



Improving Engineering Education: The past & the future

Punya Mishra, Ph.D.

College of Education
Michigan State University



Why change?

2 reasons



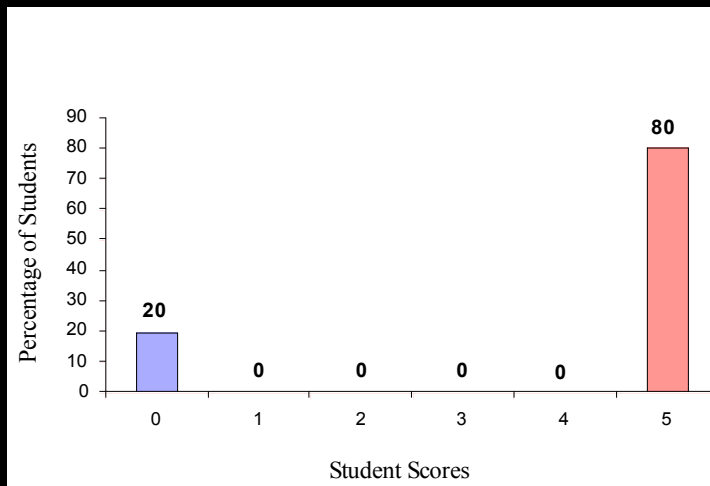
Why?

1. What we have been doing, hasn't really been working...

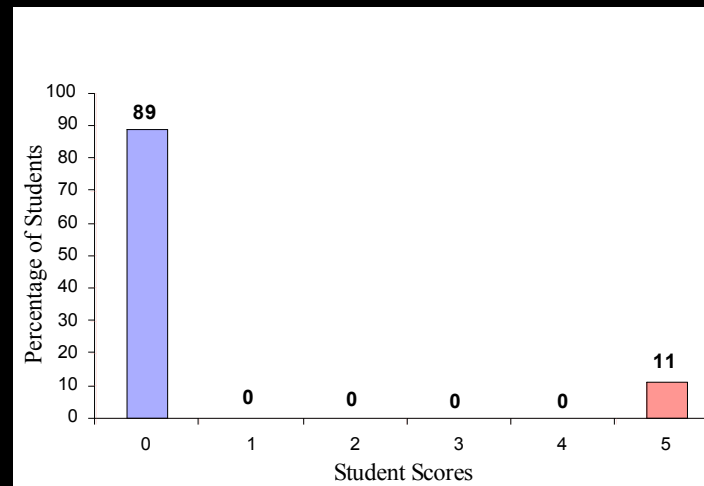


Why?

1. What we have been doing, hasn't really been working...



Standard problems



Inferential problems

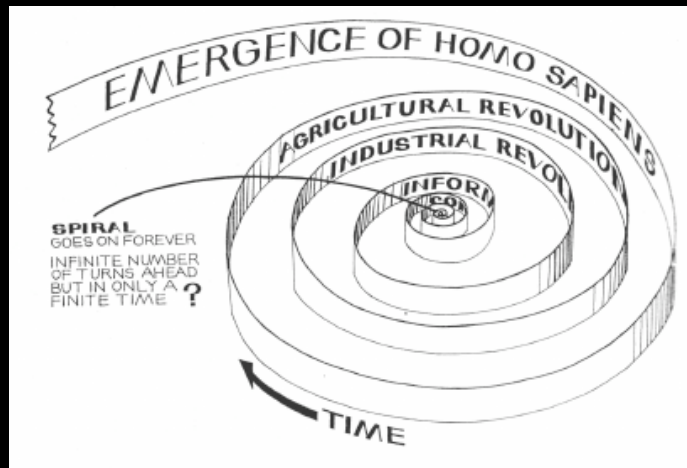


Why?

2. The world is changing - what worked before may not work as well now...



The crazy rate of change



Generations

10,000

speech

750

agriculture

500

writing

400

libraries

40

universities

24

printing

16

accurate clocks

5

telephone

4

radio

3

television

2

computers

1

internet/email

0

gps, mp3, youtube,
web2.0 etc. etc.

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TIME



**How
To Build a
Student
For the
21st Century**

BY CLAUDIA WALLIS
& SONJA STEPTOE



Research based pedagogy

- » Educational Psychology
 - » Know the learner

- » Engineering Education Research
 - » The nature of engineering knowledge



Taking learners seriously

- » If I had to reduce all of educational psychology to just one principle, I would say this: **The most important single factor influencing learning is what the learner already knows.** Ascertain this and teach accordingly — *David Ausubel*



Some pathologies of learning



Pathologies of learning/teaching *

- » **Amnesia:** Forgetting what you have learned
- » **Fantasia:** Illusory understanding & persistent misconceptions
- » **Inertia:** Knowledge that is not connected to anything else (not retrievable or applicable)

... and finally!

- » **Nostalgia:** If it worked for me, it should work for you!

* Shulman, L. (1999). What is learning and what does it look like when it doesn't go well. *Change* 31(4), 10-17



Nature of engineering problems

- » Well structured problems
- » Ill-structured problems
- » Wicked problems



Well Structured Problems

- » Standard Operating Procedures
- » Closed problems
- » Textbook knowledge
- » Step by step procedures available
 - » Lectures
 - » Labs
 - » Problem sets



Ill-structured problems

- » Heuristics & Satisficing
- » Quasi-open-ended projects
 - » Objectives are somewhat clear
 - » Limited data collection
 - » Procedures are available

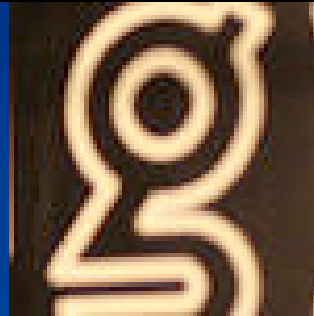


Wicked problems

- » Design projects
- » Emphasis on creativity
- » Developing a flexible mind-set
 - » Emphasis on problem finding
 - » Negotiation & collaboration (with stakeholders)
 - » Need for Social, political, & ethical knowledge

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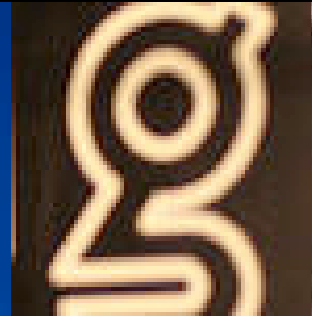


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based teaching



based teaching

intentional	humanistic	
knowledge intensive	contextual	
aesthetic	communicative	social
creative	an ongoing conversation	



The key challenges

- » Understanding the learner
- » Developing new approaches to teaching
- » Faculty development



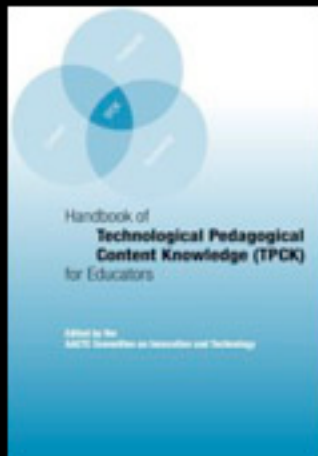
Understanding the learner

- » What do they know?
 - » Near and far transfer of knowledge
- » Student beliefs about engineering
 - » Current research (with freshman design sequence)



New approaches to teaching

- » Learning by Design
 - » Participatory, collaborative, open-ended, ACTIVE
 - » Social, ethical, political aspects of the field
 - » Using newer technologies & newer pedagogies

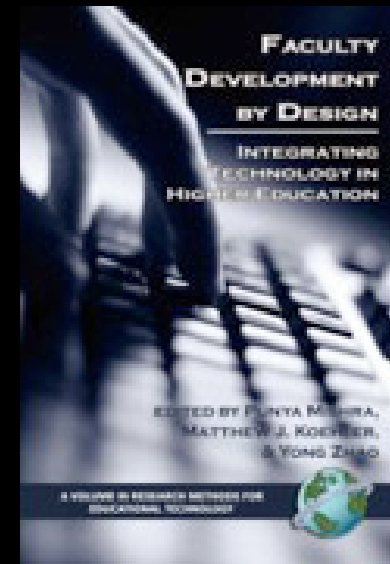


- » Extensive research across levels (K-college)



Faculty Development

- » Openness to risk-taking by faculty
- » Design based, collaborative approaches
- » Faculty development research





Thank you

Punya Mishra

punya@msu.edu

<http://punyamishra.com/>