Evolving the STEM Classroom:
Action Research and Professional Development

Ruben R. Puentedura, Ph.D.

Four Defining Characteristics of Action Research

- Practical Nature
- Change-Oriented
- Part of a Cyclical Process
- Teachers are Active Researchers and Participants

Martyn Denscombe. *The Good Research Guide: For small-scale social research projects (5th Edition).* Open University Press. (2014).

Three Approaches to Action Research	
Technical Action Research	Improve the effectiveness or efficiency of educational practice
Practical Action Research	Improve the teacher's understanding and professional development
Emancipatory Action Research	Improve the educational organization or system and remove obstacles to change

Wilfred Carr and Stephen Kemmis. *Becoming Critical: Education, Knowledge, and Action Research.* Deakin University Press. (1986).

Thick *vs*. Thin Approaches

- **Thick Approaches:** *detailed knowledge of a few cases*
  - Consider multiple intertwined causes
  - Try to explain multifaceted outcomes
  - Rely on elaborate theoretical assumptions
  - Suitable for rich understanding of specific events
  - Frequently associated with qualitative analysis
- **Thin Approaches:** *partial knowledge of many cases*
  - Look at simple causes and outcomes
  - Rely on theoretically neutral propositions
  - Suitable for hypothesis testing and generalization
  - Frequently associated with quantitative analysis
- It is possible to thicken thin approaches by e.g. triangulation, developing quantitative indicators of qualitative concepts, nested analysis

Michael Coppedge. *Democratization and Research Methods*. Cambridge University Press. (2012).

Read

Published Mar 1, 2016

ENHANCED

This book includes video.

REQUIREMENTS

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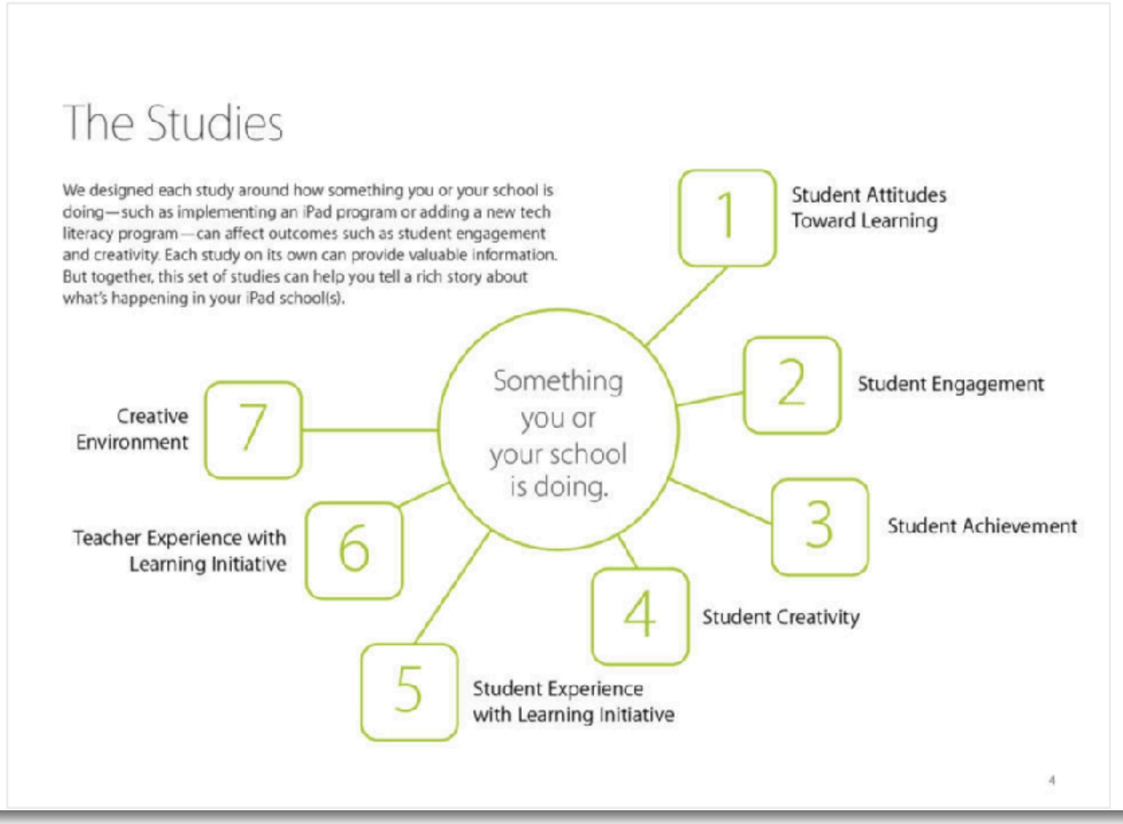
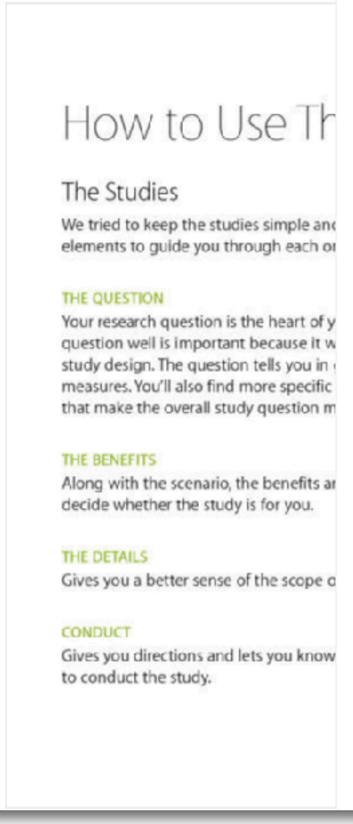
About the Book

With the help of academic researchers, we created this book to give you a few ideas about how to conduct research in your classroom, school, or even district. They're basic, easy-to-conduct studies that you can use as is or adapt to your own needs. We hope that by investing time to conduct one or more of these studies, you'll get a better understanding of how iPad is impacting your students and school and what your next steps might be.

Screenshots





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)

Meta-analysis	Number of studies	*ES* type	Mean *ES*	*SE*
Bangert-Drowns (1993)	19	Missing	0.27	0.11
Bayraktar (2000)	42	Cohen's *d*	0.27	0.05
Blok, Oostdam, Otter, and Overmaat (2002)	25	Hedges's *g*	0.25	0.06
Christmann and Badgett (2000)	16	Missing	0.13	0.05
Fletcher-Flinn and Gravatt (1995)	120	Glass's Δ	0.24	0.05
Goldberg, Russell, and Cook (2003)	15	Hedges's *g*	0.41	0.07
Hsu (2003)	25	Hedges's *g*	0.43	0.03
Koufogiannakis and Wiebe (2006)	8	Hedges's *g*	−0.09	0.19
Kuchler (1998)	65	Hedges's *g*	0.44	0.05
Kulik and Kulik (1991)	239	Glass's Δ	0.30	0.03
Y. C. Liao (1998)	31	Glass's Δ	0.48	0.05
Y.-I. Liao and Chen (2005)	21	Glass's Δ	0.52	0.05
Y. K. C. Liao (2007)	52	Glass's Δ	0.55	0.05
Michko (2007)	45	Hedges's *g*	0.43	0.07
Onuoha (2007)	35	Cohen's *d*	0.26	0.04
Pearson, Ferdig, Blomeyer, and Moran (2005)	20	Hedges's *g*	0.49[a]	0.11
Roblyer, Castine, and King (1988)	35	Hedges's *g*	0.31	0.05
Rosen and Salomon (2007)	31	Hedges's *g*	0.46	0.05
Schenker (2007)	46	Cohen's *d*	0.24	0.02
Soe, Koki, and Chang (2000)	17	Hedges's *g* and Pearson's *r*[a]	0.26[a]	0.05
Timmerman and Kruepke (2006)	114	Pearson's *r*[a]	0.24	0.03
Torgerson and Elbourne (2002)	5	Cohen's *d*	0.37	0.16
Waxman, Lin, and Michko (2003)	42	Glass's Δ	0.45	0.14
Yaakub (1998)	20	Glass's Δ and *g*	0.35	0.05
Zhao (2003)	9	Hedges's *g*	1.12	0.26

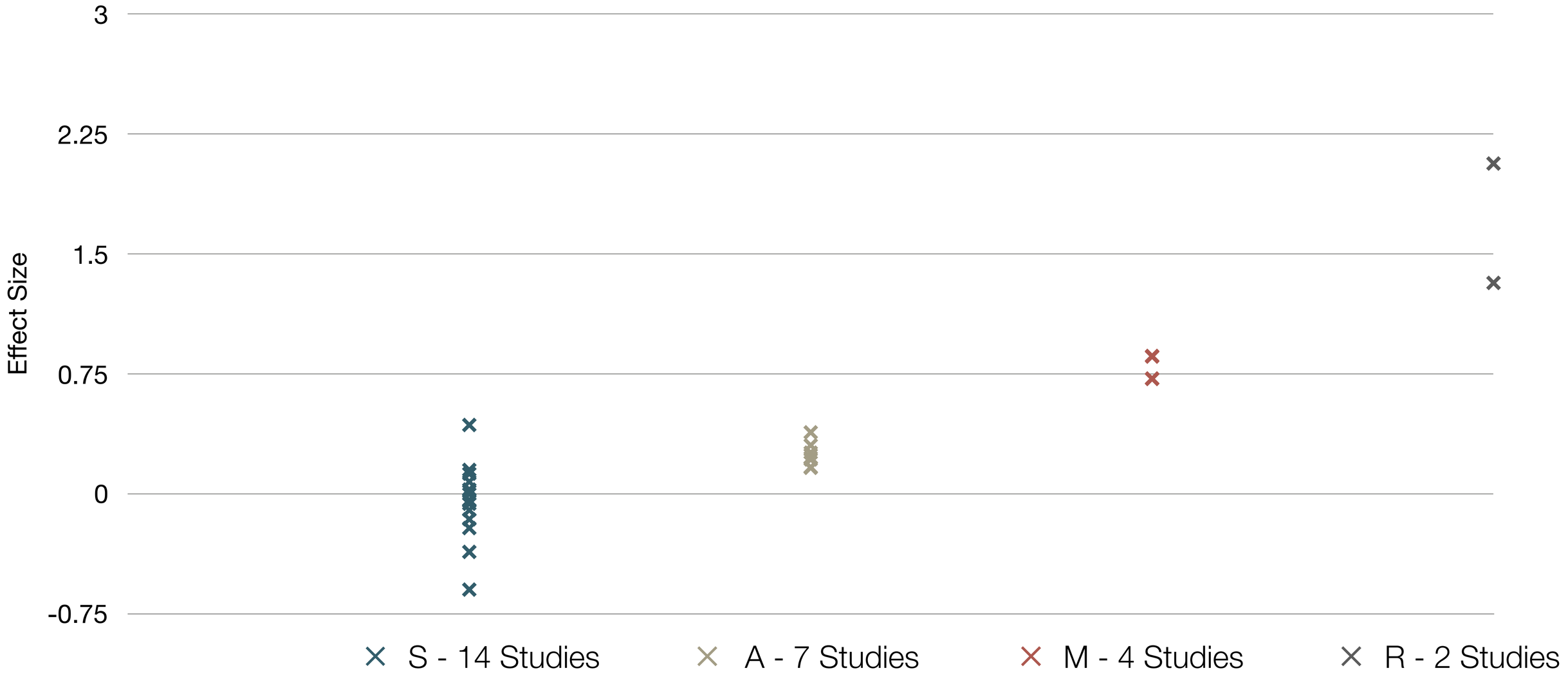
a. Converted to Cohen's *d*.

Tamim, Rana M., Robert M. Bernard, Eugene Borokhovski, Philip C. Abrami, and Richard F. Schmid. "What forty years of research says about the impact of technology on learning a second-order meta-analysis and validation study." *Review of Educational Research 81*, no. 1 (2011): 4-28.

Determining SAMR Level: Questions and Transitions

- **Substitution:**
  - What is gained by replacing the older technology with the new technology?
- **Substitution to Augmentation:**
  - Has an improvement been added to the task process that could not be accomplished with the older technology at a fundamental level?
  - How does this feature contribute to the design?
- **Augmentation to Modification:**
  - How is the original task being modified?
  - Does this modification fundamentally depend upon the new technology?
  - How does this modification contribute to the design?
- **Modification to Redefinition:**
  - What is the new task?
  - Is any portion of the original task retained?
  - How is the new task uniquely made possible by the new technology?
  - How does it contribute to the design?

SAMR and the Use of Tablets in Education



Tamim, R.M., Borokhovski, E., Pickup, D., Bernard, R.M. & El Saadi, L. “Tablets for Teaching and Learning: A Systematic Review and Meta-Analysis." *Commonwealth of Learning (COL)* (2015).

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)

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)

Bloom's Taxonomy: Cognitive Processes

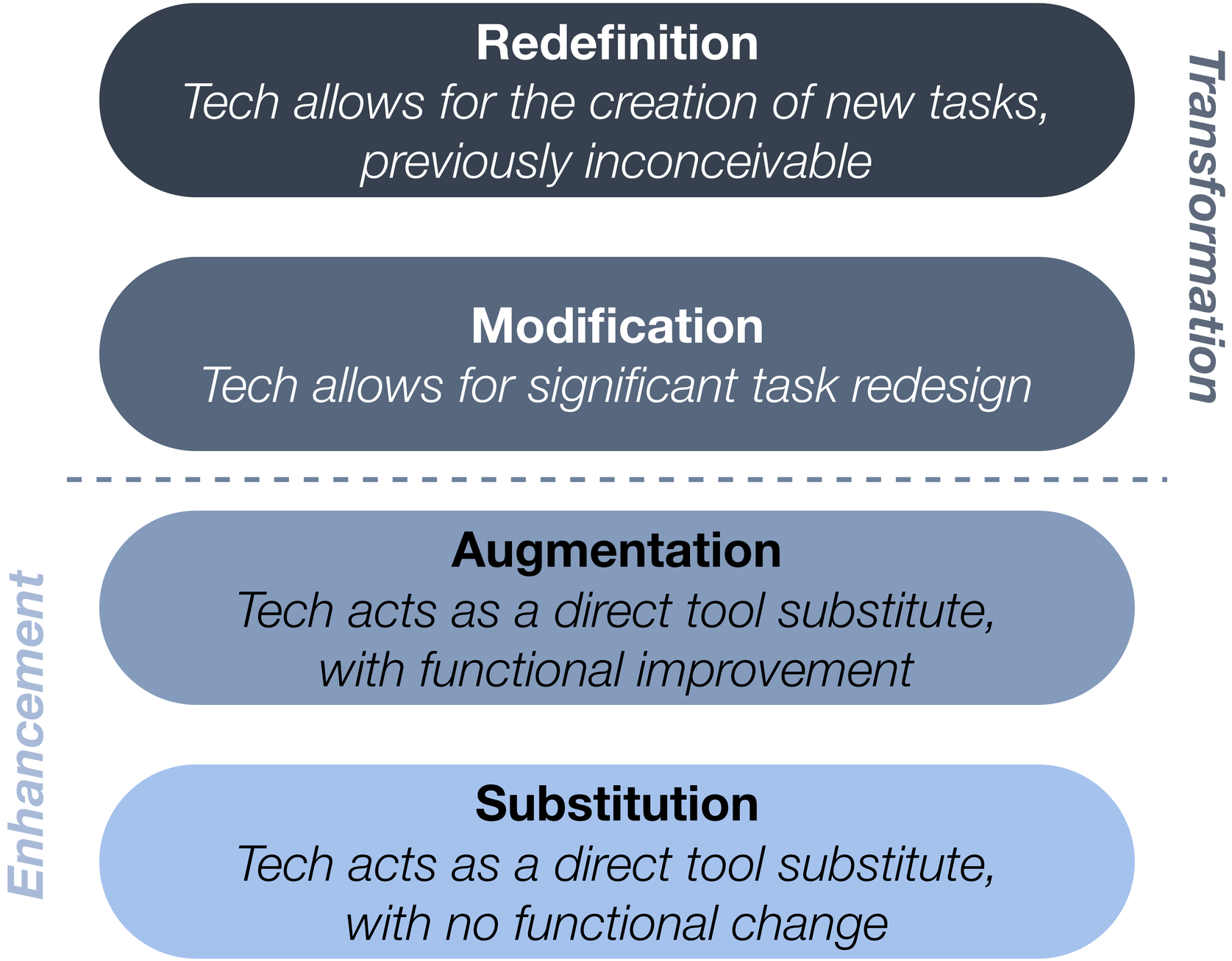
Anderson & Krathwohl (2001)	Characteristic Processes	
Remember	• Recalling memorized knowledge • Recognizing correspondences between memorized knowledge and new material	
Understand	• Paraphrasing materials • Exemplifying concepts, principles • Classifying items • Summarizing materials	• Extrapolating 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



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

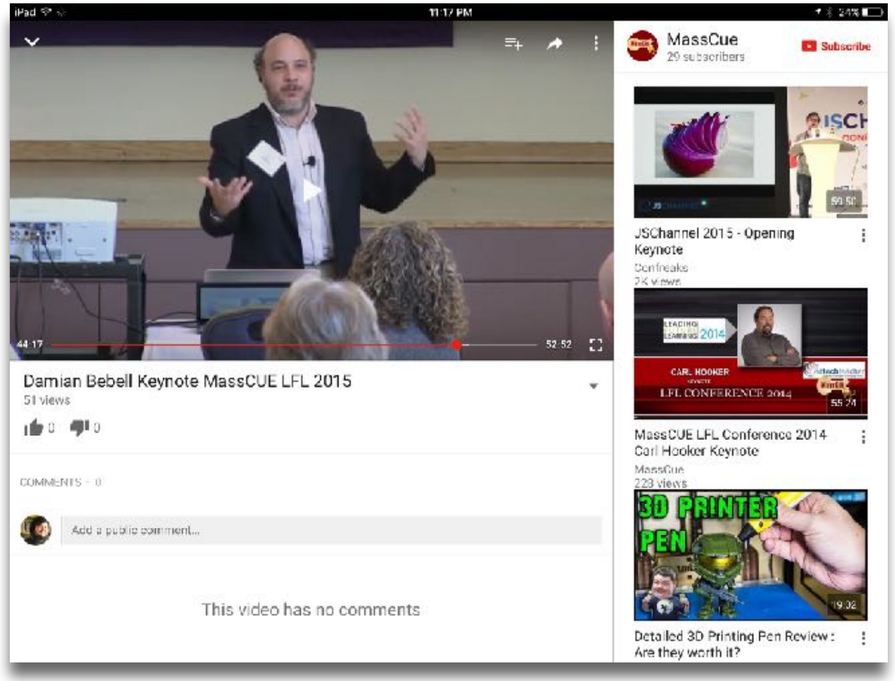
Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

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

Extending Traditional PD



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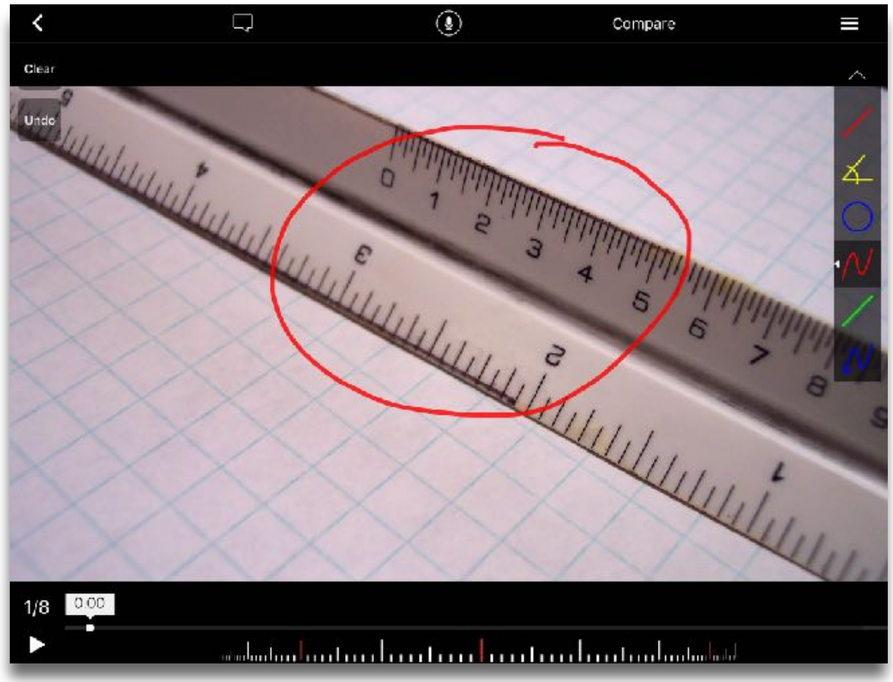
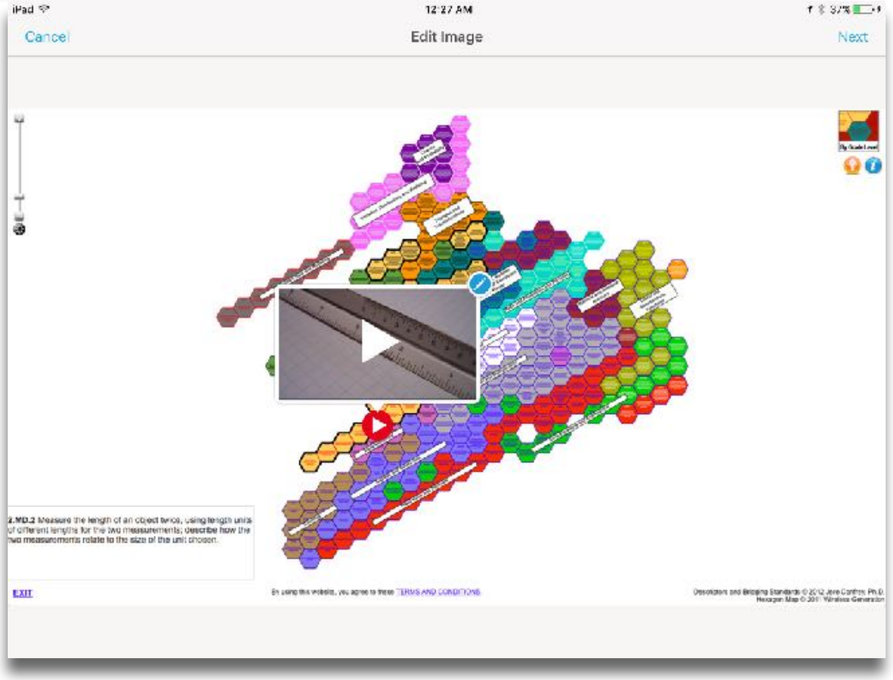
Peer Coaching as PD





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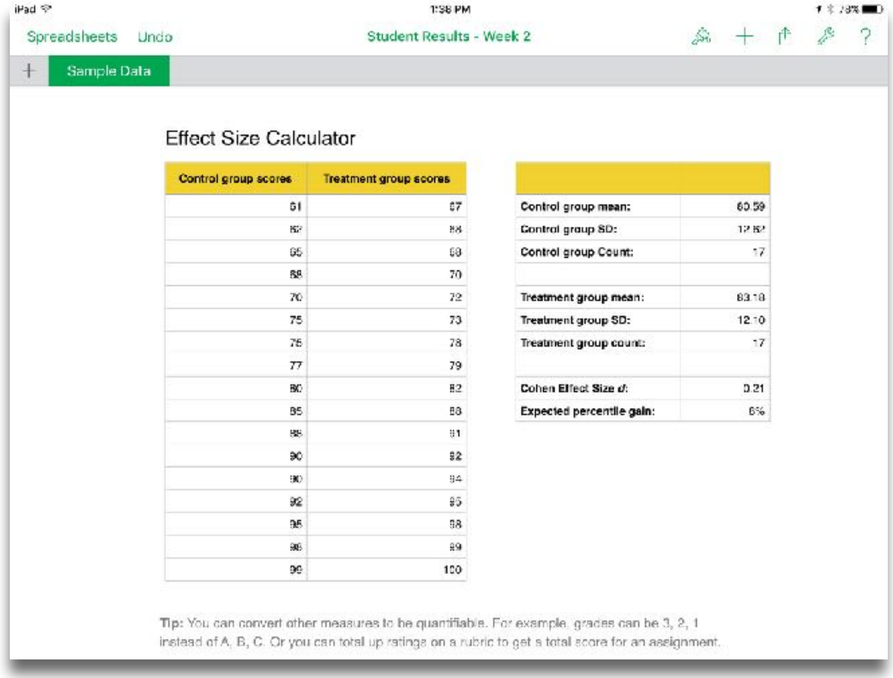
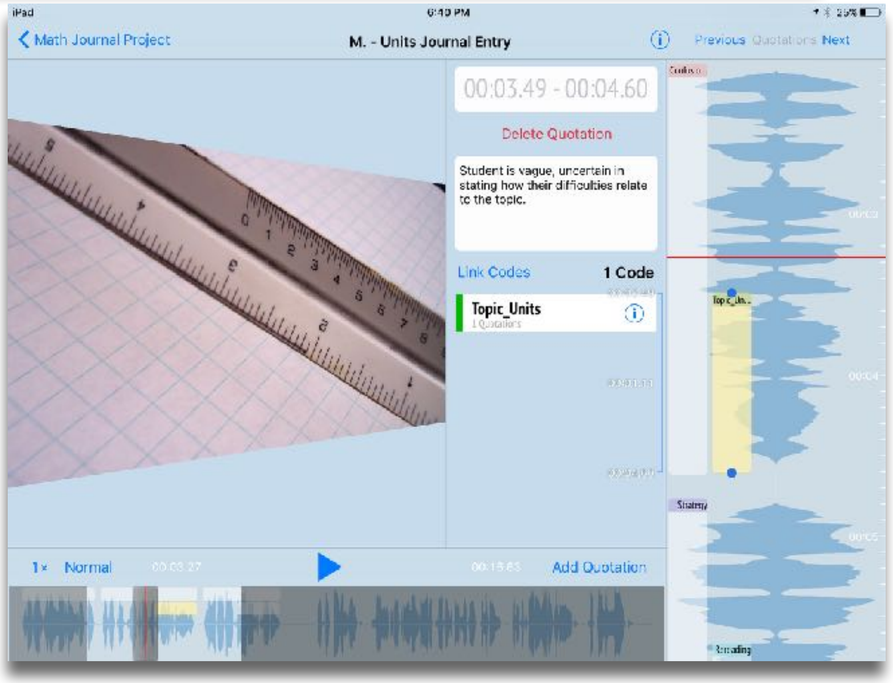
Action Research as PD





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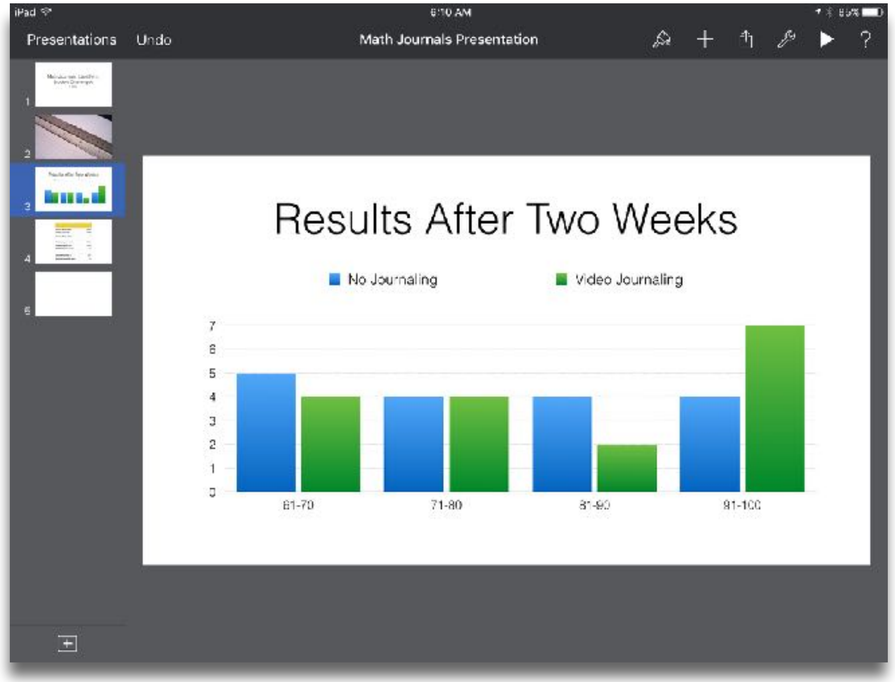
Digital Storytelling as PD



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.

Social

Bookmarks

RSS Feeds

Discussions

Microblogging

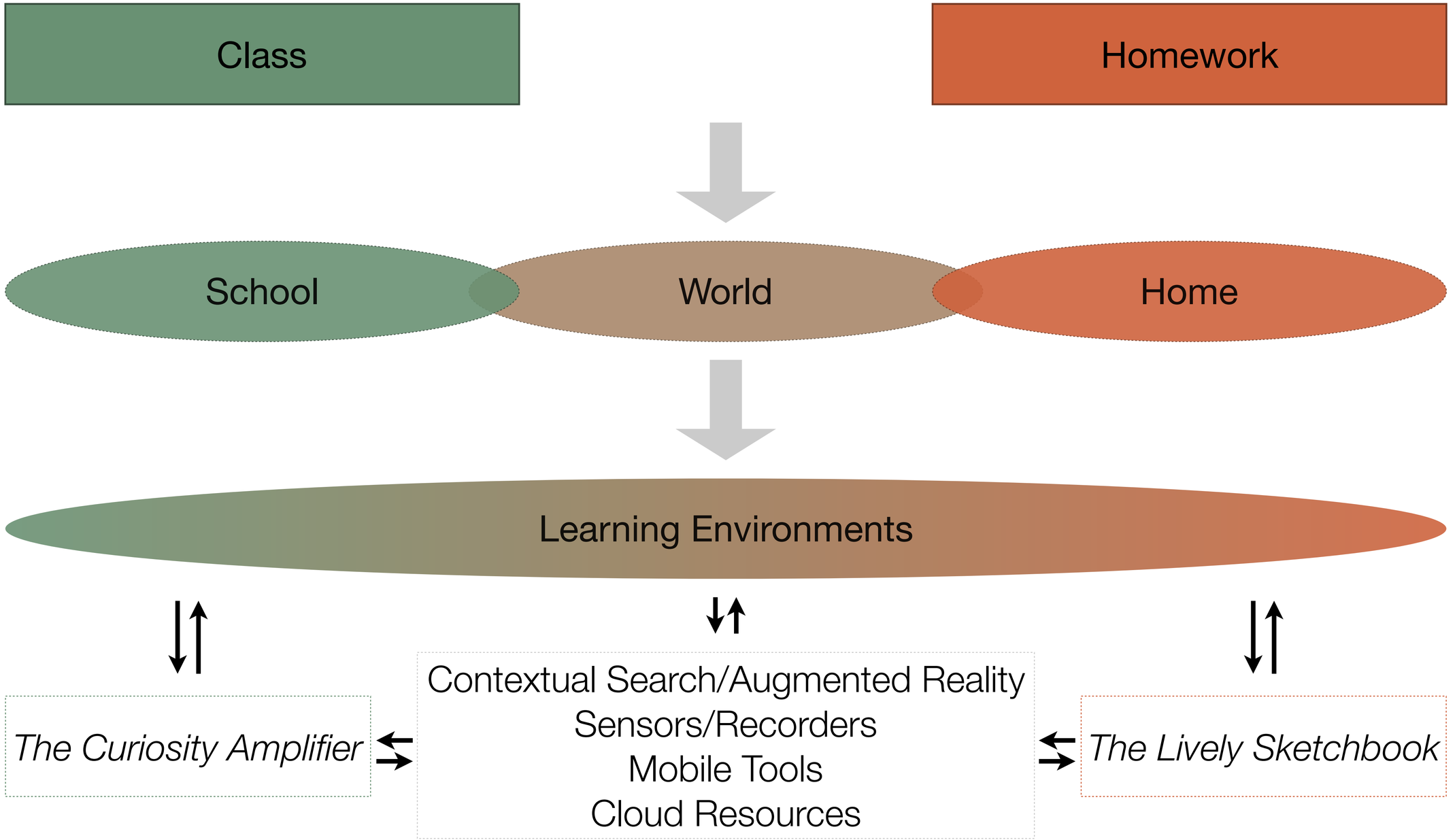
Blogging

Wikis

Telepresence

File Sharing

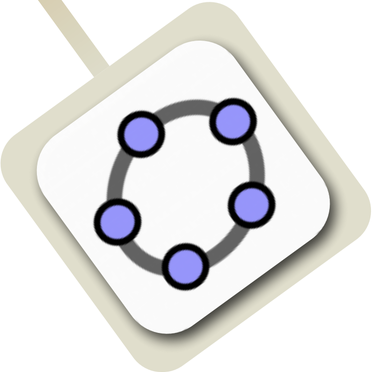
Mobility



John Seely Brown. “A New Culture of Learning”. *NMC Summer Conference, Closing Keynote*. (2010)

Ruben R. Puentedura, “The Lively Sketchbook”. *Hippasus Blog*. (2010)

Visualization



Storytelling

Narrative sources;
Narrative constraints

Pictorial vocabulary;
Narrative transitions;
Text/image integration

CDS Seven Elements;
Montage structures

Narrative structures;
Narrative flows

Ludic elements

Image Assembly → Sequential Art → Moving Image → Interactive Media → Interactive Fiction

TIME

PLACE

Infinite Canvas

CONNECTION

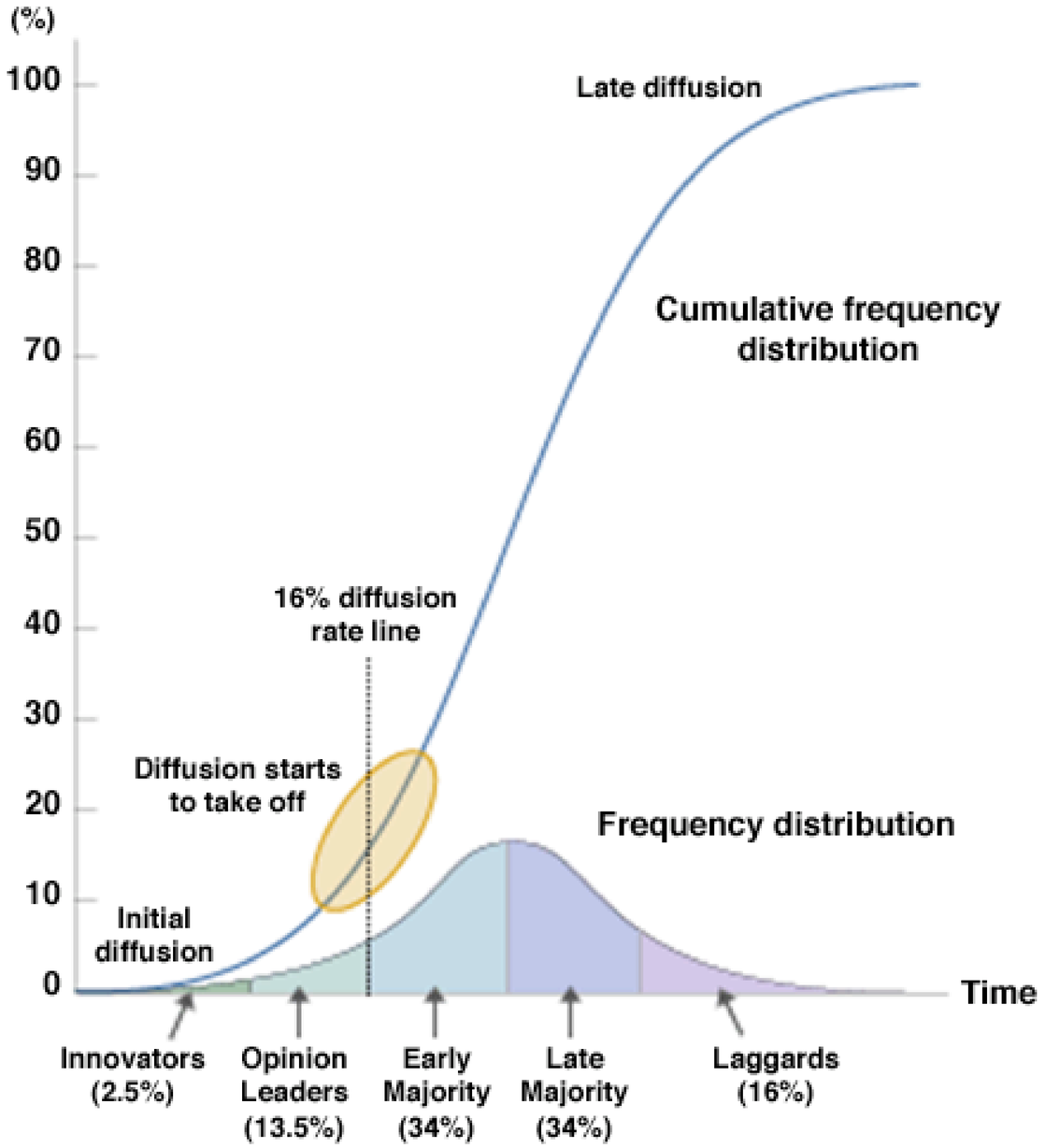
SOCIAL

Formal Definition of **Game** (Salen & Zimmerman)

"A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome."

Katie Salen and Eric Zimmerman. *Rules of Play: Game Design Fundamentals*. The MIT Press, 2003.

The EdTech Quintet – Associated Practices	
Social	Communication, Collaboration, Sharing
Mobility	Anytime, Anyplace Learning and Creation
Visualization	Making Abstract Concepts Tangible
Storytelling	Knowledge Integration and Transmission
Gaming	Feedback Loops and Formative Assessment



Everett M. Rogers. *Diffusion of Innovations, 5th Edition*. New York:Free Press, 2003.

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?

S to A: the Role of Shared Practices

- Checklists
- Augmented Note Taking Strategies
- Visualization Methods (5 Primary Domains)
- Simple Blogging
- Simple Digital Storytelling Video
- Flipped Classroom – Materials Creation
- Flipped Classroom – Peer Discussion/Instruction Methods
- Simple Interactive Fiction
- LMS Practices

A to M: Refraction

- Pick:
  - A Content Area
  - A 21C Learning Skill
  - A Shared Practice
- Create a SAMR Ladder that looks at a topic in 1. through the lens of 2., focused into actual practice by 3.

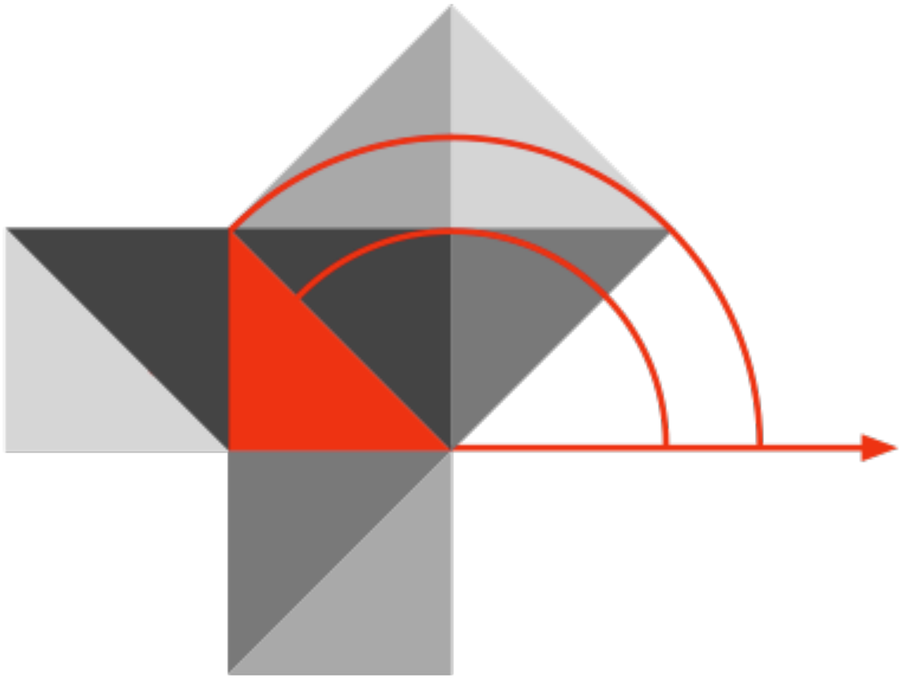
M to R: Communities of Practice and Personal Learning Networks

- Internally: *School as Community of Practice*
  - A **domain** of shared interest, commitment, and competence;
  - A **community** where joint activities, discussions, information sharing, and help processes are focused around and by the domain;
  - A **practice** with a shared repertoire of resources, such as experiences, stories, tools, and problem-solving approaches.
- Externally: *Individual Personal Learning Networks*
  - Loosely structured around a range of tools, individually chosen - no two PLNs are the same;
  - Usually online, but may involve face-to-face components (e.g. meetups);
  - Resources may range from professional society websites, to educator blogs, to Facebook groups, to Twitter feeds;
  - Involvement may range from primarily reading sources, to participating in discussions, to authoring new materials.

Etienne and Beverly Wenger-Trayner. *Introduction to communities of practice: A brief overview of the concept and its uses*. (2015) Online at: http://wenger-trayner.com/introduction-to-communities-of-practice/

Will Richardson and Rob Mancabelli. *Personal Learning Networks: Using the Power of Connections to Transform Education*. Solution Tree. (2012)

Hippasus



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