

Teaching Strategies that Help Learners Attain Creativity, Collaboration, and Leadership Skills

Chris Dede

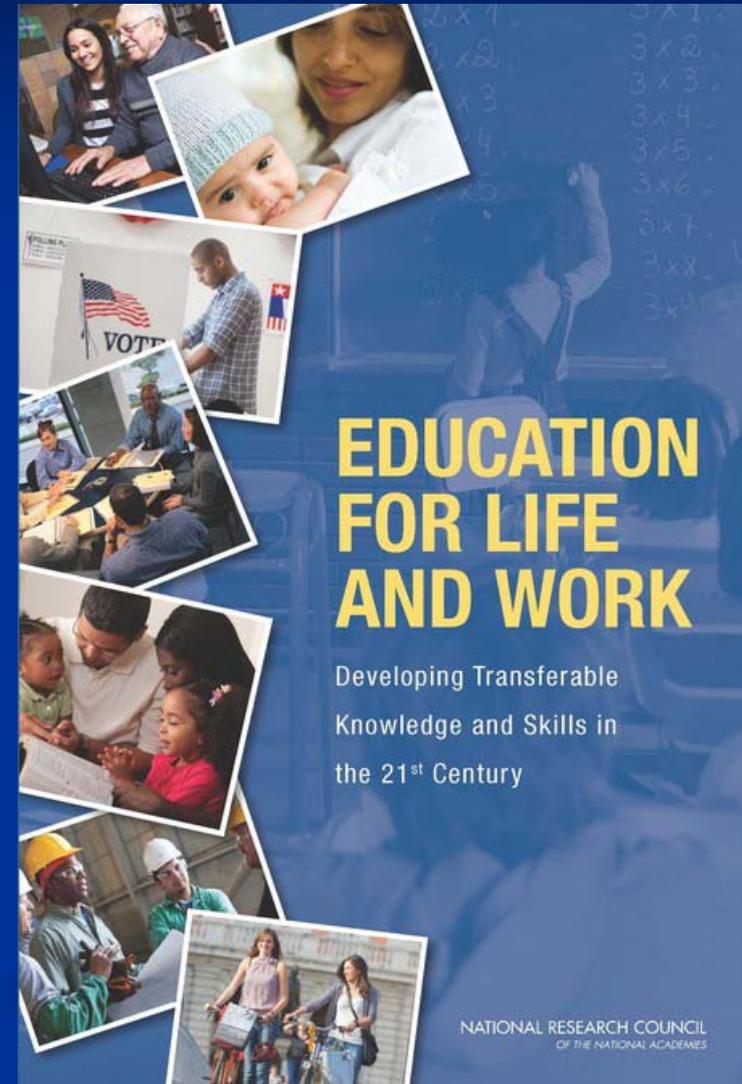
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National Research Council (2012)

Today's children can meet future challenges if their schooling and informal learning activities prepare them for adult roles as citizens, employees, managers, parents, volunteers, and entrepreneurs.

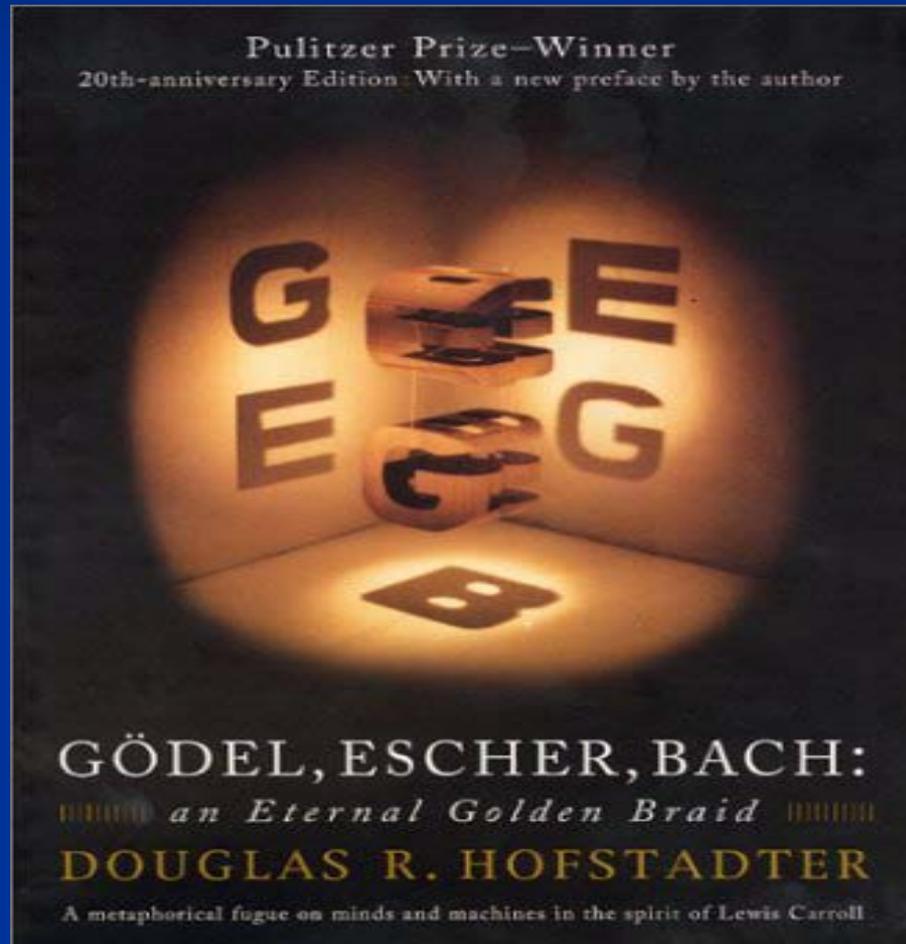




Dimensions of Advanced Knowledge and Skills

<i>Cognitive Outcomes</i>	<i>Intrapersonal Outcomes</i>	<i>Interpersonal Outcomes</i>
Cognitive processes and strategies	Intellectual Openness	Teamwork and Collaboration
Knowledge	Work Ethic and Conscientiousness	Leadership
Creativity	Positive Core Self-Evaluation	Communication
Critical Thinking	Metacognition	Responsibility
Information Literacy	Flexibility	Conflict Resolution
Reasoning	Initiative	
Innovation	Appreciation of Diversity	

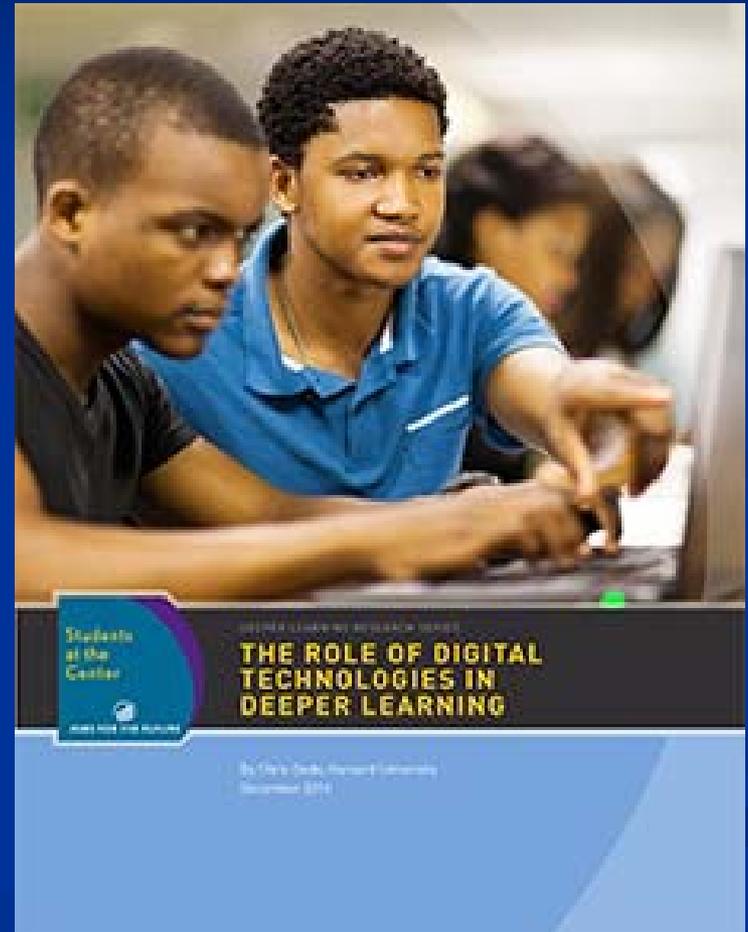
Multidimensional Evaluations



Dede “Deeper Learning” (2014)

Deeper learning is an instructional strategy that can help students master skills for success in the 21st century.

Technology is a powerful way of implementing effective deeper learning



“Deeper Learning”

- Case-based learning
- Collaborative learning
- Apprenticeships
- Self-directed, life-wide learning
- Learning for transfer
- Interdisciplinary studies
- Diagnostic assessments

Module 1: Pond Ecosystem

Modeled after Black's Nook Pond in Cambridge, MA



<http://ecomuve.gse.harvard.edu>



Field Guide

Finding different species in the EcoMUVE
to help build the food web

Drag

Connect

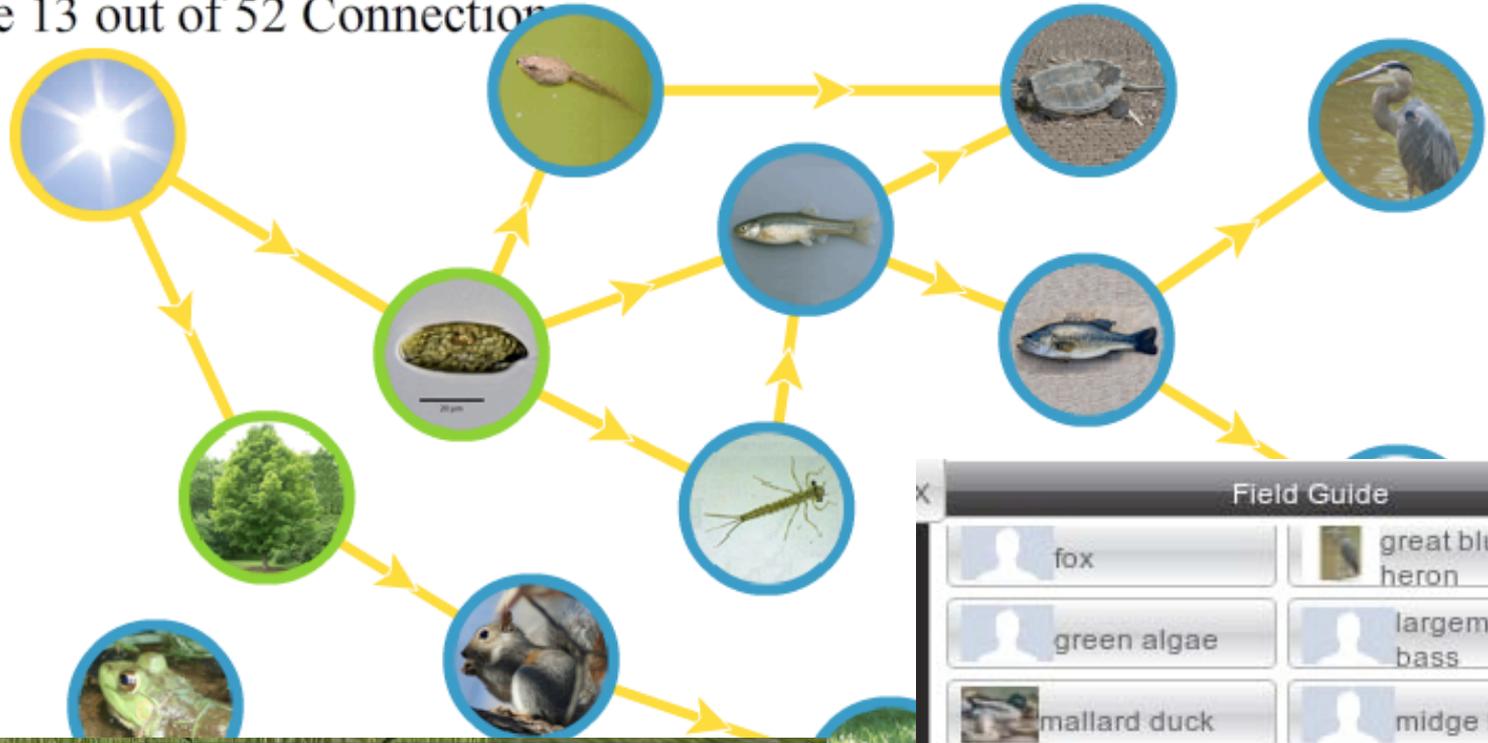
Disconnect

Check

Print

Field Guide

You have 13 out of 52 Connections



snapping turtle

Save Cancel

Field Guide

fox	great blue heron
green algae	largemouth bass
mallard duck	midge larvae
mosquito larvae	predaceous diving beetle
protist	red-tailed hawk
rotifer	snail
snapping turtle	squirrel
sugar maple	tadpole
water chestnut	white pine



Talking with Manny the Gardener

Different characters provide information for students



Animating a water molecule

The Atom Tracker helps students see the flow of matter through the ecosystem.



Population reading for Herons

This data helps students understand how species' populations change over time

Naturalist	Microscopic Specialist	Water Chemist	Private Investigator
Observe pond for similarities to EcoMUVE	Observe duckweed	Observe pond for similarities to EcoMUVE	Talk to virtual golfer
Observe virtual fish	View 3D model of duck	Measure dissolved oxygen	Observe storm water pipe overlay
Calculate fish population size	Video of starch decomposition by bacteria	Video of how oxygen dissolves in water	Find inlet and outlet of pond
Collect macroinvertebrates	Observe virtual bacteria	Measure water temperature	Talk to young girl about what a watershed is
ID macroinverts and calculate tolerance index	Measure pH	Measure phosphates	Measure turbidity

Work together to create video that summarizes the health of the pond based on whole team's observations

Logfiles: Events, Chats, Notebooks...

Database of Logdata - Track students' behaviors: where they went, what data they collected, path to solve problem

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	administra	testID	eventID	stage	timestamp	locationX	locationY	locationz	locationYa	assetID	detail	studentID	Description
2	3141592	497	0	0	2009-12-06	0	0	0	0	1	1	102282	assessment started
3	3141592	497	1	1	2009-12-06	364	23	-76	0	2	10	102282	stage started
4	3141592	497	2	1	2009-12-06	263	10	-6	270	2	10	102282	stage started
5	3141592	497	3	1	2009-12-06	263	8	-6	270	14	1	102282	notebook opened
6	3141592	497	4	1	2009-12-06	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
7	3141592	497	5	1	2009-12-06	257	8	-397	0	143	20	102282	Arrow selection of Surface of the bay in front of the tent
8	3141592	497	6	1	2009-12-06	0	0	0	0	2	11	102282	stage ended
9	3141592	497	7	1	2009-12-06	0	0	0	0	2	13	102282	stage ended ungracefully
10	3141592	497	8	1	2009-12-06	0	0	0	0	1	3	102282	
11	3141592	498	0	0	2009-12-06	0	0	0	0	1	1	102282	assessment started
12	3141592	498	1	1	2009-12-06	364	23	-76	0	2	10	102282	stage started
13	3141592	498	2	1	2009-12-06	263	10	-6	270	2	10	102282	stage started
14	3141592	498	3	1	2009-12-06	263	8	-6	270	14	1	102282	notebook opened
15	3141592	498	4	1	2009-12-06	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
16	3141592	498	5	1	2009-12-06	263	7	-6	270	14	3	102282	pop density tab clicked in notebook
17	3141592	498	6	1	2009-12-06	263	7	-6	270	14	4	102282	salinity tab clicked in notebook
18	3141592	498	7	1	2009-12-06	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
19	3141592	498	8	1	2009-12-06	263	7	-6	270	14	1	102282	notebook opened
20	3141592	498	9	1	2009-12-06	0	0	0	0	2	11	102282	stage ended
21	3141592	498	10	1	2009-12-06	0	0	0	0	2	13	102282	stage ended ungracefully
22	3141592	498	11	1	2009-12-06	0	0	0	0	1	3	102282	
23	3141592	499	0	0	2009-12-06	0	0	0	0	1	1	102282	assessment started
24	3141592	499	1	1	2009-12-06	364	23	-76	0	2	10	102282	stage started
25	3141592	499	2	1	2009-12-06	263	10	-6	270	2	10	102282	stage started
26	3141592	499	3	1	2009-12-06	263	8	-6	270	14	1	102282	notebook opened
27	3141592	499	4	1	2009-12-06	263	7	-6	270	14	2	102282	nitrate tab clicked in notebook
28	3141592	499	5	1	2009-12-06	233	4	-5	291	3	4	102282	teleport KB kelp
29	3141592	499	6	1	2009-12-06	236	6	-4	291	2	11	102282	stage ended
30	3141592	499	7	4	2009-12-06	129	10	125	0	2	10	102282	stage started
31	3141592	499	8	4	2009-12-06	124	2	117	108	212	20	102282	Arrow selection of Striped surfperch
32	3141592	499	9	4	2009-12-06	123	0	123	0	107	22	102282	Population density reading for Bull kelp
33	3141592	499	10	4	2009-12-06	129	10	118	180	209	22	102282	Population density reading for Sea otter
34	3141592	499	11	4	2009-12-06	137	0	121	37	200	22	102282	Population density reading for Corraline algae
35	3141592	499	12	4	2009-12-06	133	0	117	0	111	24	102282	Temperature reading for Bay floor
36	3141592	499	13	4	2009-12-06	133	0	117	0	111	25	102282	Turbidity sample taken of Bay floor
37	3141592	499	14	4	2009-12-06	108	0	107	37	200	23	102282	Salinity reading for Corraline algae
38	3141592	499	15	4	2009-12-06	122	0	117	0	111	24	102282	nitrate reading for Bay floor

Match In-world Interactions to Rubrics

Question	Skill	observable variable	Evidence	score
question 1 final	Claim/Reasoning	20	55 claim pollution	0
question 2 final	Evidence	21		
add item for 21	Evidence	31	1 dead bee	5
add item for 21	Evidence	31	4 green bee	5
add item for 21	Evidence	31	8 green larvae	5
add item for 21	Evidence	31	10 lab nectar	5
add item for 21	Evidence	31	13 green nectar	5
question 3 final	Experiment: Water	22	13 green nectar	5
question 3 final	Experiment: Water	22	10 lab nectar	2
question 4 final	Experiment: DNA	23	60 no DNA results	5
question 4 final	Experiment: DNA	23	4 green bee	2
question 4 final	Experiment: DNA	23	1 six bee	2
question 5 final	Experiment: Blood	24	1 six bee	2
question 5 final	Experiment: Blood	24	4 green bee	5
question 6 final	All data: Evidence Tadpole	25	6 green larvae	5
question 7 final	All data: Evidence Frogs	26	4 green bee	5
question 8 final	All Data: Experiment: Wat	27	13 green nectar	5
question 9 final	All Data: Experiment: DNA	28	60 no DNA results	5
question 9 final	All Data: Experiment: DNA	28	4 green bee	2
question 9 final	All Data: Experiment: DNA	28	1 six bee	2
question 10 fina	All Data: Experiment: Bloc	29	1 six bee	2
question 10 fina	All Data: Experiment: Bloc	29	4 green bee	5

Path Analysis for Defined Tasks

Individual and Group Paths



Heat Maps



Usage of Individualized Guidance



Bug Catcher: Bog Hints

Hint 1 Hint 2 Hint 3

Click on one of the message tabs above to view hints about this area, object, or River City citizen.

River City

Mosquito Catcher- Next to the Bog:

The current site is Bog

Number Observed
Mosquito count =

Number Of Samples
Sample Number =

Reset Counter Freeze New Sample

A screenshot of the "Mosquito Catcher" interface. It features a central circular grid with a yellow background and a grid pattern, containing several black mosquito icons. To the left of the grid is a "Number Observed" section with a "Mosquito count" label and an input field. To the right is a "Number Of Samples" section with a "Sample Number" label and an input field. Below the grid are three buttons: "Reset Counter" (blue), "Freeze" (red), and "New Sample" (green).

Interacting with Animated Pedagogical Agents

The image displays two side-by-side screenshots of a chat interface. Both screenshots feature a header with the text "Ask Dr. C. Your Personal Mars Expert" and a cartoon illustration of a man with a beard and glasses, identified as Dr. C. Below the illustration is a dropdown menu with three options: "Brian N", "Diane K", and "Jody C".

The left screenshot shows the user "Diane K" has selected the question "Why is Mars called the Red Planet?". Below the question is a "CLEAR" button and a "SEND" button. The chat history shows a message from "Dr C: Busy day today! But I still have time to answer any of your questions about Mars, space, or science." and the user's question "Diane K: Why is Mars called the Red Planet?".

The right screenshot shows the same interface, but the user "Diane K" has received an answer from "Dr C: Mars probably got the nickname, The Red Planet, due to the rusty color of its soil, which is comprised of iron-rich minerals. The Egyptians called it 'the red one' because it appears more reddish in the night sky. What makes it appear reddish is a combination of the fact that its surface is comprised of iron-rich minerals that essentially rust (or oxidize) and that the dust made of these minerals is kicked up into the atmosphere, giving the atmosphere a reddish hue from far away. The Martian surface is not all".

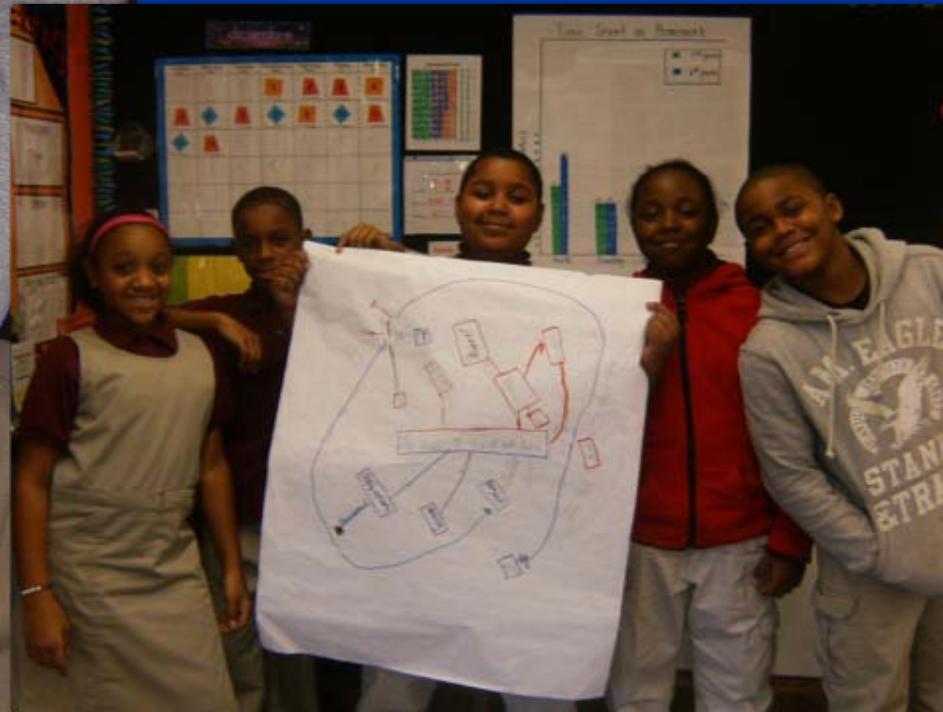
Documenting Progress and Transfer in Similar Settings



- Student takes on identity of a scientist
- Students complete quests
- 60 minutes
- Four Phases:
 1. Orientation
 2. Problem Identification
 3. Experimentation
 4. Competing Explanations

<http://vpa.gse.harvard.edu>

Collaborative construction of concept maps



Constructing explanations

“Were there measurements that surprised you? If so, tell us why?”

“Was the pond healthy? Explain why.”

Students exposed to EcoMUVE provided richer explanations



Explanations included:

- plausible scientific mechanisms
- connections to prior knowledge
- comparison among variables

What Can We Inculcate and Assess?

- Inquiry skills?
- Collaboration?
- Leadership?
- Self-efficacy?
- Metacognition?

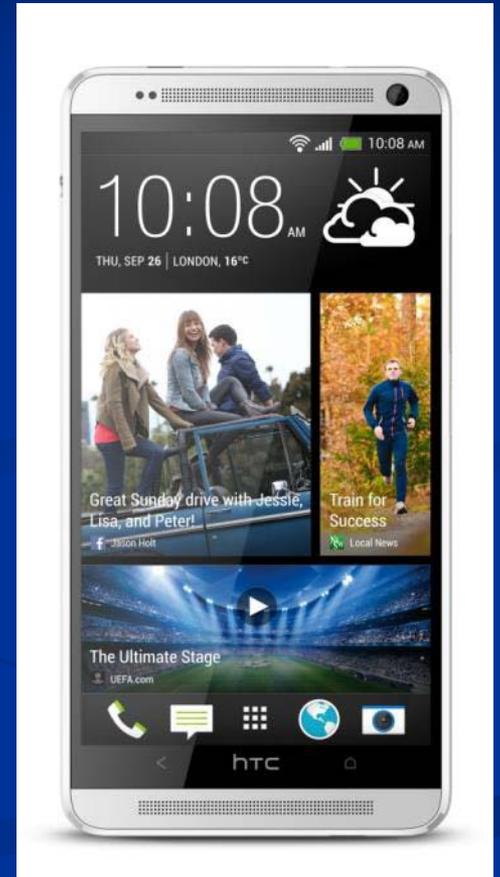
Formative/Diagnostic

- Formative diagnostic assessment provides *more leverage for improvement* than summative measures
- Formative diagnostic assessment is *richer and more accurate* than summative measures
- Potentially, formative diagnostic assessment *could substitute for* summative measures.

1976



2014





(Conner Flynn)

Augmenting Real World Ecosystems

<http://ecomobile.gse.harvard.edu>

GoPro Cameras Capture EcoMOBILE Experience





Interface for Your Digital Life

IN THE FUTURE YOUR MOBILE PHONE WILL ACT AS YOUR DIGITAL “6TH SENSE”

A Different Model of Pedagogy

- Experiences central, rather than information as pre-digested experience
- Knowledge is situated in a context and distributed across a community
- Reputation, experiences, and accomplishments as measures of quality

Core Principles of Professional Development

- Teachers teach as they were taught.
- The important issue is not technology usage, but changes in content, pedagogy, assessment, and learning outside of school.
- Continuous peer learning is the best strategy for long-term improvement.

Professional Development: Communities of “Unlearning”

- ❖ Developing fluency in using emerging interactive media
- ❖ Complementing presentational instruction with collaborative inquiry-based learning
- ❖ **Unlearning** almost unconscious assumptions and beliefs and values about the nature of teaching, learning, and schooling

Transformation of Formal Education



Personalized Learning

...ensuring that a student's educational path, curriculum, instruction, and schedule be personalized to meet her unique needs, **inside and outside of school**... through a wide range of resources and strategies appropriate for her learning style, abilities, and interests, as well as social, emotional, and physical situation.



Innovate to Educate:
**System [Re]Design for
*Personalized Learning***
A Report From The 2010 Symposium



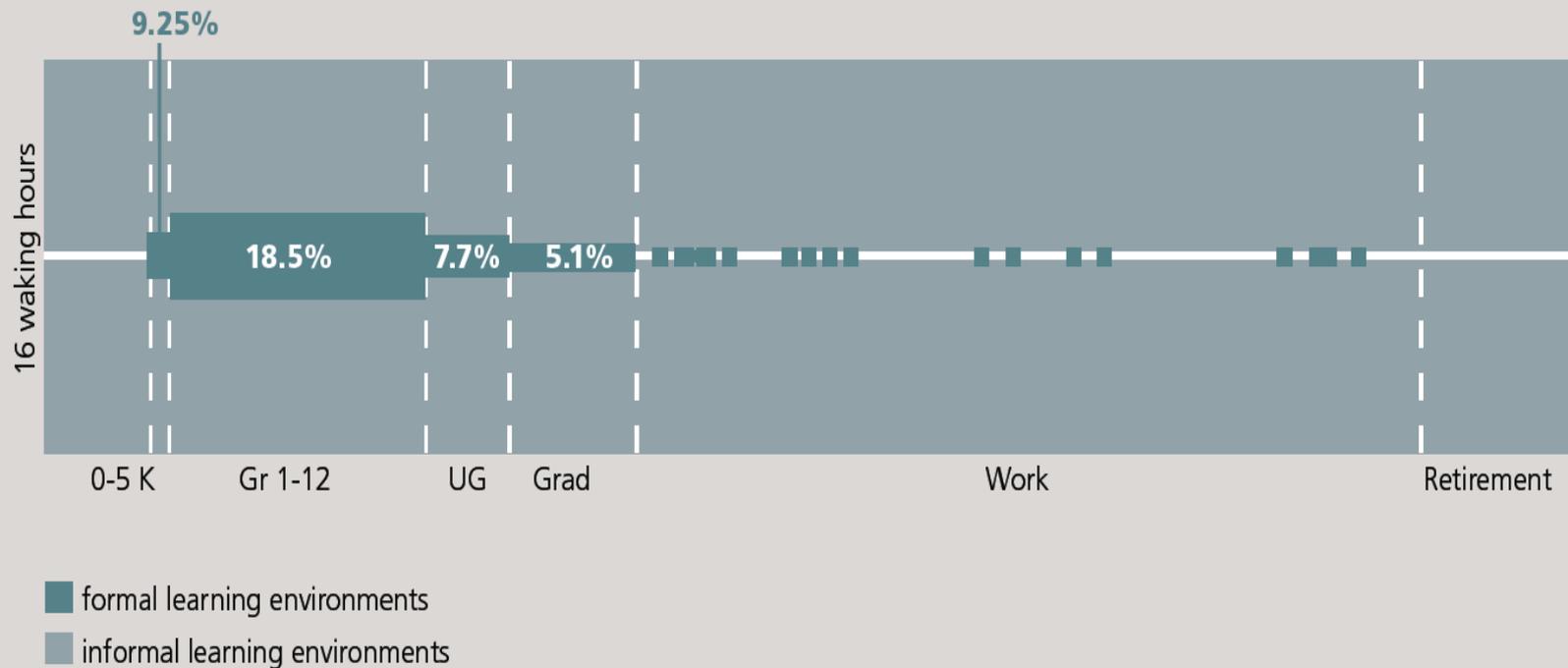
Software & Information
Industry Association

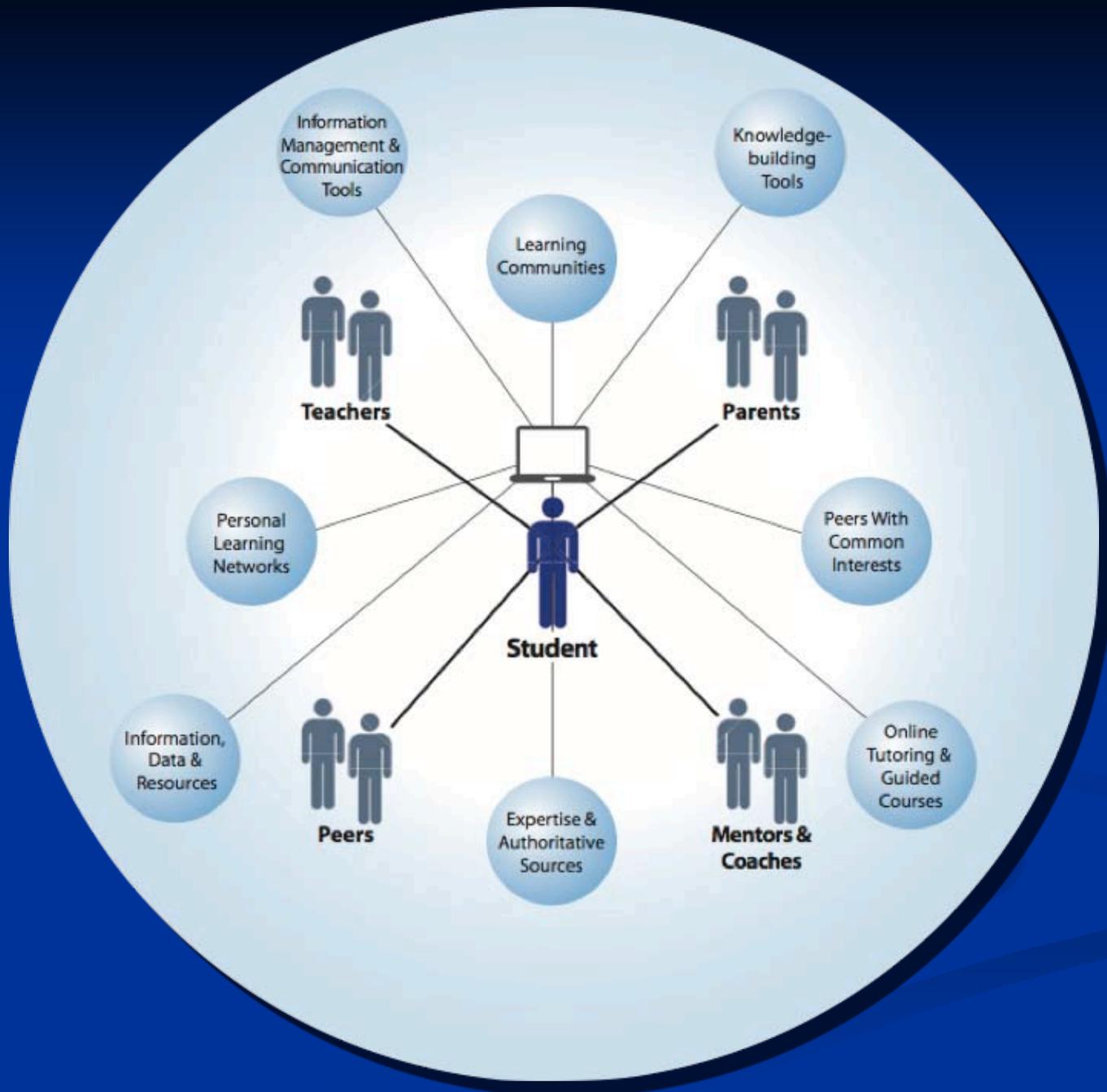
IN COLLABORATION WITH



The Plan Treats Learning as Life-long and Life-wide

Life-long and Life-wide Learning





Connected Teaching

Teachers will engage students and provide personalized learning with 24/7 teacher support. Online environments will ensure that every student has access to effective teaching.

