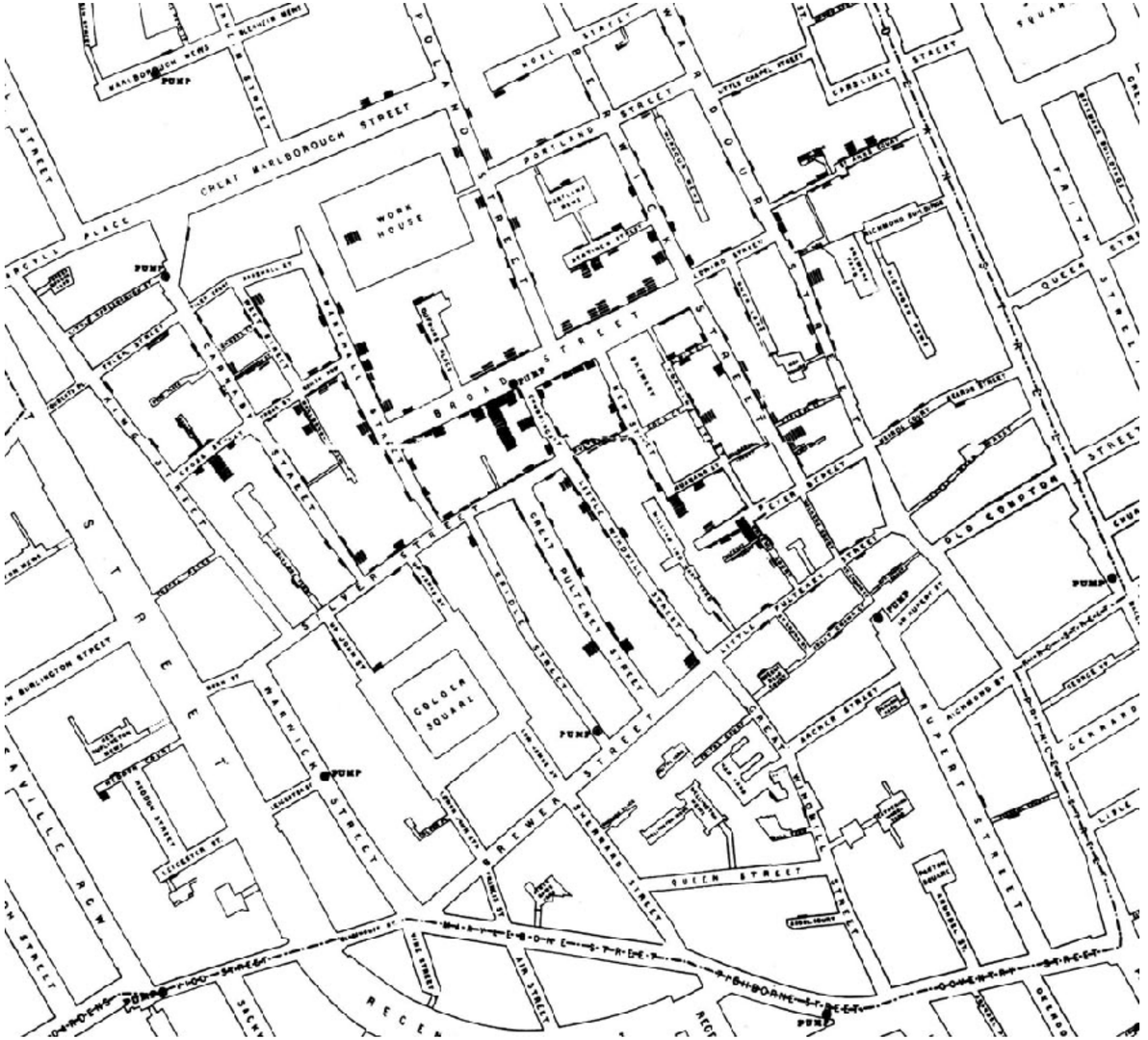
Educational Technology, Research, and Creativity

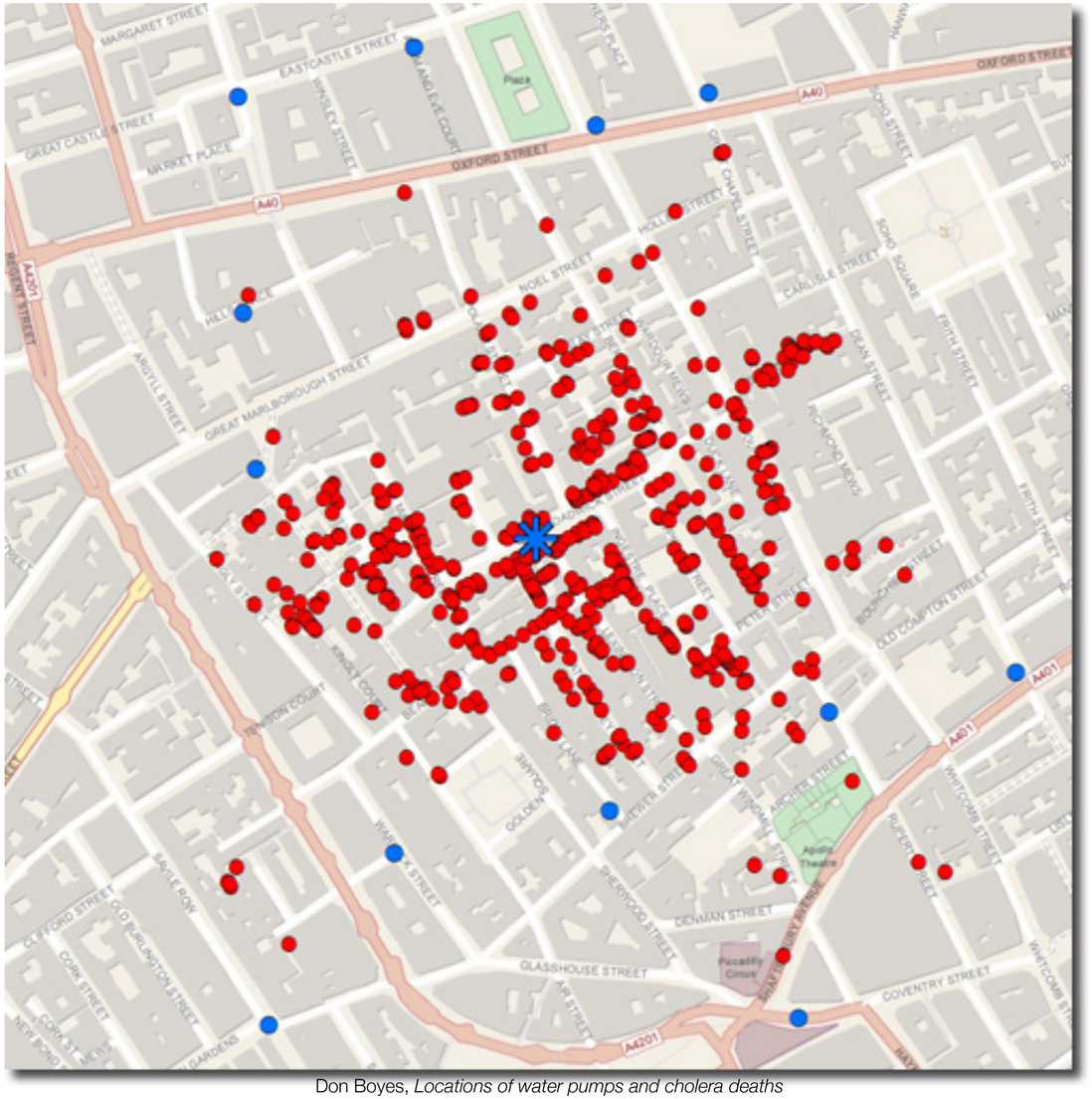
Ruben R. Puentedura, Ph.D.

Why Clusters Matter: John Snow and Cholera



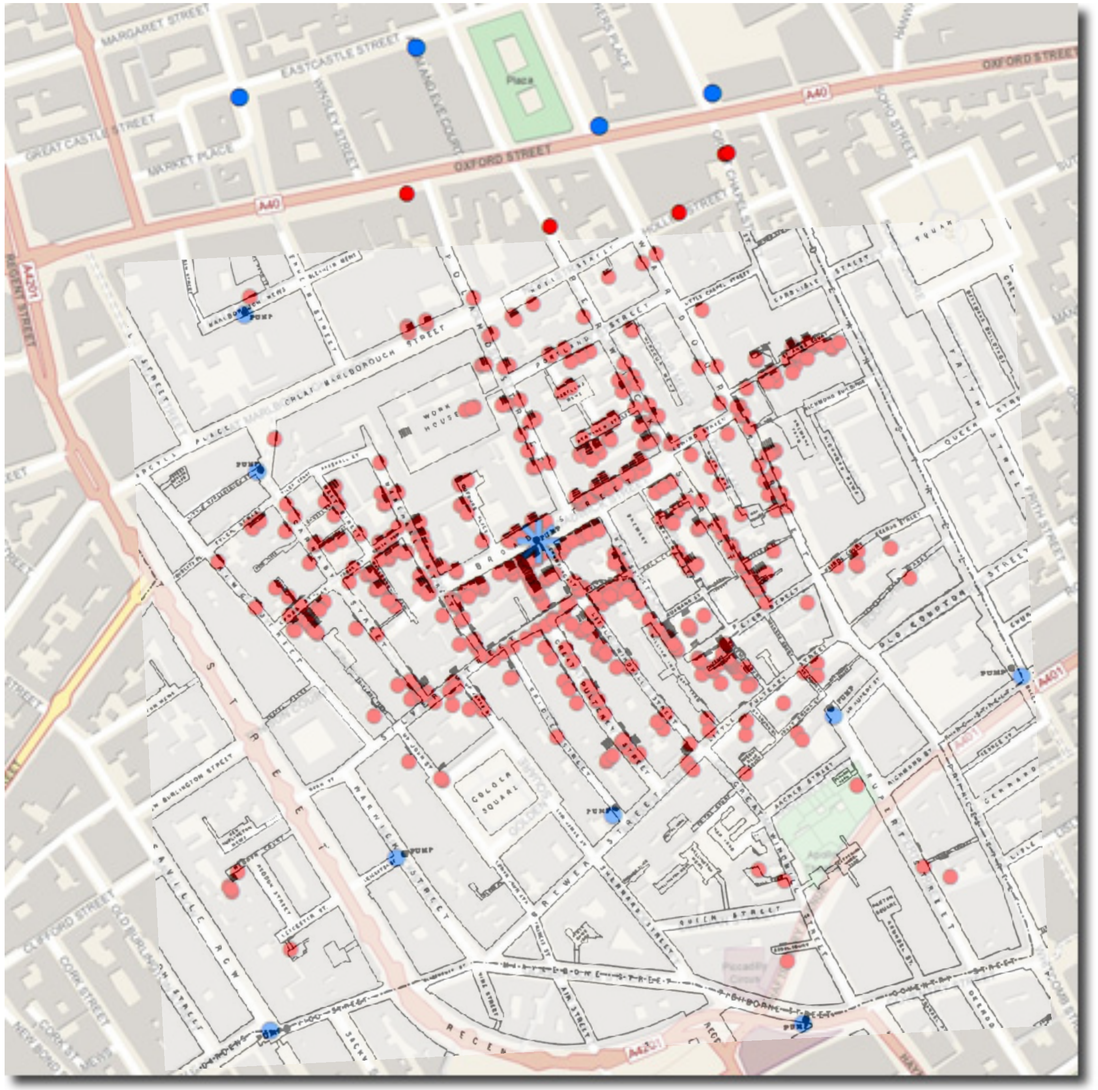
John Snow, *On the Mode of Communication of Cholera (1855)*

Why Clusters Matter: John Snow and Cholera



Don Boyes, *Locations of water pumps and cholera deaths*
http://donboyes.com/2011/10/14/john-snow-and-serendipity/pumps-and-deaths-drop/

Why Clusters Matter: John Snow and Cholera

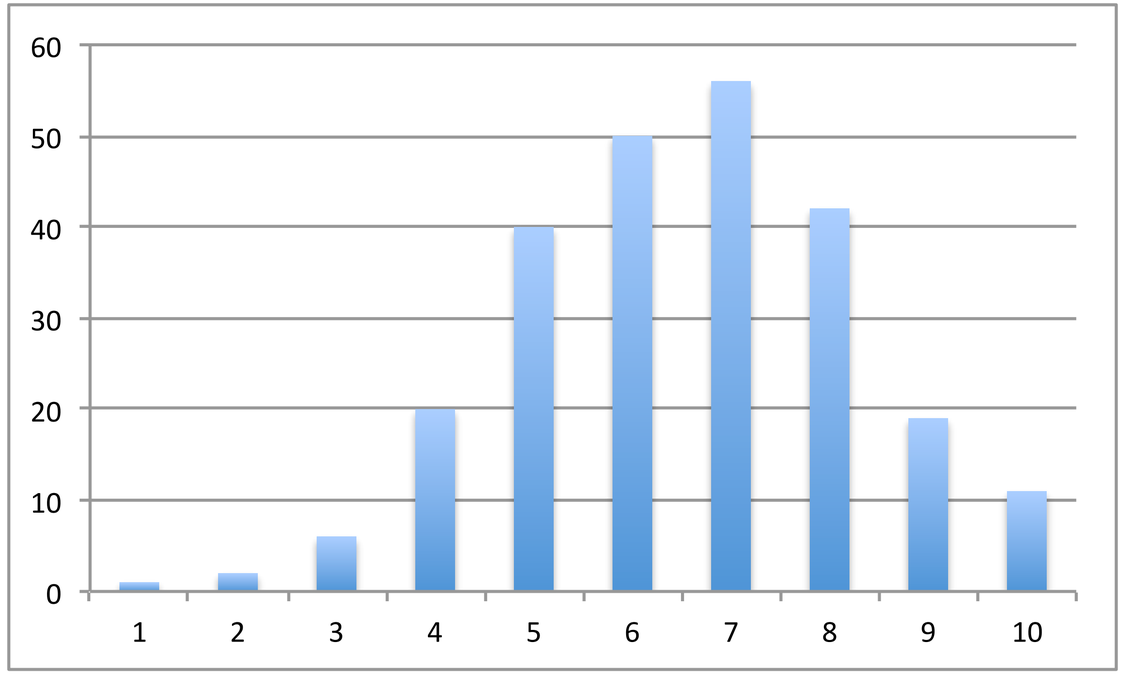


DEATH'S DISPENSARY.

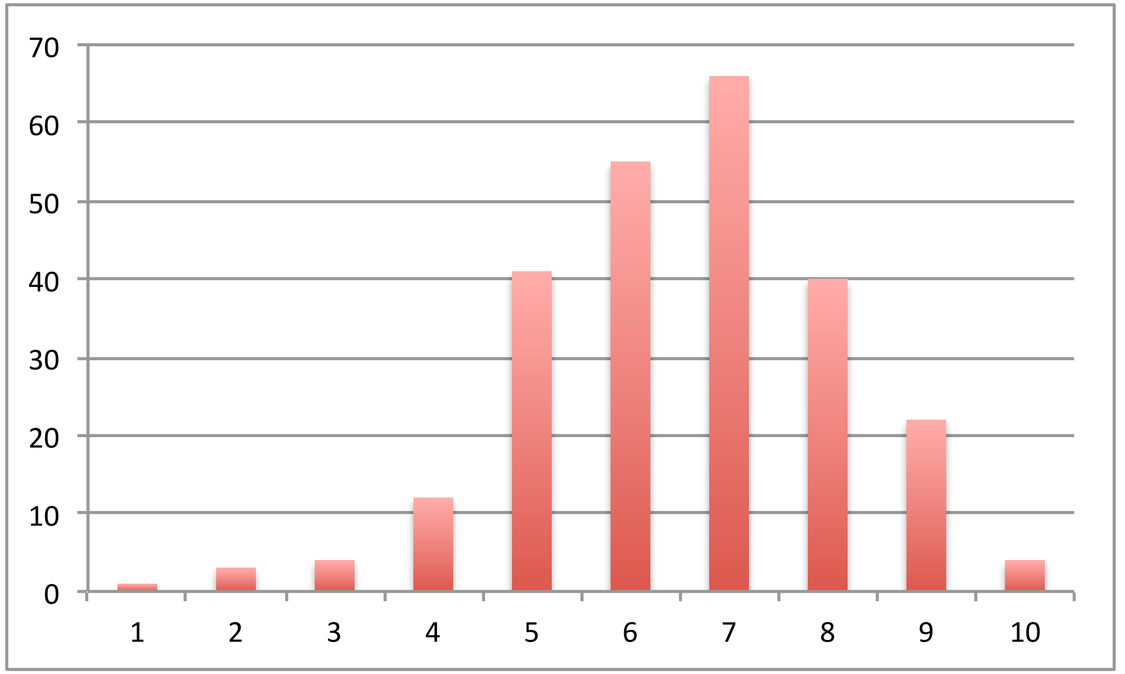
OPEN TO THE POOR, GRATIS, BY PERMISSION OF THE PARISH.

Image Credit: Justin Cormack

Some Simple Data…

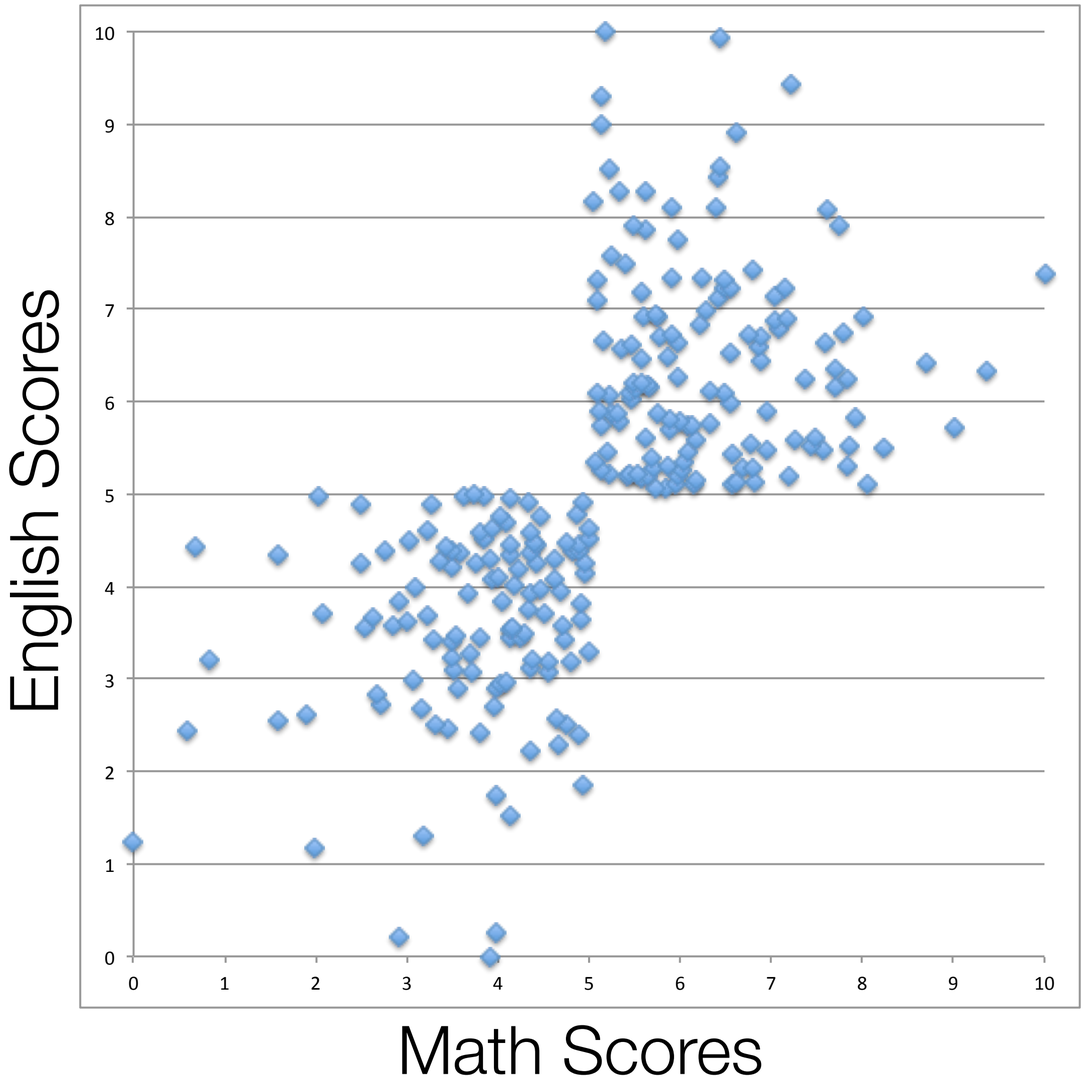


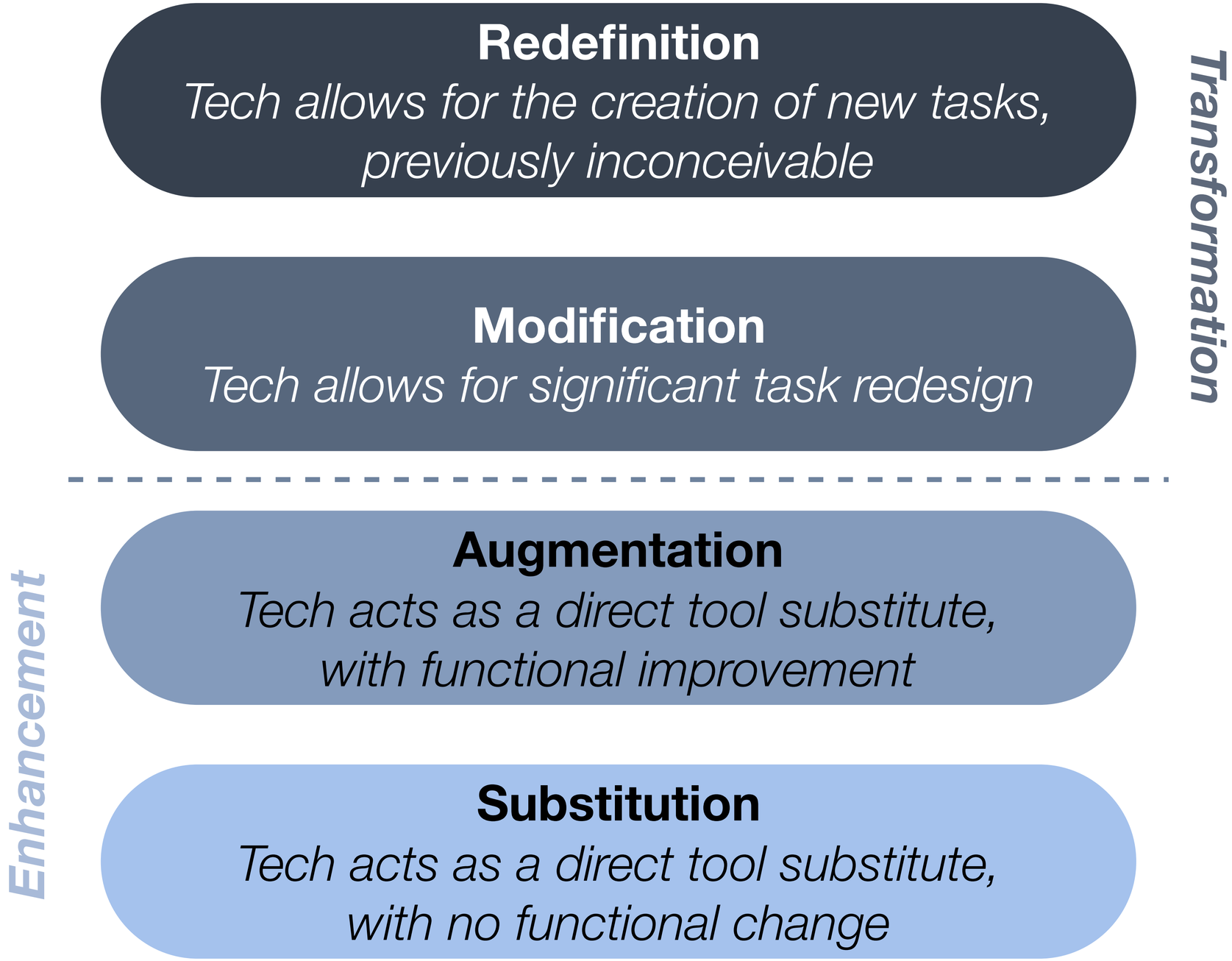
English Scores



Math Scores

…That Isn't That Simple





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

Competency / Concept	Evaluate Historical Accounts	Interpret Primary Sources	Apply Chronological Reasoning	Contextualize	Construct Acceptable Historical Accounts
History as an Interpretive Account					
The Relationship of Past and Present					
Historical Evidence					
Complex Causality					
Significance					

Redefinition

Tech allows for the creation of new tasks, previously inconceivable

Modification

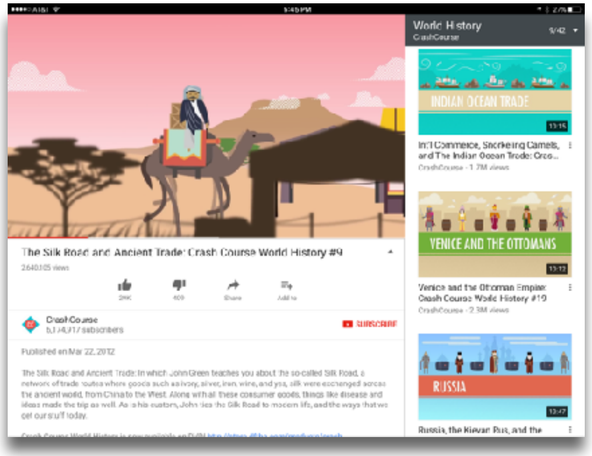
Tech allows for significant task redesign

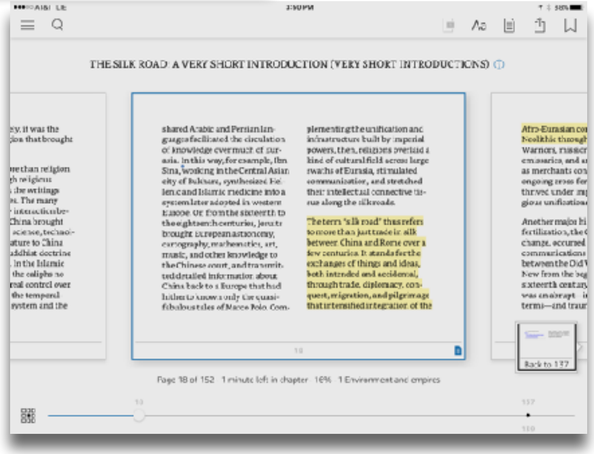
Augmentation

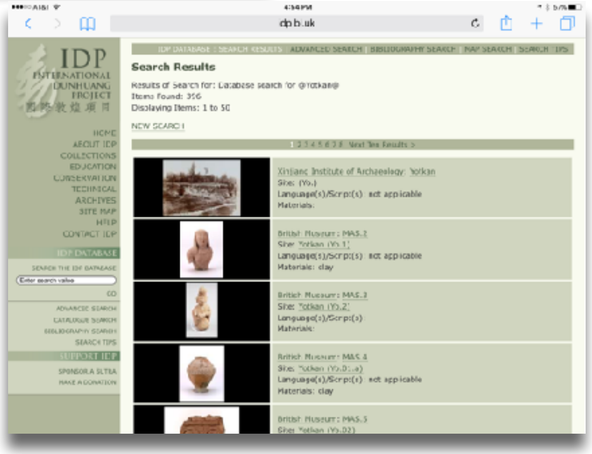
Tech acts as a direct tool substitute, with functional improvement

Substitution

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







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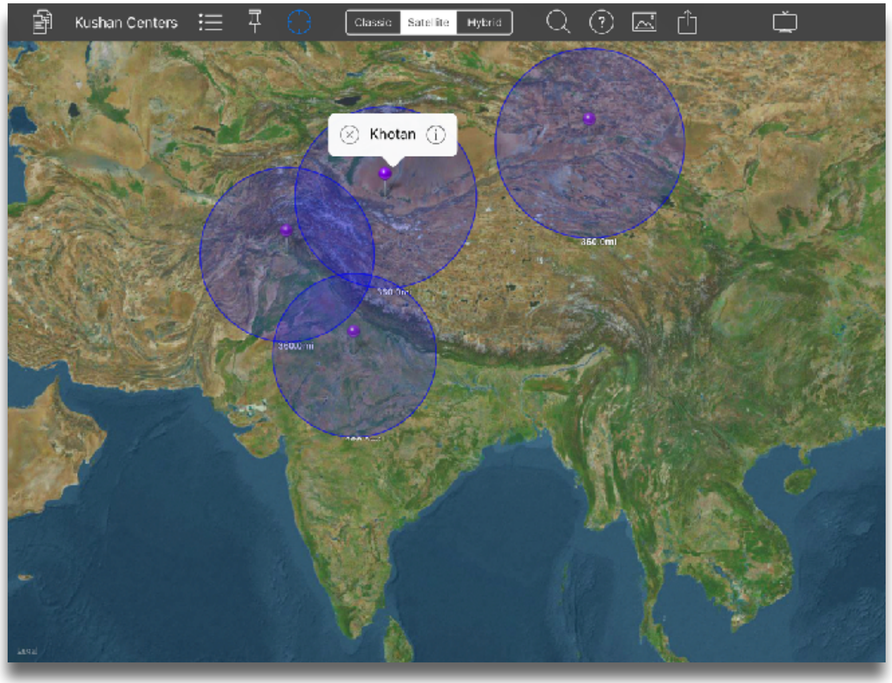

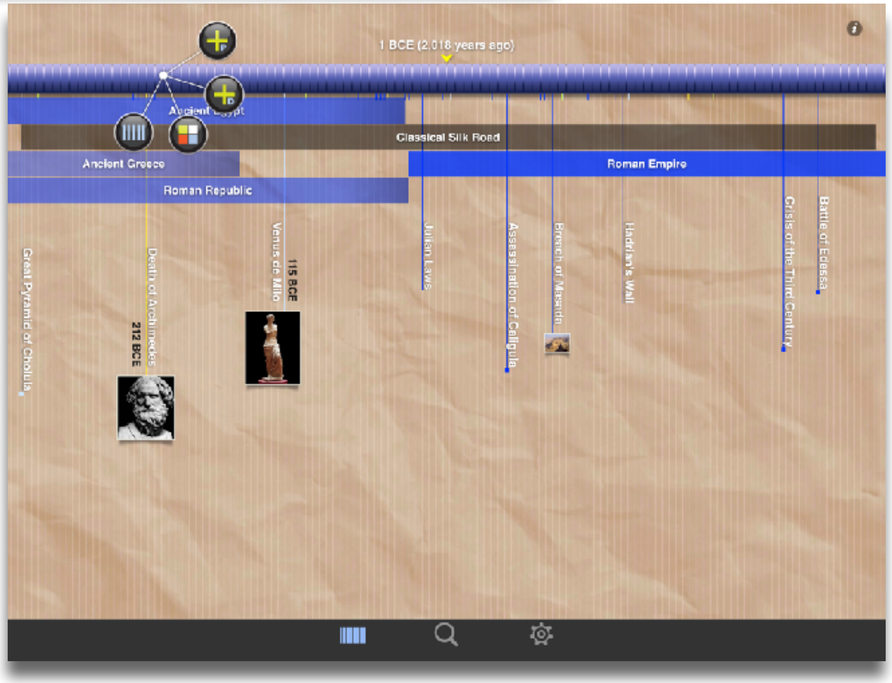

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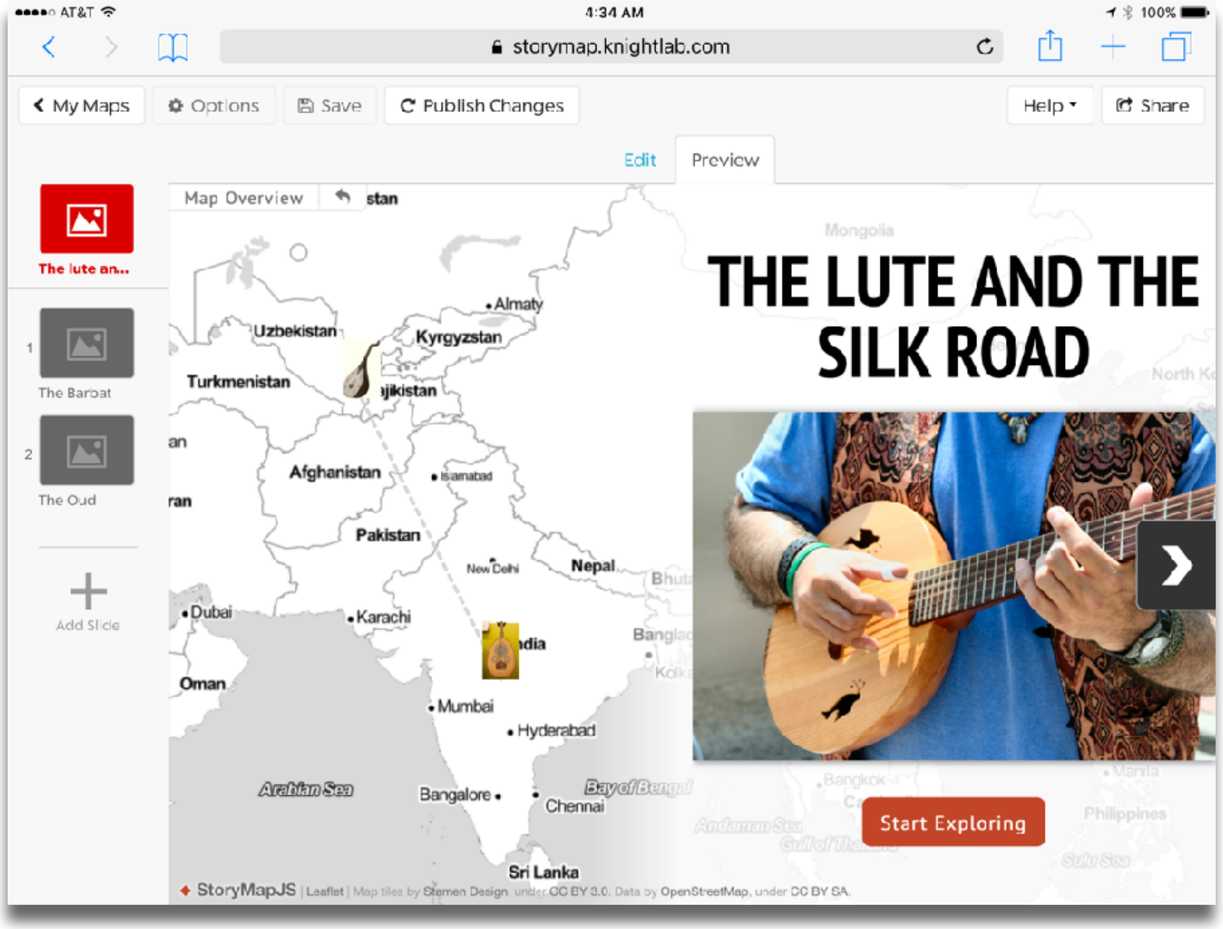

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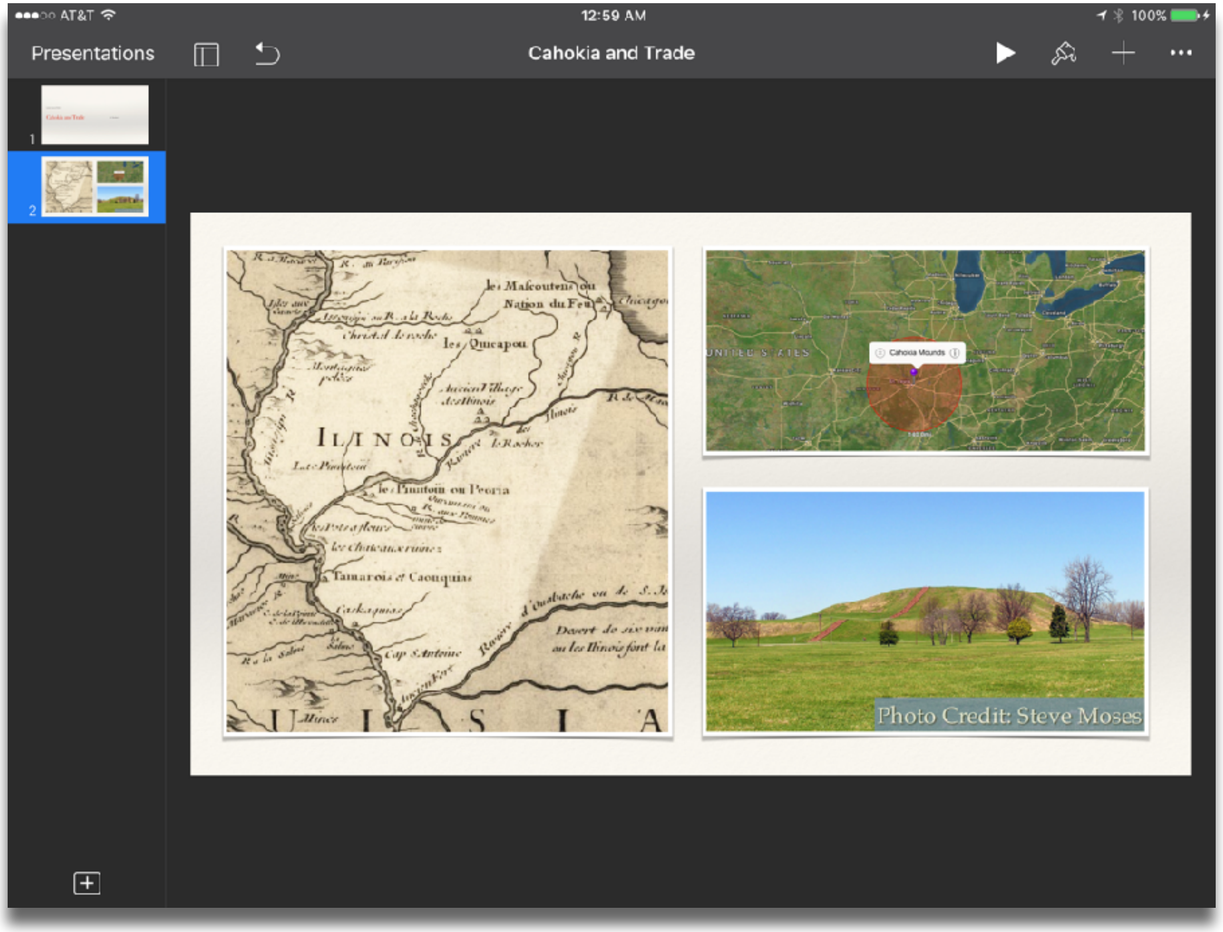
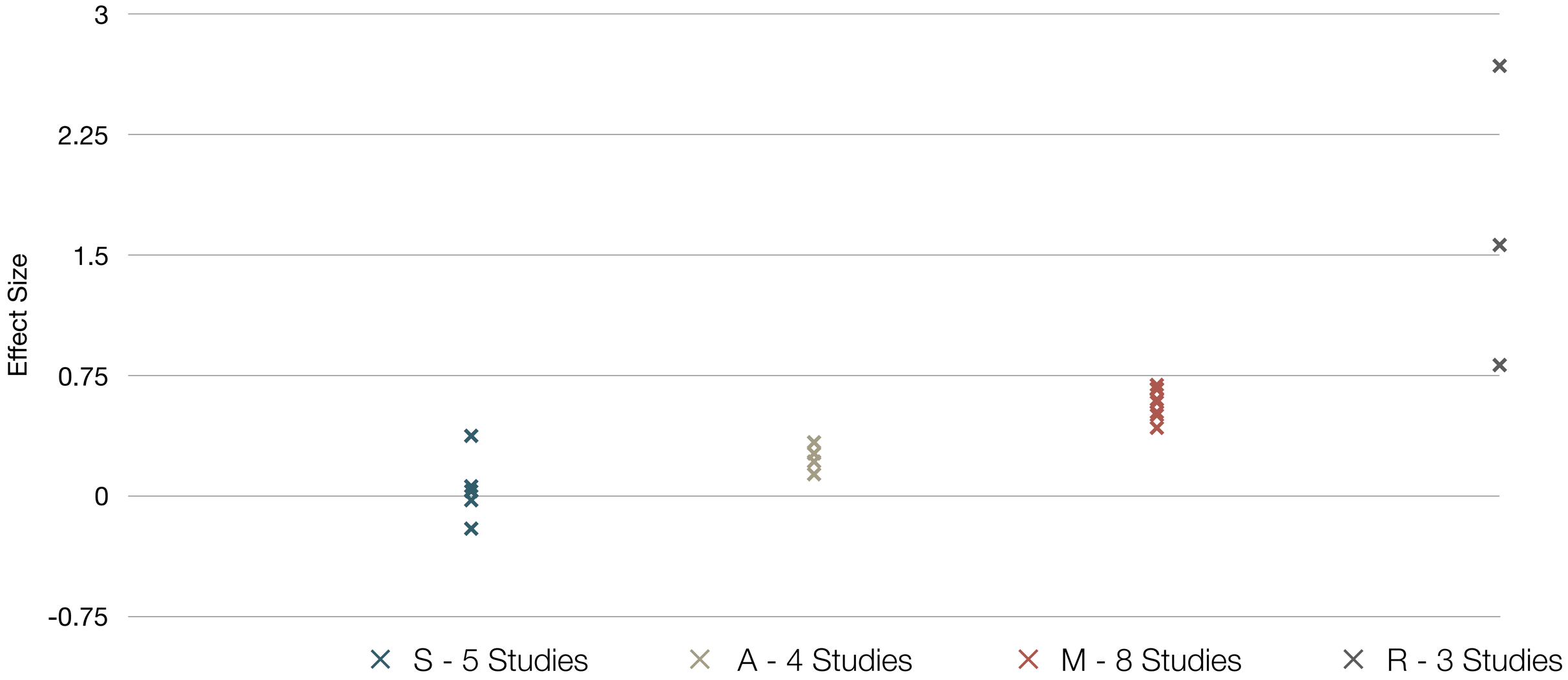


Meta-analysis	Number of studies	*ES* type	Mean *ES*	*SE*
Bangert-Drowns (1993)	19	Missing	0.27	0.11
Bayraktar (2000)	42	Cohen's *d*	0.27	0.05
Blok, Oostdam, Otter, and Overmaat (2002)	25	Hedges's *g*	0.25	0.06
Christmann and Badgett (2000)	16	Missing	0.13	0.05
Fletcher-Flinn and Gravatt (1995)	120	Glass's 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*.

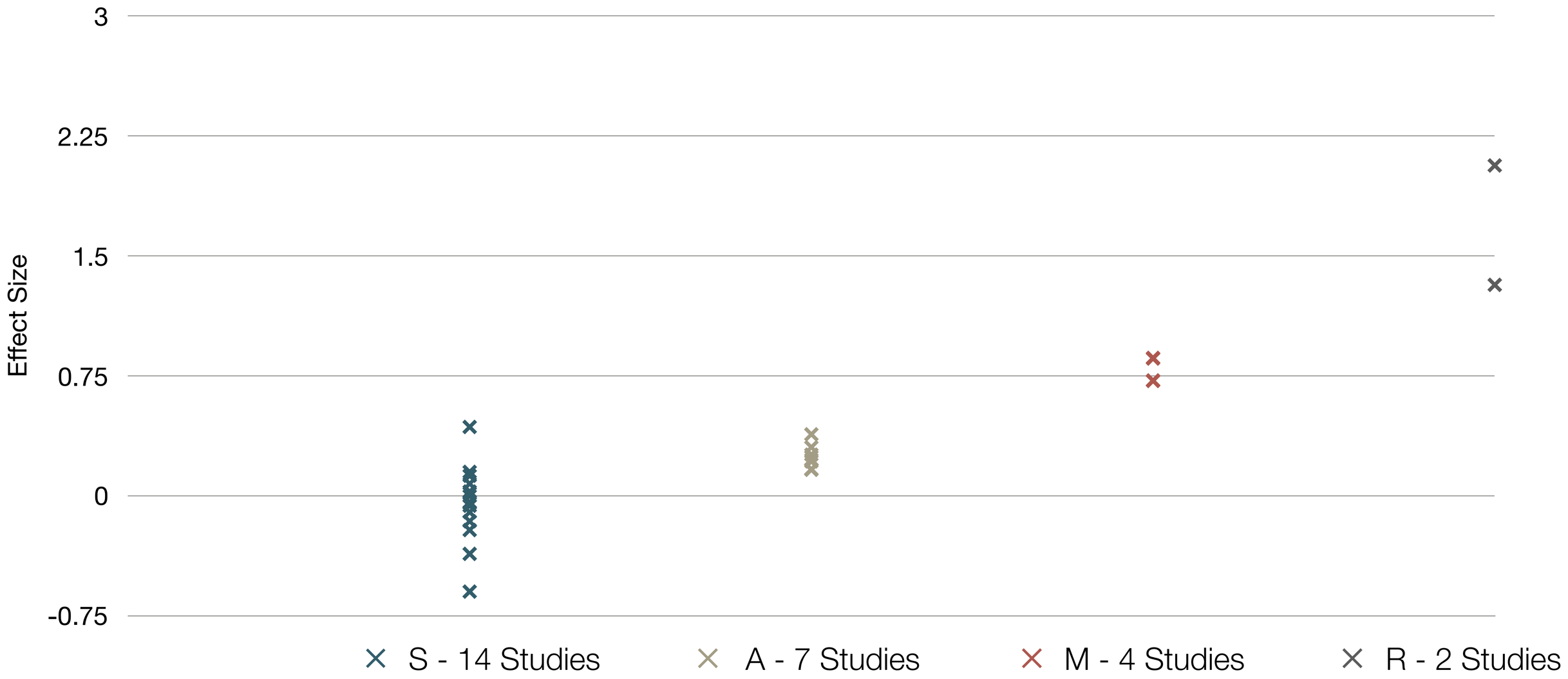
Tamim, Rana M., Robert M. Bernard, Eugene Borokhovski, Philip C. Abrami, and Richard F. Schmid. "What forty years of research says about the impact of technology on learning a second-order meta-analysis and validation study." *Review of Educational Research 81*, no. 1 (2011): 4-28.

SAMR and the Use of Technology to Enhance Reading Performance in Middle School

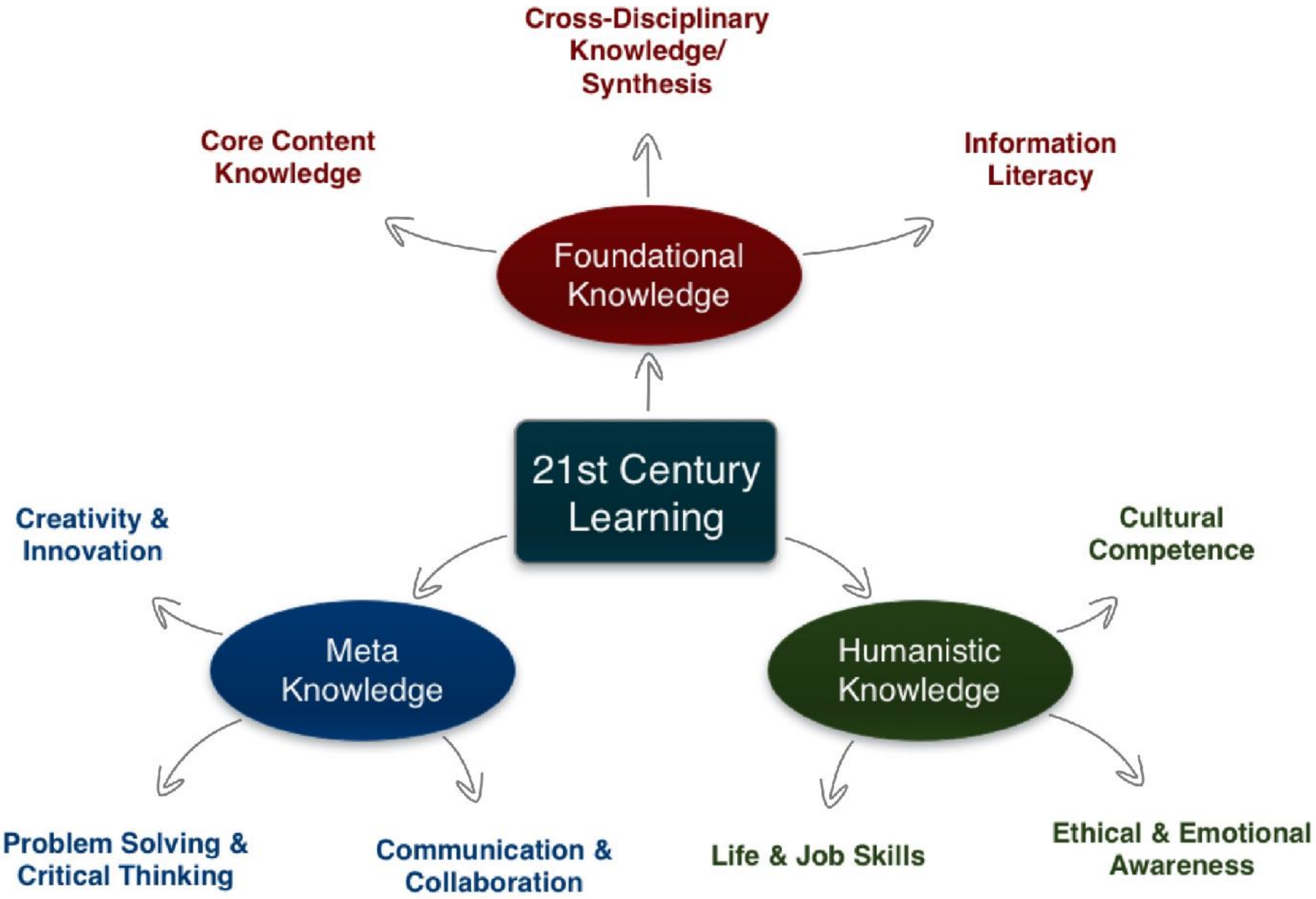


Pearson, P.D., Ferdig, R.E., Blomeyer Jr, R.L., & Moran, J. "The Effects of Technology on Reading Performance in the Middle-School Grades: A Meta-Analysis With Recommendations for Policy." *Learning Point Associates/North Central Regional Educational Laboratory (NCREL)* (2005).

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).



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)

“*Gakushiryoku* - ability required for university graduates for an unpredictable era including the education, knowledge and experience to make correct decisions in the face of unexpected difficulties.”

MEXT - *Summary of Report: Towards a Qualitative Transformation of University Education for Building a New Future - Universities Fostering Lifelong Learning and the Ability to Think Independently* (2012)

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 (6th Edition).* McGraw-Hill Education (UK). (2017).

Using SAMR to Guide Teacher Professional Development

Just as SAMR can be used to guide classroom uses of technology, so it can be used to guide the use of technology in teacher PD. In the example illustrated in the slides that follow:

- S: PD specialist lectures are recorded and archived for future use; online materials such as eBooks are likewise added to this PD library.

- A: Classroom observations are recorded and annotated by the visiting teacher coach, in order to inform PD conversations, and provide an archival record of evolving teacher practice.

- M: Teachers engage in practical action research within the context of their classroom practice, using student observations and learning artifacts to support thick, thin, or combined research approaches.

- R: Teachers share the results of their action research with their fellow faculty, as well as with a wider audience, acting as mentors to both groups.

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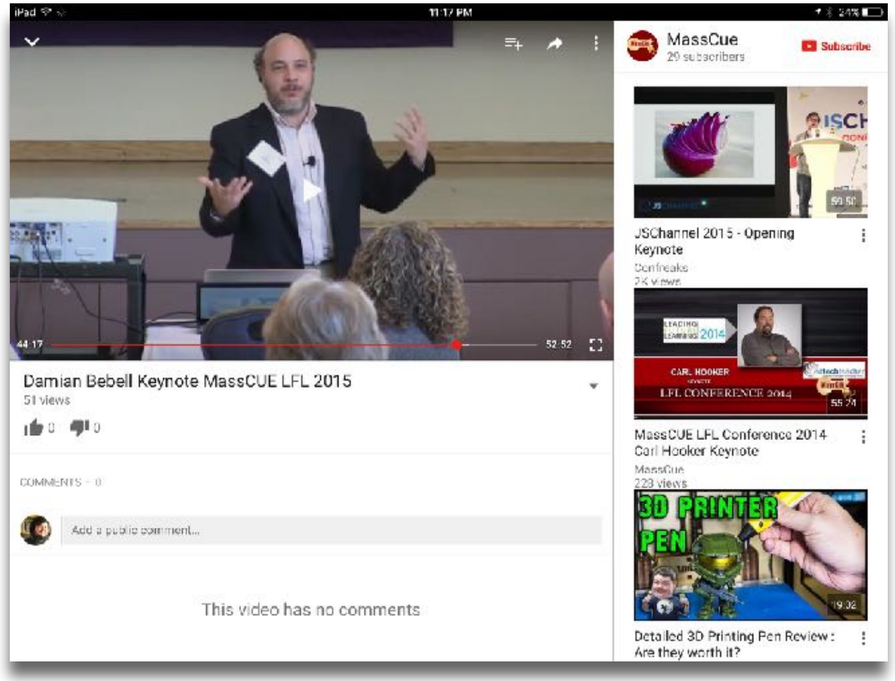
Extending Traditional PD



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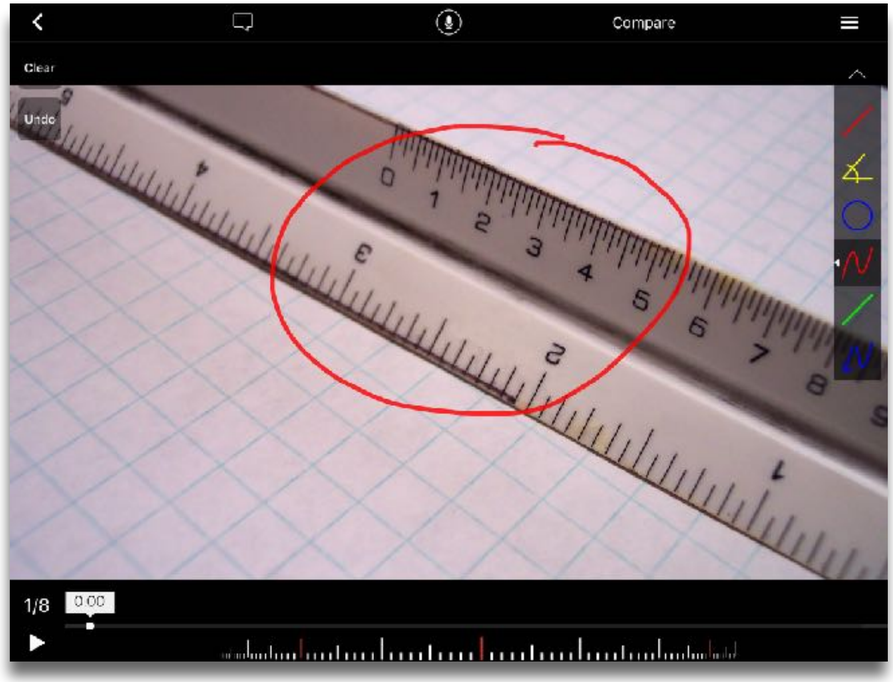
Peer Coaching as PD



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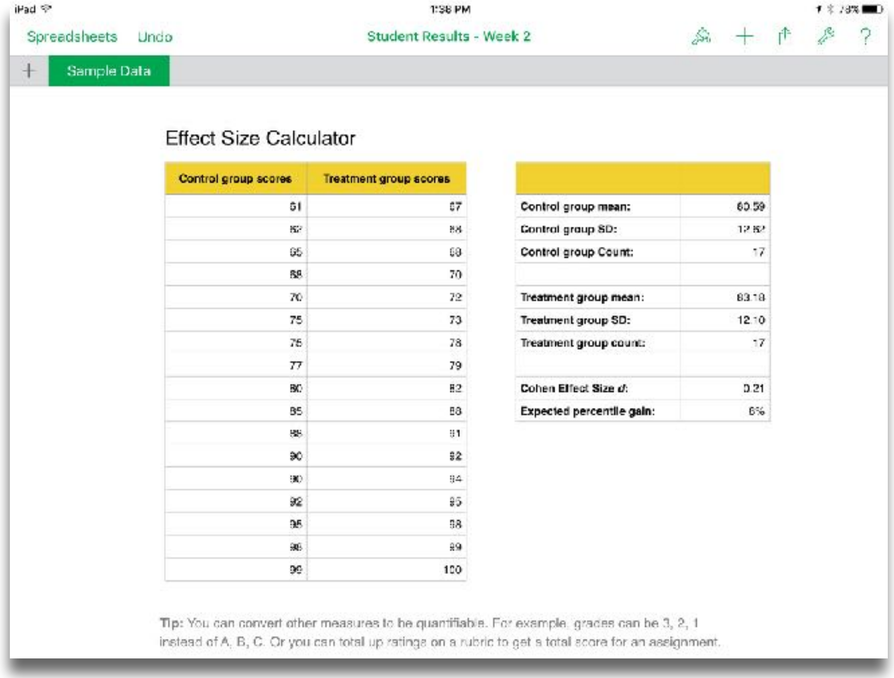
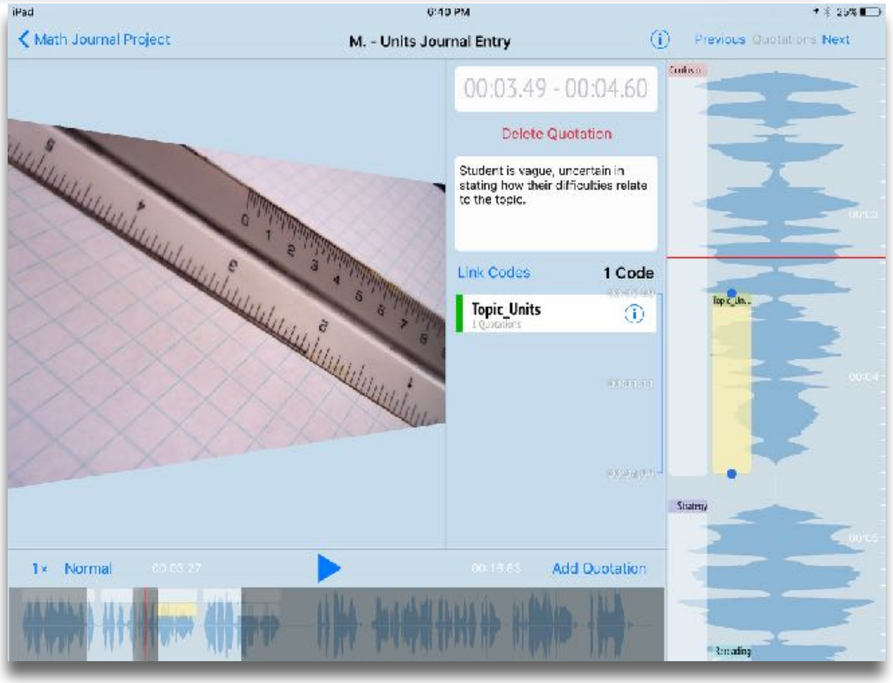
Action Research as PD





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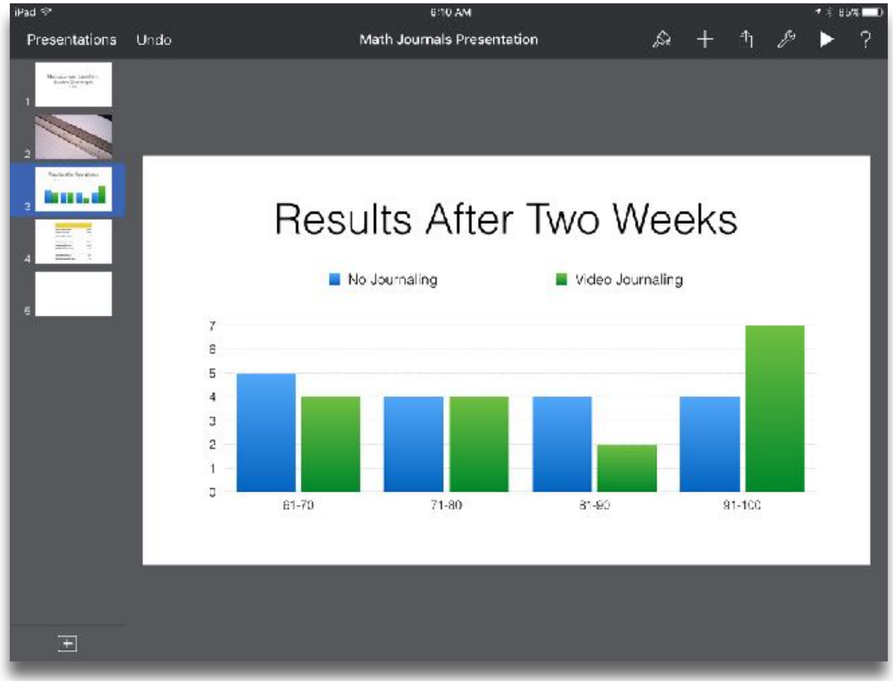
Digital Storytelling as PD



Measuring Creativity

8:07 AM 100%

Research for Educators

9:15 AM 25%

4

Student Creativity

Measuring creativity is important, especially considering the many different opportunities students have to express it with iPad. This study specifically focuses on divergent thinking—the ability to generate many possible solutions.

Study adapted from Dr. Steven Stemler, associate professor, Wesleyan University. Read the research article:

Tap to read a teacher scenario.

THE QUESTION

How can I measure my students' creativity, especially their divergent thinking?

Get more specific:

- Are my students divergent thinkers?
- Has the use of iPad increased my students' creativity?

THE BENEFITS

Better understand the creative process.

Better understand how iPad might be affecting your students' divergent thinking.

Provide a broader understanding of what students are learning.

THE DETAILS

Method: Student answers

Grade: 2–8

Sample: Students

Length of study: 1 day

Suggested apps: Pages and Numbers

13

9:16 AM 24%

CONDUCT

Give your students 10 minutes to complete the Five Arms Task.

Ask your students:

- Imagine that one day you woke up with five arms instead of two.
- How would your life be different?
- List as many ways as you can think of.

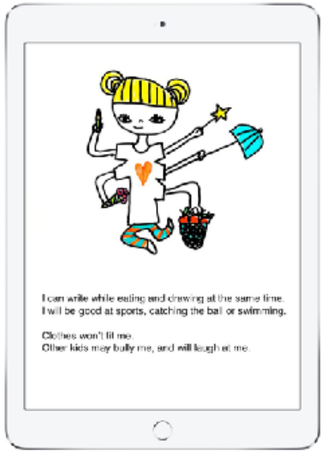
ANALYZE

Use this coding rubric to analyze your students' answers. Enter your codes into the data template, then use the visualization template to better represent and understand your data.

Code the data | Enter your data | Visualize your data

REFLECTION

- What patterns do you see in student creativity?
- How can these results tell the story of learning in your classroom?
- What can you do to improve students' divergent thinking skills?
- What factors might influence student creativity scores?



Score: Fluency = 7; Categories = 4; Originality = 1; Elaboration = 1; Total = 13

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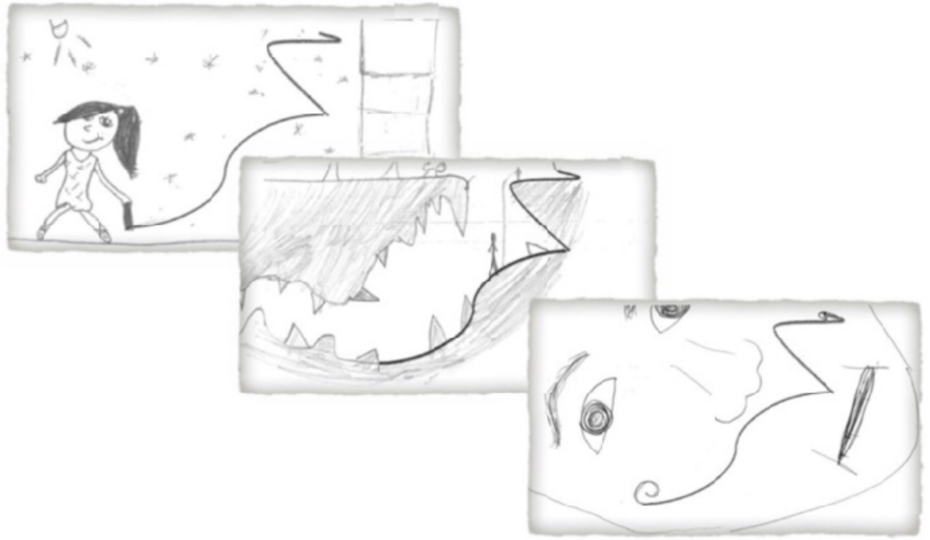
Measuring Creativity in the Classroom

Steven E. Stemler[1], Damian Bebell[2],
Alison Denzer-King[1], Maile McCann[1], Yvette Yun[1],
William Ireland[1], Adi Tur-Kaspa, & Ashlyn Drake[1]

[1] Wesleyan University
[2] Boston College

Contact information:
steven.stemler@wesleyan.edu, bebell@bc.edu
http://purposeofschool.org



Section 5

Major Approaches to Measuring Creativity

There are two major approaches to measuring creativity. Each has certain advantages and limitations and we devote a separate chapter to each. They are:

1. Measuring Creative Thinking - This approach assumes that creative thinking is an ability that is independent of the subject matter. For example, those who are creative thinkers would be equally likely to be creative in Physics, Dance, Writing, or Mathematics mainly because of the way they think about how to approach problems and solutions.

2. Measuring Creativity in Student Work - This approach assumes that creativity is found within the context of tangible products. Although it is possible for students to generate creative works in many different subject areas, we would not necessarily expect them to be creative in more than one subject area. Further, the highest value in this approach is placed on the tangible product or outcome of student work rather than how students think about or approach the problem.

6

Section 3

General Rubric for Measuring Creativity in Student Work

In addition to rating student work on the three core dimensions below, raters sometimes also provide a single, overall "Creativity" score based on their general impression of the work. This is typically done using a 1-10 scale (where 10 represents "extraordinarily creative"). The ratings should be done before evaluating the specific dimensions listed in the rubric.

Example Rubric for Rating the Creativity of Student Work

Score	Originality	Elaboration	Appropriateness
1	Ideas were obviously unoriginal. Ideas taken from a well-known source.	The student clearly spent very little time on creating the work and put no effort into bringing their ideas to life.	The work did not fulfill its purpose or relate to the problem/question at all.
2	Ideas were mostly unoriginal and those that were original were fairly unimaginative.	The student slightly elaborated upon their ideas but clearly put little effort into doing so.	The work is slightly related to the problem/question but does not fulfill its purpose.
3	Ideas were generic, but not unoriginal. Not much thought was used in coming up with the ideas.	The student adequately elaborated upon their ideas as expressed in the work.	The work minimally fulfills the purpose but does so in a very basic way.
4	Ideas were mostly original and imaginative. Perhaps some of the other students has similar ideas.	The student elaborate on their ideas, demonstrating skill and effort. The idea is fleshed out perfectly in the context of the work.	The work fulfills its purpose and does so by incorporating multiple interesting elements.
5	Ideas were completely original and imaginative. Very few or none of the other students came up with a similar idea.	The student elaborates on their ideas, demonstrating skill and effort. The ideas are given more meaning and complexity through their application in the work.	The work fulfills its purpose clearly, efficiently, and imaginatively. May incorporate knowledge and themes from diverse areas.

This rubric can be adapted and used across a wide range of subjects. Here are just a few examples to get you thinking:

Math: Students can create a set of word problems incorporating formulae or techniques they have recently learned. By asking students to write the problem, they must come up with original and relevant situations in which math can be used to solve the problem.

Science: Students can be asked to bring household objects to school and then describe how something they have learned in class relates to how the object functions.

English: Students could be asked

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Section 4

How Can I Measure Creative Thinking In The Classroom?

In this section, we will focus on three different tests of creative thinking, developed by Professor Steven Stemler of the Wesleyan University Psychometric Laboratory, that you can freely use and score for your own students. The three creative thinking tests we will discuss here include:

- Divergent Thinking
- Adaptability
- Mental Flexibility

Section 6

The Five Arms Test of Divergent Thinking

Gallery 2.1 Example Responses and Scores on The Five Arms Test

Fluency: 7 **Originality:** 1

Flexibility: 6 **Elaboration:** 1

Grading Criteria

Fluency: How many ideas did the student come up with? Count the raw number of ideas generated.

Flexibility: The number of uses the student thinks of that categorically/ thematically different.

Originality : How rare is the answer compared to everyone else who responded?

Elaboration : How detailed and developed are the ideas?

Section 8

The Line Completion Test of Adaptability

Gallery 2.2 Example Responses and Scores on Line Completion Test

"This is a drawing of a man's face. The line is a mustache, I added swirls at the end to make it more obvious."

Overall	Original	Elaboration	Incorporation
7.5/10	2/2	1.5/2	2/2

Grading Criteria

Originality: How rare or unusual is the response compared to everyone else who responded?

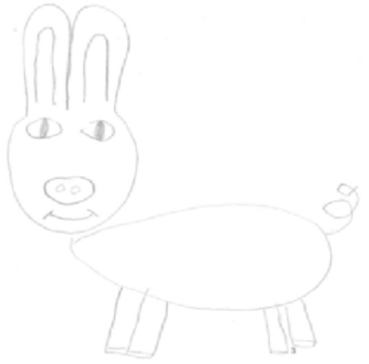
Incorporation: The degree to which the given line is incorporated to the rest of the drawing in an appropriate and sensible way.

Elaboration: How well developed is the drawing and/or the accompanying description?

Section 10

The New Word Match Test of Mental Flexibility

Gallery 2.3 Example Responses on New Word Match Test



"Fordin means an unusual animal like a spider with the eyes of a human or a monkey with a human face."

Grading Criteria

The New Word Match Task is graded on how closely the rater can guess the meaning of the word by looking at the drawing, compared to the definition the student provides in words.

2 = Exact match

1 = Partial match (key detail missing)

0 = No match

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

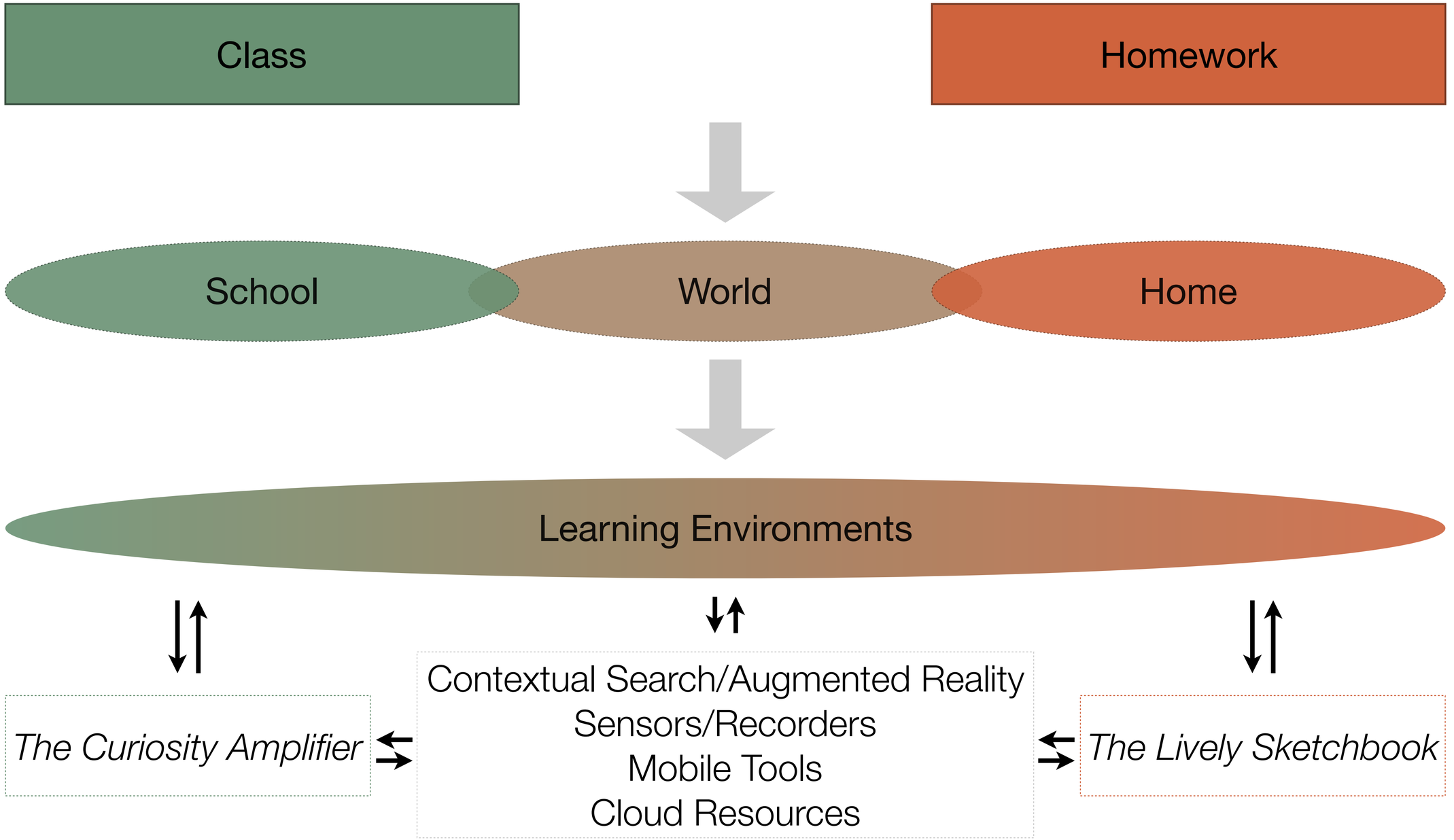
Blogging

Wikis

Telepresence

File Sharing

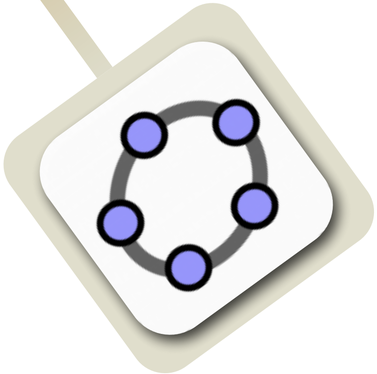
Mobility



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)

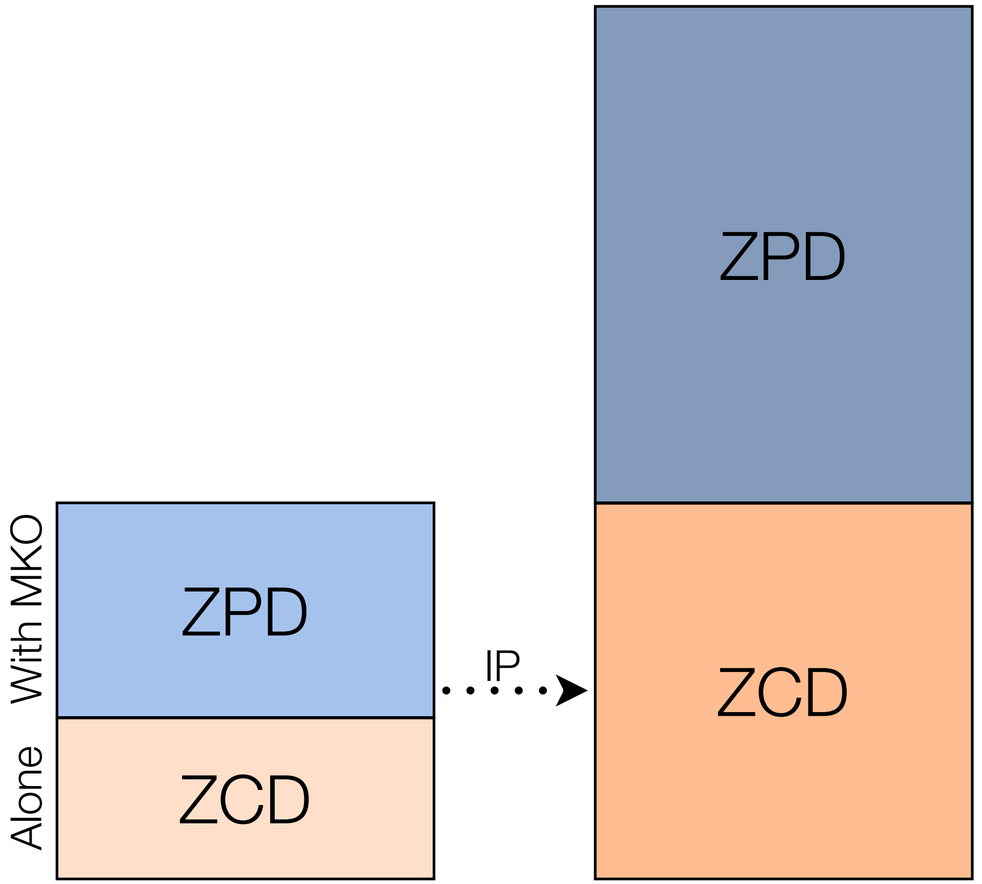
"A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome."

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

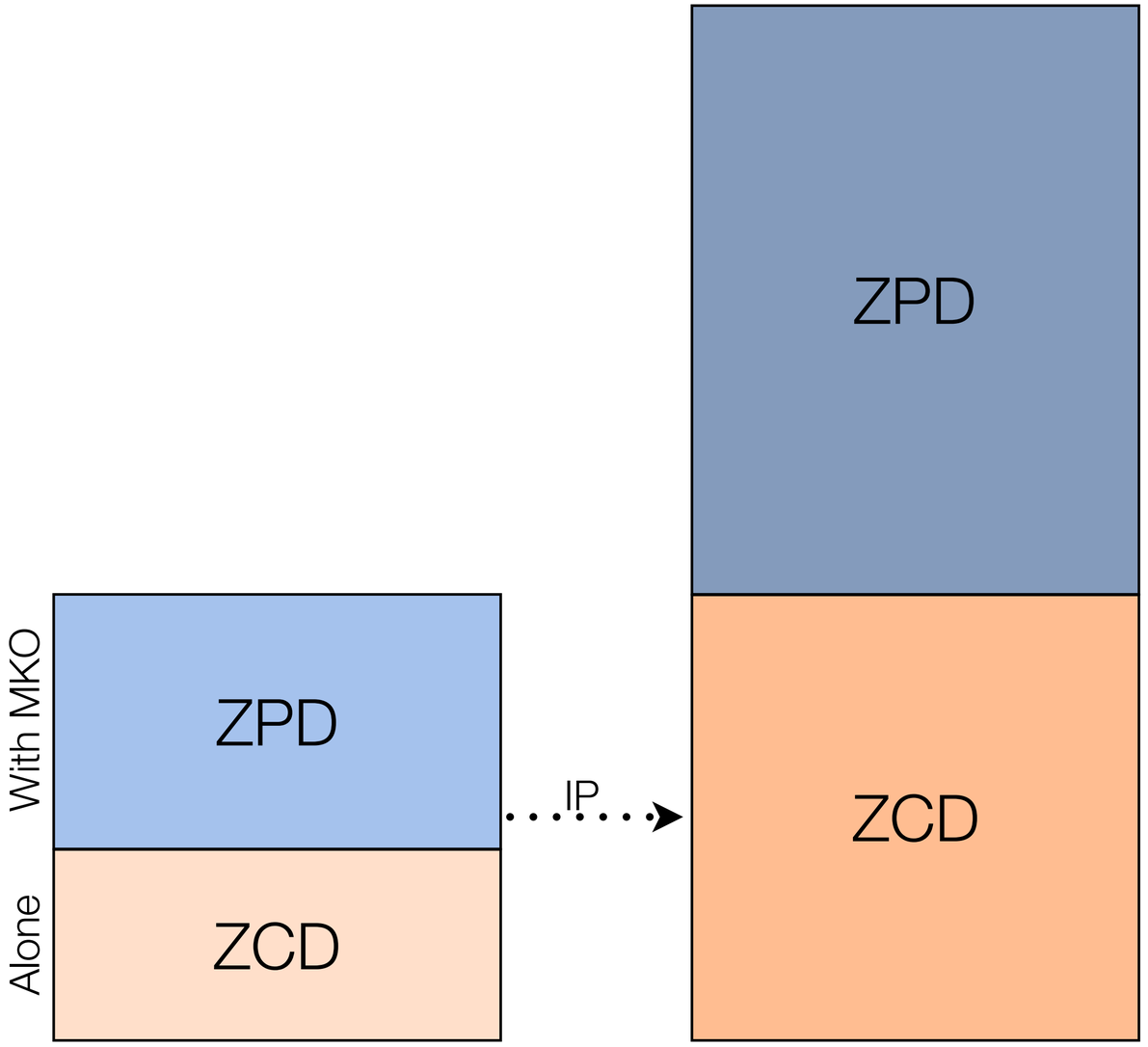
The Value of Shared Practices

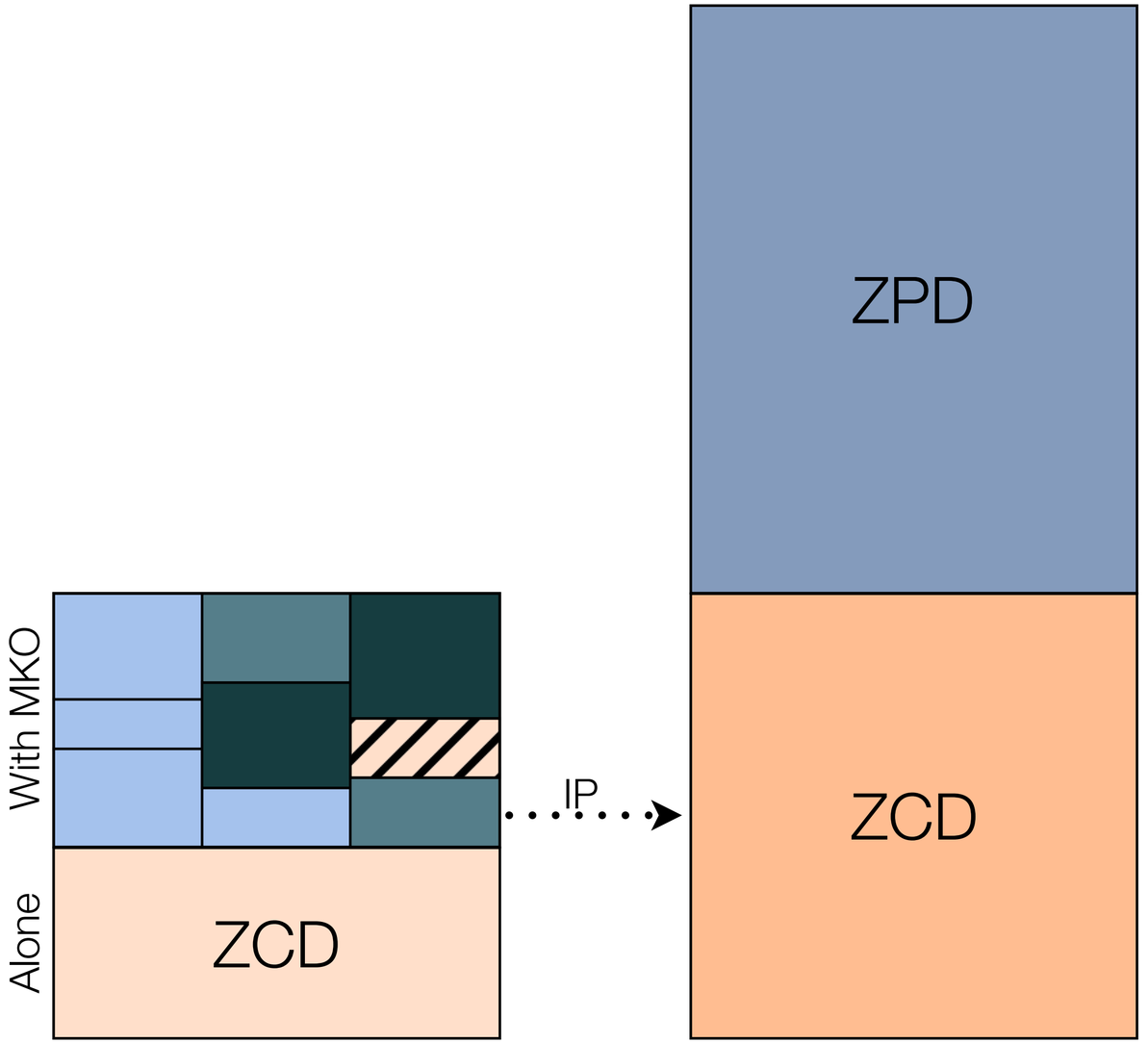
- Augmented Note Taking and Annotation
- Visualization Methods:
  - 5 Primary Domains: Space, Time, Networks, Text, Number
- Simple Blogging
- Simple Digital Storytelling Video
- Flipped Classroom:
  - Materials Creation
  - Peer Discussion/Instruction Methods
- Simple Interactive Fiction
- LMS Practices



- 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 (IP) is required to close the loop.

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


With MKO
ZPD
Alone
ZCD
IP
ZPD
ZCD



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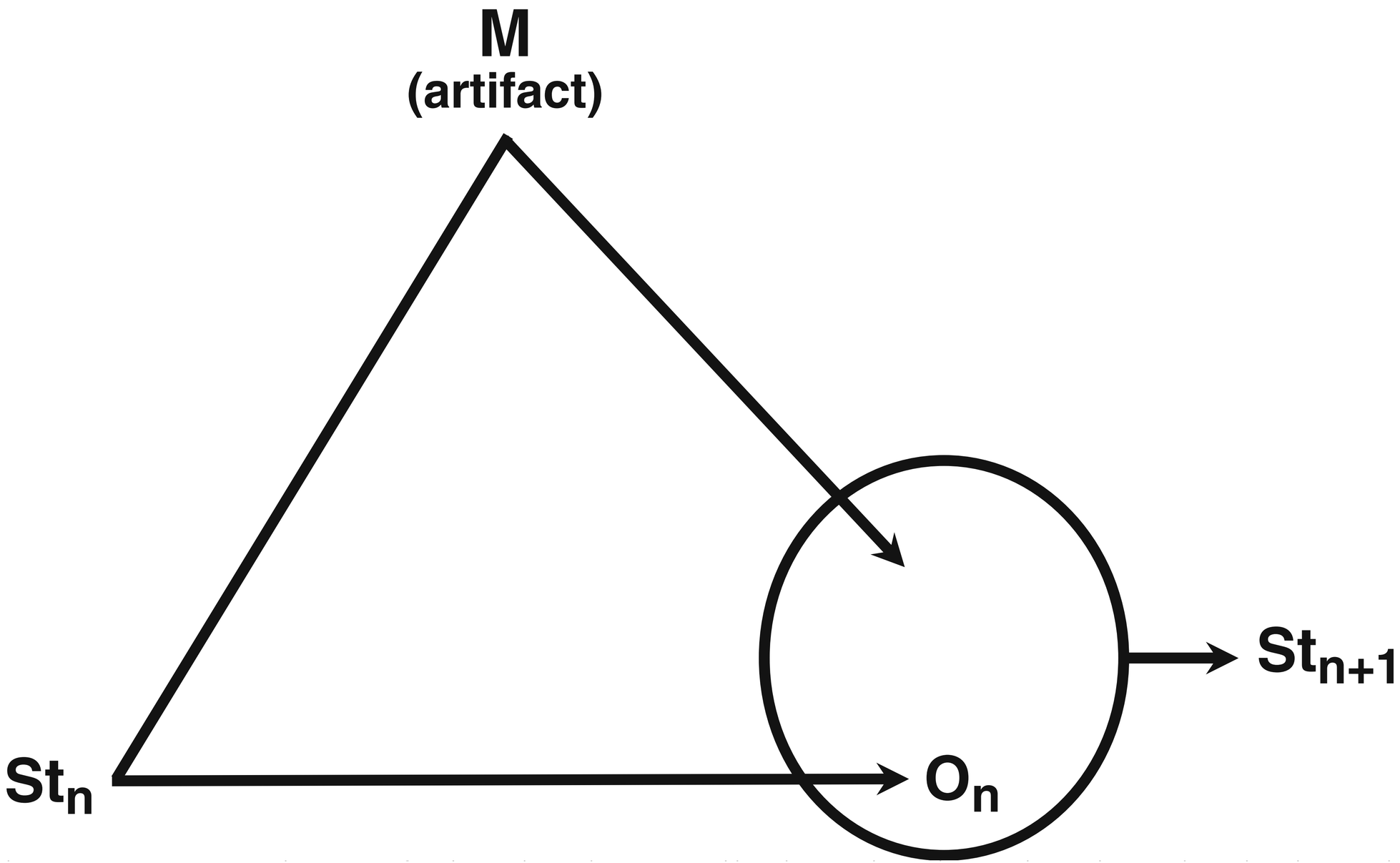
Ann Pendleton-Julian and John Seely Brown. *Pragmatic Imagination: Single from Design Unbound* (2016).

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

The EdTech Quintet – Associated Practices	
Social	Provides diversity to the ZPD
Mobility	Creates the context for the process
Visualization	Aids in segmenting ZPD, bridging gaps
Storytelling	Aids in the integration of the ZPD
Gaming	Provides frameworks for independent practice



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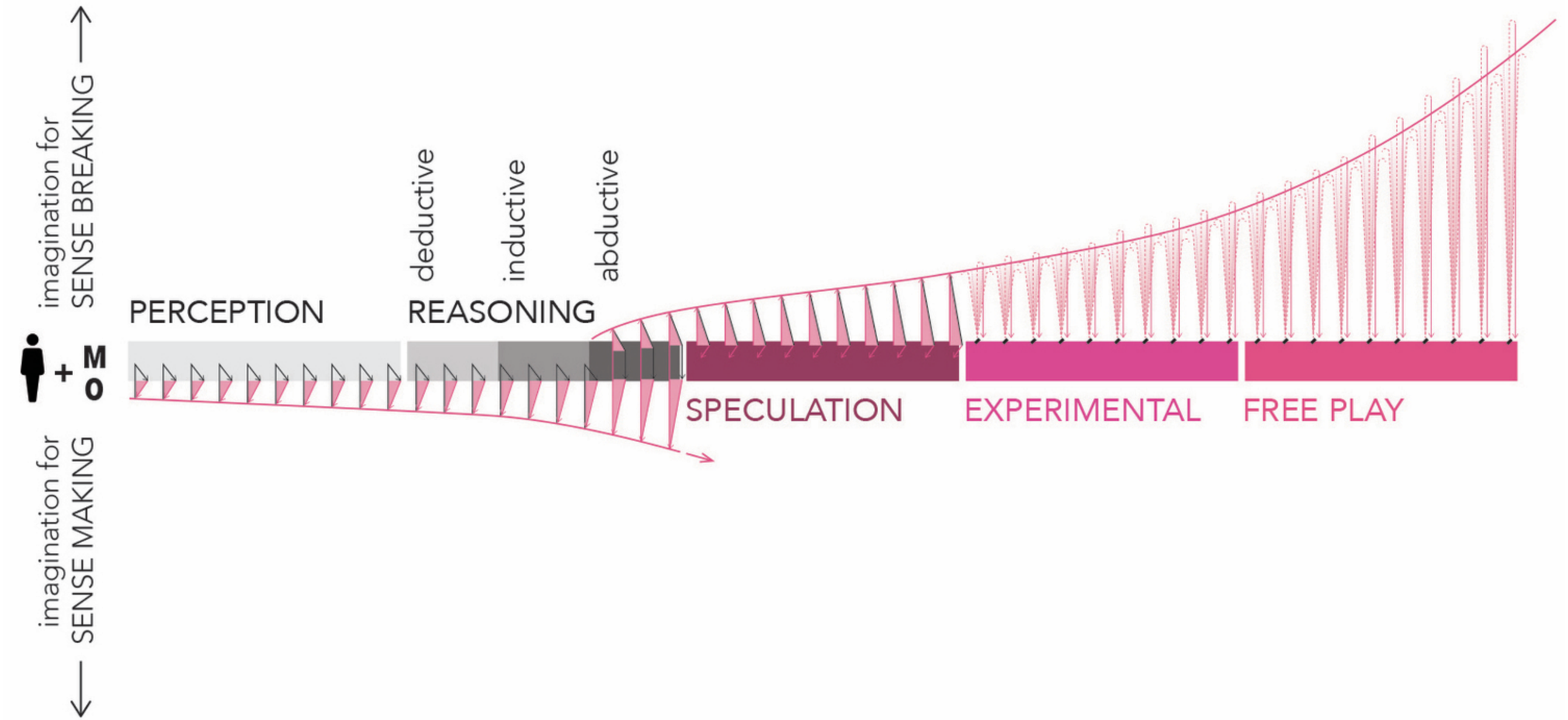

Ann Pendleton-Jullian & John Seely Brown, *Pragmatic Imagination: Single from Design Unbound*. Blurb (2016)

Ann Pendleton-Jullian & John Seely Brown: The Pragmatic Imagination

Six Principles:

1. The imagination serves diverse cognitive processes as an entire spectrum of activity.

2. The imagination both resolves and widens the gap between what is unfamiliar and what is known.

3. The Pragmatic Imagination pro-actively imagines the actual in light of meaningful purposeful possibilities.

4. The Pragmatic Imagination sees thought and action as indivisible and reciprocal.

5. The imagination must be instrumentalized to turn ideas into action - the entire spectrum of the imagination.

6. Because the imagination is not under conscious control, we need to understand, find, and design ways to set it in motion and scaffold it for play and purpose.

Ann Pendleton-Jullian & John Seely Brown, *Pragmatic Imagination: Single from Design Unbound*. Blurb (2016)

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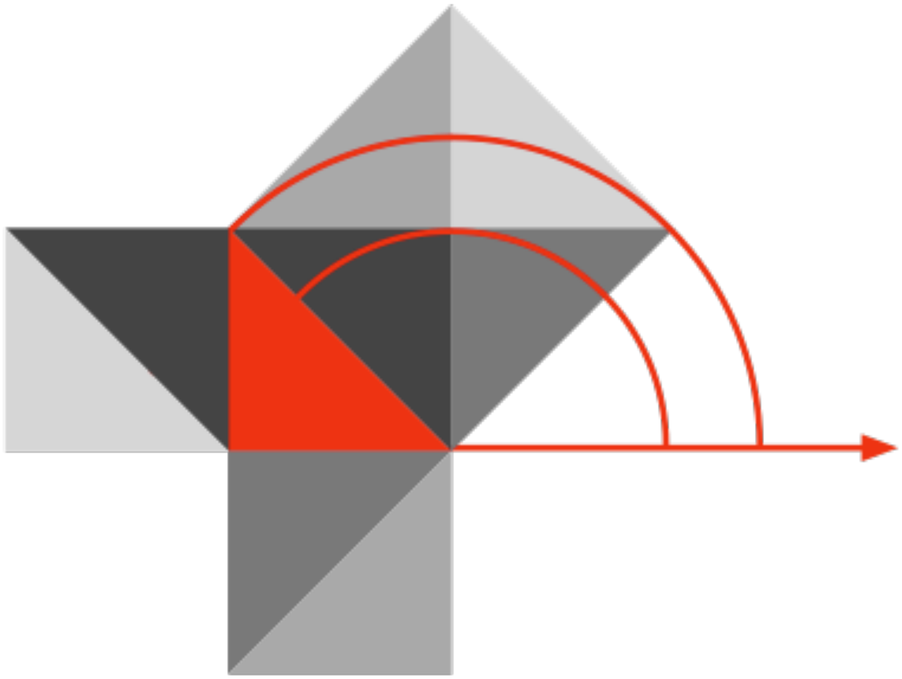

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