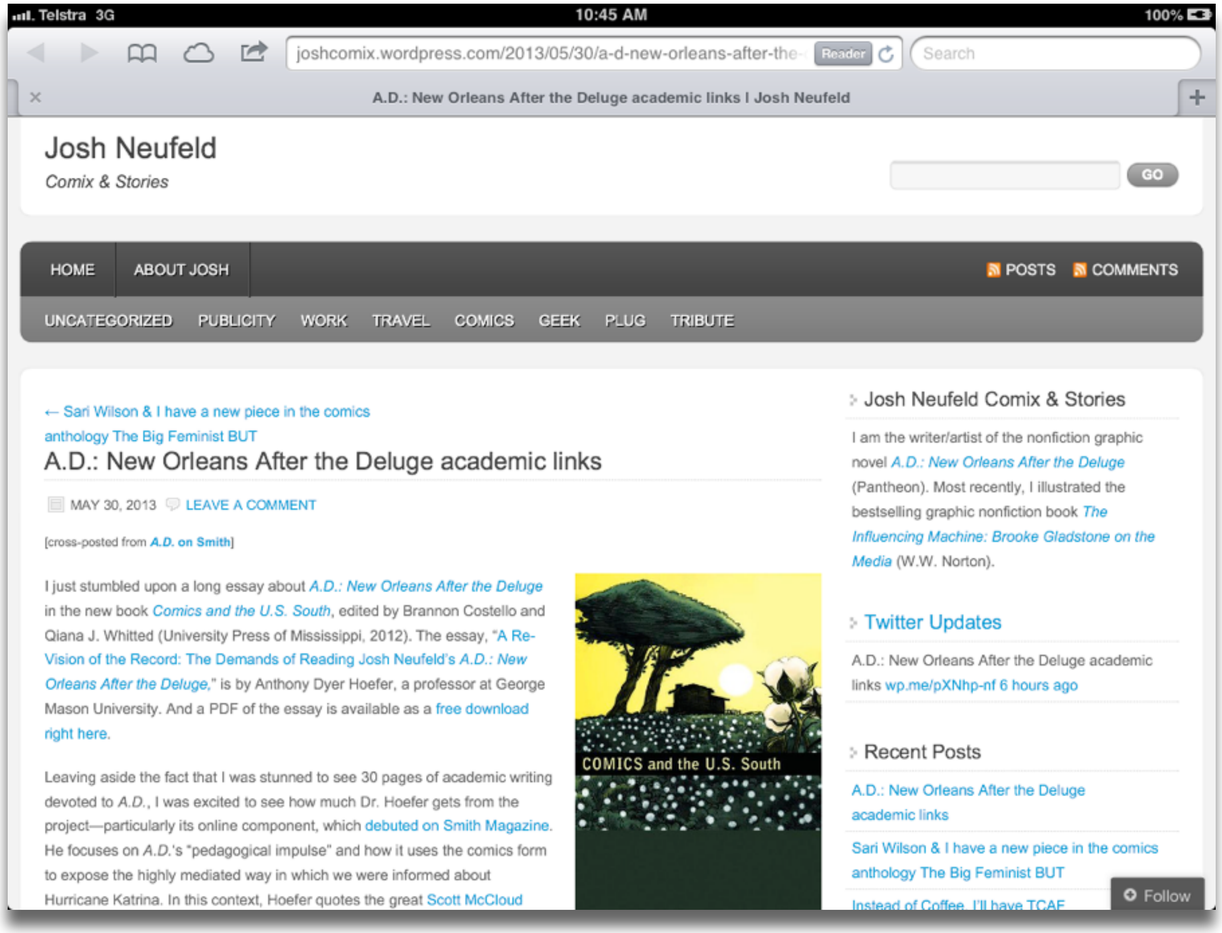

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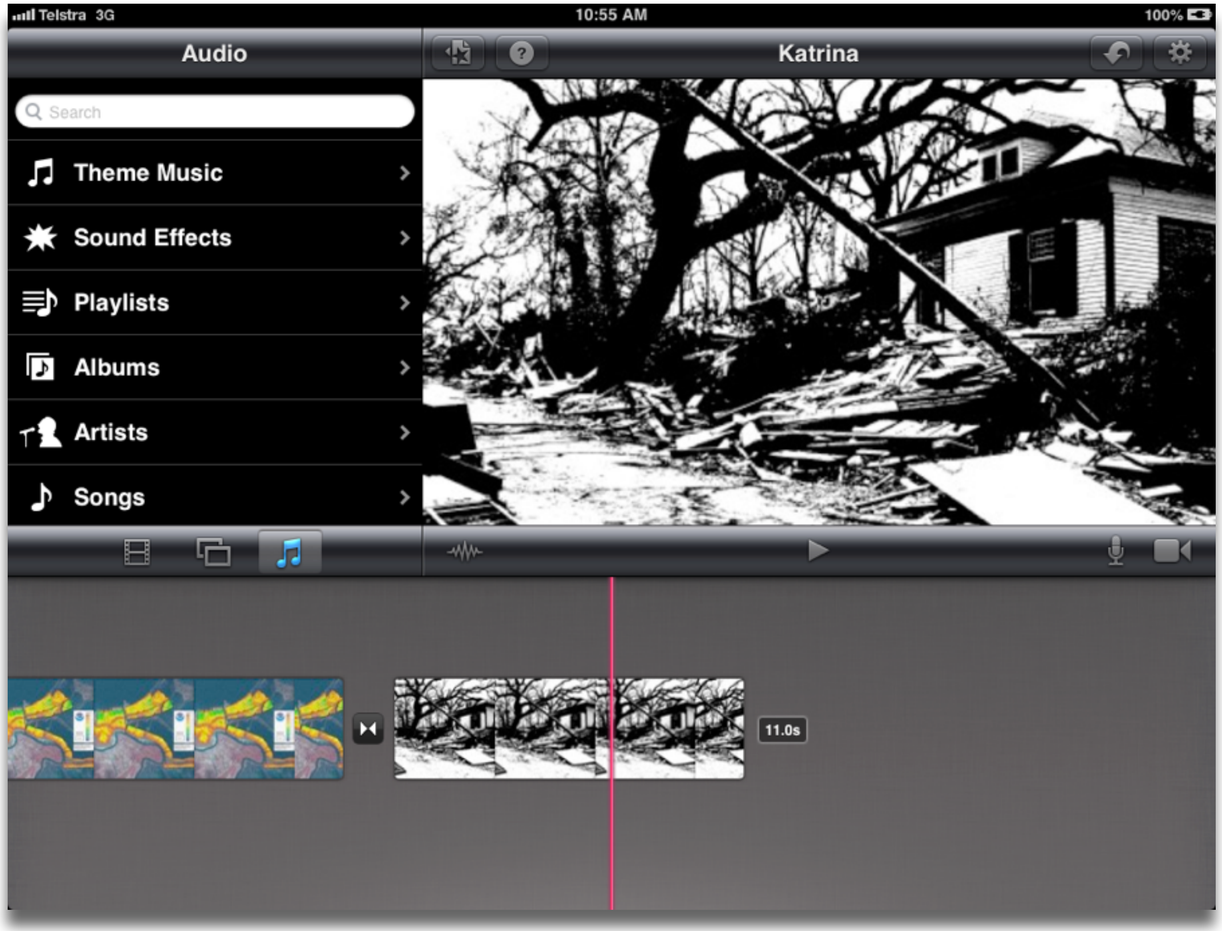


Part 2: The Assessment Challenge

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

Traditional Rubric Design

	Advanced	Proficient	Basic	Below Basic
Topic	Topic is clear	Topic is generally clear	Topic is vague	Topic is unclear
Focus	Demonstrates focus on topic	Minor lapses in focus on topic	Major lapses in focus on topic	Fails to demonstrate focus on topic
…	…	…	…	…

	Advanced	Proficient	Basic	Below Basic
Pretty noises	Has multiple pretty noises	Has only one pretty noise	No pretty noises	Bad, bad, ugly noises
Photos	Lots of colorful photos	One colorful photo	No colorful photos	Ugly, drab photos
(Oh yeah, we'll get to why they created this - eventually…)	…	…	…	…

Example: A Rubric for Concept Maps (Shuman *et al.*, 2004)

	1	*2*	*3*
Comprehensiveness – covering completely/broadly	The map lacks subject definition; the knowledge is very simple and/or limited. Limited breadth of concepts (i.e. minimal coverage of coursework, little or no mention of employment, and/or lifelong learning). The map barely covers some of the qualities of the subject area.	The map has adequate subject definition but knowledge is limited in some areas (i.e., much of the coursework is mentioned but one or two of the main aspects are missing). Map suggests a somewhat narrow understanding of the subject matter.	The map completely defines the subject area. The content lacks no more than one extension area (i.e., most of the relevant extension areas including lifelong learning, employment, people, etc. are mentioned).
Organization – to arrange by systematic planning and united effort	The map is arranged with concepts only linearly connected. There are few (or no) connections within/between the branches. Concepts are not well integrated.	The map has adequate organization with some within/between branch connections. Some, but not complete, integration of branches is apparent. A few feedback loops may exist.	The map is well organized with concept integration and the use of feedback loops. Sophisticated branch structure and connectivity.
Correctness - conforming to or agreeing with fact, logic, or known truth	The map is naïve and contains misconceptions about the subject area; inappropriate words or terms are used. The map documents an inaccurate understanding of certain subject matter.	The map has few subject matter inaccuracies; most links are correct. There may be a few spelling and grammatical errors.	The map integrates concepts properly and reflects an accurate understanding of subject matter meaning little or no misconceptions, spelling/grammatical errors.

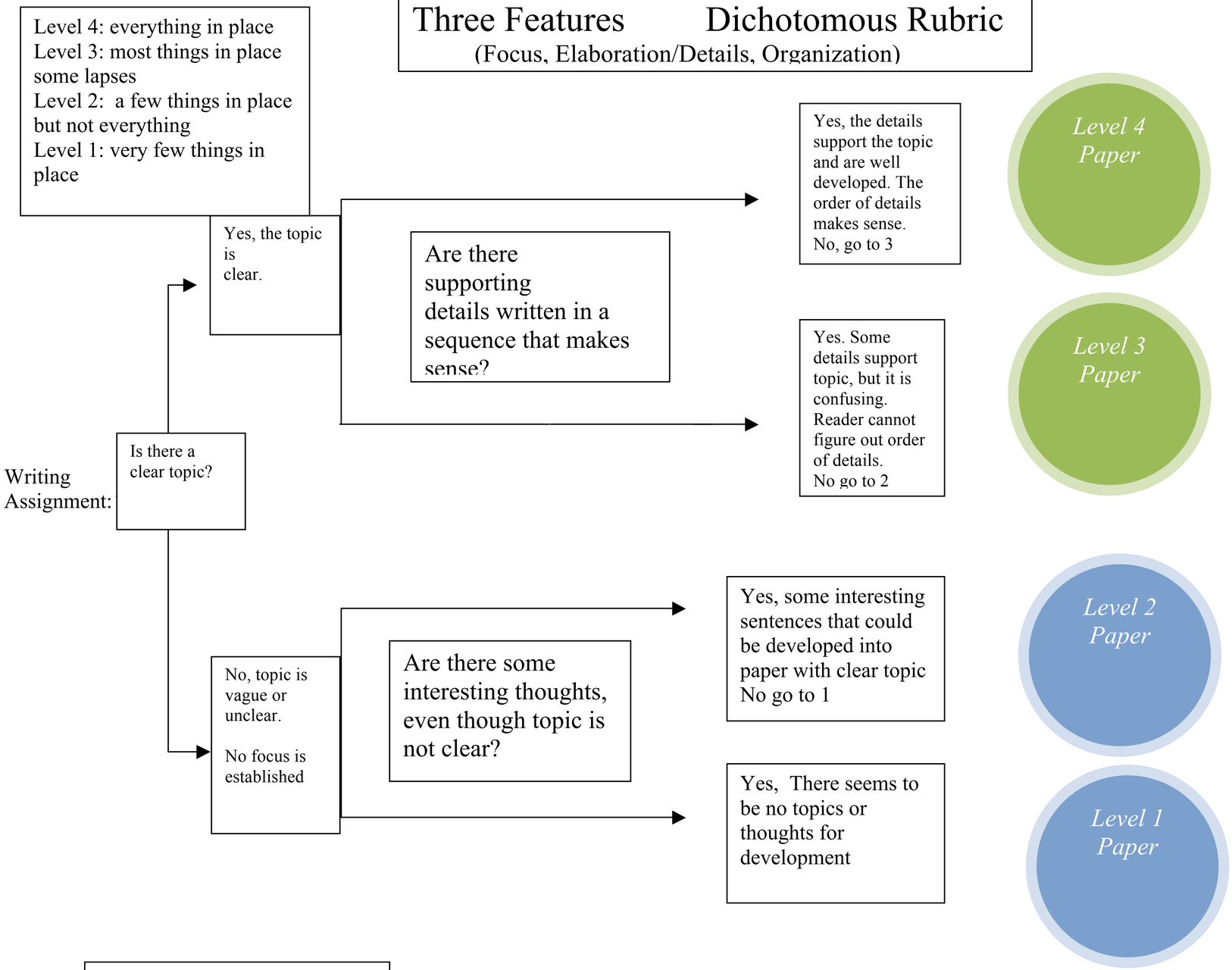
Shuman, L.J., M.E. Besterfield-Sacre, J. Gerchak, M. Lyons and H. Wolfe. “Scoring Concept Maps: An Integrated Rubric for Assessing Engineering Education.” *Journal of Engineering Education*. 105-115 (April 2004)

Example: A Rubric for Sociology Online Discussion (Evans, 2010)

	4 Points	2 Point	0 Points
Content	You show that you can apply or extend the idea you are discussing.	Some of your messages analyze, interpret, or apply the material well, but some do not. This might either be because the analysis was not done well, or because it was not attempted (that is, was simply opinion or hearsay).	Your messages generally show little evidence of analysis, consisting instead of opinion, feelings and impressions.
Accuracy	You accurately represent the concepts discussed.	You generally represent the concepts accurately, but you do not do so in all cases.	You have significant issues with regard to accurately representing the concepts.
Use of material	You use and cite sources, including the text and articles and/or bring in an outside source, all of which clearly add *significantly* to the discussion.	You clearly refer back to a definition, example or concept from the reading or lecture.	You do not bring in or refer to any material from the text, outside sources, or lectures.
Sociological Analysis	You focus on the sociological implications of the issue at hand (e.g., social meaning, the outcomes for society or groups, the social function served).	You touch on some sociological issues, but focus also on individual ones.	You focus primarily on individual issues.
	2 Points	**1 Point**	**0 Points**
Responses	You extend or politely question the post of another person in a way that advances the discussion.	You add new examples that continue the idea created by another person.	Your responses are primarily agreement.
Participation	You write at least three or more substantive comments (using the above criteria) based on the discussion assigned.		You write fewer than three substantive comments.
Time of Posting	Your posts are spread widely during the discussion.	You post at two significantly different times.	Your posts are clustered within a short period of time.
Posts Read	You have read at least 75% of the posts in the discussion.	You read at least 50% of the posts in the discussion.	You read less than 50% of the posts in the discussion.
Clarity	You use standard grammar and spelling and your meaning is clear.	Your posts have some grammar or spelling mistakes or your meaning is not entirely clear.	Your posts have significant grammar or spelling mistakes or your meaning is not clear.

Three Features Dichotomous Rubric

(Focus, Elaboration/Details, Organization)

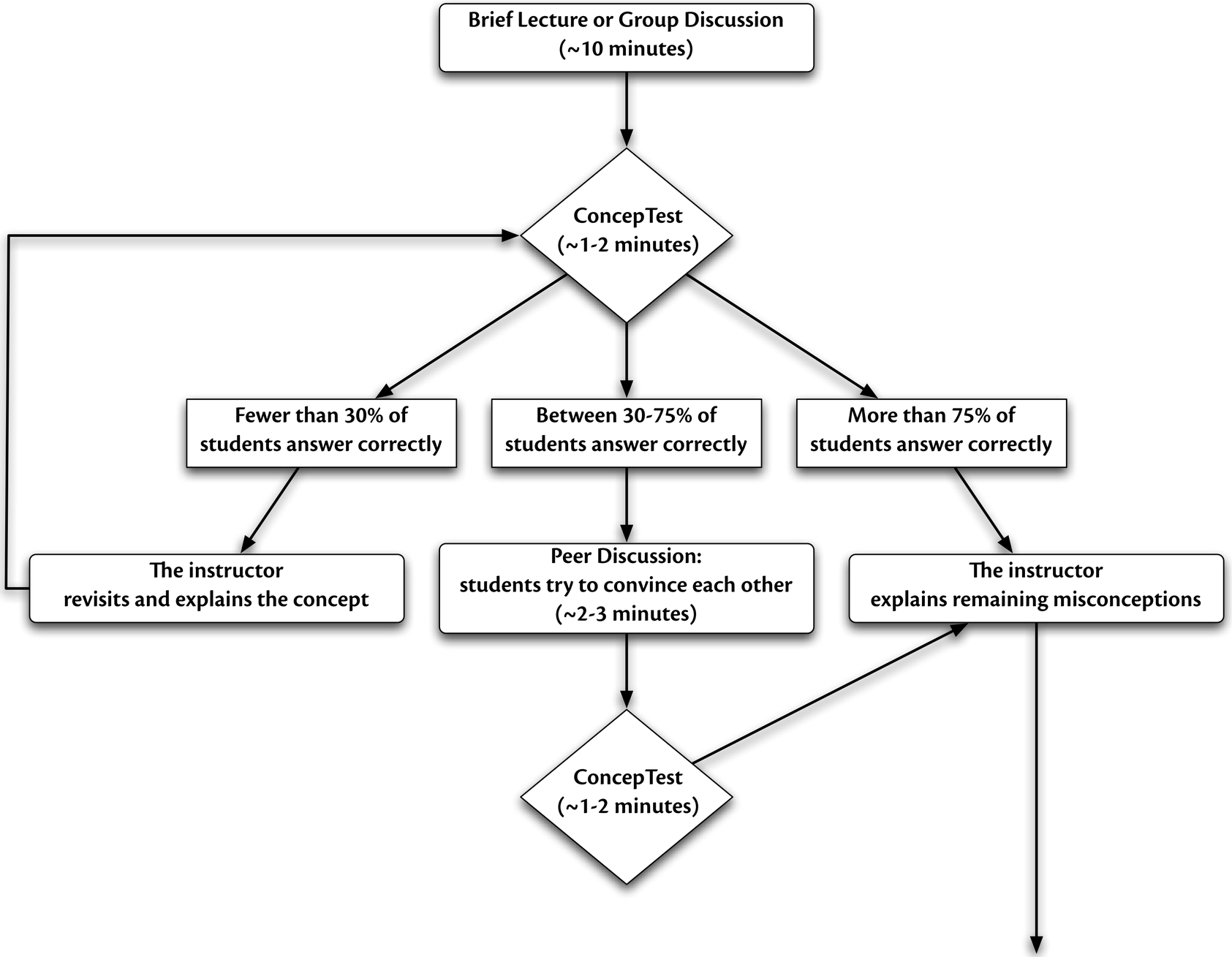


Developed by Vickie Hedrick

Hedrick, V. *Continuous Improvement in the Language Arts Classroom*. Quality Press (2010)

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



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

Redefinition

Tech allows for the creation of new tasks, previously inconceivable

Modification

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Augmentation

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Substitution

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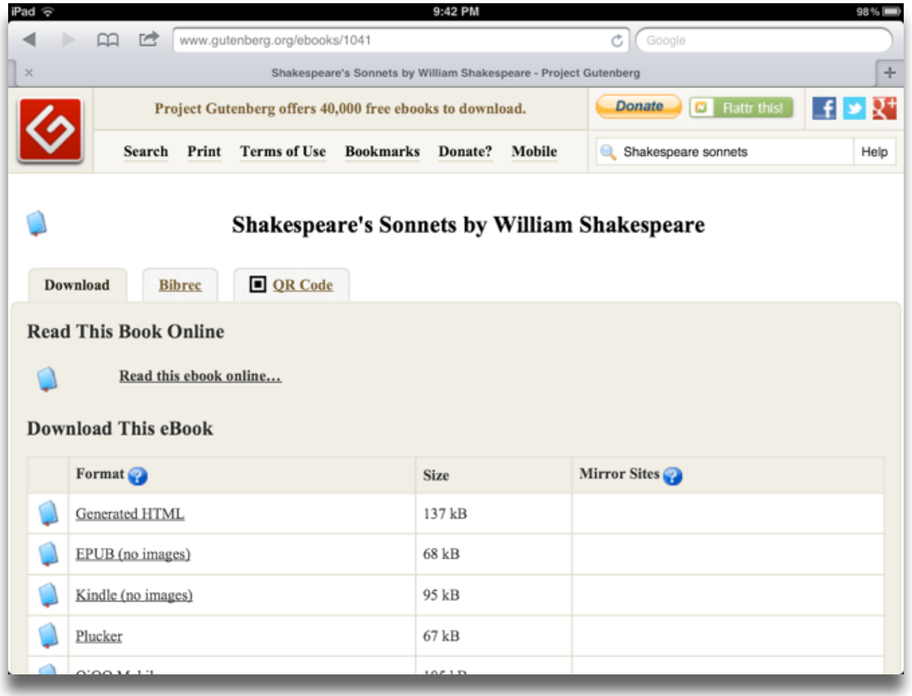

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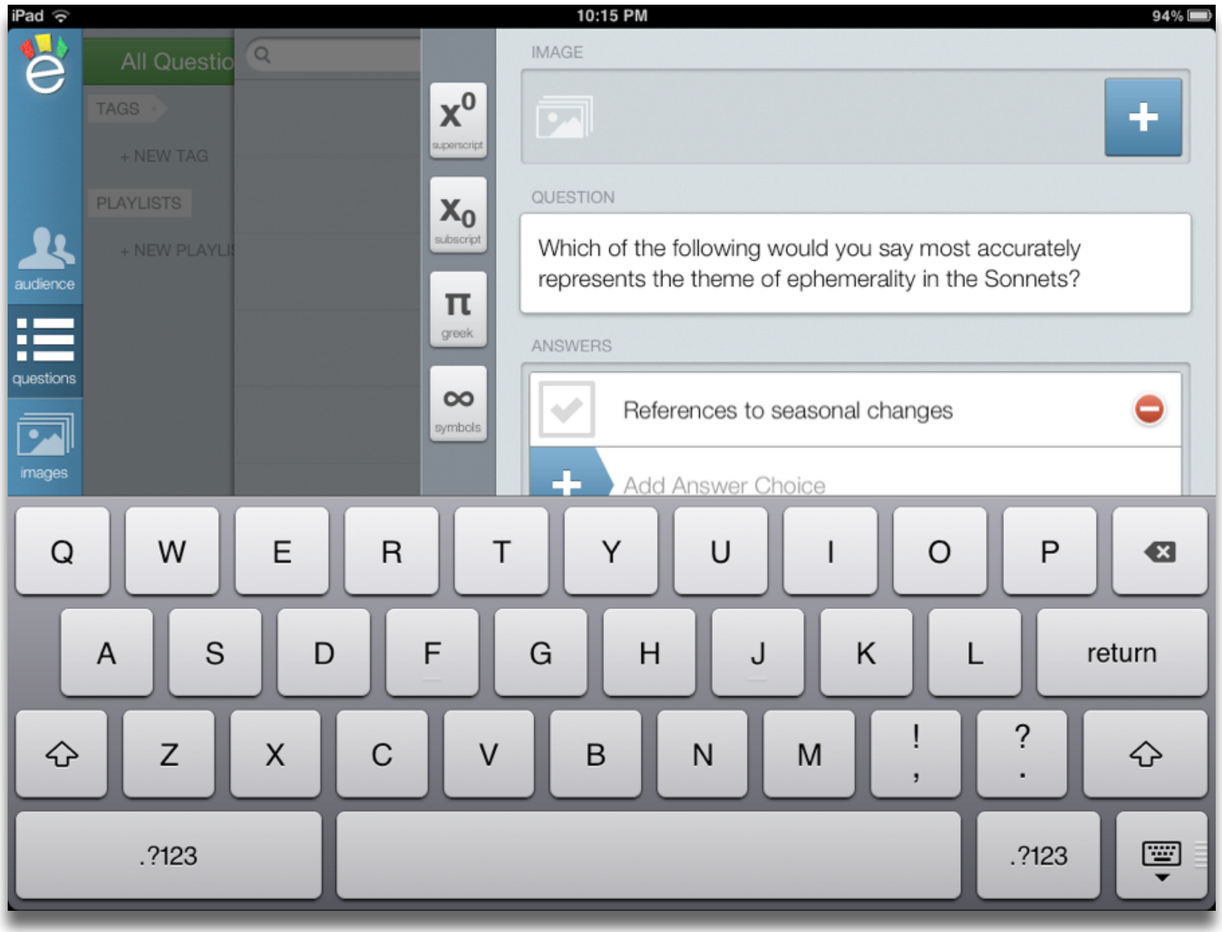

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3. Providing Feedback that Moves Learners Forward

- 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

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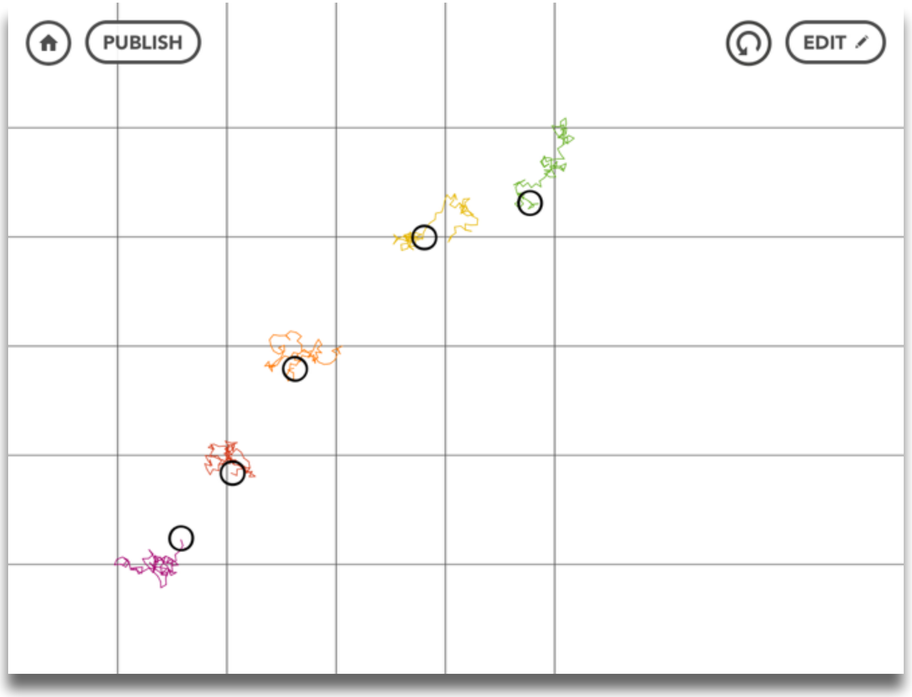

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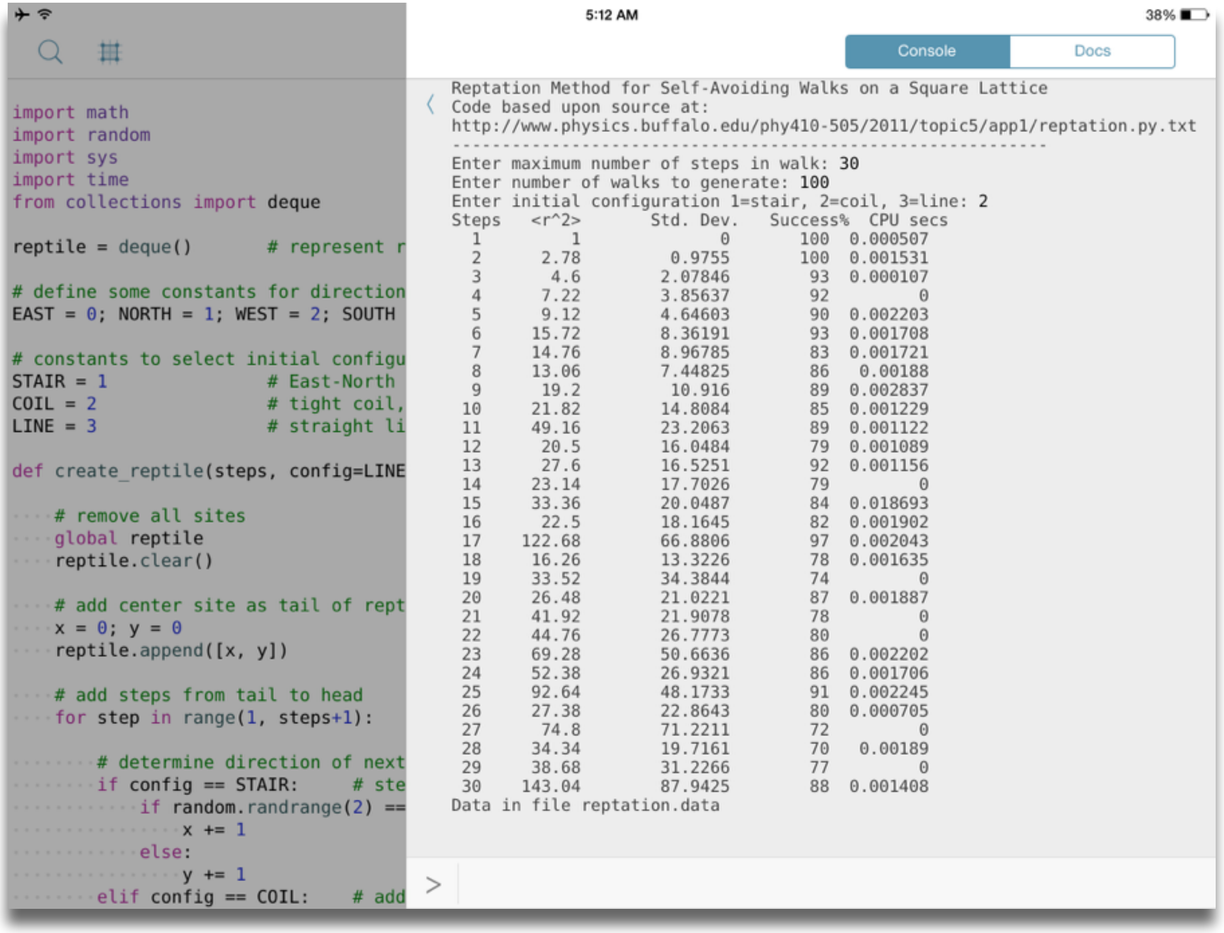

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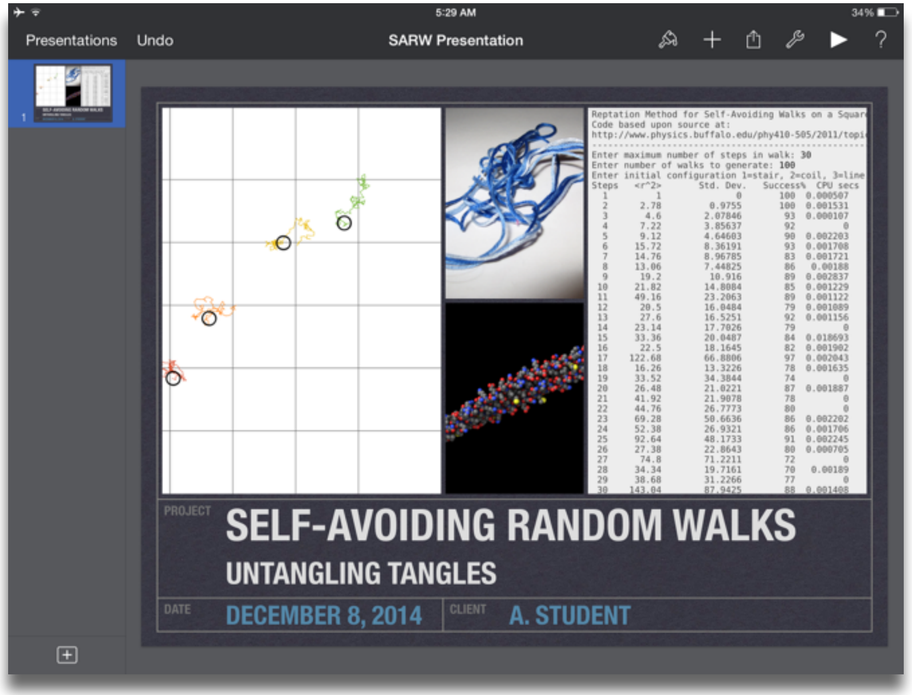
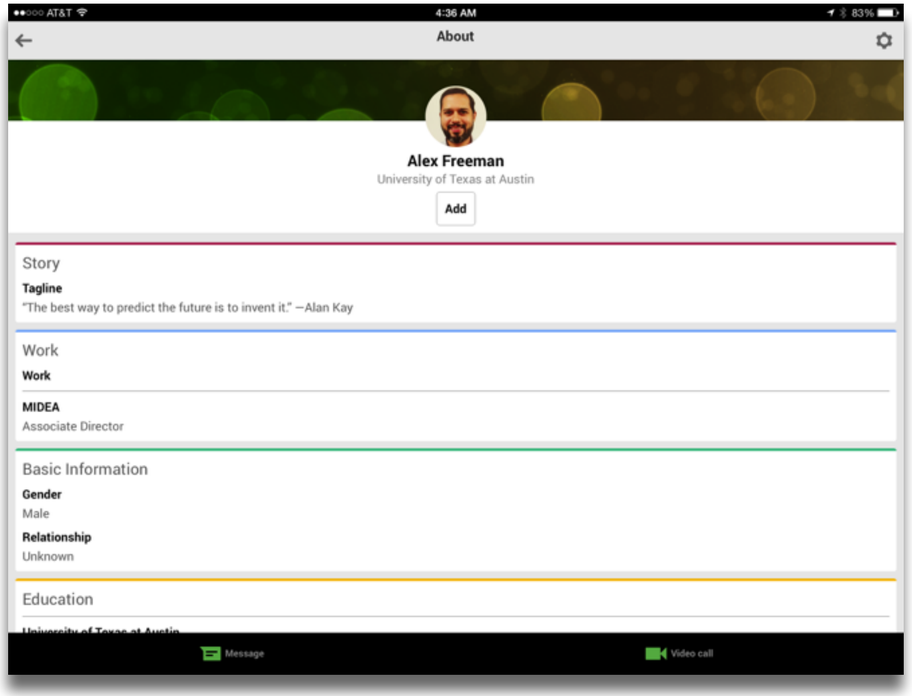
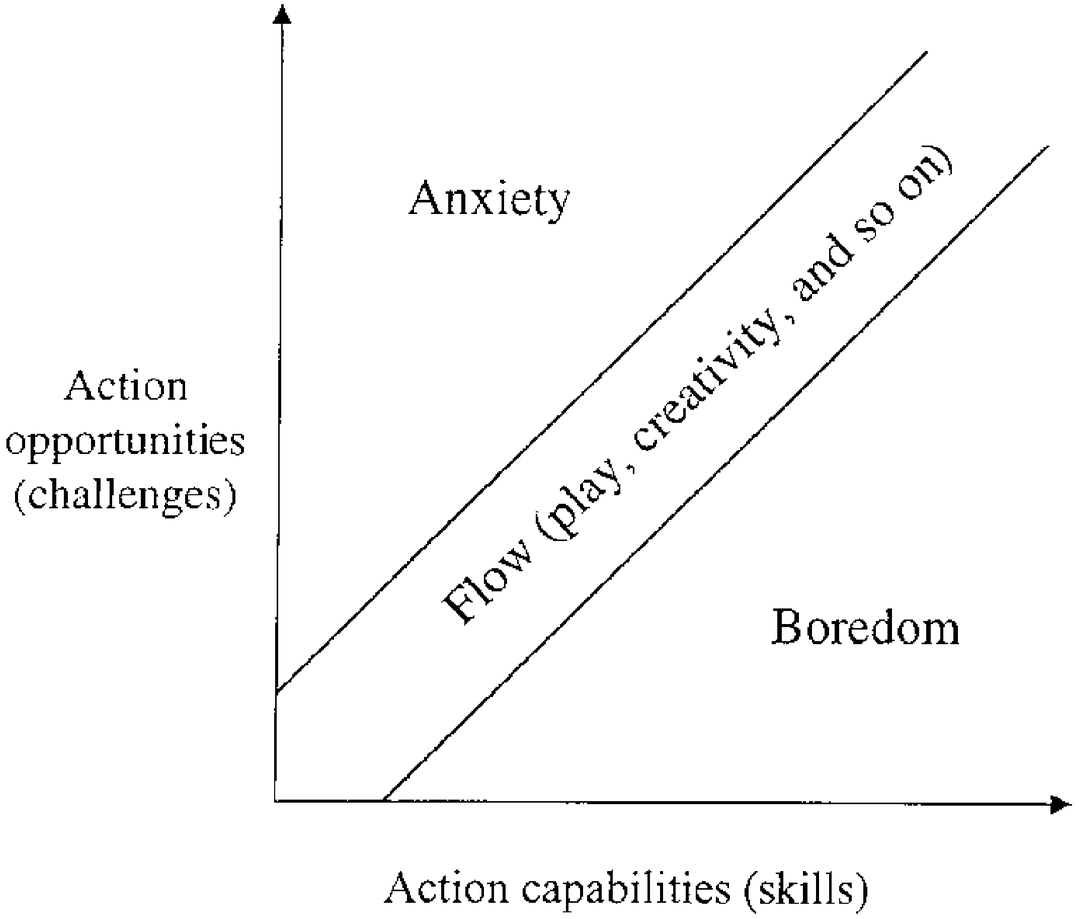
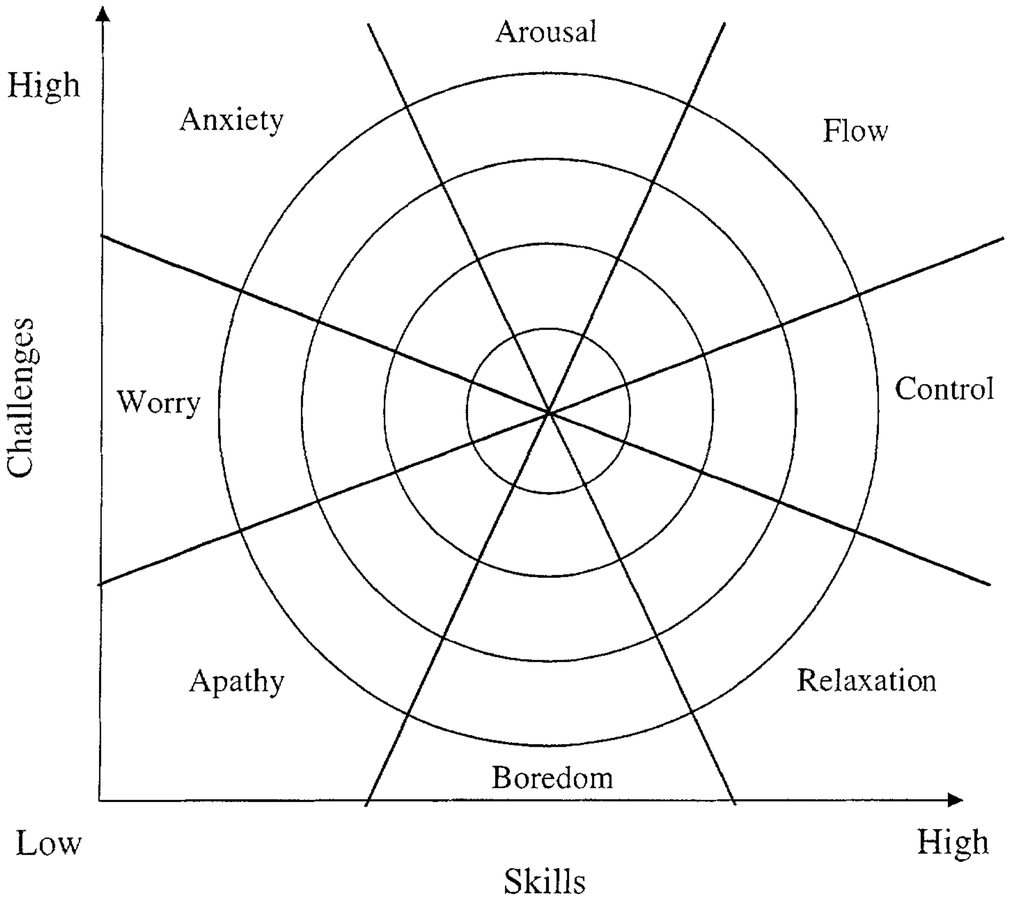




5. Activating Students as Owners of their Own Learning

- 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)

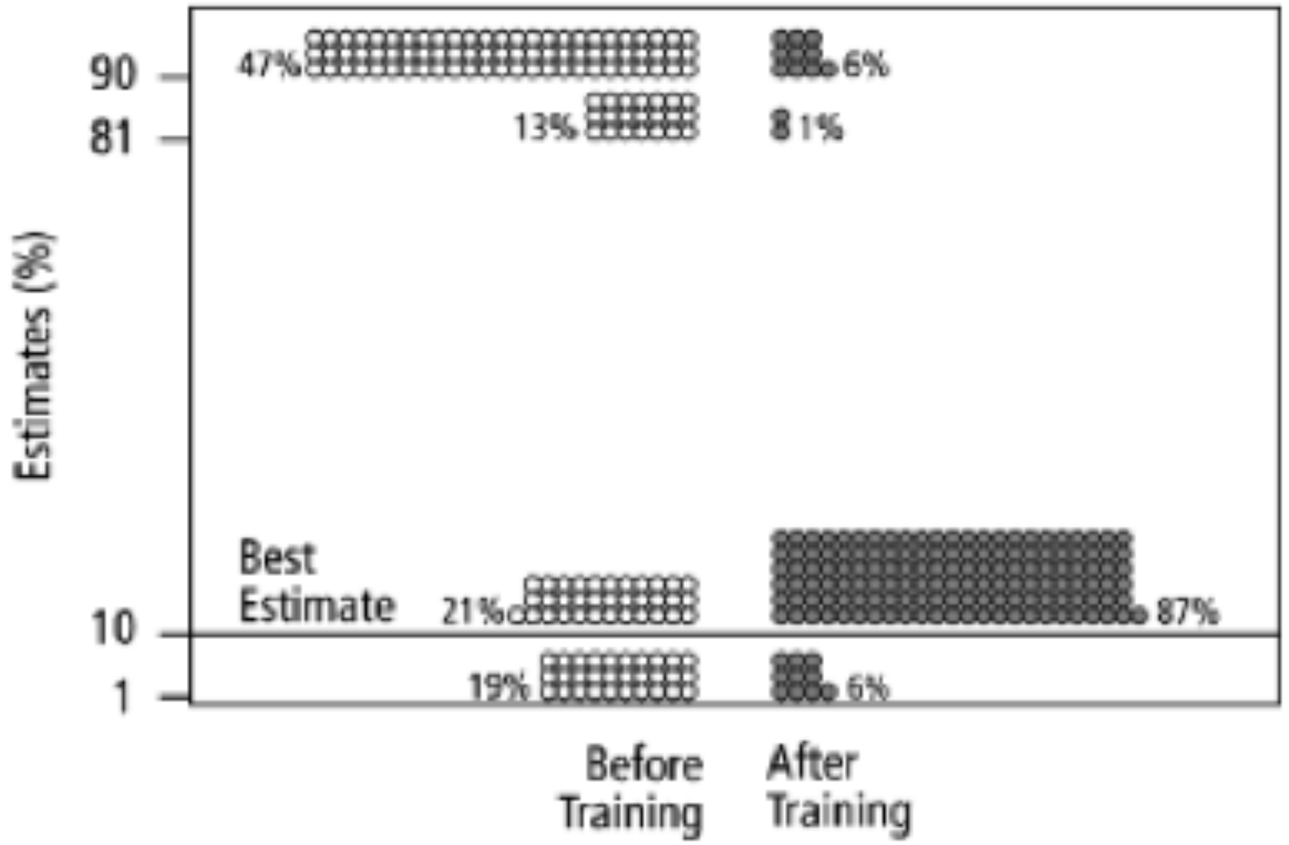


Fig. 2. Estimates by 160 gynecologists of the probability that a woman has breast cancer given a positive mammogram, before and after receiving training in how to translate conditional probabilities into natural frequencies.

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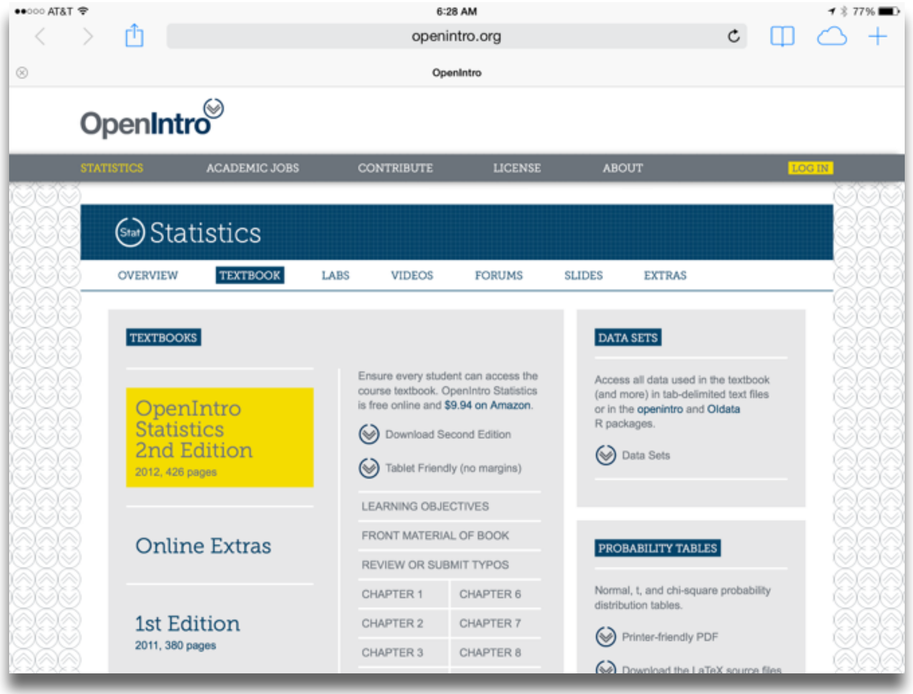

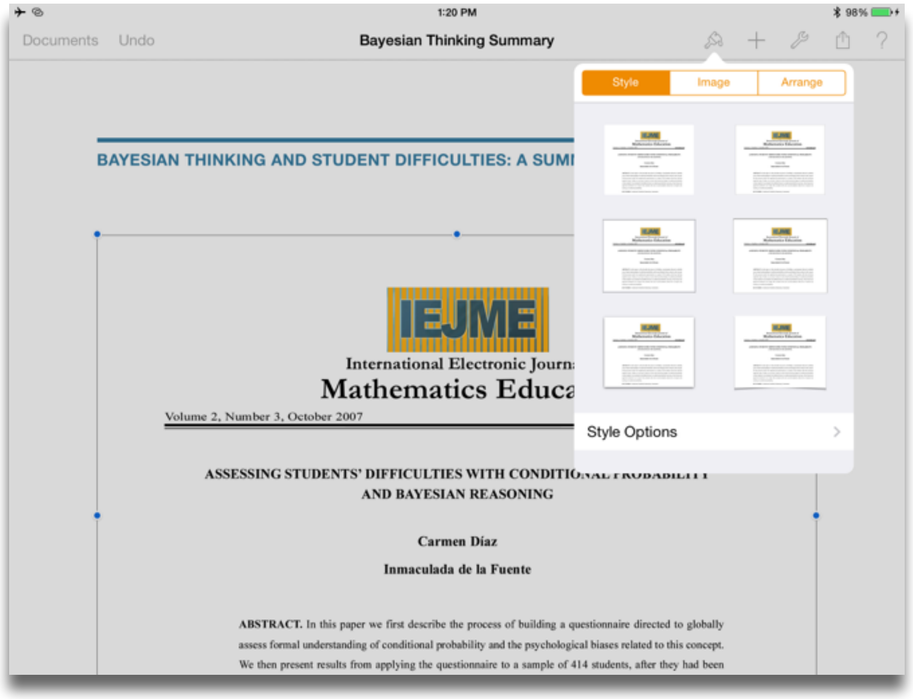

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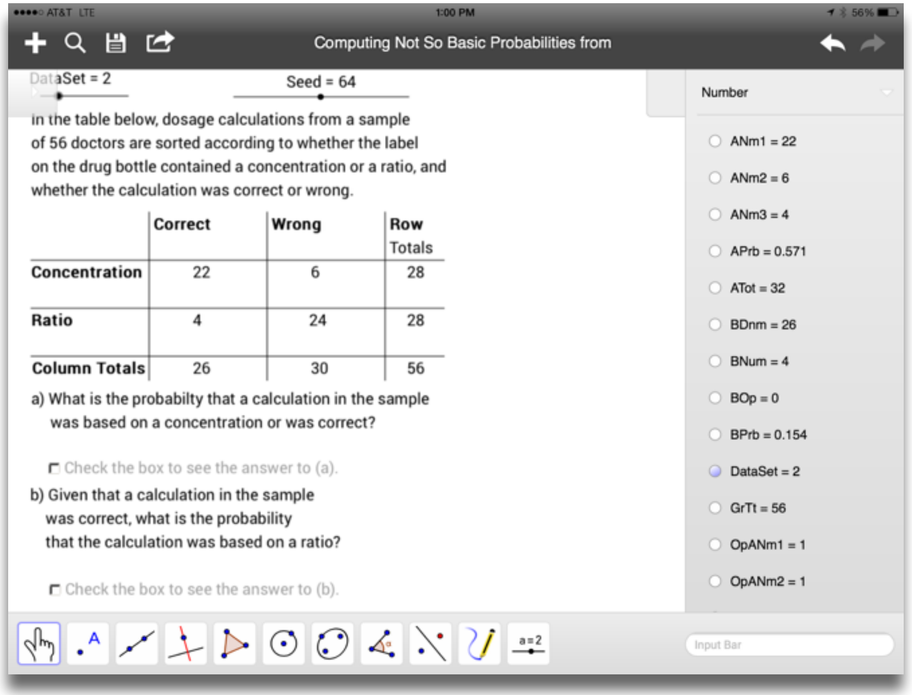

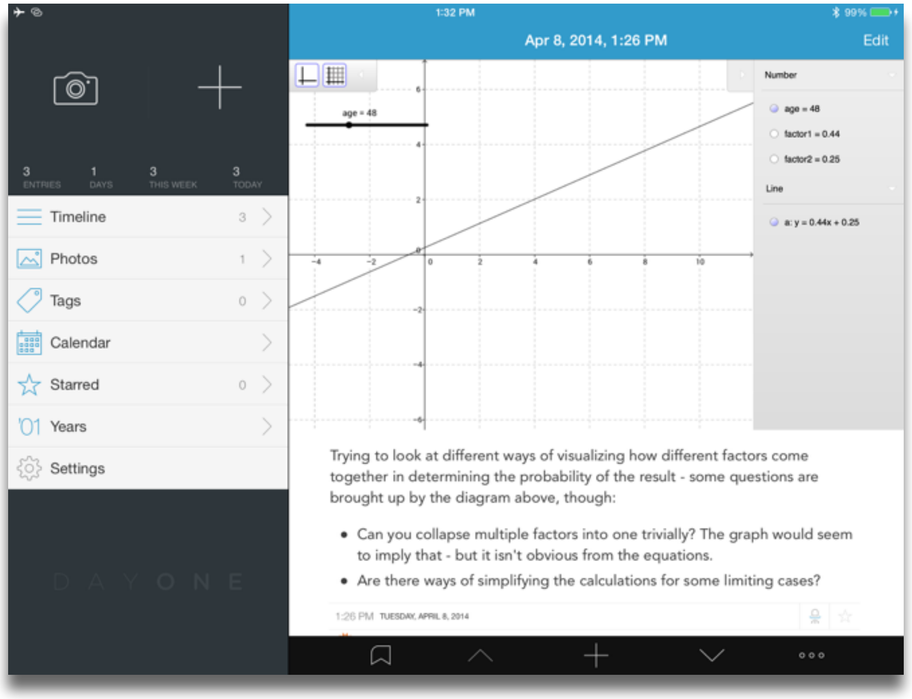

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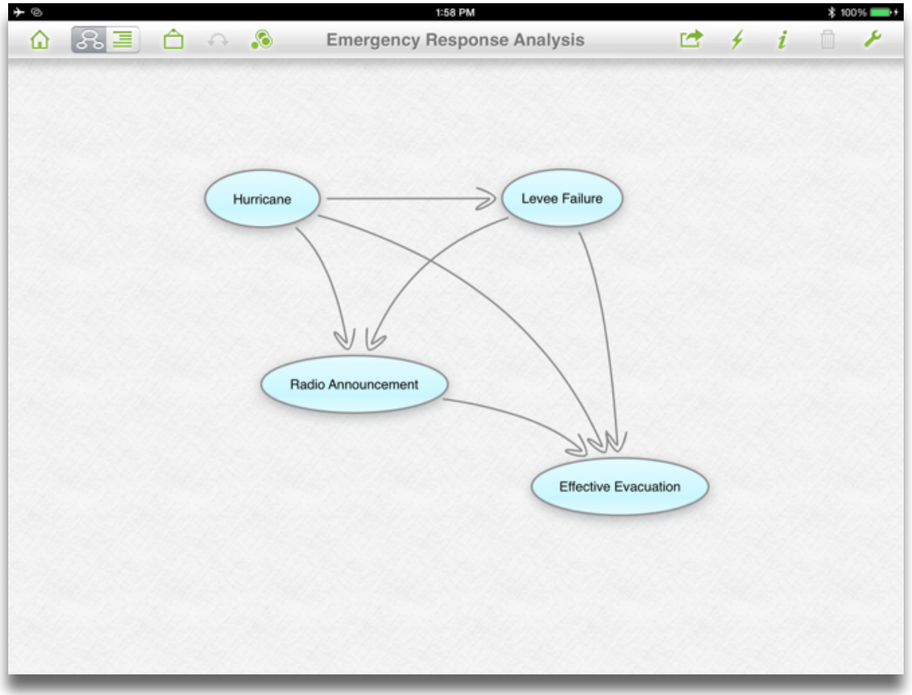

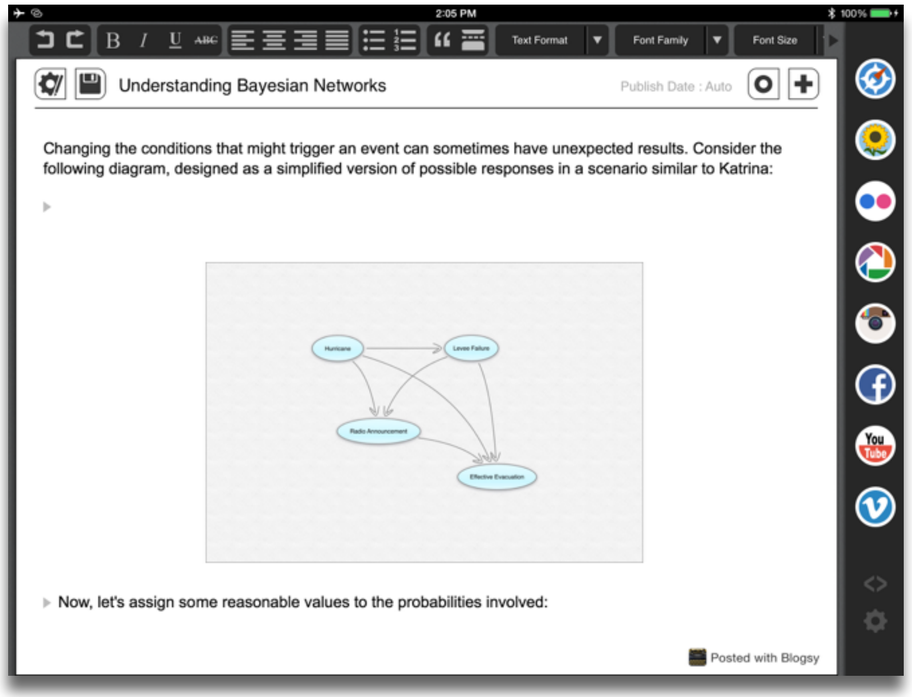

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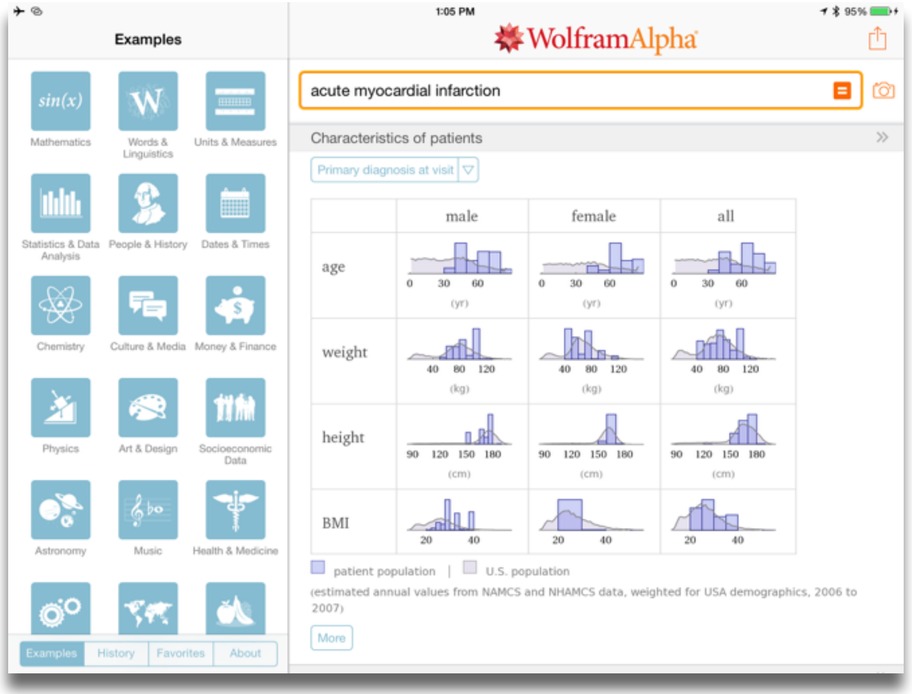

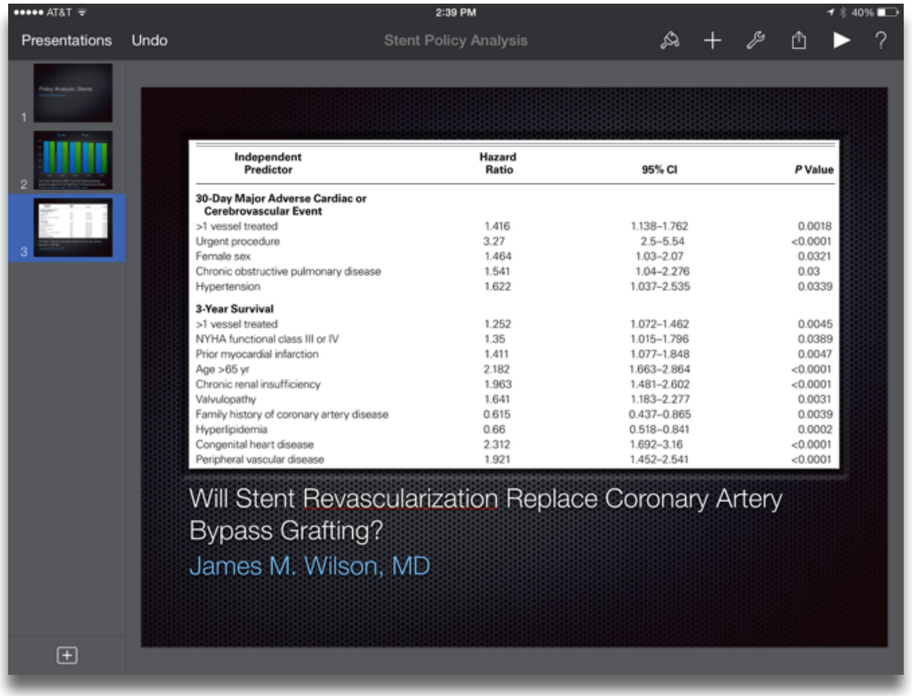

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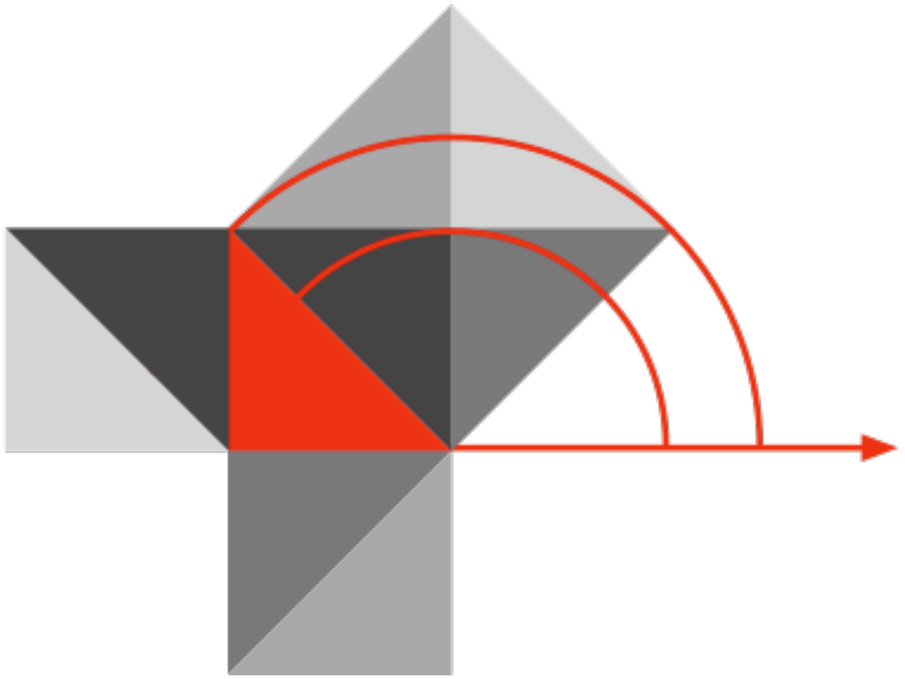

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