Three orientations & four problems of technology enhanced learning

AIED2007 keynote

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National Central University, Taiwan

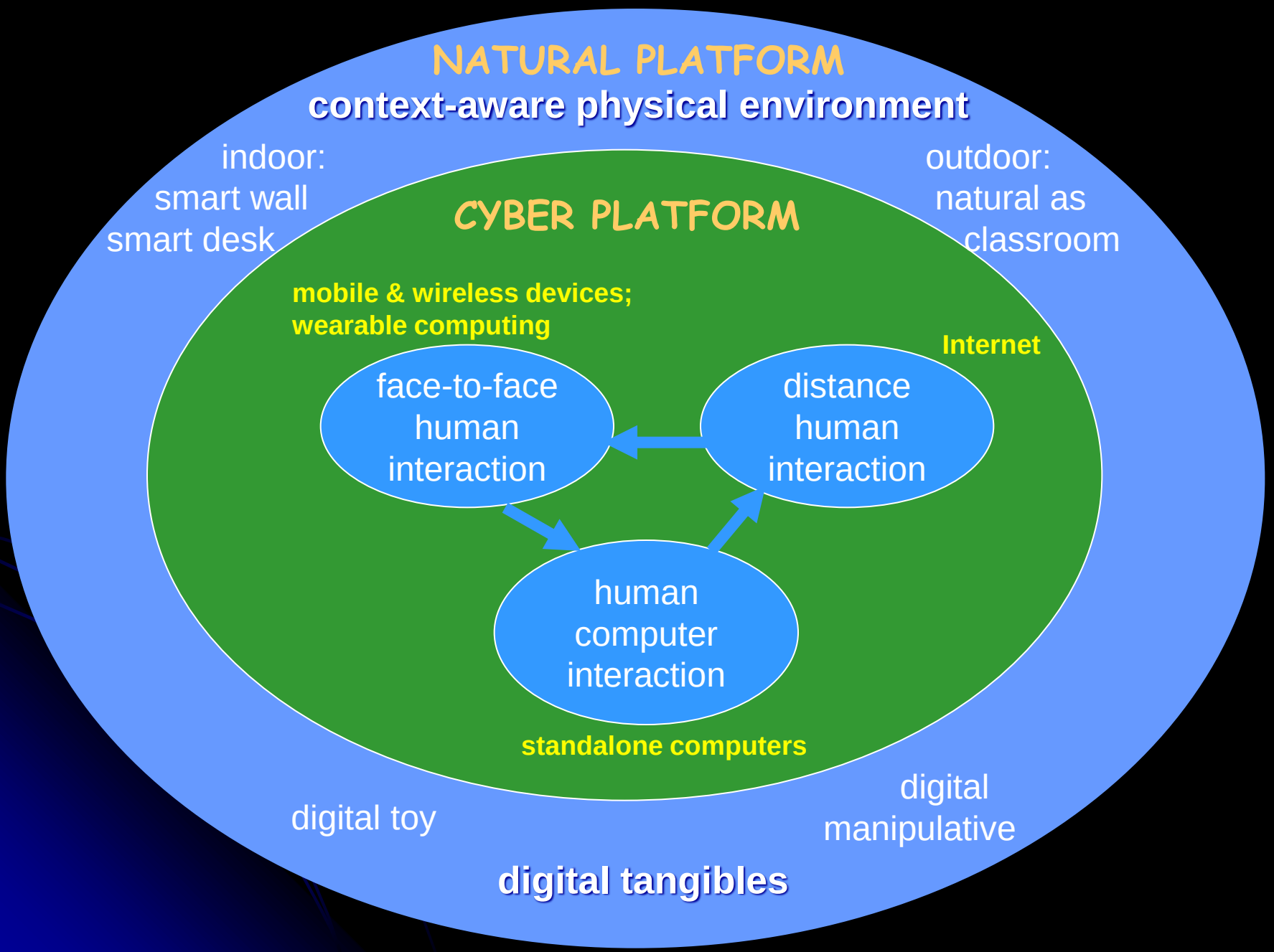
(slightly updated a few places to address some questions after the talk)

Dedicate to John Self!

One who inspired a generation of researchers & was a not-yet-known co-founder of the ICCEs!

Three orientations of research

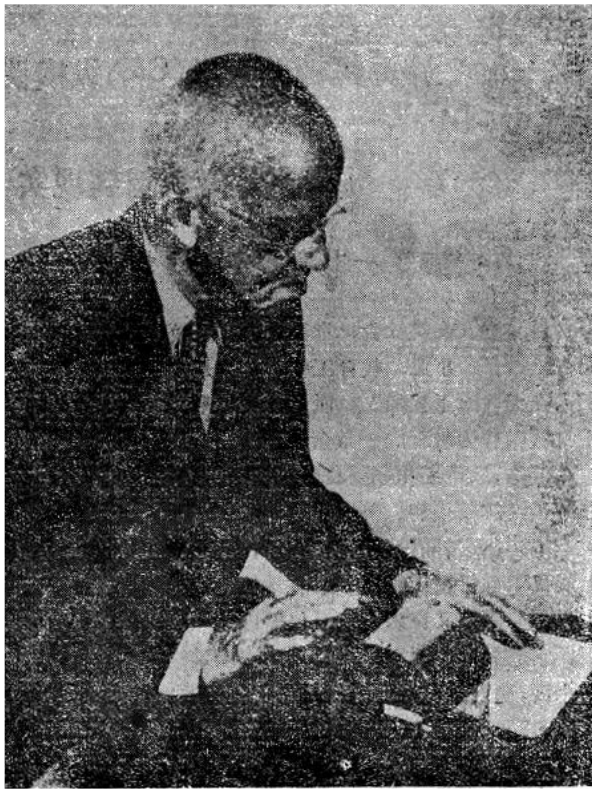
- **Dream-based research**
  - exploring the potential implications of some emerging technologies
- **Adoption-based research**
  - proving the feasibility of spreading our work in the real world practice
- **Humanity-based research**
  - developing an individual's capacity *almost* entirely from that individual's perspective
  - cultivating well being of the globe as learners' value


invisible & ubiquitous computing
NATURAL PLATFORM
context-aware physical environment
indoor:
smart wall
smart desk
outdoor:
natural as
classroom
CYBER PLATFORM
mobile & wireless devices;
wearable computing
Internet
face-to-face
human
interaction
distance
human
interaction
human
computer
interaction
standalone computers
digital toy
digital
manipulative
digital tangibles

“The further backward you look, the further forward you can see”

Winston Churchill

Sidney Pressey's Teaching Machine in 1920's



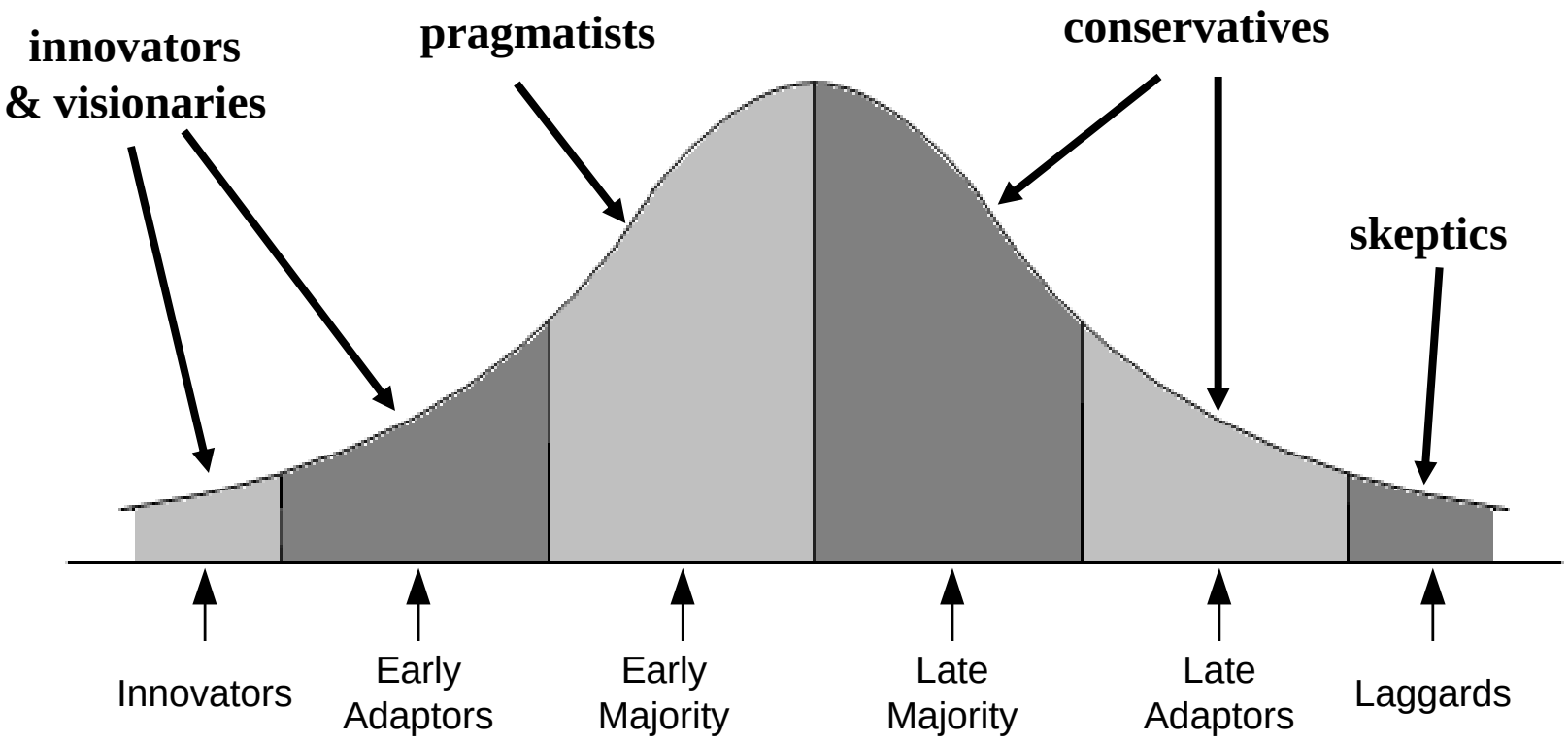
Whenever there is a dream, there is a day it comes true!

- It was not Pressey's machine, nor was it the first computer in 1946

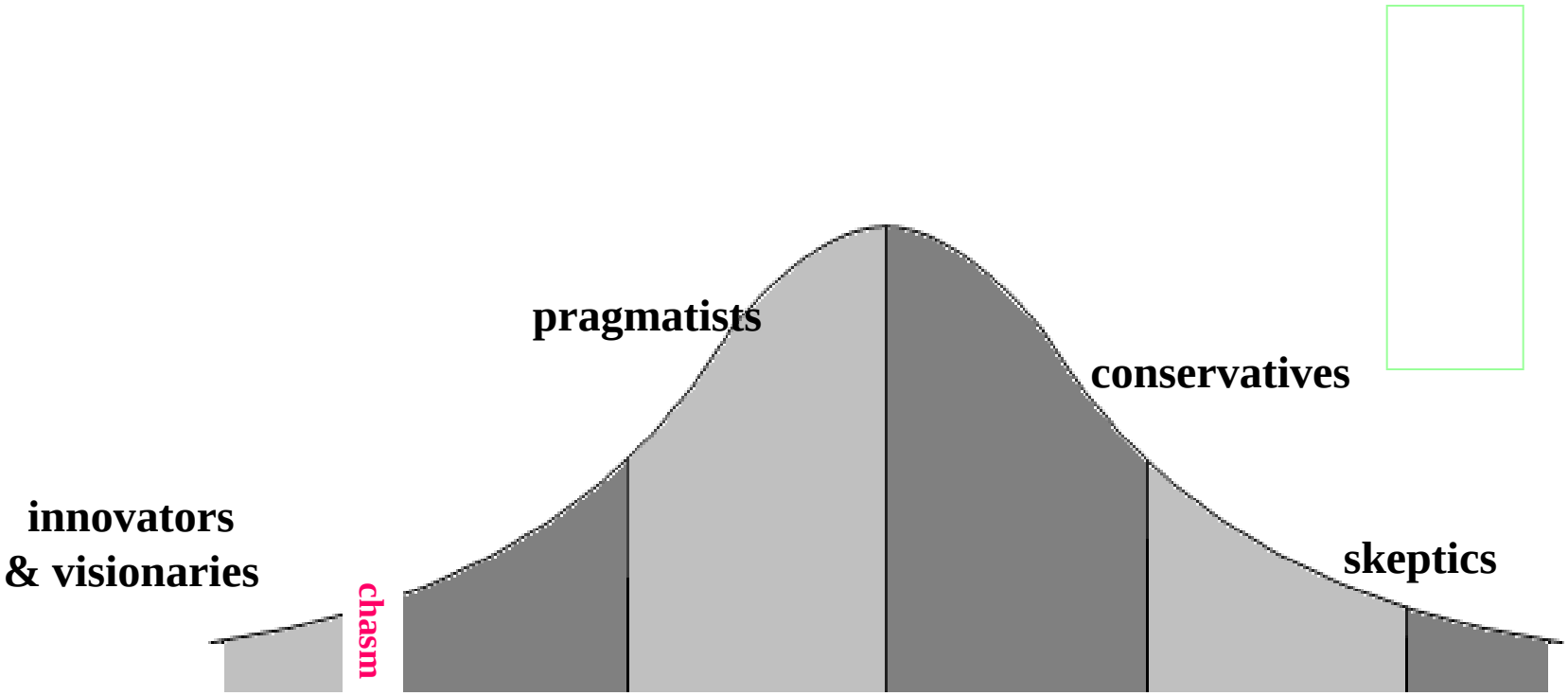
- Was it traditional CAI in 60's ?
- Was it artificial intelligence in 70's ?
- Was it multimedia and simulation in 80's ?
- Was it Internet in 90's ?
- Was it mobile & game in 00's ?

This is the Dream-Based Research!

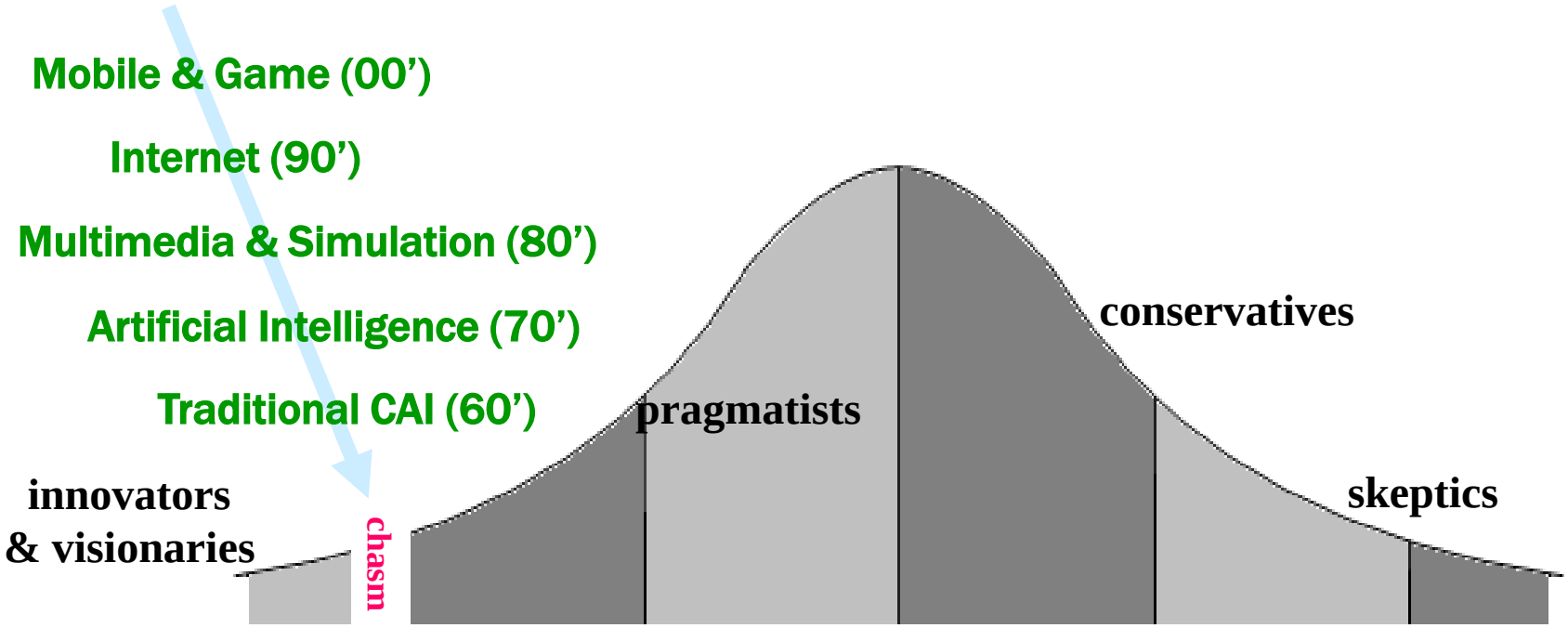
Adoption cycle of innovations
(Ryan,1948; Rogers,1958; Moore,1991)



Chasm between innovators & visionaries and pragmatists (G. A. Moore, 1991)

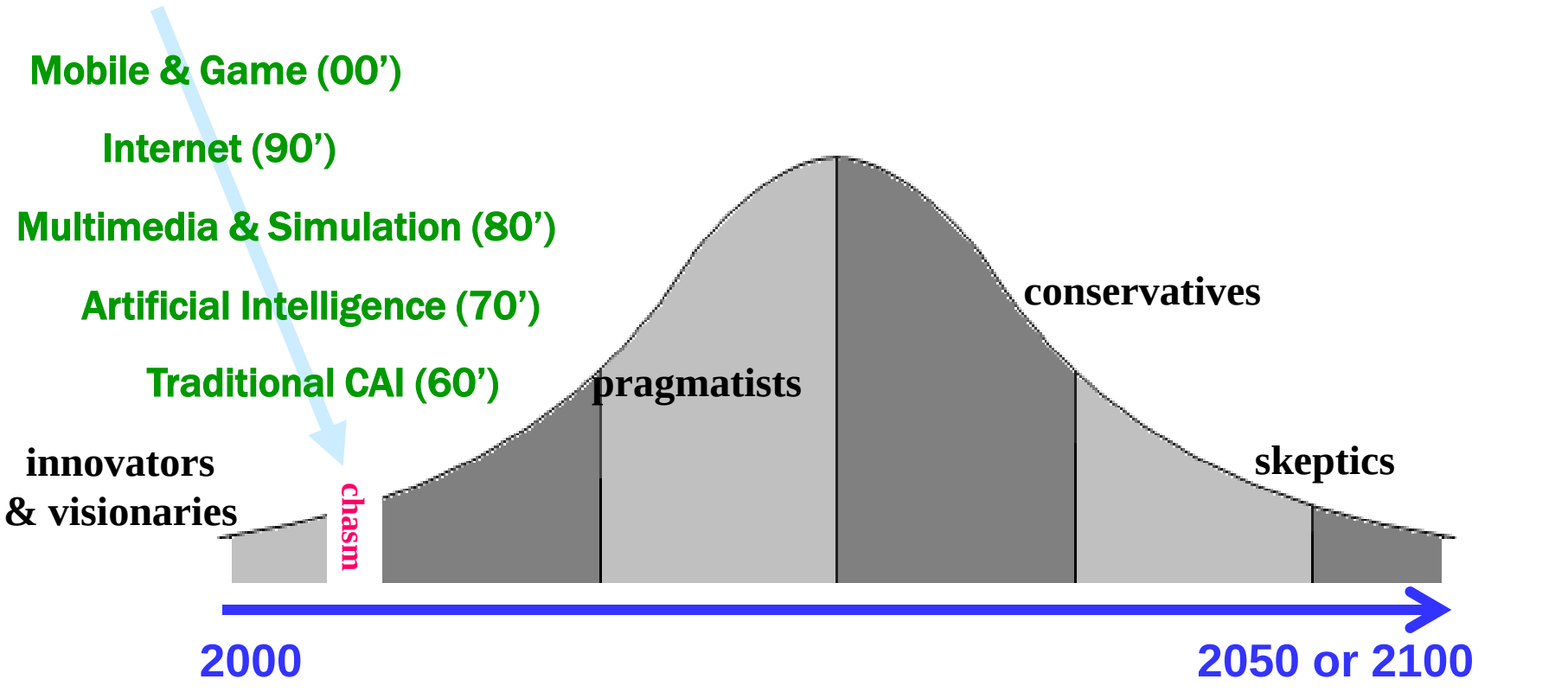


To cross the chasm
— synergy of technologies



This is the Adoption-Based Research!

How long is the time span, 50 or 100 years? What happens after crossing the chasm?



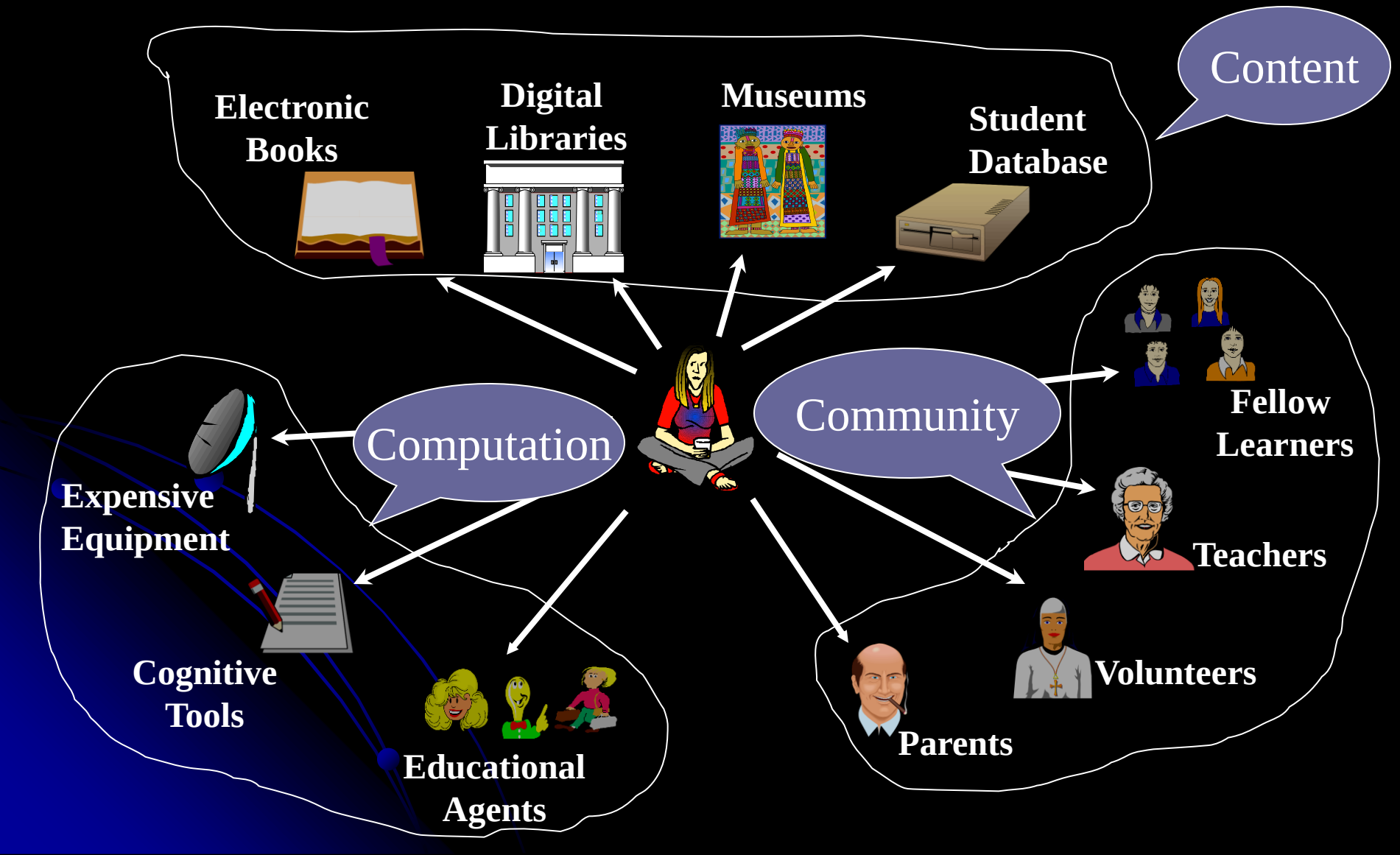
This is the Humanity-Based Research!

More on Humanity-Based Research

‘Humanity’ ?

1. **Stressing on individuality**
   - individuality is the basis of humanity
   - the very existence of a class is for the sake of an individual
   - the very existence of the learning partners is for the sake of that individual
   - thus, learning is not for the class as a whole, but for an individual
   - optimize individual capacity development

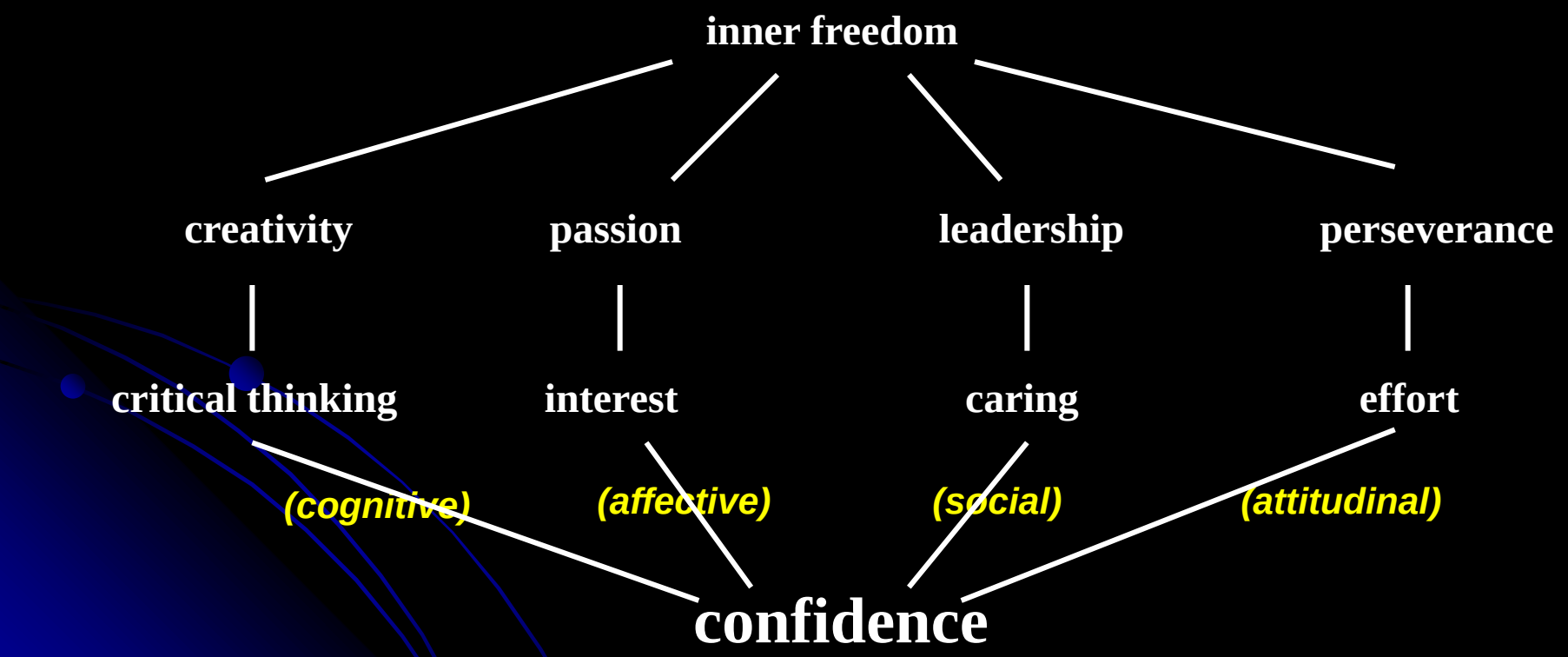
Every thing is for the sake of the learner



‘Humanity’ ?

2. **Learning beyond knowledge acquisition**
   - knowledge acquisition is a vehicle for fostering other humanity qualities
   - cognitive, affective, social, attitudinal

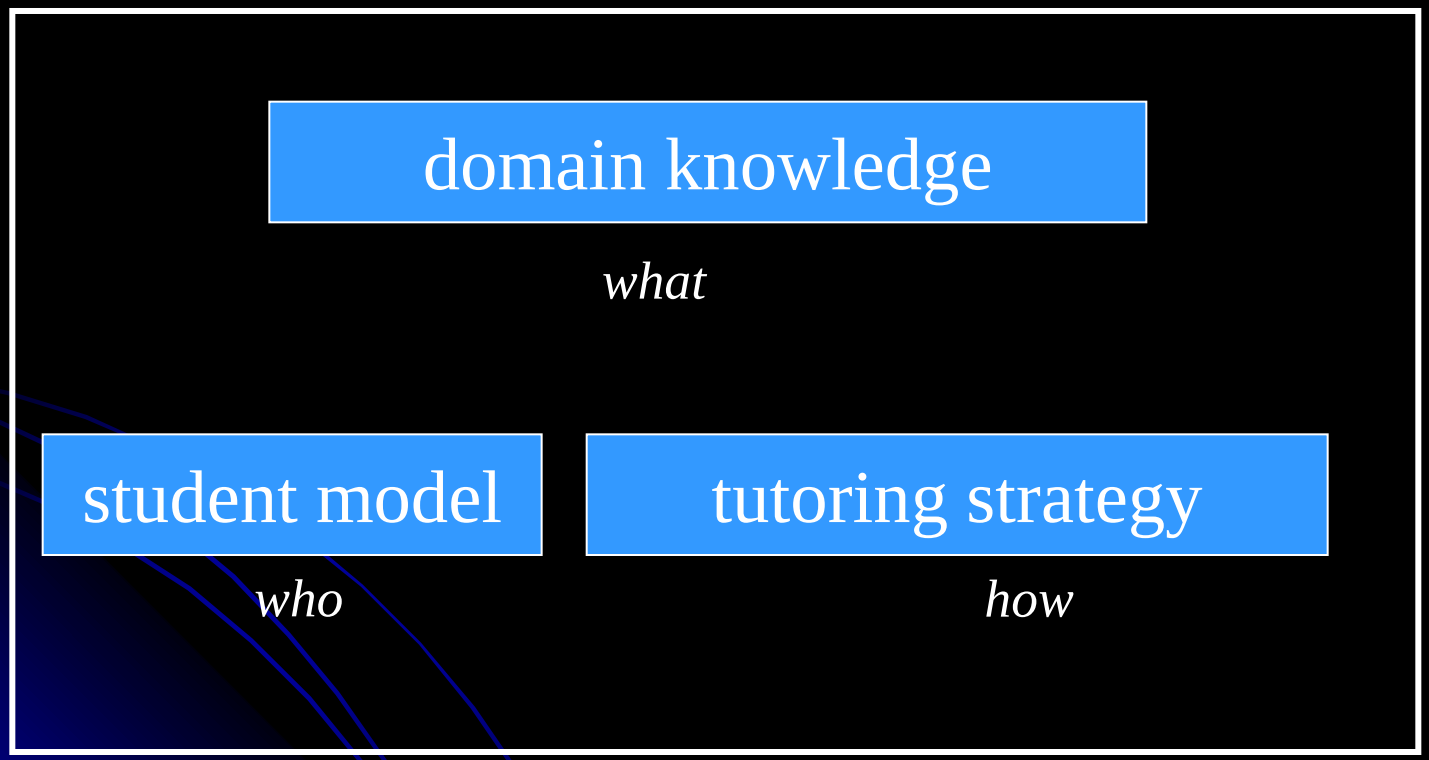
Beyond knowledge acquisition

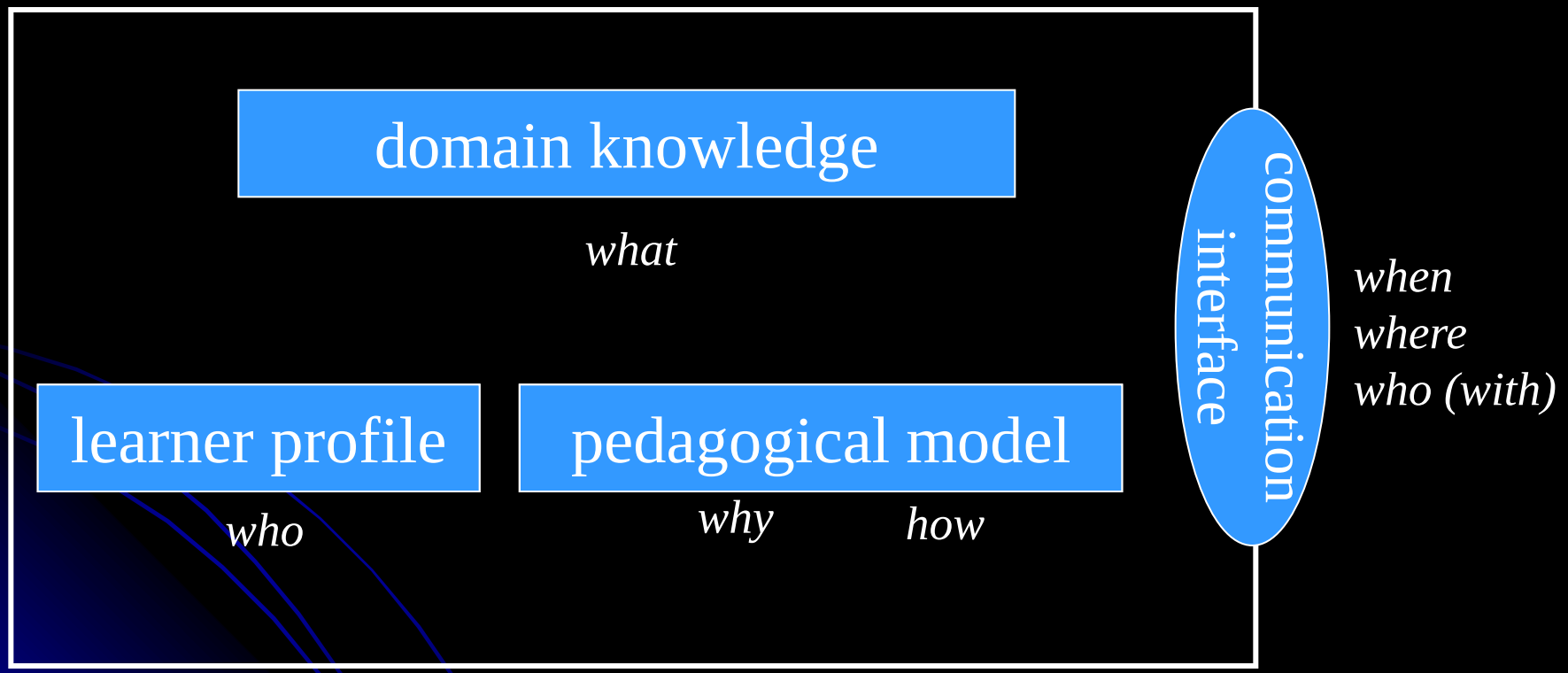


John Self spelled out this humanity issue:

“The defining characteristics of intelligent tutoring systems research: ITSs care,” (Self, 1999)

Classical ITS model (Self, 1974)




domain knowledge
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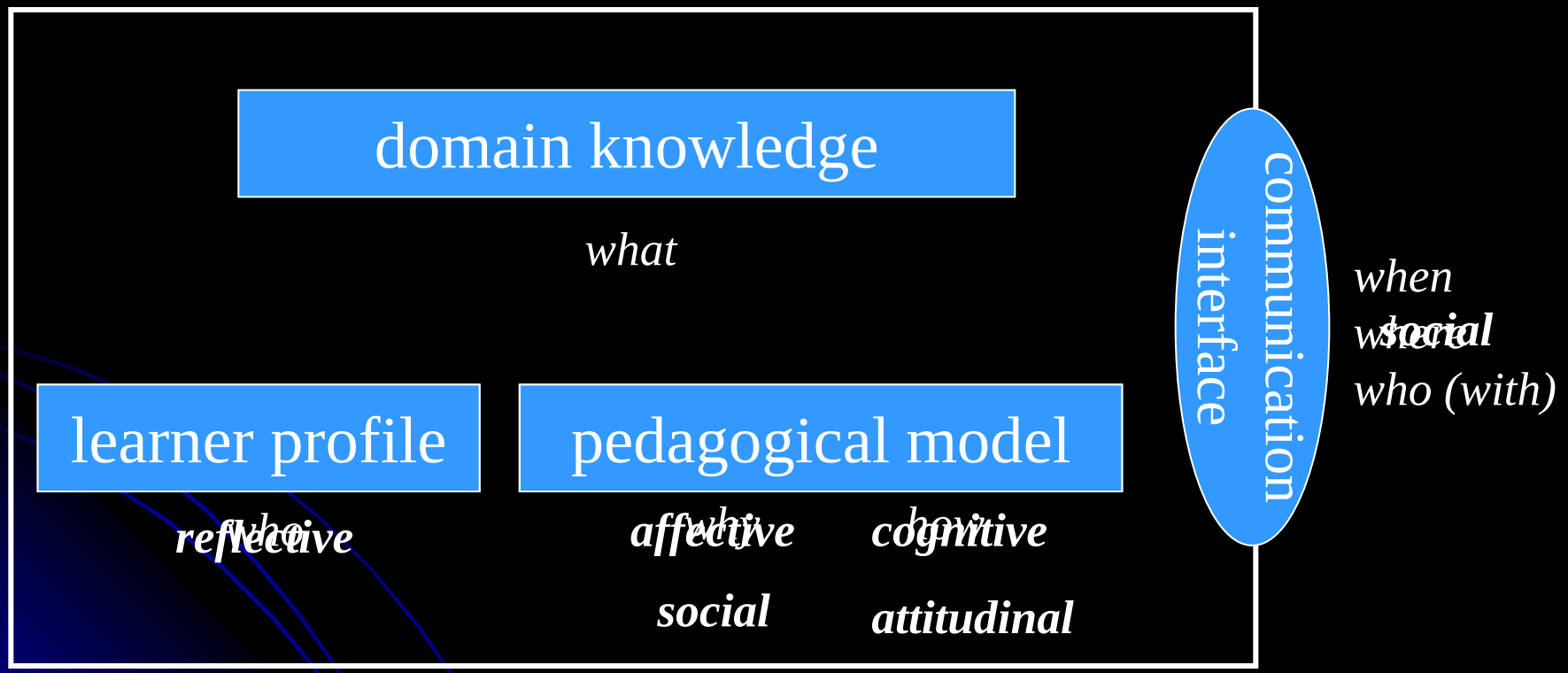
Going beyond knowledge acquisition



‘Humanity’ ?

3. **Building foundations for the better globe**
   - bettering yourself
   - nurturing a caring family
   - incubating a humane society
   - fostering the peaceful and collaborative globe

   ~ *Da-Hseh*

What are we researchers doing?

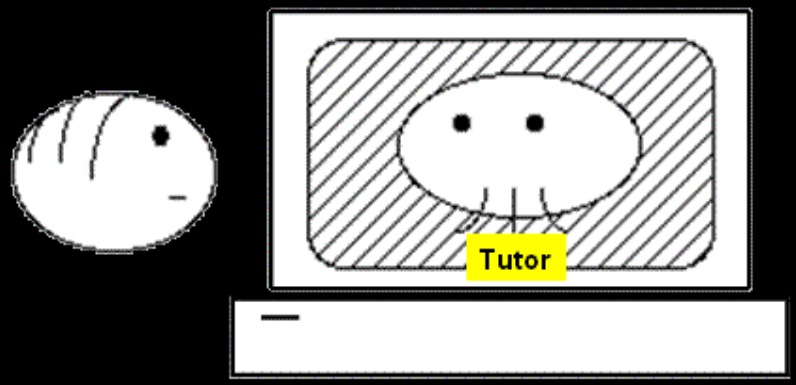
Dream-Based Research?

Adoption-Based Research?

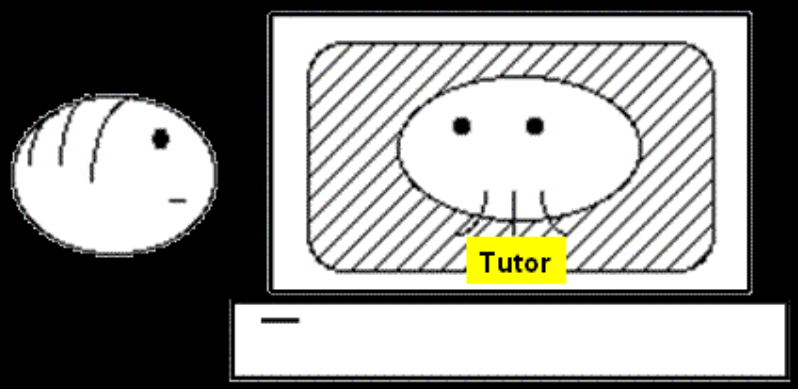
Humanity-Based Research?

Does AIED / ITS have a dream?

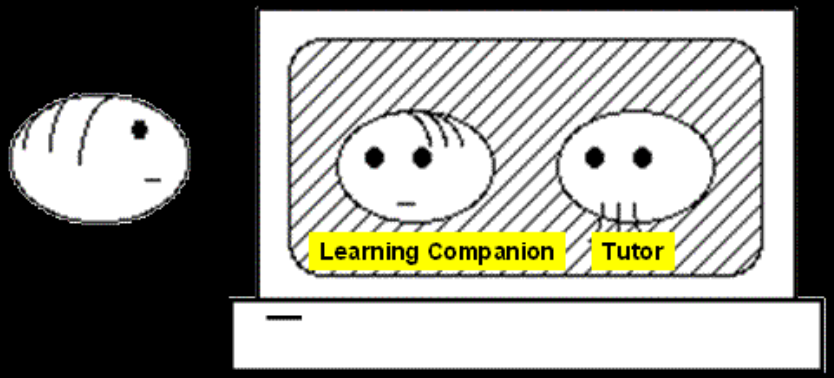
- Yes, we did
- Bloom's 2 sigma problem



- We still do
- An extended dream



Intelligent Tutoring System (ITS)
(Carbonell, 1970)



Learning Companion System
(Chan & Baskin, ITS1988)

Lifelong learning companion

(Chan, 2000; Chan, et. al., 2001; Chou & Chan, 2003)

baby: learning companion as a magic cradle 

small kid: learning companion as a toy 

pupil: learning companion as a pet 

teenager: learning companion as a peer 

adult: learning companion as a mentor 

elder: learning companion as a pet 

My animal companions

– “Disneyficating the learner”

My-Pet-Our-Pet

Telling the owner how to improve My-Pet's attributes

Topic progress

Topic level

My-Pet's attributes

Cognitive domain

Affective domain

Social domain

Numerical value

Descriptive text

Gaming on PDA

Game1

Character Building

Game3

Game2

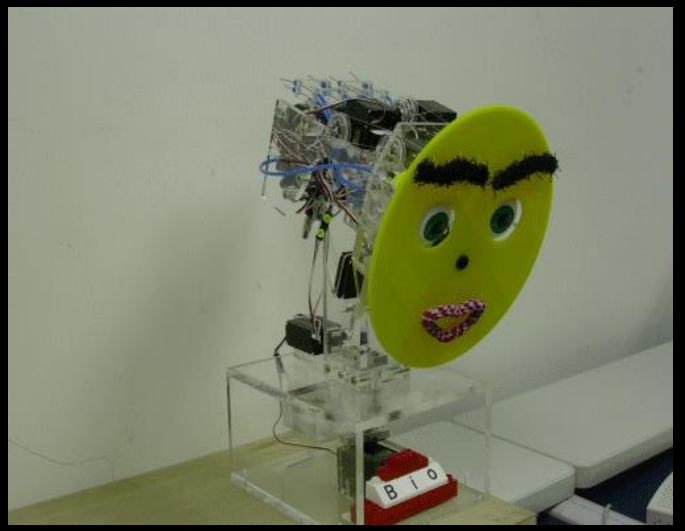
Affect Enrichment

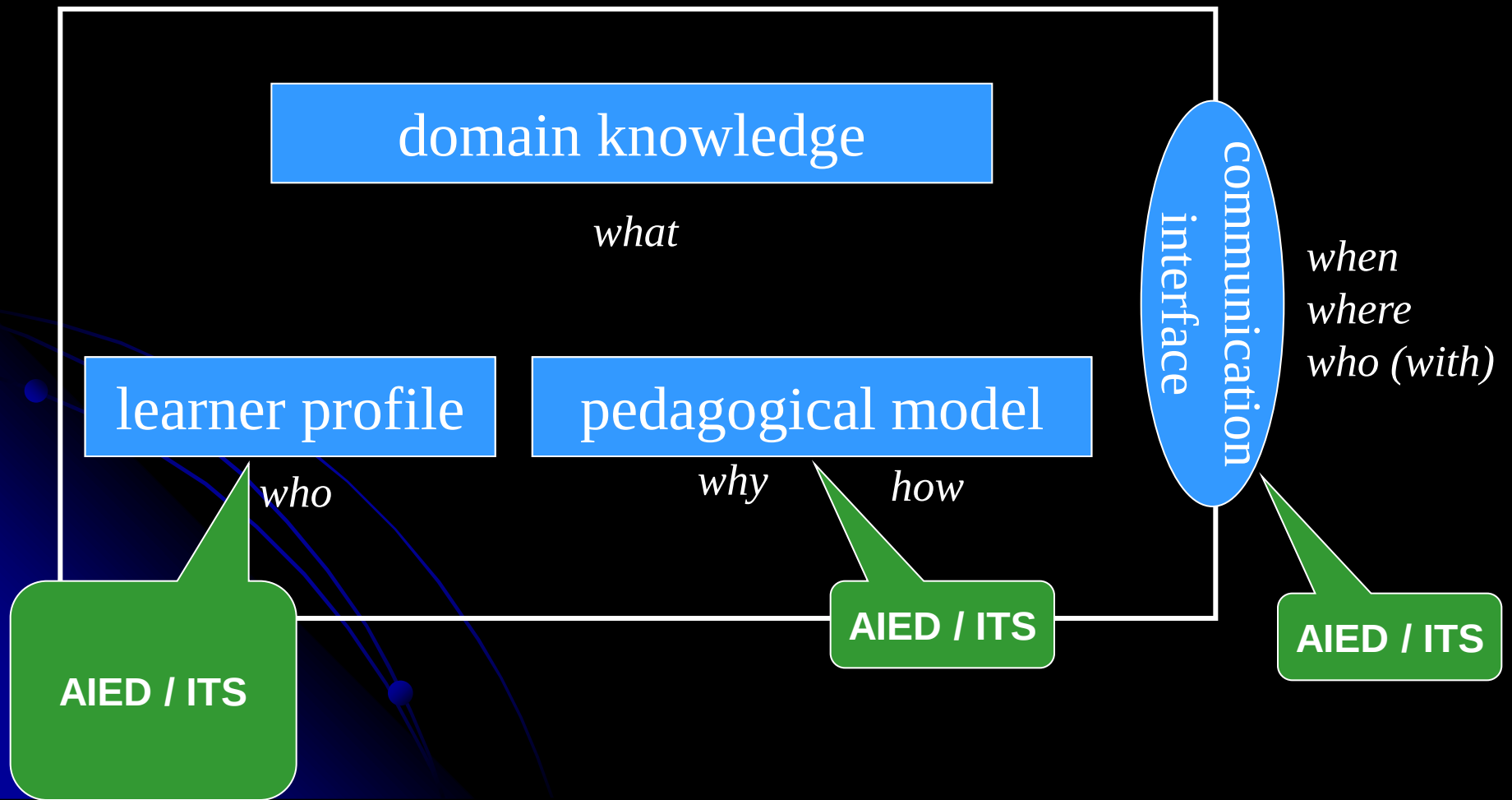
Game4

Game5

Game6

Physical Companion (Shu, et. al., 2007)

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AIED / ITS
AIED / ITS
AIED / ITS

Does CSCL have a dream?

Assumption 1:

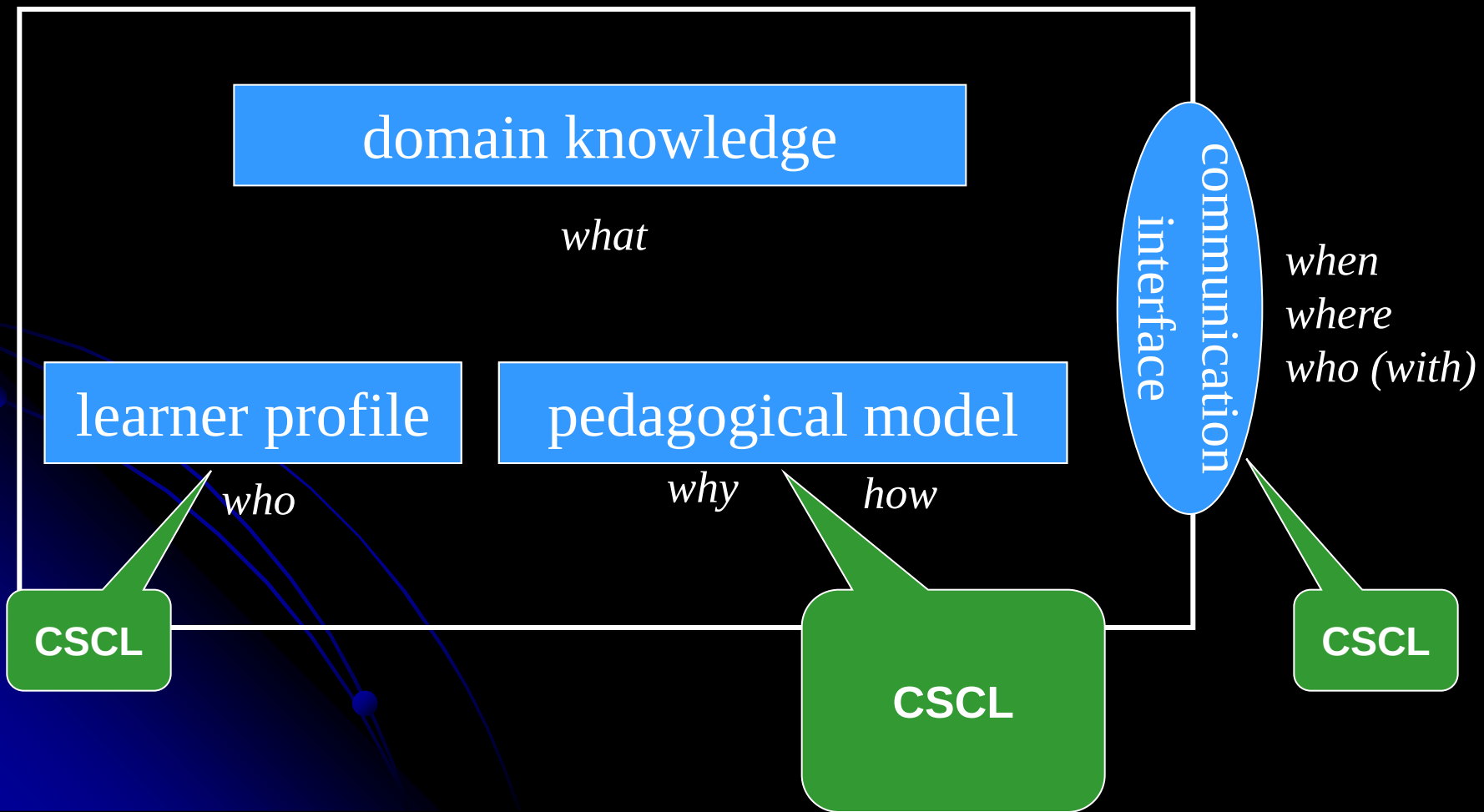
- Collaboration is a good thing, a good culture, so is collaborative learning

Assumption 2:

- Collaborative learning is ‘usually’ good learning

CSCL DREAM: Making every learning experience a collaborative and effective learning

Extended CSCL DREAM: How to make our globe a better one through collaborative learning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CSCL
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Acronyms

WMUTE =

Wireless, **M**obile, and **U**biquitous **T**echnologies in **E**ducation

MLearn = **M**obile **Learn**ing

DIGITEL =

DIgital **G**ame & **I**ntelligent **T**oy **E**nhanced **L**earning

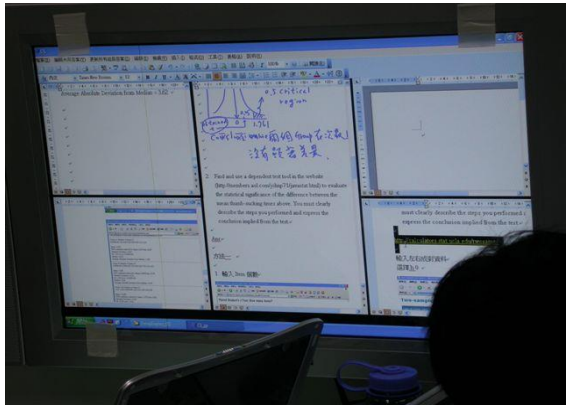
One-to-one Technology Enhanced Learning

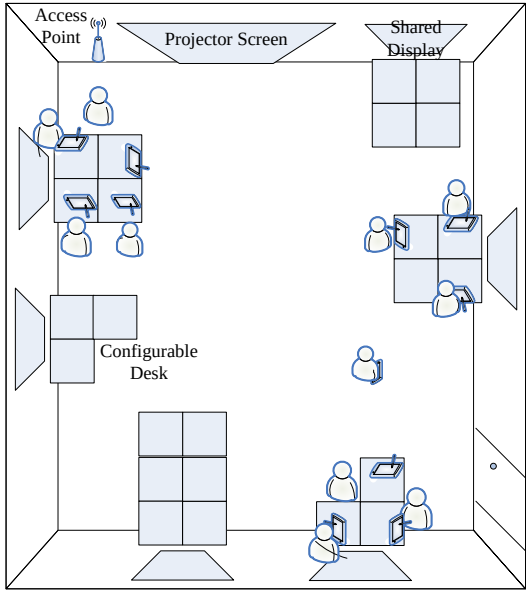
Soloway & Norris, (WMTE2002, ITS2004)

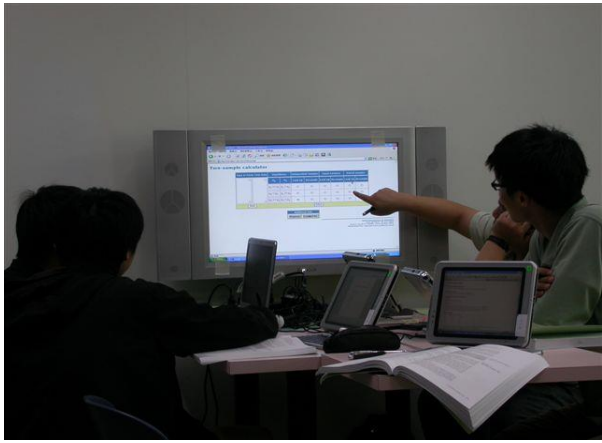
1 student : 1 pencil
1 student : 1 book
1 student : 1 computer

Classroom dynamics will change

Classroom dynamics will change







In the Campus

Outside the campus

Bird Watching

Zoo Visit

Linking a class to the outside

~ ITS 2000

virtual learning community

1:1 learning in physical space

EduCities
(1.5 million people)

EduTowns
(2,500 schools)

EduVillages
(20,000 classes)

Does WMUTE / MLearn have a dream?

Seamless learning space

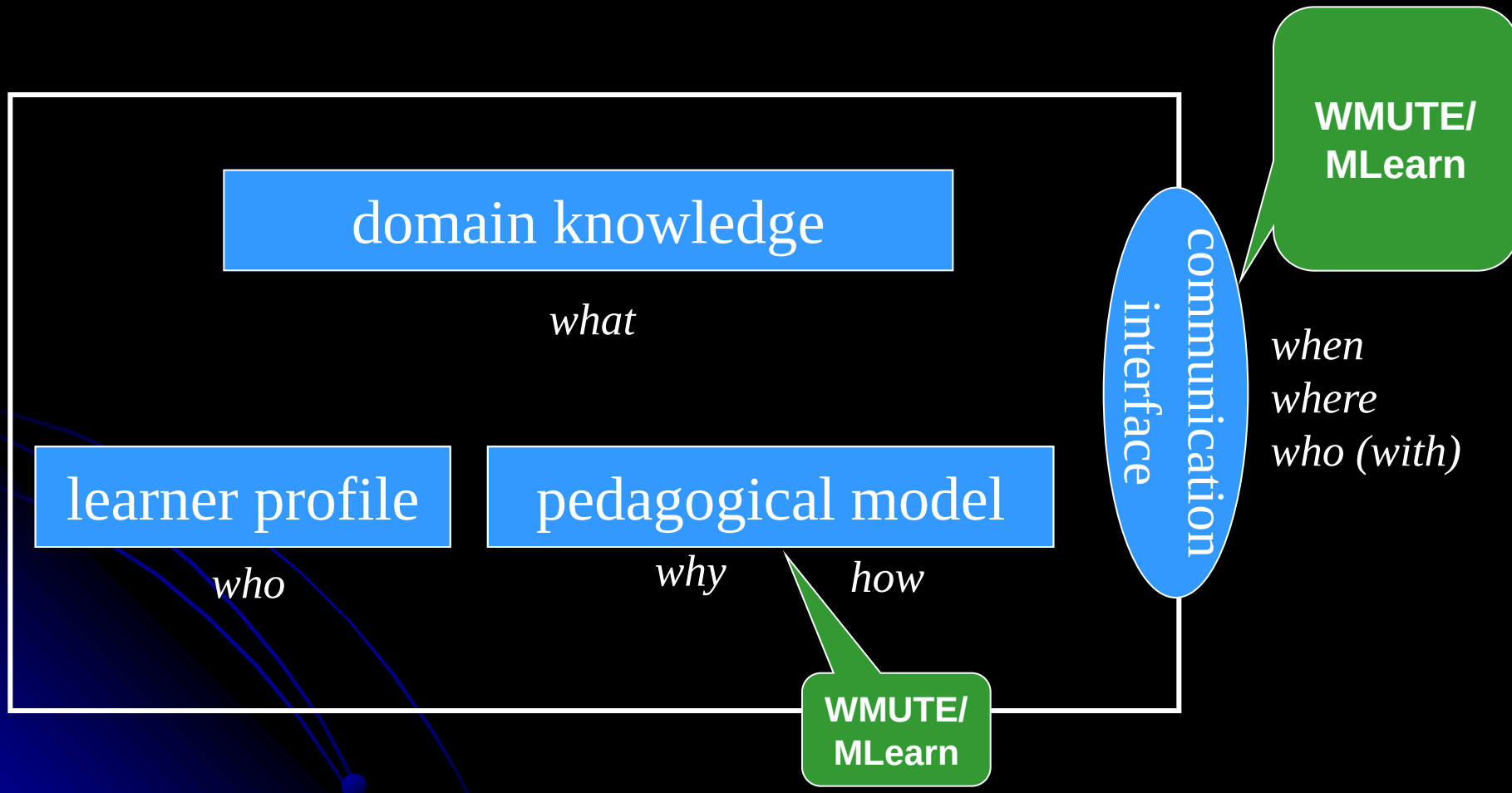
seamlessly learning across over
learning scenarios from
Physical Space X Social Space

Physical / Virtual Space: classroom, campus, home, museum, etc.
Social Space: individual, small group, class, online community, agents, etc

WMUTE / MLearn **DREAM**

Assumption: context-aware, authentic, and situated learning is good learning

- Exploring this vast space of scenarios to find new scenarios or sequence of scenarios for good learning experience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WMUTE/ MLearn

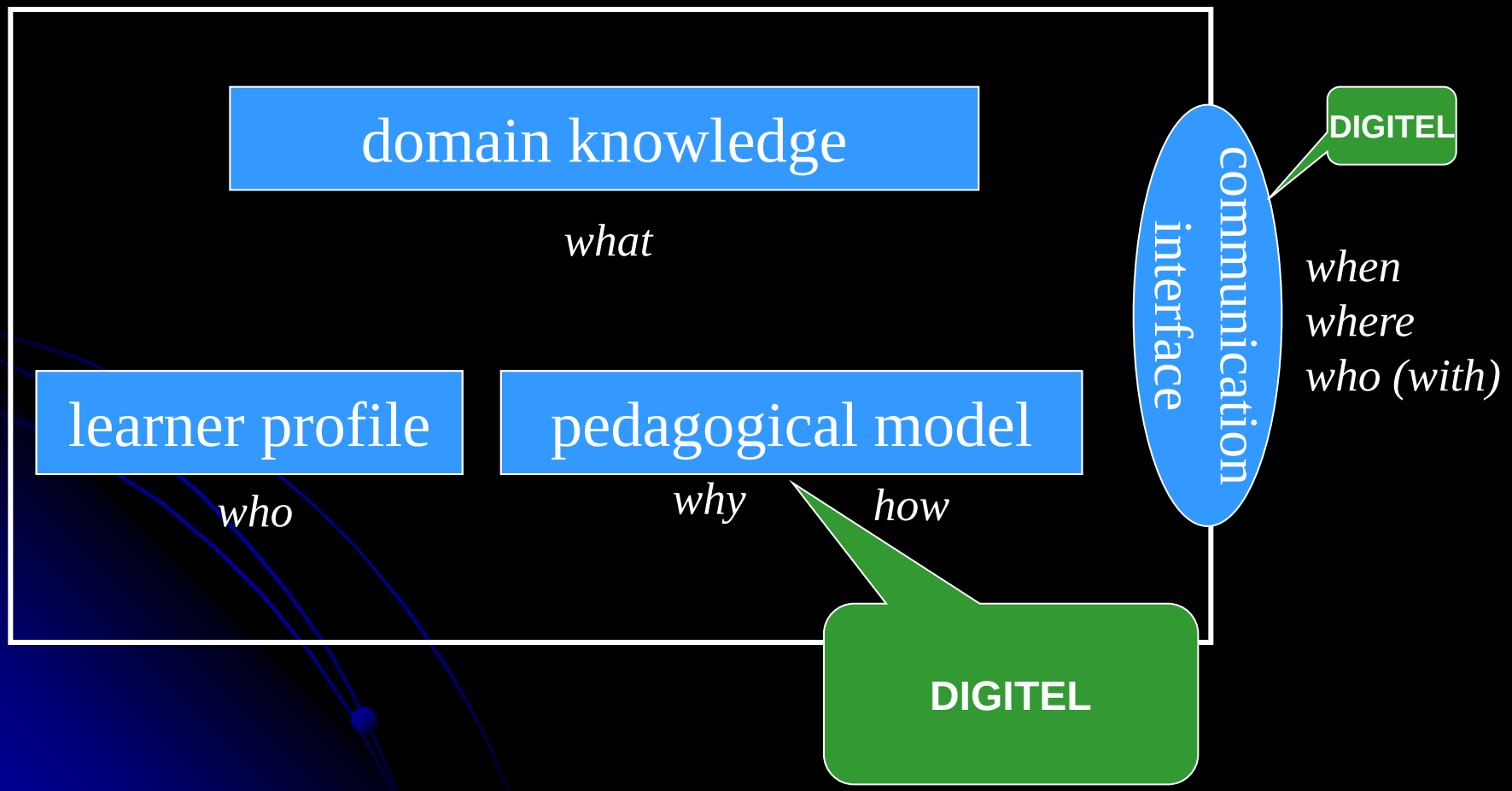
Does DIGITEL have a dream?

DIGITEL DREAM:

Every learning experience is fun, engaging, pleasurable and joyful!

All learning without fun must be DEAD!

Gaming will be a dominating pedagogy, subsuming individual and collaborative learning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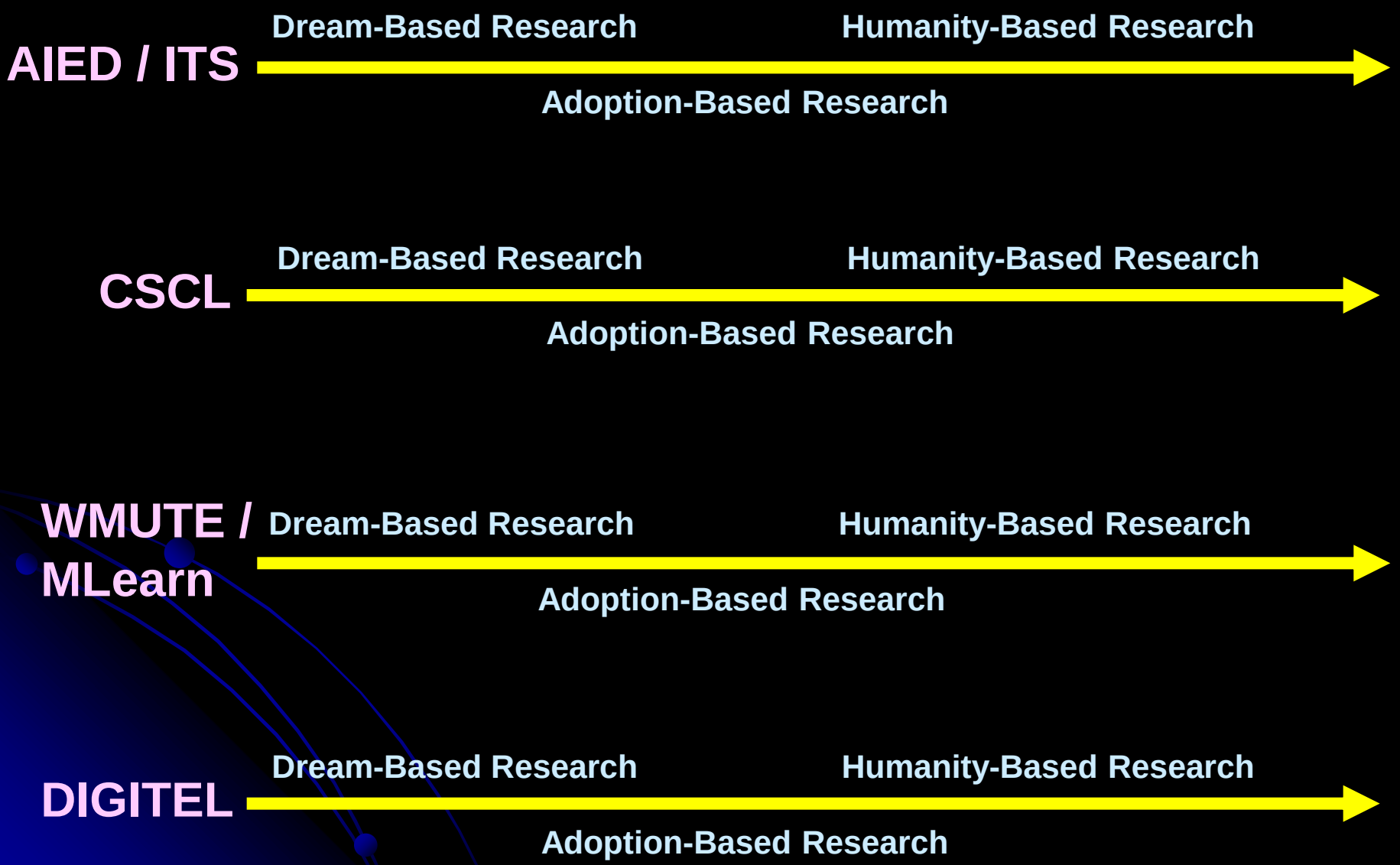
AIED / ITS
Dream-Based Research
Humanity-Based Research
Adoption-Based Research
CSCL
Dream-Based Research
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WMUTE / MLearn
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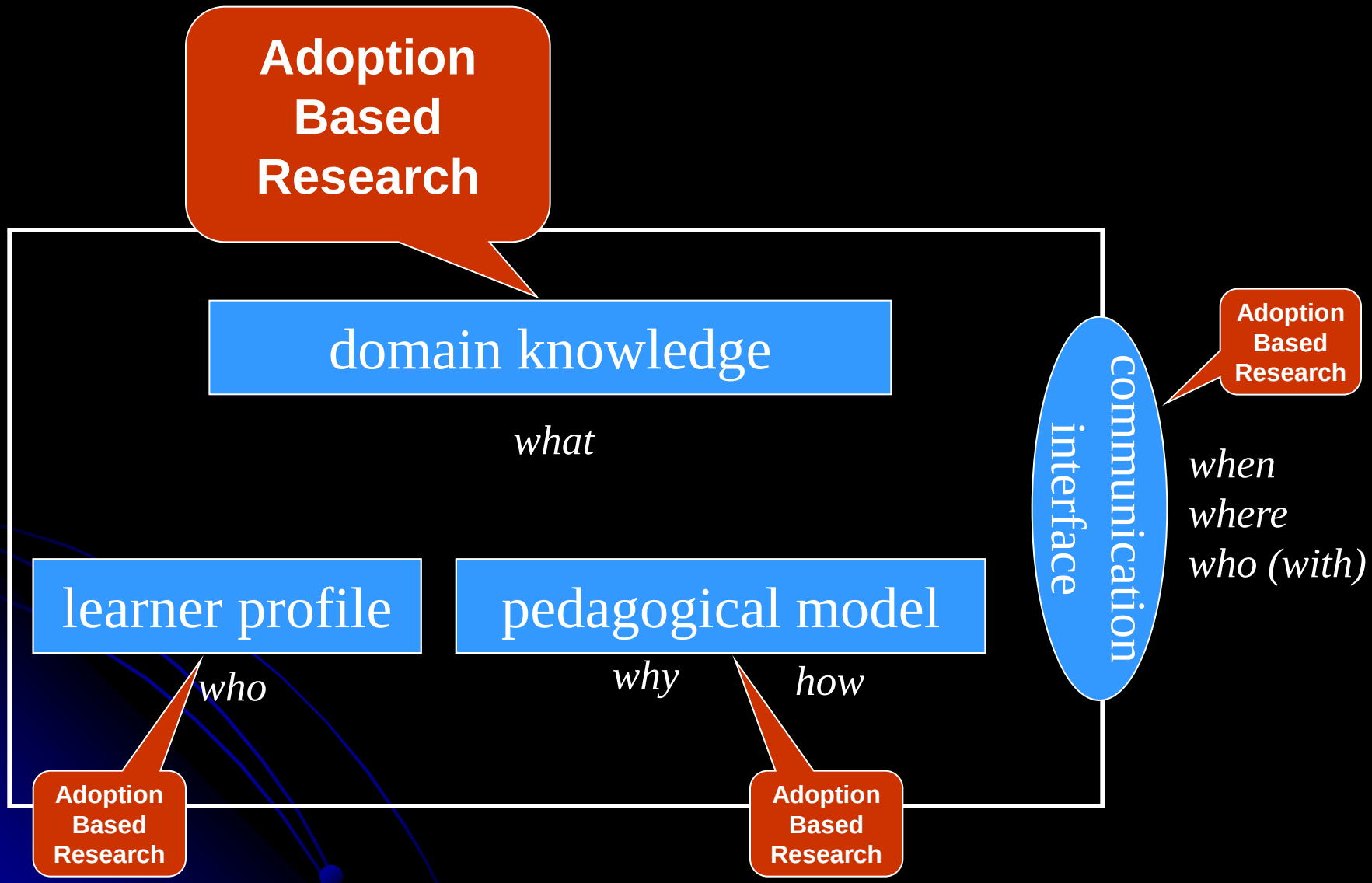
DIGITEL
Dream-Based Research
Humanity-Based Research
Adoption-Based Research


Adoption Based Research
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Adoption Based Research

We are all doing Dream-Based Research!

Some have started to do Adoption-Based Research

The Four Problems of Technology Enhanced Learning

The four problems

1. The ***productivity*** problem
   - the performance or output/input problem
2. The ***school restructuring*** problem
   - the problem how school is being transformed
3. The ***lifelong personalized curriculum*** problem
   - the extension of the ITS's Holy Grail problem
4. The ***global educational goal*** problem
   - rethinking the educational goal from the global perspective

Why these problems?

- May tell us ***unequivocally*** where we are heading to, both in the near or the farther future, say, tens or 100 years
- the 3 research orientations are indeed leading towards to these goals
- nurturing collective, global endeavor to resolve the problems

The four problems

1. The ***productivity*** problem
   - the performance or output/input problem

Adoption-Based Research

Washington Post

"Educational software, a $2 billion-a-year industry that has become the darling of school systems across the country, has no significant impact on student performance, according to a study by the U.S. Department of Education…."

By Amit Paley, Thursday, April 5, 2007; Page A01

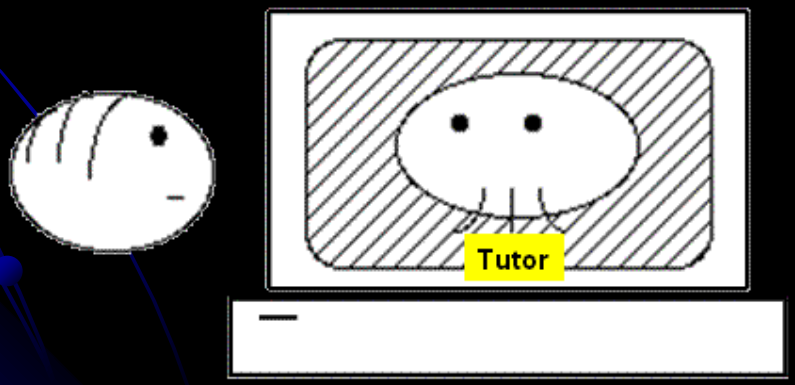
G11 website: www.g1to1.org

But many claims of successful research

- An example: He Kekang from Beijing Normal University
  - claiming a great leap in elementary classes for learning Chinese
    - tens of experimental classes; in cities and in poor rural areas in China
  - Grade 4 students as good as Grade 6 students

How about Bloom's 2-sigma problem?

How about intelligent tutoring systems?

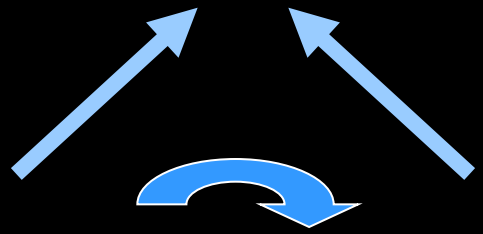


The ***productivity*** problem

compared to traditional classrooms

- 2-sigma learning performance improvement
  - summative assessment (Bloom, 1984)
  - robust learning
    - retention
    - transfer
    - accelerated learning
- 2-sigma affect improvement
  - assuming there could be objective measure on affect
  - still not clear which affect attributes are most crucial …
  - confidence (or efficacy) and interest must be included

The *Productivity* Problem



Design-based research

1. ***Innovative pedagogy driven***
2. **Reporting rationales and lessons learnt in the design iteration process**
3. **Describing open-mindedly interesting users' behavior**

Evidence-based research

1. ***Vigorous assessment driven***
2. **Theorizing some phenomena and then designing experiment**
3. **Explaining and/or further theorizing experiment findings**

The ***productivity*** problem

compared to traditional classrooms

- 2-sigma learning improvement
  - summative assessment (Bloom, 1984)
  - robust learning
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    - transfer
    - accelerated learning
- 2-sigma affect improvement
  - assuming there could be objective measure on affect
  - still not clear which affect attributes are most crucial …
  - confidence (or efficacy) and interest must be included
- Doubling teacher's efficiency
  - or halving teacher's effort

"8-fold (2 x 2 x 2) improvement problem"

Definitions

lazy =

less effort → worse or better result

intelligently lazy =

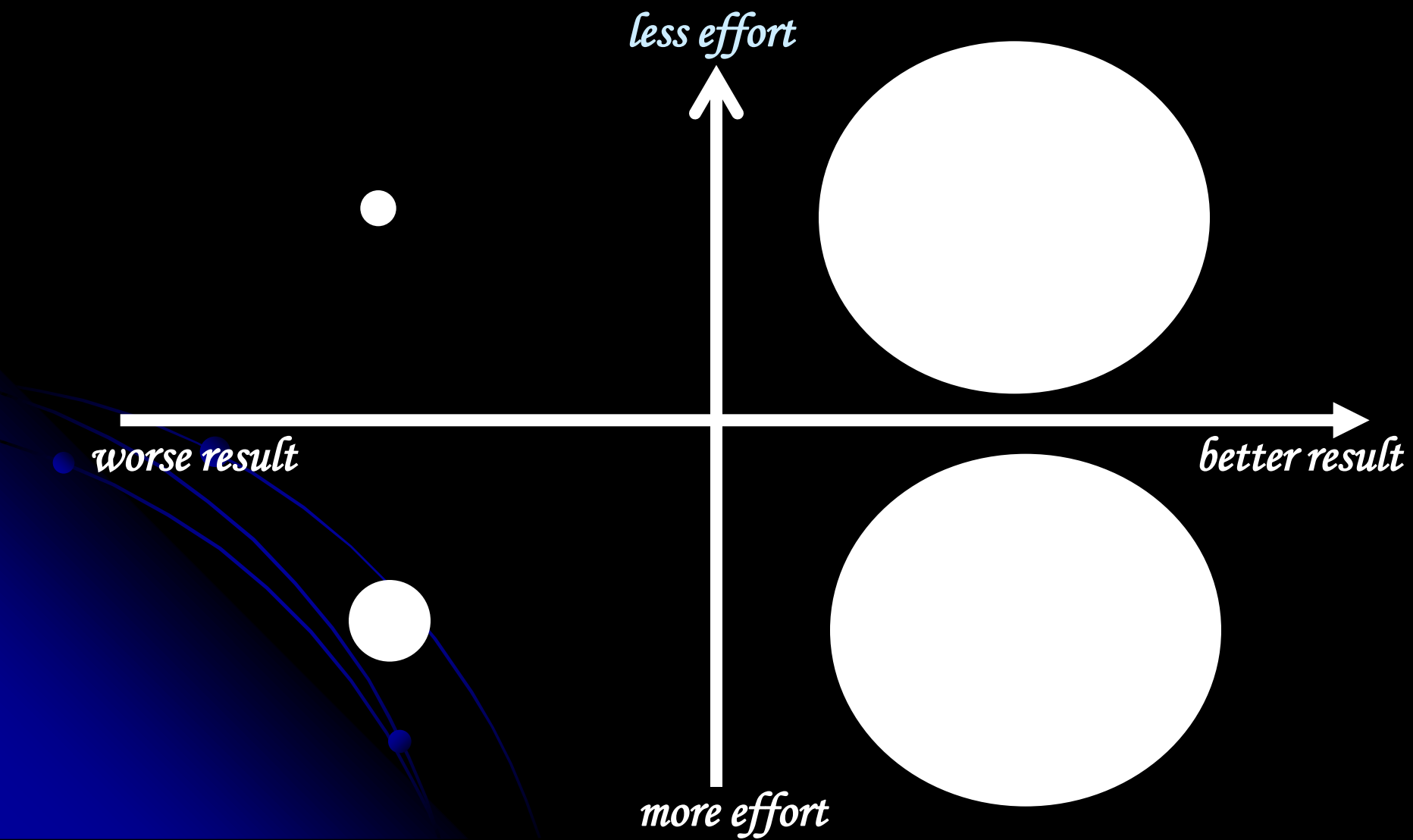
less effort → better result

diligent =

more effort → better result

Our research in the future should direct more to teacher's point of view

Our research now… from teachers' point of view



Making people intelligently lazy

is the very essence of existence of technology

No one will buy a washing machine
if it can not make one intelligently lazy!

No one want to be labeled as "lazy".
What I mean is people want to be "productive"!

Definition

$$\text{intelligent laziness quotient} = \frac{\text{learners' outcome}}{\text{teacher's effort}}$$

$$\max(\text{intelligent laziness quotient}) = \frac{\max(\text{learners' outcome})}{\min(\text{teacher's effort})}$$

A necessary condition for resolving the productivity problem:

A FULL implementation of technology enhanced learning for the whole curriculum

The four problems

1. The ***productivity*** problem
   - the performance or output/input problem
2. The ***school restructuring*** problem
   - the problem how the school is being transformed

Dream-Based Research /
Adoption-Based Problem

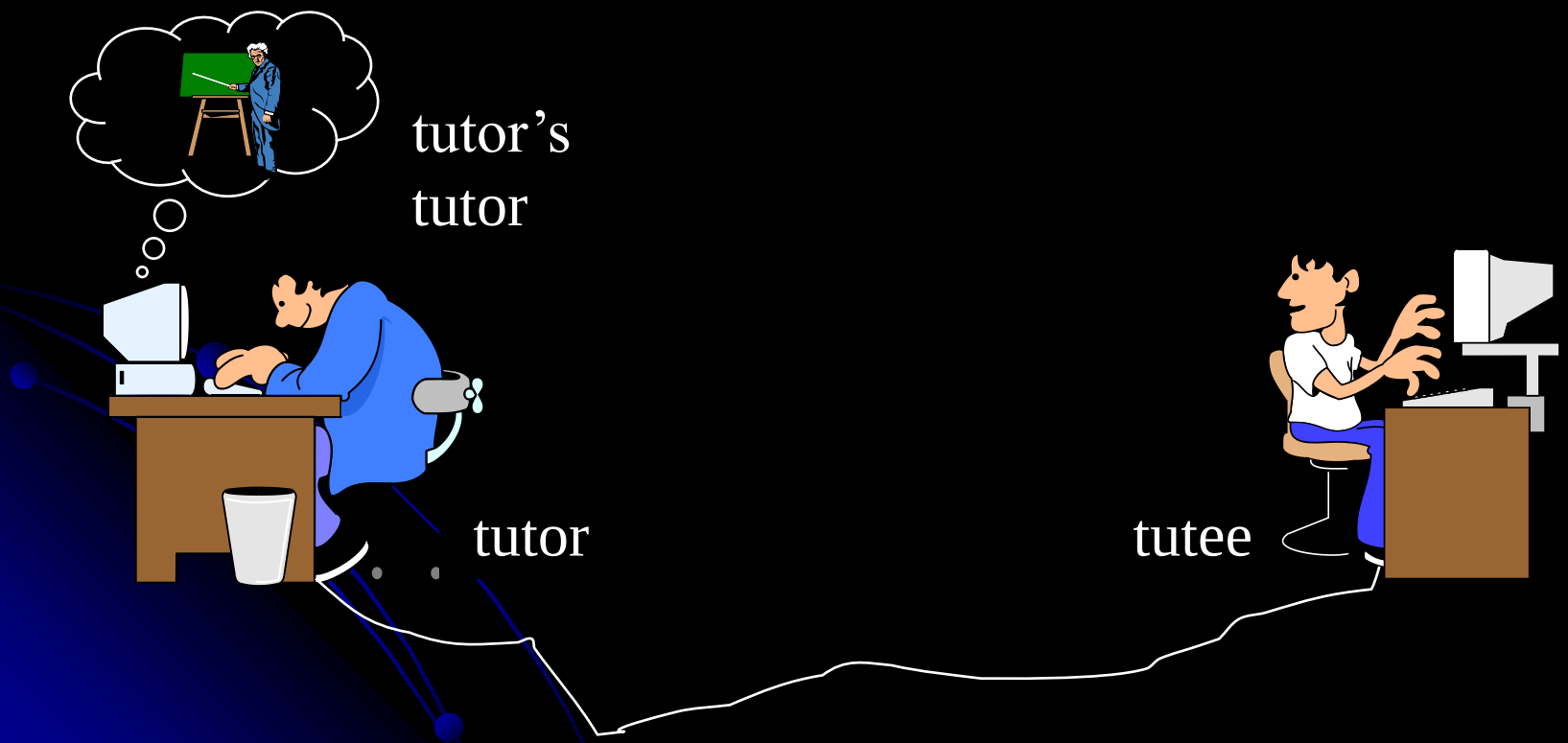
The *school restructuring* problem

schools still exist

1. More and more informal learning to become parts of formal (school) learning
   - *online learning* for homework
   - *ubiquitous and seamless learning* to capture learning in everyday life activity
   - *game-based learning* – a dominating pedagogy

Gaming and small group learning will be prevalent in 1:1 classrooms

reciprocal teaching & dyad competitive games



The *school restructuring* problem

schools still exist

2. "school of their own"
   - teaching mainly by peers
     - small group collaborative learning
     - mutual peer tutoring
     - f2f or online
     - classrooms for 30 students will be very few
   - the elder students mentoring the younger
     - both academic and daily life matters
     - cross-age interactions as many as same-age interactions
     - schools are more like a village
   - strong demand on sense of knowledge ownership and hence "ownership in learning"
     - math of their own, language of their own, etc.

The *school restructuring* problem

schools still exist

3. "school as embryo society" or "learning as work"
   - Epistemic games (David Shaffer): activities simulating professionals such as engineers, journalists, architects, etc.
   - Extending school to knowledge building society (Marlene Scandemaria & Carl Brieter)
   - Technology enhanced drama or play
     - early fostering of interest to future career and of life commitment

The four problems

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   - the extension of the ITS's Holy Grail problem

Dream-Based Research /
Humanity-Based Research

One-to-one Technology Enhanced Learning

Soloway & Norris, (ITS2004)

1 student : 1 pencil
1 student : 1 book
1 student : 1 computer
1 student : 1 intelligent tutor
1 student : 1 set of learning companions
1 student : 1 class (Yuan-Tseh Lee, 2000)
1 student : 1 optimal curriculum

The four problems

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4. The ***global educational goal*** problem
   - rethinking the educational goal from the global perspective

Humanity-Based Research

Well-being of the humankind

The globe is at stake!

- “Until our own generation, no one had grounds to worry whether the next human generation would survive or enjoy a planet worth living on.” (Jared Diamond, 1992)
- Nuclear holocaust; earth resource exhaustion; mass-extinction of species; polarization of the society (MIT’s OLPC is an endeavor toward this), etc.
- Should we just pursue Gross National Product?
  - Or Bhutan’s Gross National Happiness: economy, culture, environment, and governance?

We researchers are the designers of the education and hence the future society

We are very powerful, too powerful!

good citizens?

gangsters?

What constitutes human nature?

- Heredity, Development, Aggression, Sex, Altruism, Religion (Edward Wilson, 1978)
- Many MMOGs design address wealth, fame, and power in the process of building identity
- MMOG for learning must affect extensively learners' value system

What is this global educational goal?

What should we do for the global educational goal problem?

A global, collective endeavor!

G11 website: www.g1to1.org

The four problems

1. The ***productivity*** problem
   - **AIED / ITS, WMUTE / MLearn**
2. The ***school restructuring*** problem
   - **WMUTE / MLearn, CSCL**
3. The ***lifelong personalized curriculum*** problem
   - **AIED / ITS**
4. The ***global educational goal*** problem

The four problems

(Switch the order, considering time frame and urgency)

1. The ***global educational goal*** problem
   - rethinking the educational goal from the global perspective
2. The ***productivity*** problem
   - the performance or output/input problem
3. The ***school restructuring*** problem
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Summary

- Describe 3 orientations of research
  - Dream-Based Research, Adoption-Based Research, Humanity-Based Research
- Use Self's architecture to analyze the current subfields
- Describe 4 problems for the longer future
  - productivity, school restructuring, lifelong personalized curriculum, global educational goal

Thank you!