TPACK Concepts and Practices

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ABSTRACT

TPACK(Technological Pedagogical Content Knowledge) is a theoretical concept that has seen widespread adoption in the area of teacher development for technology integration. This presentation analyses the theoretical development of the TPACK construct and examples of its application for teacher development in pre-service and in - services contexts. It will also discuss future directions for the research and application of TPACK.

AGE

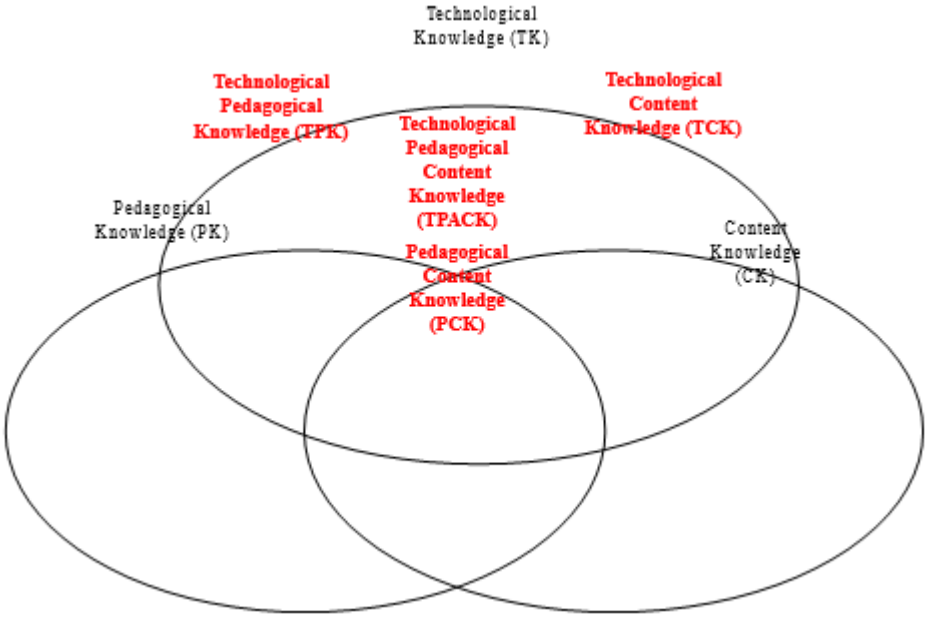
1. Theoretical conceptions of TPACK
2. Application 1 – TPACK as teacher education framework
3. Application 2 – TPACK for teacher profiling
4. Application 3 – TPACK for lesson design
5. Synthesizing the approaches – An example
6. Future Directions

WHAT IS CONTENT KNOWLEDGE (TPACK)?

- Teachers' body of knowledge in terms of technology integration
- A form of professional understanding
- Acronym changed from TPCK to TPACK to better reflect the integrations between Technology, Pedagogy, and Content Knowledge for effective technology integration (See Thompson & Mishra,2007)

THE TPACK

CONSTRUCTS (MISHRA & KOEHLER, 2006) Why teaching teachers TK alone does not help them better integrate technology



BASIC ELEMENT

TPACK Constructs	Definition	Example
TK (Technological Knowledge)	Knowledge about how to use ICT hardware and software and associated peripherals	Knowledge about how to use Web 2.0 tools (e.g. Wiki, Blogs, Facebook)
PK (Pedagogical Knowledge)	Knowledge about the students' learning, instructional strategies, different educational theories, and assessment methods	Knowledge about how to use problem-based learning (PBL) in teaching different subject matter
CK (Content Knowledge)	Knowledge of the subject matter	Knowledge about Science or Math subjects

INTEGRATION OF TWO

PCK (Pedagogical Content Knowledge)	Knowledge of representing content knowledge and adopting pedagogical strategies to make the specific content/topic more understandable for the learners Knowledge of pedagogical use of certain form of technology for learning	Knowledge of using analogies to teach electricity (see Shulman, 1986)
TPK (Technological Pedagogical Knowledge)	**(Not subject specific)**	The notion of Webquest, KBC, using ICT as cognitive tools, computer-supported collaborative learning
TCK (Technological Content Knowledge)	Knowledge about how to use technology to represent/research and create the content in different ways **(Not considering teaching)**	Knowledge about online dictionary, corpus technology, Geospatial technology (Google earth and map), Geometer's Sketchpad, specialized databases, data logger, topic specific simulation

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SYNTHESIS ON THE TREE

TPACK (Technological Pedagogical Content Knowledge)	Knowledge of using various technologies to teach, represent, and facilitate knowledge creation of specific subject content	Knowledge about how to use Wiki as an communication tool to enhance collaborative learning in social science

Cox, S., & Graham, C. R. (2009). Diagramming TPCK in Practice:
Using and elaborated model of the TPCK framework to analyze and depict teacher knowledge. *TechTrends, 53*(5), 60-69.

HOW DO TEACHERS
KOEHLER, MISHRA & YAHYA (2007)

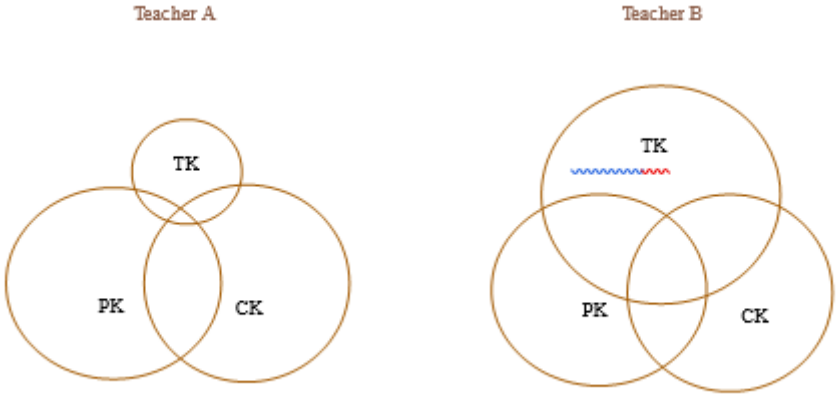
Purpose: Trace the TPACK development of 18 graduate students as they designed an online course.

Data source: Transcript of classroom discussions, interviews, and observations.

Examples of coding adapted from the article:
- CK: Teaching examples e.g. spanking, not spanking
- PK: "They need to build teambuilding skills"
- TK: "Use dropdowns for links to the chapter"
- PCK: "How do you use rewards for learning?"
- TCK: "Make a link to some websites on jigsaw learning"
- TPK: "Where will students click to get to that activity?
- TPACK: "How to deliver this content to students? Use powerpoint?"

Key conclusion: Integration of technology, pedagogy, and content occur through design.

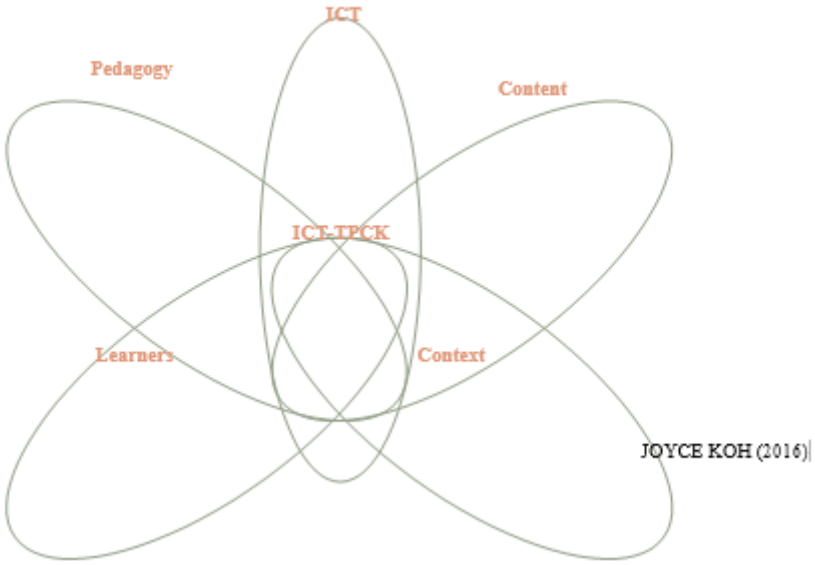
Which Teacher Has



The ICT-TPCK

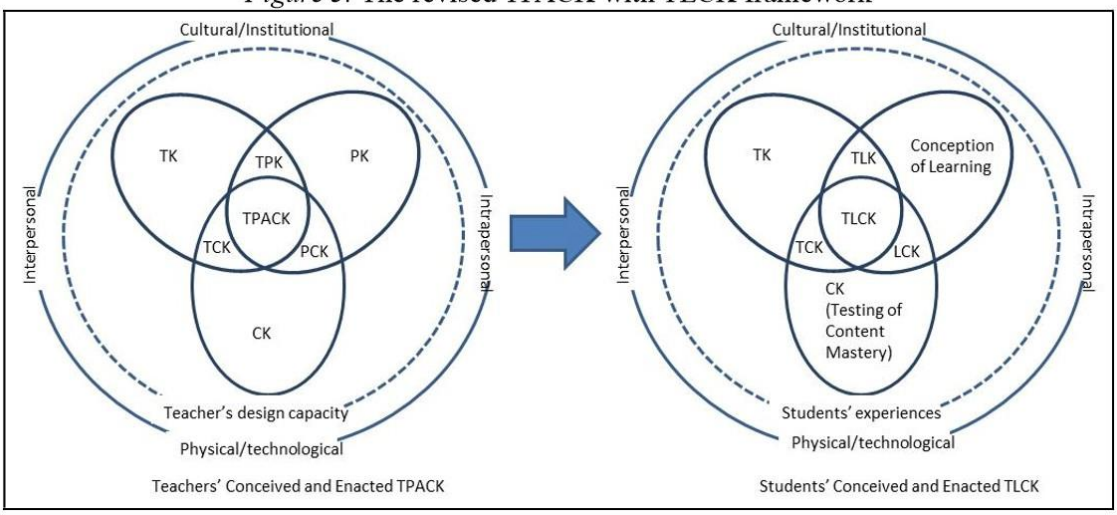
VALANIDES, 2009)

Knowledge of how to teach difficult content more effectively with ICT.

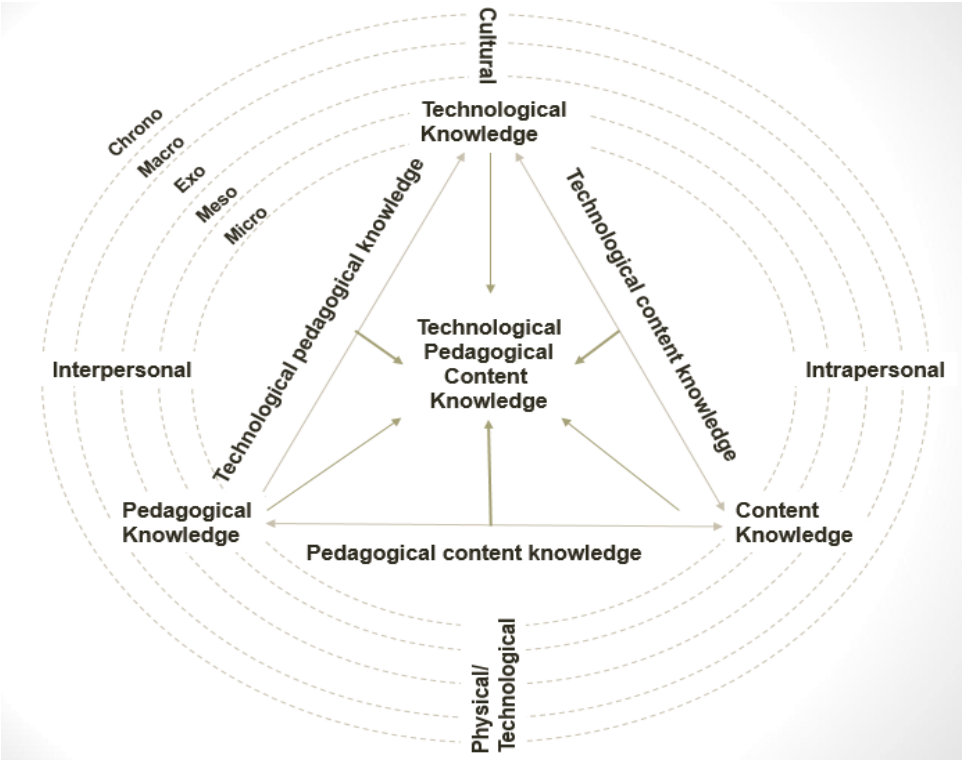


TPACK-IN-ACTION MODEL (CHAI, KOH & TSAI, 2013)

Figure 3. The revised TPACK with TLCK framework



MULTILEVEL CONTEXTUAL TPACK (CHAI, KOH, LIM, & TSAI, 2014)



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21 CENTURY LEARNING DESIGN THINKING MODEL (KOH, CHAI, WONG & HONG, 2015)

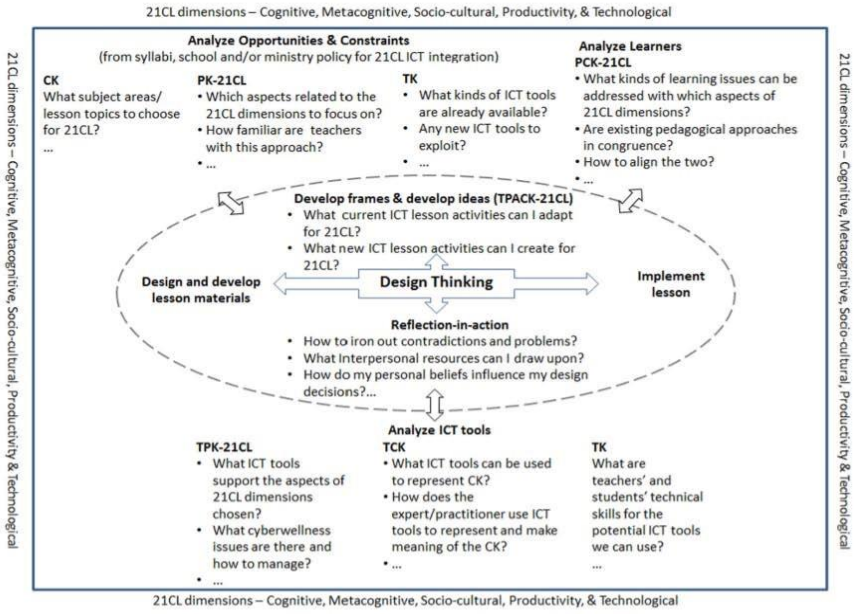


Fig. 1 21CL ICT design thinking framework (21CL-ICTDT)

Tpack As Teacher Aplication 1 Education Framework
Mapping Teacher Education (Niess, 2005)

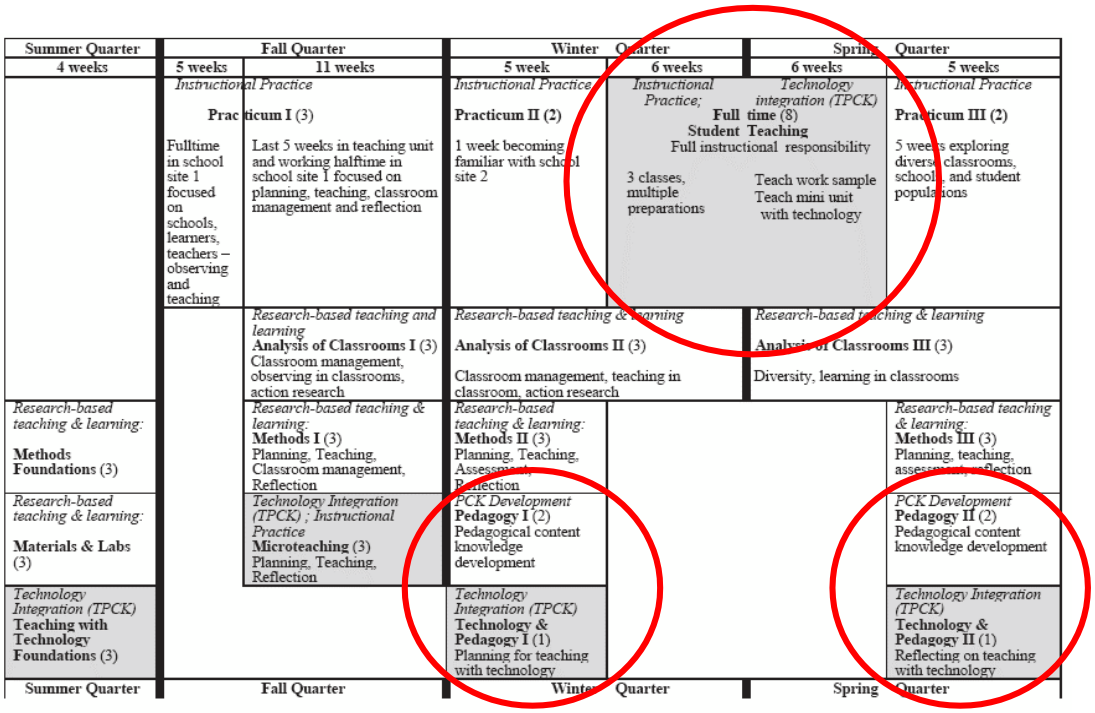


Fig. 1. Teacher preparation program displaying program themes (technology theme shaded).

The TTF Project-Australia (Source: Http://TTFEDU.AU/)

Designing Ict Pedagogies In Teacher Education (Koh & Divaharan, 2011)

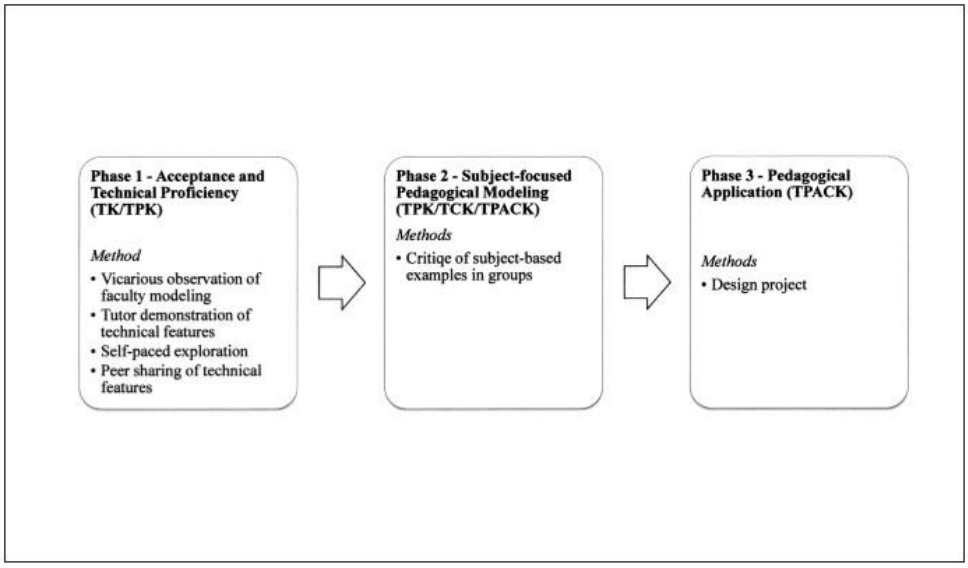


Figure 4. Revised TPACK-Developing Instructional Model.

TPACK FOR TEACHER APLICATION 2

Proliferation Of

1. General TPACK survey (Schmidt et al., 2008; Chai, Koh, & Tsai, 2010)
2. TPACK for K-12 online instruction(Archambault & Crippen, 2009)
3. TPACK for Science survey (Graham et al.,2009)
4. Web-based TPACK (Lee & Tsai, 2010)

5. TPACK for Meaningful Learning(Chai, Koh, & Tsai, 2011; Koh, Chai, & Tsai, 2014)

Analysis Of TPACK CLUSTERS (KOH & CHAI, 2014A)

Table 1
Cluster solutions derived for pre-service and in-service teachers.

	Pre-service (N = 164, 100.00%)		In-service (N = 102, 100.00%)	
	Cluster 1	Cluster 2	Cluster 1	Cluster 2
Cluster size	N = 92 (56.10%)	N = 72 (43.90%)	N = 62 (60.78%)	N = 40 (39.22%)
Gender	Male (N = 50, 54.30%)	Male (N = 5, 6.90%)	Male (N = 27, 43.55%)	Male (N = 3, 7.50%)
	Female (N = 42, 45.70%)	Female (N = 67, 93.10%)	Female (N = 35, 56.45%)	Female (N = 37, 92.50%)
Years in service	NA	NA	M = 7.47	M = 7.76
			SD = 5.18	SD = 5.99
Age	M = 24.47	M = 26.21	M = 33.11	M = 34.15
	SD = 2.82	SD = 5.55	SD = 5.43	SD = 7.50
Pre-TK	M = 5.23	M = 4.10	M = 5.65	M = 4.08
	SD = .75	SD = .95	SD = .76	SD = 1.05
Pre-PK	M = 5.21	M = 4.15	M = 5.86	M = 5.47
	SD = .66	SD = .71	SD = .45	SD = .70
Pre-CK	M = 5.56	M = 4.51	M = 5.98	M = 5.79
	SD = .71	SD = 1.03	SD = .66	SD = .72
Pre-PCK	M = 5.02	M = 3.92	M = 5.35	M = 5.08
	SD = 1.04	SD = .80	SD = .96	SD = 1.09
Pre-TCK	M = 4.76	M = 3.54	M = 5.52	M = 3.92
	SD = 1.02	SD = .89	SD = .72	SD = 1.15
Pre-TPK	M = 5.08	M = 3.73	M = 5.62	M = 4.12
	SD = .80	SD = .93	SD = .65	SD = .82
Pre-TPACK	M = 4.46	M = 3.05	M = 5.03	M = 3.38
	SD = .95	SD = .92	SD = .92	SD = .89

IN-SERVICE TEACHERS' PERCEIVED TPACK CONNECTIONS (KOH, CHAI, & TSAI, 2013)

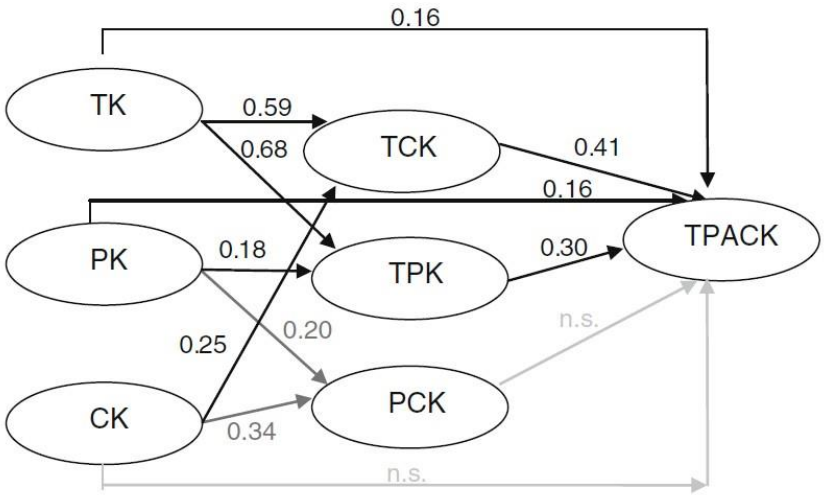


Fig. 3 Unbroken paths to TPACK

INFLUENCE OF DESIGN DISPOSITIONS (KOH, CHAI, HONG & TSAI, 2015)

Table 3. Results of structural equation modelling.

Hypothesis	Path	Path coefficient	Standard error	Critical ratio
1	DD –> LDP	0.59***	0.08	7.09
	DD –> TPACK	0.17*	0.08	2.03
2	LDP –> TPACK	0.69***	0.08	8.97

Note: $^{*}p < 0.05$, $^{***}p < 0.001$.

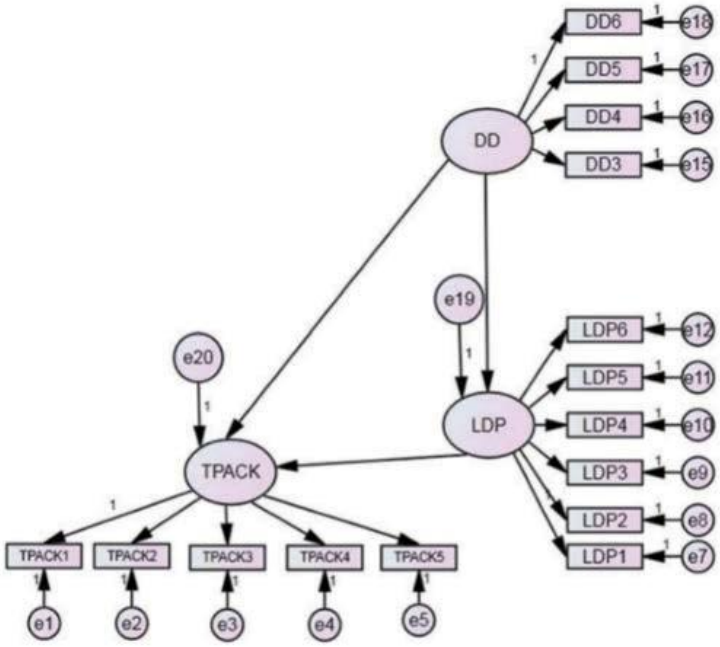
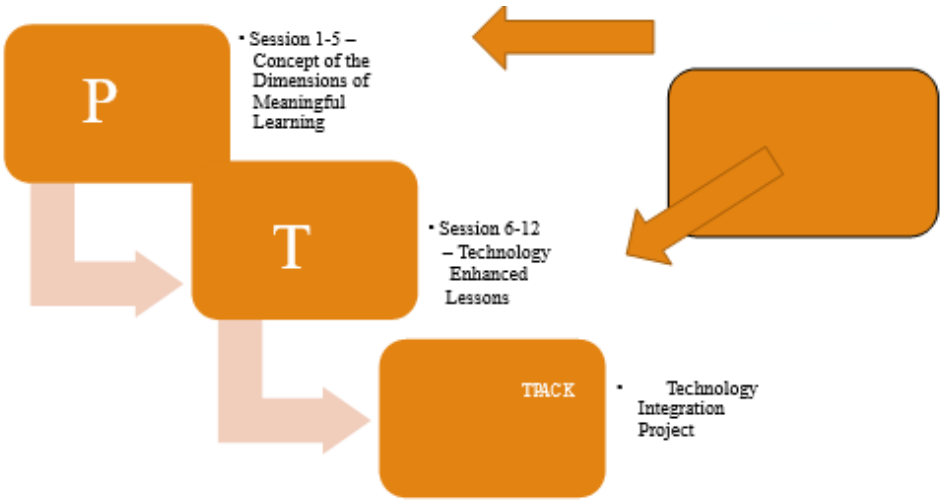
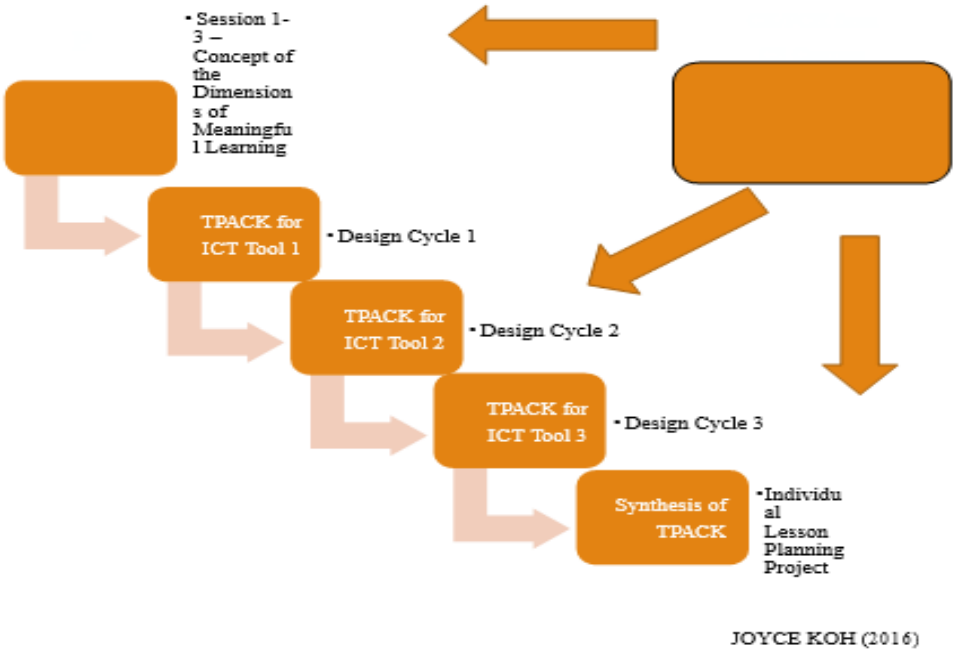


Figure 1. The structural equation model of DD, LDP, and TPACK.

DESIGN OF PRE-SERVICE ICT MODULE AT NIE (CHAI, KOH & TSAI, 2010)



REDESIGN OF PRE-SERVICE ICT MODULE AT NIE (KOH & CHAI, 2012)



Comparison of 2

Table 2. Descriptive Data and Results of Independent Samples t Test

Factors	Pre-test (N=439) M	SD	Post-Test (N=365) M	SD	*t*	*d*
TK	4.39	1.09	5.05	1.01	8.90 ***	0.63
CK	4.87	1.04	5.48	0.82	9.21 ***	0.65
PK	4.95	0.90	5.47	0.79	8.62 ***	0.61
TPACK	4.91	1.01	5.54	0.81	9.83 ***	0.69

*** $p < .001$

Table 1 – Descriptive data and results of paired-sample t-test

TPACK factor	Pre-study survey M	SD	Post-study survey M	SD	t	d
TK	4.72	1.07	5.27	0.76	4.88**	0.59
PK	4.65	0.85	5.15	0.70	4.92**	0.64
CK	5.09	1.02	4.89	0.99	-2.13*	-0.20
TCK	4.06	1.15	5.14	0.79	8.47**	1.09
TPK	4.38	1.14	5.27	0.79	6.80**	0.91
PCK	4.45	0.98	4.65	0.90	1.54	0.21
TPACK	3.74	1.21	5.17	0.75	11.11**	1.42

** p<0.001 *p<0.05

Pros and Cons of

a. Allows understanding of teachers

   perseptions

b. Allows modelling of teacher development trends

   Based on perception data

   Does not tell you how teachers make
   Design happen

Gaps in Teachers

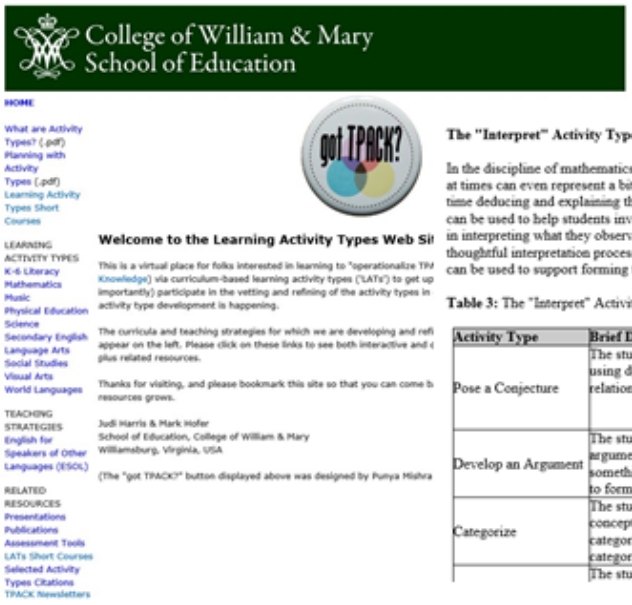
Anlysis of pre-service teachers 'ICT

Lesson plans

Faced challenges in designing student-centerred lesson activities to support knowledge construction

TPACK FOR LESSON DESSIGN
Aplication 3

TPACK AS LESSON IDEAS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HOME

What are Activity Types? (.pdf)
Planning with Activity Types (.pdf)
Learning Activity Types Short Courses

LEARNING ACTIVITY TYPES
K-6 Literacy
Mathematics
Music
Physical Education
Science
Secondary English Language Arts
Social Studies
Visual Arts
World Languages

TEACHING STRATEGIES
English for Speakers of Other Languages (ESOL)

RELATED RESOURCES
Presentations
Publications
Assessment Tools
LATs Short Courses
Selected Activity Types Citations
TPACK Newsletters

got TPACK?

Welcome to the Learning Activity Types Web Si

This is a virtual place for folks interested in learning to "operationalize TPA Knowledge) via curriculum-based learning activity types ("LATs") to get up importantly) participate in the vetting and refining of the activity types in activity type development is happening.

The curricula and teaching strategies for which we are developing and refi appear on the left. Please click on these links to see both interactive and c plus related resources.

Thanks for visiting, and please bookmark this site so that you can come b resources grows.

Judi Harris & Mark Hofer
School of Education, College of William & Mary
Williamsburg, Virginia, USA

(The "got TPACK?" button displayed above was designed by Punya Mishra

The "Interpret" Activity Types

In the discipline of mathematics, individual concepts and relationships can be quite abstract, and at times can even represent a bit of a mystery to students. Often students need to spend some time deducing and explaining these relationships to internalize them. Educational technologies can be used to help students investigate concepts and relationships more actively, and assist them in interpreting what they observe. This table displays activity types that can support this thoughtful interpretation process, and provides some examples of the available technologies that can be used to support forming the interpretations.

Table 3: The "Interpret" Activity Types

Activity Type	Brief Description	Possible Technologies
Pose a Conjecture	The student poses a conjecture, perhaps using dynamic software to display relationships	Dynamic geometry software (e.g., Geometer's Sketchpad), Content-specific interactive tool (e.g., ExploreMath), e-mail
Develop an Argument	The student develops a mathematical argument related to why they think that something is true. Technology may help to form and to display that argument.	Concept mapping software, presentation software, blogs, specialized word processing software (e.g., Theorist)
Categorize	The student attempts to examine a concept or relationship in order to categorize it into a set of known categories	Database software, online databases, concept mapping software, drawing software
	The student explains the relationships	Data visualization software

Source: http://activitytypes.wm.edu/

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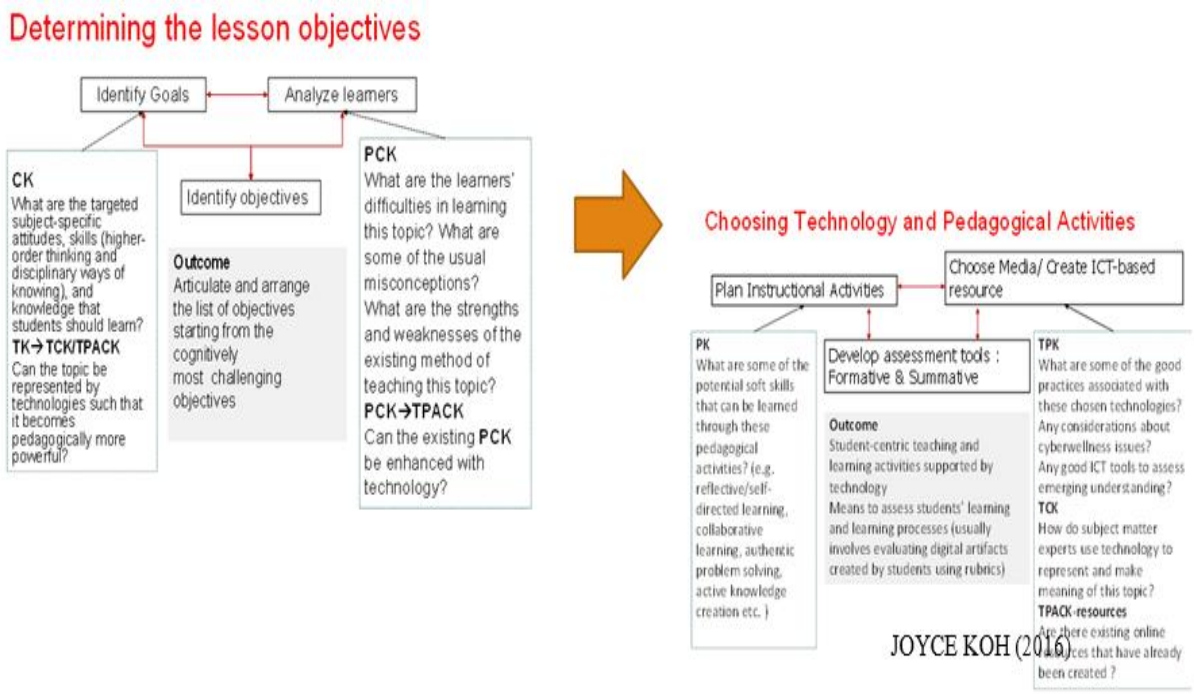
TPACK CONSTRUCTS AS EPISTEMIC RESOURCES (CHAI & KOH, 2017)

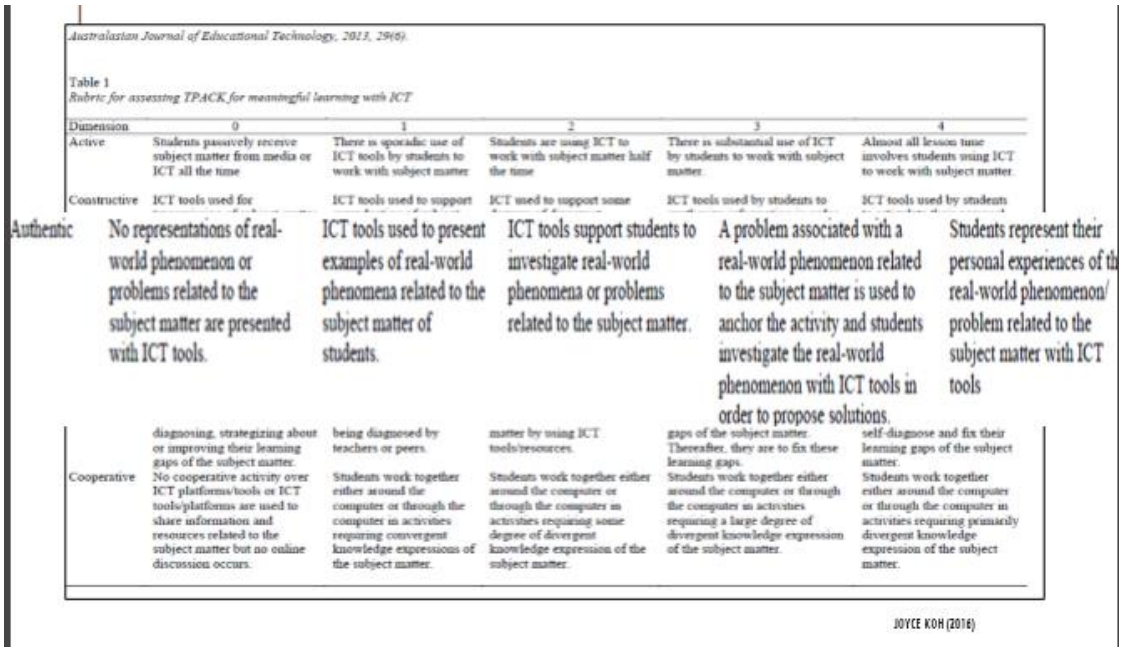
ICT lesson planning models are designed to trigger consideration of different TPACK aspects



TPACK AS DESIGN THINKING (KOH & CHAI, 2014

Transcript	TPACK Transformations
1. HOD a. Did we consolidate and collate their responses? b. In our initial conception, we said that they could key their responses into the portal so that they can revisit their own or their friends' answers. c. Since they have so many responses, why don't they key it in somewhere? d. They can use their phone or the laptop.	TPK (Clarify) TPACK (Clarify) TPACK(Propose New
2. Teacher A - There were two questions on the LMS forum for them to write their points about the flags.	TPACK(Clarify)
3. HOD a. How about archiving their own responses? b. How about a GoogleDoc for each group? c. It will be good to record their own learning, consolidate and share with their friends.	TPACK(Clarify) TPACK(Refine new idea) TPACK(Support new idea)
4. Teacher B – The problem with the phone is that students cannot access shared postings ... even using GoogleDoc on	TK (Identify Gap)

Tpack Lesson Plan Assessment Rubric To Support 21st century Meaningful Learning With Ict (Koh, 2013)



Australasian Journal of Educational Technology, 2013, 29(6).

Table 1
Rubric for assessing TPACK for meaningful learning with ICT

Dimension	0	1	2	3	4
Active	Students passively receive subject matter from media or ICT all the time	There is sporadic use of ICT tools by students to work with subject matter	Students are using ICT to work with subject matter half the time	There is substantial use of ICT by students to work with subject matter.	Almost all lesson time involves students using ICT to work with subject matter.
Constructive	ICT tools used for	ICT tools used to support	ICT used to support some	ICT tools used by students to	ICT tools used by students
Authentic	No representations of real-world phenomenon or problems related to the subject matter are presented with ICT tools.	ICT tools used to present examples of real-world phenomena related to the subject matter of students.	ICT tools support students to investigate real-world phenomena or problems related to the subject matter.	A problem associated with a real-world phenomenon related to the subject matter is used to anchor the activity and students investigate the real-world phenomenon with ICT tools in order to propose solutions.	Students represent their personal experiences of th real-world phenomenon/ problem related to the subject matter with ICT tools
	diagnosing, strategizing about or improving their learning gaps of the subject matter.	being diagnosed by teachers or peers.	matter by using ICT tools/resources.	gaps of the subject matter. Thereafter, they are to fix these learning gaps.	self-diagnose and fix their learning gaps of the subject matter.
Cooperative	No cooperative activity over ICT platforms/tools or ICT tools/platforms are used to share information and resources related to the subject matter but no online discussion occurs.	Students work together either around the computer or through the computer in activities requiring convergent knowledge expressions of the subject matter.	Students work together either around the computer or through the computer in activities requiring some degree of divergent knowledge expression of the subject matter.	Students work together either around the computer or through the computer in activities requiring a large degree of divergent knowledge expression of the subject matter.	Students work together either around the computer or through the computer in activities requiring primarily divergent knowledge expression of the subject matter.

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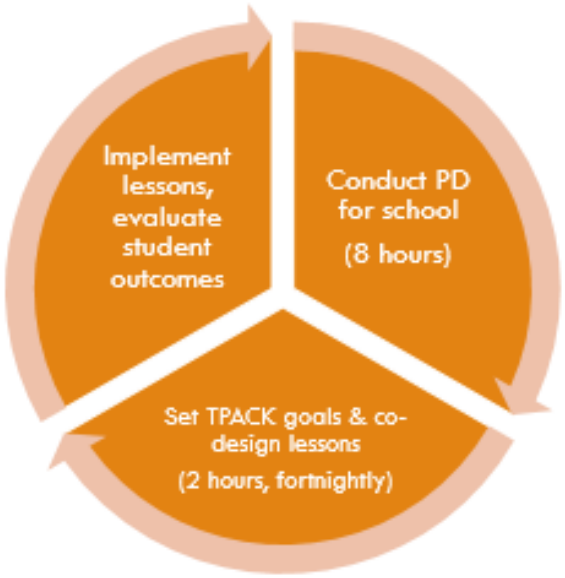
Synthesizing The Approaches
A 1 Year Design-Based Tpack Development Process For School-Based Ictintegration (Koh, Chai & Lim, In-Press)



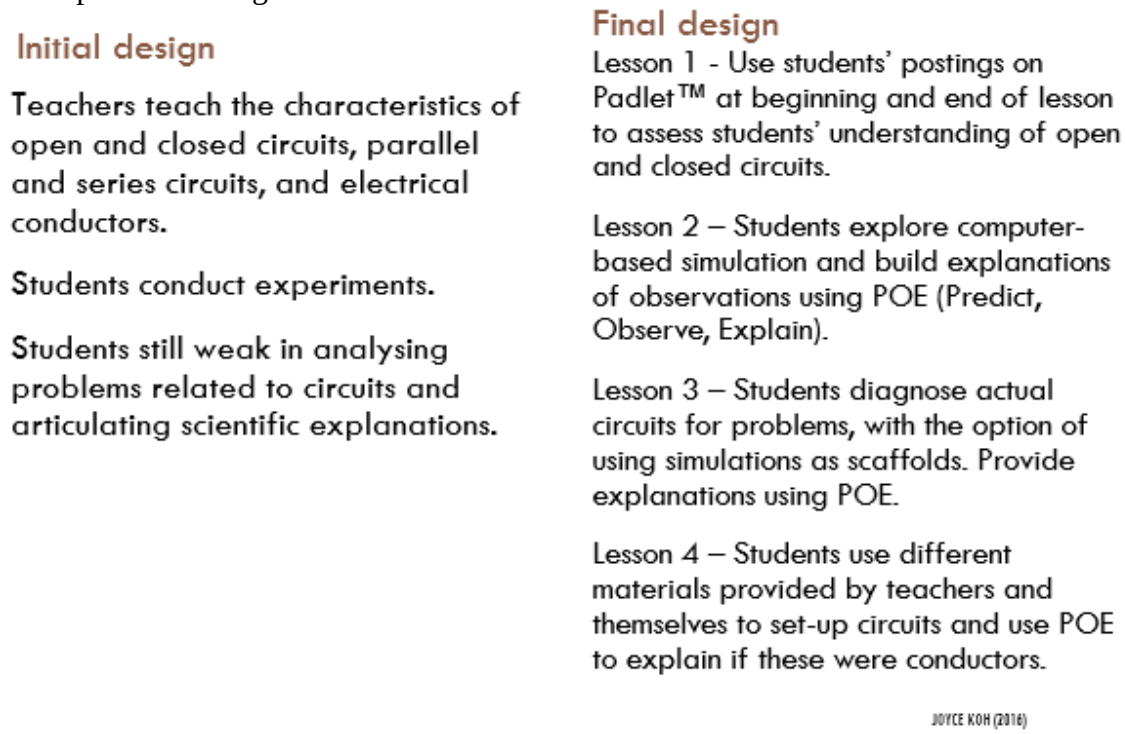
Participants

1. 2 Singapore primary schools
2. 47 teachers, organized into 10 subject-based design teams
3. Schools are focusing on integrating 21st century learning into curriculum

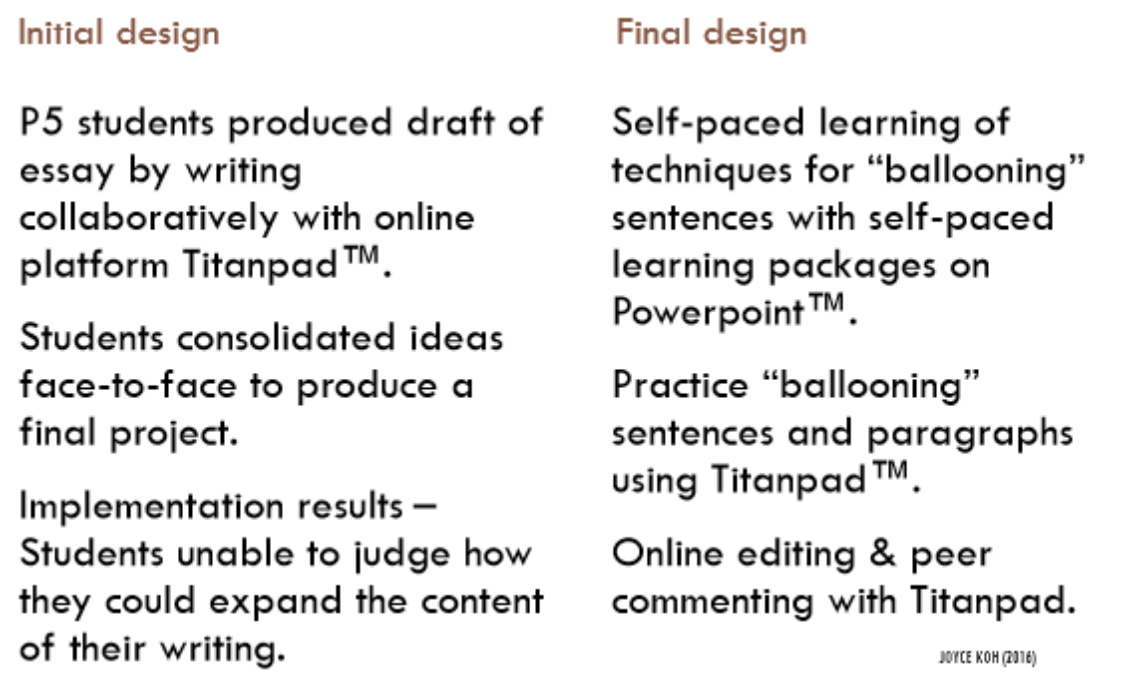
EXAMPLE OF REDESIGNED LESSON –MATH

Initial design	Final design
Use online manipulatives for P5 students to practice visualization of fractional parts.	Problem 1 – Distribute a bag of sweets equally among peers (whole numbers).
Create a totally new lesson for the topic of Averages that is based on authentic problem-solving.	Problem 2 – Compute school's average utility bill across the school year with Microsoft Excel™, analyse possible reasons for above-average usage in particular months & brainstorm ways for conservation.
	Problem 3 – Collect data to find average mass of peers' school bags and individually reflect on strategies to avoid carrying unnecessarily heavy bags to school. JOYCE KOH (2016)

Example Of Redesigned Lesson –Science



Example Of Redesigned Lesson –English



Outcomes

TPACK Survey - Improved teacher confidence in TPACK

1. TPACK lesson design – 9 out of 10 groups improved their lesson design ratings for meaningful learning dimensions
2. Evidence of improvement in student learning

FUTURE DIRECTIONS

For Pre-Service Teacher Education

1. Assess both teacher perceptions and design products
2. Develop TPACK Activity Types as scaffolds for specific technologies, pedagogies, and content
3. Develop lesson planning scaffold

FOR IN-SERVICE TEACHERS

1. Engage TPACK development in schoolbased design teams
2. Examine teachers' design outcomes and impact on student learning
3. Examine teachers' design thinking for supporting TPACK development

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