

FACULTY OF

**EDUCATION, SCIENCE,
TECHNOLOGY & MATHEMATICS**



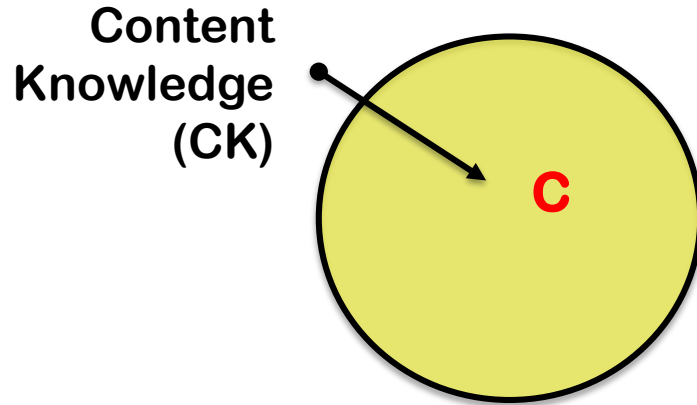
**UNIVERSITY OF
CANBERRA**

Understanding Mathematics Teachers' TPACK through the Examination of Critical Instructional Events

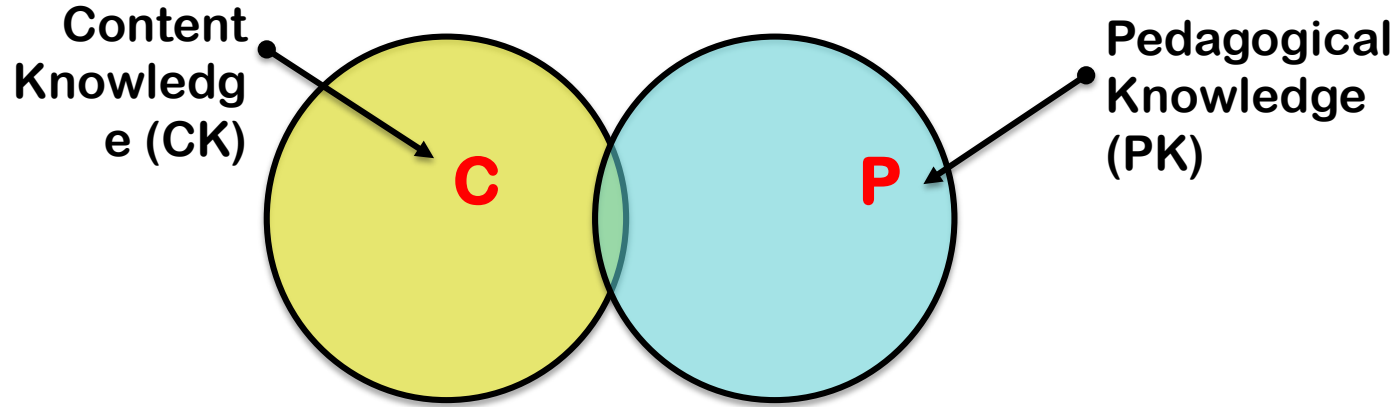
Sitti Maesuri Patahuddin

(GRCOS) #00212K

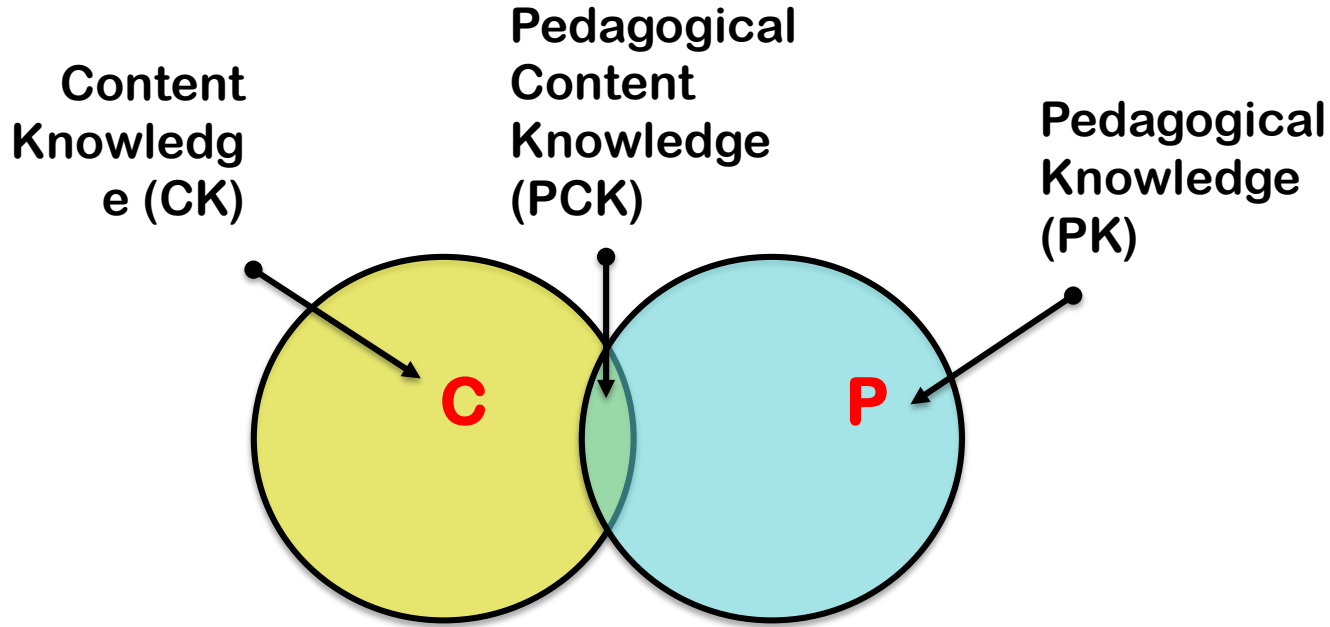
TPACK constructs



TPACK constructs

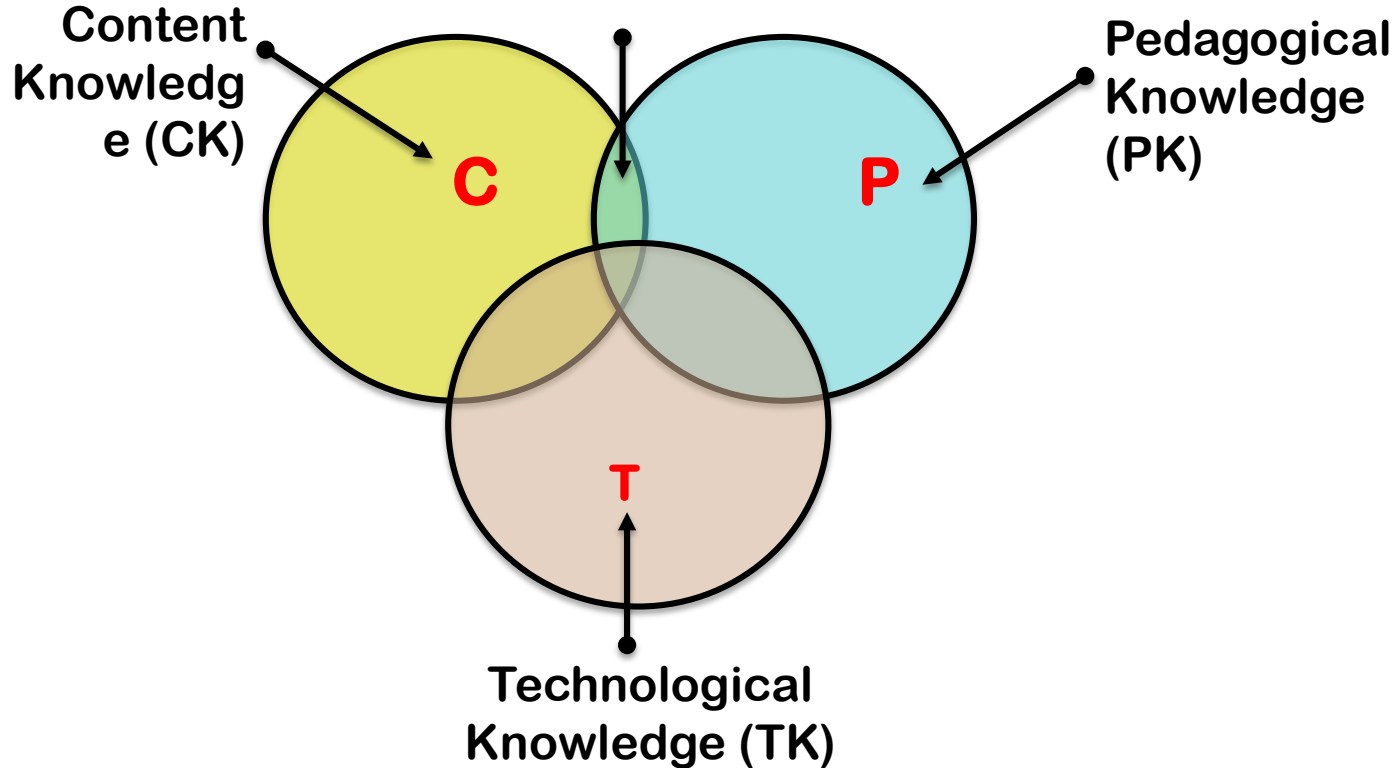


TPACK constructs

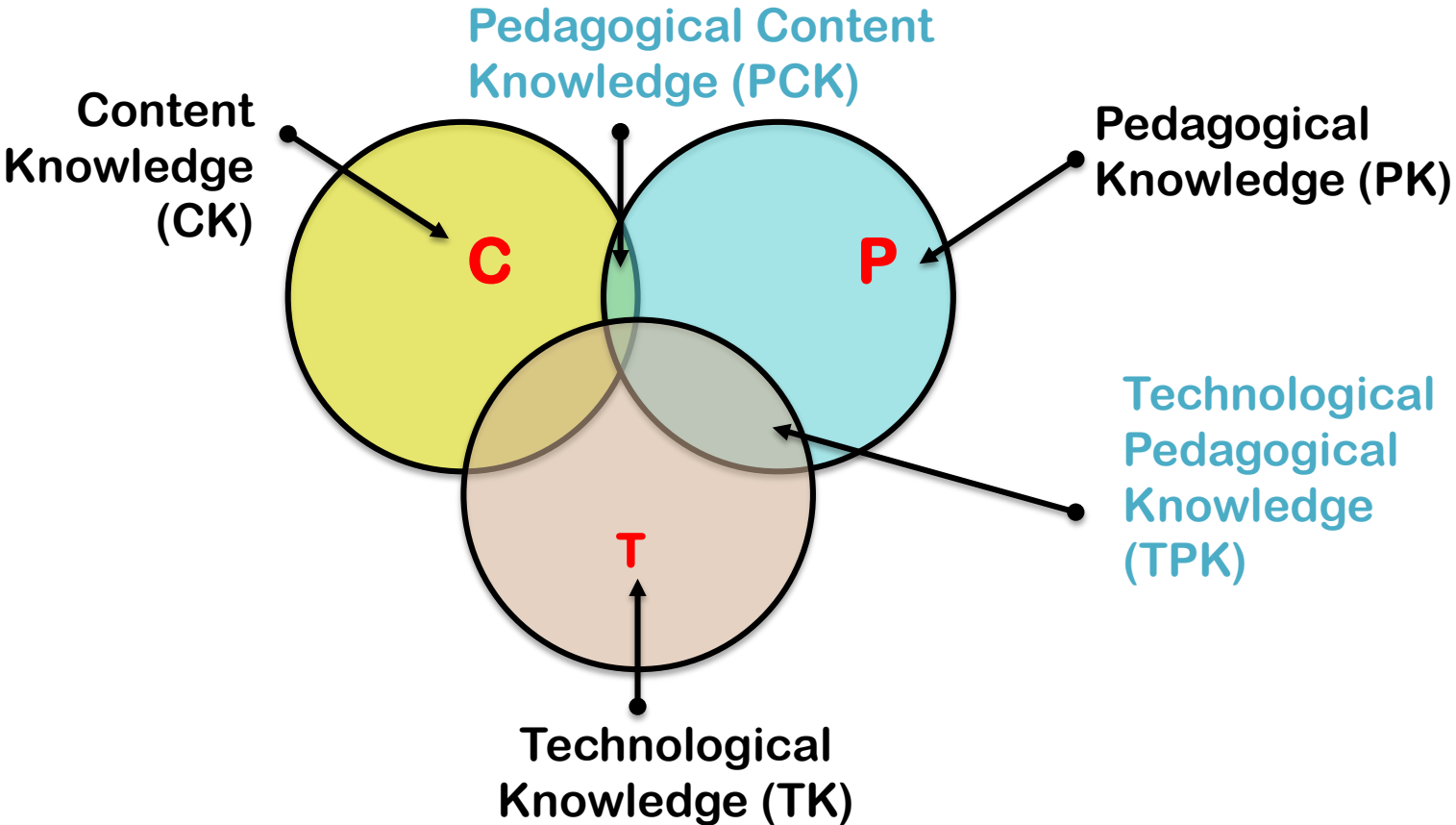


TPACK constructs

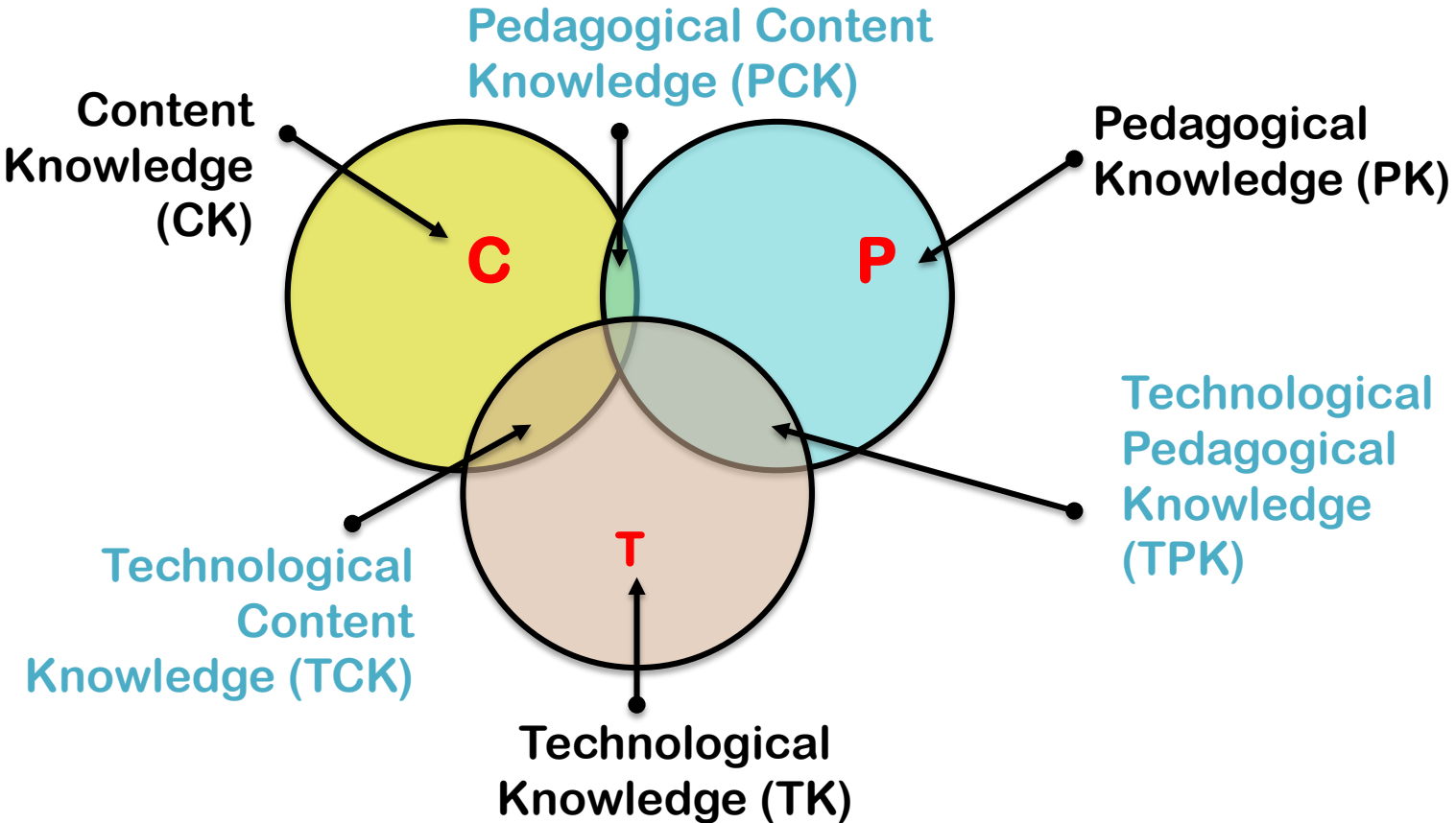
Pedagogical Content
Knowledge (PCK)



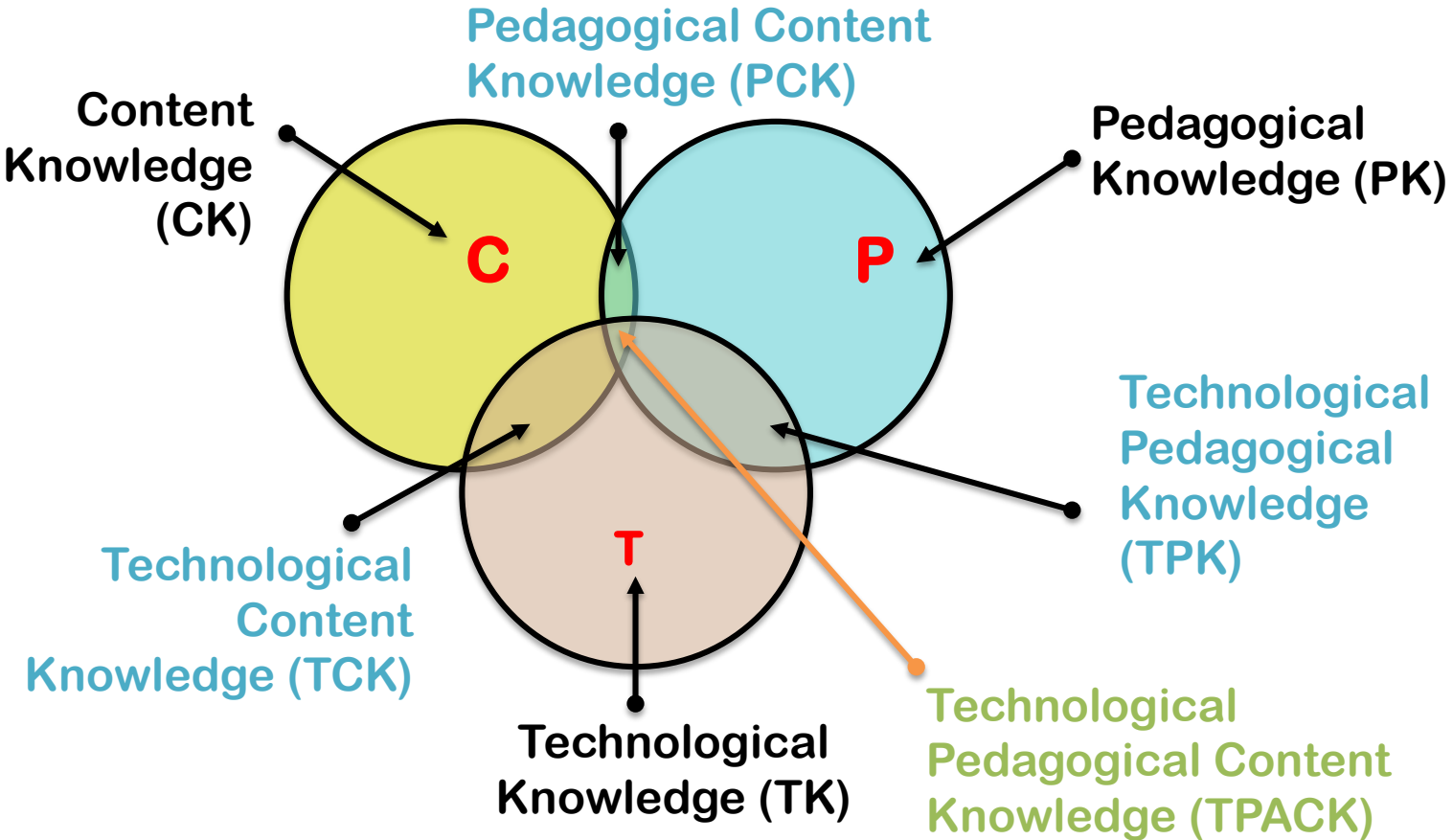
TPACK constructs



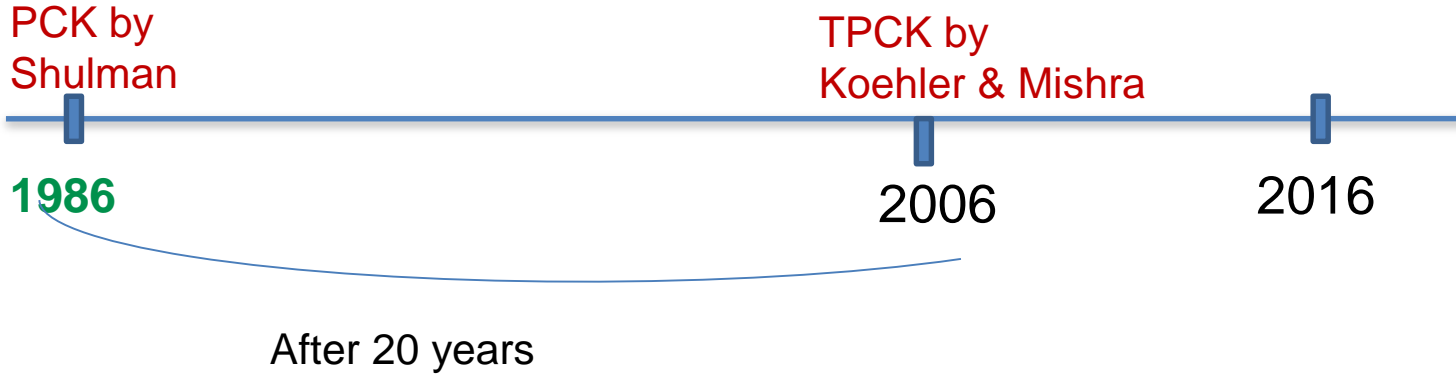
TPACK constructs



TPACK constructs



History of TPACK?



TPACK framework is more readily accepted by education technologists rather than content specialists. (p.35)- Chai, Koh, & Tsai (2013)

Findings from the literature

- Most studies - TPACK – through surveys or interviews - without observing teachers in the classroom
- The need to gain insight on teachers' TPACK during their practice by analysing data from their authentic teaching or in real classroom.

Research Question:

- What TPACK constructs are most influential in shaping and understanding mathematics teachers' pedagogical practices using digital technology?

Examining critical events

- A critical event, which is "unplanned, unanticipated or uncontrolled" is a situation that holds significance for learning, both for students and teachers.
- Critical events in a classroom situation provide opportunities for rich analysis of classroom practices

(Woods, 2012)

Videoring

- Focusing on what the teacher said and did

Transcribing + watching

- Make sense the whole story

Methods

Breaking into episodes

- 10 episodes were identified

Focus on technology-tasks

- 7 episodes -- directly related to web-based tasks

Identify 7 constructs in each episode

- Generate table of analysis

Summarise the results

- Finding pattern from the the summary table

Approx 100 mnt out of 270 mnt video from a Year 7 class

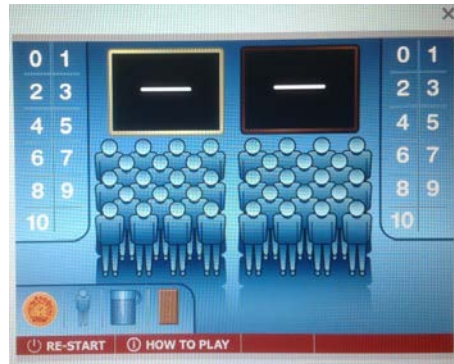
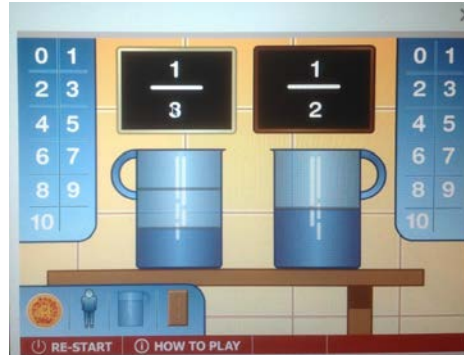
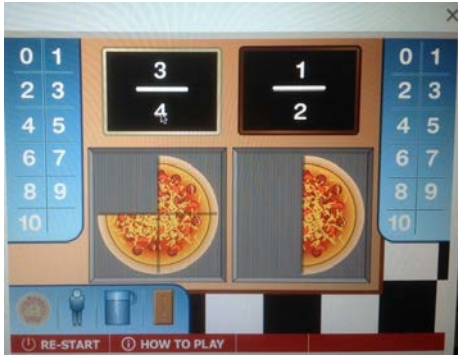
Dynamic interactions:

What are the affordances and limitations of this website?



What can the students do?
What did they do and say?

Website used



<http://www.bbc.co.uk/skillswise/game/ma17frac-game-fractions-side-by-side>

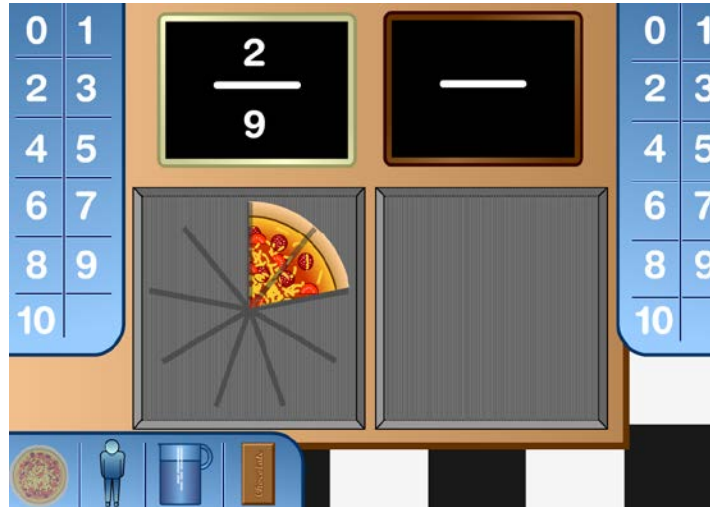
What the students can do?



A user can manipulate by **dragging** numbers, read, **look**, discuss, ask, or just “trial and error”

CRITICAL Event

when a misconception emerged or incorrect conjectures developed as a result of a student's learning using the exploratory website.

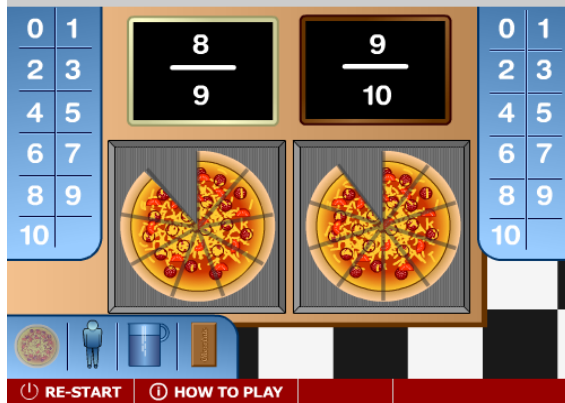


$$\frac{8}{7} \quad \frac{2}{9}$$

“I told you so, that’s empty so two ninths is greater”

$$\frac{8}{9} = \frac{9}{10}$$

This virtual manipulatives create difficulties to differentiate just by looking at the pictures



A/B and B/C are sometimes the same

CRITICAL Event

Research Question:

- What TPACK constructs are most influential in shaping and understanding mathematics teachers' pedagogical practices using digital technology?

TCK

The affordances of the applet—to present fractions in symbolic and various pictorial representations.

Lack of demonstrated knowledge of its affordances as a tool to compare fractions meaningfully (e.g., recognise what is invariant when comparing fractions with the same numerators)

TPK

- The applet can afford exploratory and cooperative learning activities
- The teacher did not demonstrate her pedagogical strategies using technology in ways resolved misconceptions
- The teacher preferred students to reach their own conclusions. *“In order no one becomes confused, everyone will learn this on the website” and “You will find the answer of those questions after you worked with the website”.*
- There was no evidence of the teachers’ attempts to utilise the technology in discouraging students from chorusing answers.

PCK

- For example, she clearly presented all the fraction examples by writing them on the board, stating in words and pointing with her finger, therefore allowing students to see and listen.
- However, she did not exhibit the use of effective mathematics questioning to elicit and clarify ideas and extend her students' prior knowledge

TPACK

- The teacher did not explore emerging critical ideas (e.g., misconceptions) to explain and discuss core concepts in comparing fractions. She apparently did not anticipate the way in which the software responds to an improper fraction, such as $8/7$, would affect student learning.
- It would appear that the limitation of the software providing a blank representation led the students' misconception when comparing $2/9$ and $8/7$. She could have utilised the applet to scaffold students to visualising $8/7$ by observing the “sevenths” (e.g., $1/7$, $2/7$, $3/7$, $4/7$, etc.).

Discussion

- The examination of critical instructional events through the TPACK lens assisted in understanding the complexity of mathematics teaching (including opportunities and challenges) using the exploratory web-based applet.

Discussion

- The critical events illustrated that the teacher's TPK was consistent with an unguided exploratory learning pedagogy, which has been shown in many studies to be inferior to a guided inquiry learning approach.

Discussion

- This finding highlighted the influence of technology on teacher's pedagogical decision which is consistent with Inan, Lowther, Ross, and Strahl's study (2010), who found that teachers' classroom practices were shaped by the types of technologies used.

Discussion

- The applet did not enable users to zoom in to see the difference between the two pictures and it did not present improper fractions. However, these constraints could be harnessed as a stimulant to deepen mathematical thinking, as there is no way to present all fractions in pictorial form.
- The mathematics teaching should help learners understand the abstract concepts, and the manipulative should be used to bridge this process.

Implications

- Teachers can draw upon the TPACK framework as a guideline to ensure their planning accommodates for the possible challenges that might emerge during the learning process.

Analysing Mathematics Teachers' TPACK Through Observation of Practice

Siti Maesuri Patahuddin¹ · Tom Lowrie¹ · Barney Dalgarno²

© De La Salle University 2016

Abstract Technological pedagogical content knowledge (TPACK) has been well accepted as a framework to understand and describe types of knowledge required by teachers to teach specific content with technology effectively. However, limited studies have used the framework in analysing the complexity of technology integration in mathematics classrooms. This study investigates, through examining critical instructional events, the most influential TPACK constructs in understanding and shaping teachers' pedagogical practices using digital technology. This case study was conducted in an early secondary mathematics classroom in Indonesia that used a web-based resource to support students' understanding of fractions. The finding suggests that the qualitative examination of the four intersected TPACK constructs assists in understanding the challenges and the opportunities to teachers when utilising an exploratory-based technology. It demonstrates that the combination of pedagogical stances and choice of technology significantly influence the visibility of other TPACK constructs. Implications of this study include the need of thoughtful planning prior to using web-based

resources and the importance to utilise critical events in developing and assessing teachers' TPACK.

Keywords TPACK framework · Mathematics teaching · Exploratory web-based applet · Qualitative examination of practice · Critical event

Introduction

Substantial literature has been published on technological pedagogical and content knowledge (TPACK) (Chai et al. 2013a, b; Koh et al. 2015; Voogt et al. 2013) as it is a well-known framework for understanding the professional knowledge required by teachers to teach specific content with technology effectively. In particular, TPACK has been used widely in mathematics education research (e.g. Agyei and Voogt 2015; Depaepe et al. 2013; Jang and Tsai 2012; Muir et al. 2016; Polly 2011). For example, Polly (2011) used the TPACK framework to examine teachers' experiences in a professional development programme.

