Magic Touch
Solutions to problems are easy to find, the problem is a great contribution. What’s truly an art is to wring from your mind a problem to fit a solution
— Piet Hein
Educational Technology & Teacher Education
The TPACK framework

January 2009
My collaborator & friend
A true collaboration
The role of technology in teaching/learning
(what do teachers need to know?)
Frozen in time?
<table>
<thead>
<tr>
<th>Generations</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>speech</td>
</tr>
<tr>
<td>750</td>
<td>agriculture</td>
</tr>
<tr>
<td>500</td>
<td>writing</td>
</tr>
<tr>
<td>400</td>
<td>libraries</td>
</tr>
<tr>
<td>40</td>
<td>universities</td>
</tr>
<tr>
<td>24</td>
<td>printing</td>
</tr>
<tr>
<td>16</td>
<td>accurate clocks</td>
</tr>
<tr>
<td>5</td>
<td>telephone</td>
</tr>
<tr>
<td>4</td>
<td>radio</td>
</tr>
<tr>
<td>3</td>
<td>television</td>
</tr>
<tr>
<td>2</td>
<td>computers</td>
</tr>
<tr>
<td>1</td>
<td>internet/email</td>
</tr>
<tr>
<td>0</td>
<td>gps, mp3, youtube, web2.0 etc. etc.</td>
</tr>
</tbody>
</table>
So what are teachers to do?
How are they using technologies?
In the US
9,000 schools and over 35,000 mathematics and science teachers in 22 countries/education systems
NOT
that increased technology use led to student learning

INSTEAD
the effectiveness of technology use [ICT] depended on the teaching approaches used in conjunction with technology

AND
Pedagogical ICT competence was the best positive predictor of teachers’ pedagogical adoption of technology”
THUS

it is NOT the technology alone, but rather how teachers integrate it with their teaching that matters.
IN OTHER’s WORDS:
If you are not going to change pedagogy then technology use makes no significant difference
– Tom Reeves (yesterday, standing right here)
Use

Innovation

Technology

Integration

Technology

Technology
Technology

What is it?
Understanding Technology
Technology solves problems
But creates new ones
How?
Affordances
(and constraints)
But
Users redefine technologies
Why is this important?
Only repurposing makes a technology an educational technology.
This is a creative, innovative act
The crucial mediating role played by the teacher...
Teacher proof
Curriculum
To sum up
Rapid rate of change

Understanding technology
  Affordances & constraints
  The importance of repurposing
    (from Tech to Ed Tech)

The crucial role of the teacher
Technology & Teaching
Pedagogy
knowledgeable, accessible, wise, funny, cerebral, benevolent, fair, firm, flexible, playful, serious ... & more
Teaching is always about something
The goals of education
The disciplines
Disciplines teach us to see
Disciplines teach us to see

Knowledge | Methods | Purposes | Forms
Disciplines teach us to see

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Methods</th>
<th>Purposes</th>
<th>Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>facts, concepts</td>
<td>knowledge creation &amp;</td>
<td>reasons why disciplines exist</td>
<td>genres, symbol</td>
</tr>
<tr>
<td>relationships</td>
<td>validation</td>
<td></td>
<td>systems</td>
</tr>
</tbody>
</table>
Knowing a discipline
Teaching a discipline
Mathematician
Not necessarily a good teacher of math
artist
physicist
economist
Quality teaching is
transformation of content for in a disciplined manner
To sum up
Teaching is messy & complex

The importance of discipline(s)

Teaching is about transforming disciplinary knowledge to meet the needs of students
Adding technology
Pedagogy

Content

Technology
The transformation of content due to technology

mathematics
science
physics
engineering
history
political science
education

.
Antonie van Leeuwenhoek
Christiaan Huygens
Literacy technologies
A book is a machine to think with
New literacies
# Periodic Table of the Elements

![Periodic Table of the Elements](image)

*Note: Lanthanide Series and Actinide Series are marked.*
Treptow's Electronic Form

This table was first reported by Richard Treptow in 1994. It takes a very different approach to periodicity than the other tables. It does so by arranging sub-blocks of elements into progressively larger blocks as we increase the atomic number. There are 7 blocks, one for each value of n (the principal quantum number). Each block contains as many elements that can have the given principal quantum number i.e. 2^n.

The first block has one square - representing the 1s orbital. The top half gets the first element and the bottom half gets the next element. Notice how this clearly shows that the first element has an unpaired electron and the second one has two paired electrons of opposite spin.

Notice how we could determine the presence of paired and unpaired electrons in the electronic configuration of elements.

Atoms get bigger as we move outward among the representative elements.

Atomic radii show minor variation in the transition and inner-transition elements.

Also once again there is a sharp edge where the alkali metals - lithium, sodium etc. start - though the halogens - fluorine, chlorine etc. differ from them in just one atomic number.
To sum up
Technology & content are intimately related!
Technology and the transformation of pedagogy
Pedagogy

Content

Technology
open courseware
Online learning
"I agree"

"me too!"

"nice post"

Hmmm...

"I agree"

"me too!"

Good job

"I agree"

"I agree"
Me too
Me too
Laptops in the classroom
(the idea of micro-blogging)
What have we covered so far?
What’s missing?
Pedagogy

Content

Technology

Context
So?
Context

- Pedagogy
- Content
- Technology
The most important overlap
TPCK

Technological Pedagogical
Content Knowledge
And how are we supposed to pronounce this again? ToothPICK?
TPACK

Technological Pedagogical AND
Content Knowledge
TPCK

TPACK

Total PACKage
Total PACKage
what doesn’t work
Context

Pedagogy

Content

Technology
... from thought ... to thing

Learning Technology by
Faculty Development Course
Designing online courses

- Prototype a section of the course
- Pilot a section of the course
- Redesign a section of the course
Looking at the data!
Content
Pedagogy
Technology
Representations
Pedagogy
Content
Technology

Context
Measuring TPACK

Case studies of teachers learning about technology integration (Koehler et al. 2004)

Qualitative studies of conversations (Koehler, Mishra, & Yahya, 2007)

Survey measures (Koehler & Mishra, 2005) + ongoing

Studying teacher creativity (Deschryver & Mishra, 2008)

At other institutions...
An early case study
“Designing an online course requires changes in what we teach and how we teach.”

More...

“Our group has chosen technologies that fit the course content and the instructors teaching philosophy.”

More...
Ongoing
TPACK & Creativity

Mix and Match (Bricolage)
Representation
Perspective
Provisionality

Domain Knowledge
Serendipity
Iteration
Interconnectedness
Expression

Pre-service mathematics teachers
Hampered by lack of knowledge of C, P & T
Developing a TPACK survey

In collaboration with Iowa State University

To be presented at SITE09 and AERA09
Also see:

Banyas & Mishra (2008)
- affordances of learning management systems & instructor teaching philosophies

Peruski & Mishra, (2005)
- activity theory analysis of teaching online

Dirkin & Mishra (2008)
- transactional relationship between beliefs, values and teaching with technology
Walking the walk
Reflections on learning
An online course!

Pick any card from the deck below and commit that card to memory.

Be careful not to indicate which card you picked with your cursor.
When you are finished, click the red button below.
Working with school districts for teacher professional development
Documenting & sharing examples of “pretty good” practice
Mr. Forton’s solution is to use video capture to acquire video of simple and complex examples of motion. He then has the students use the software *World in Motion* to plot the and create a graph of the motion. This way students can see the translation of energy and other hard to conceptualize physics principles.

Review the problem.
Spreading the word

The Society for Information Technology in Teacher Education (SITE), The American Association of Colleges of Teacher Education (AACTE), The National Associations of Childhood Teacher Educators (NACTE), National Council for the Social Studies (NCSS), Association for Mathematics Teacher Educators (AMTE), The Association of Teacher Educators (ATE), and the International Society for Technology in Education (ISTE).
What does the generative level of TPACK look like?

- Repurpose technology
- Working with constraints
- Become curriculum designers
- Using creativity
Design principles

Integrated (T, P & C)
Spiral development (baby steps)
Changing teacher beliefs (Nudge)
Collaborative teams
Importance of creativity (repurposing/redesign)
Modeling / Humility
Iterative
So far...

Understanding technology

Teaching as lying at the intersection of C, P, & T (in specific contexts)

Going beyond use & integration

Three levels: mechanical, meaningful, generative

Some broad design principles
The future
Looking into the crystal ball
Looking forward

* Strategies for developing TPACK
  * Where do we start?
* Measuring TPACK
* Individual or group?
* Connecting to TE programs (PD/degree)
In closing
Understand maps?

Go beyond concrete understandings?

Make maps more personal?
Solutions

KidPix,
Mapquest,
satellite photos,
virtual field trips
etc...
The transformative aspects of technology
The walls between art and engineering exist only in our minds.
The walls between Technology Content & Pedagogy exist only in our minds
The walls between Technology, Content & Pedagogy exist only in our minds if we are willing to play.
Coming up...
Looking at the world in strange ways
We shall have to evolve problem-solvers galore—since each problem they solve creates ten problems more.
— Piet Hein

punya@msu.edu
punyamishra.com