Global Engineering Deans Council Conference 2013
Keynote

Open, Online & Digital Education: Transforming Teaching & Learning
- Education 3.0 -

Extended Version

October 21, 2013

Tae-Eog Lee

telee@kaist.ac.kr

Director
Center for Excellence in Learning & Teaching

KAIST

Failed Mission of Education?

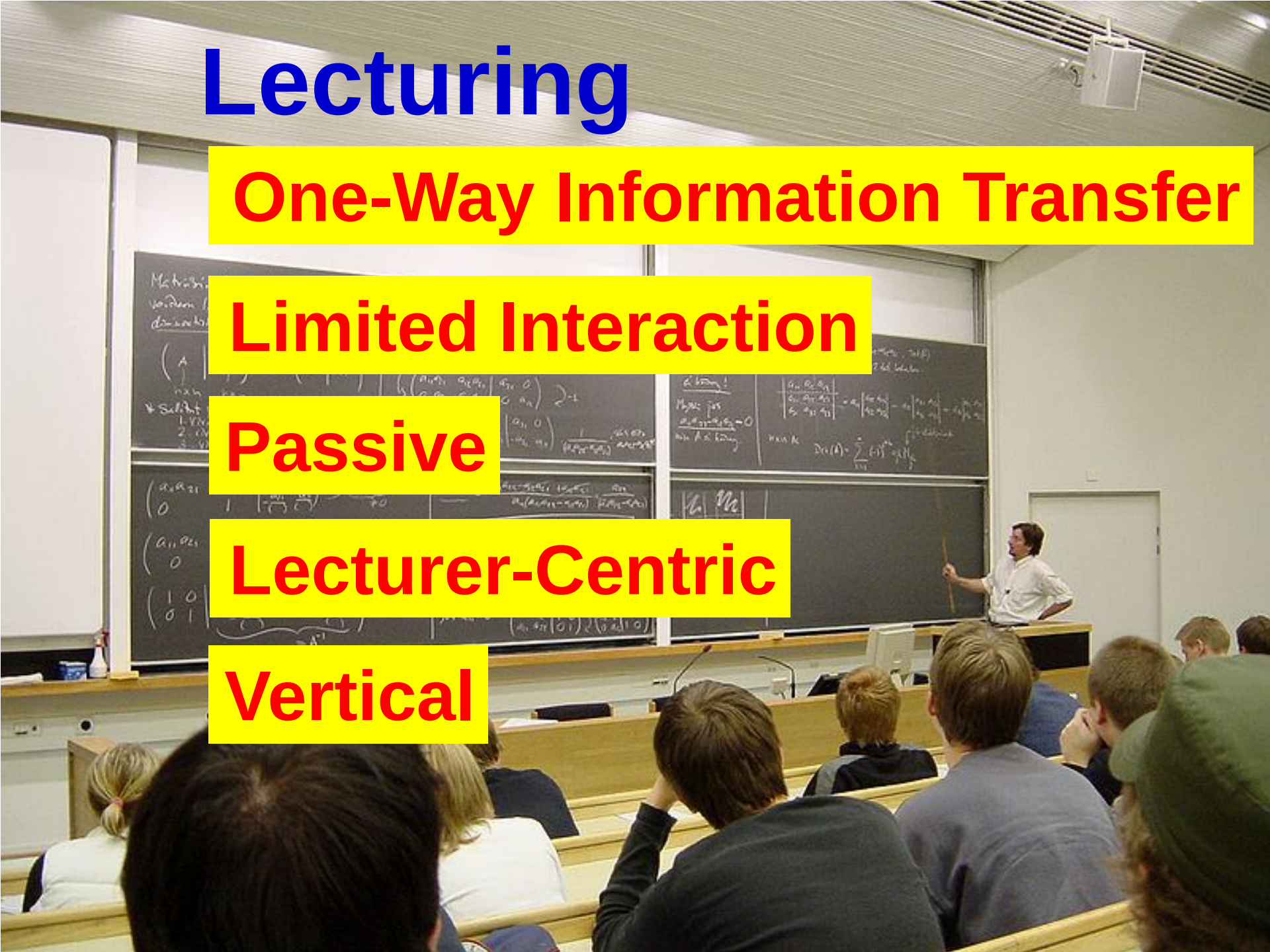
Harvard Conference on Teaching & Learning, Feb. 2012

Failed mission of understanding genuine meaning of the learned, making questions, deriving knowledge, and applying it and creating new ones in a new context

Harvard Univ.: Donation of $40 million for teaching and learning innovation by Gustave M. and Rita E. Hauser

- **Teaching & learning innovation methods**
- **Classroom Innovation**

Lecturing



One-Way Information Transfer

Limited Interaction

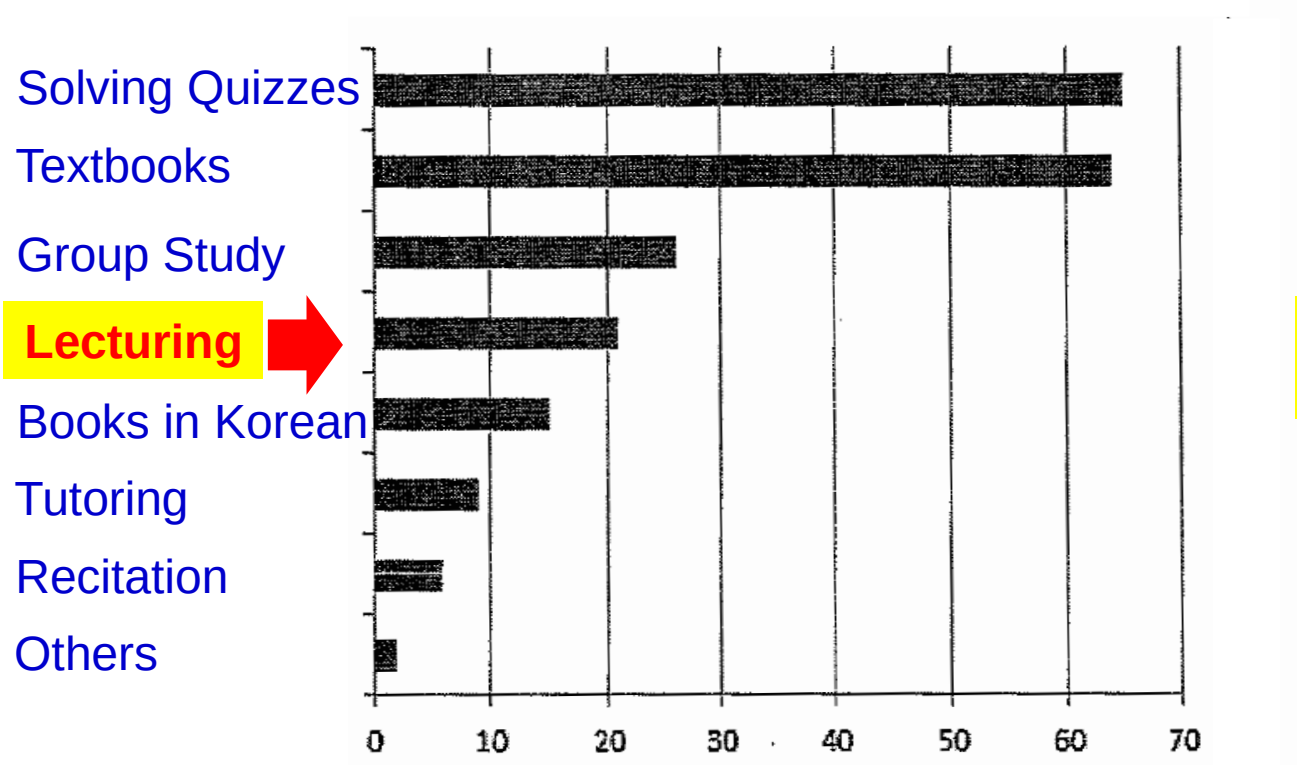
Passive

Lecturer-Centric

Vertical

What are the most helpful for your study?

- **A survey for students in a "tutoring" class for a basic compulsory course (lecturing)**
  - **Nov. 9, 2012, KAIST**



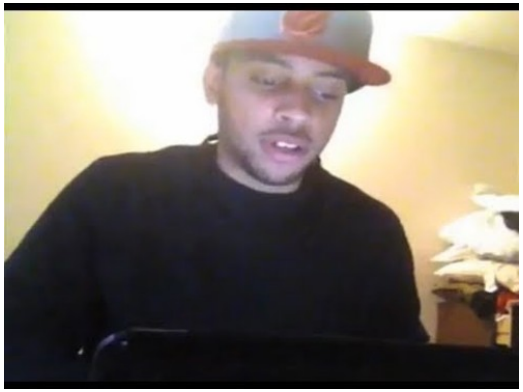
‘LectureFail’ Project

Chronicle of Higher Education

- http://chronicle.com/article/Lecture-Fail/130085/

- Debate on College Teaching at YouTube

- Students
- Professors



PowerPoint Abuse

Teaching

Learning

? ? ?

Lecturing

Who invented current "standards" for curriculums, class hours & schedules, classrooms, lecturing, ...?

Prussia for Mass Education

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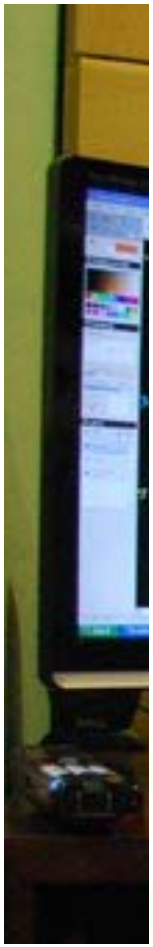
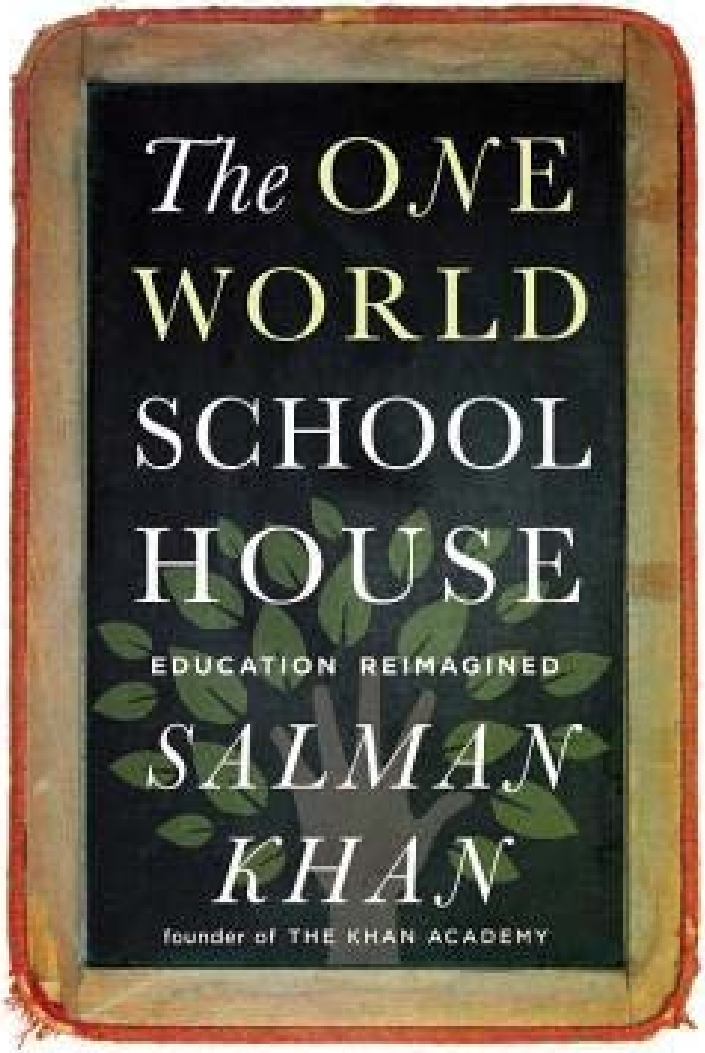
Khan Academy



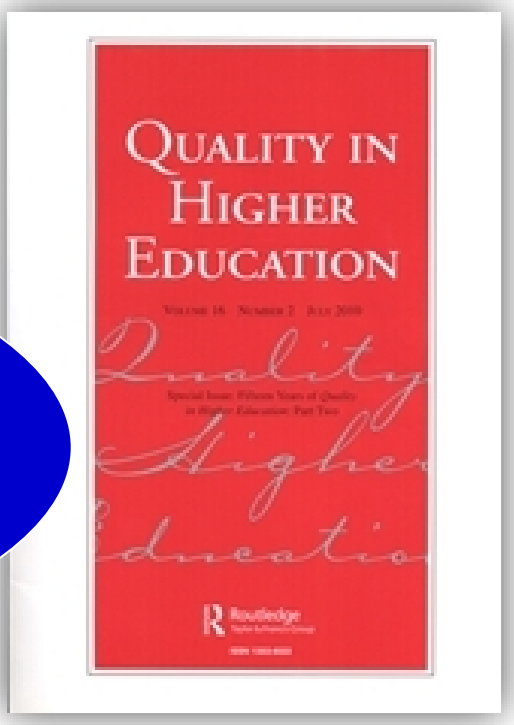


Salman Khan

Paradigm Shift in Higher Education

Massive Education,
Volume Expansion

Quality



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Innovation in Knowledge-Based Society & Industry Needs

Creative

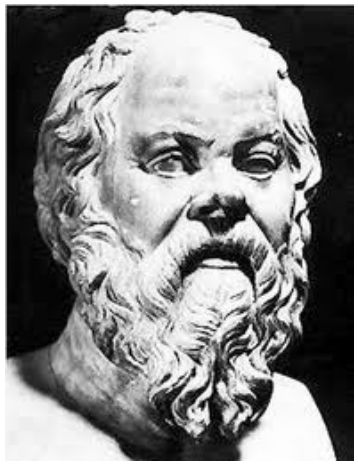
Synthesizing

Communication, Teamwork, Leadership

Communication

Interaction

Q&A, Discussion



Socrates

Self-Learning

Confucius

All Lost, Lecturing for Mass Education

Paradigm Shift in Teaching & Learning

Conventional

- Lecturer-Centric
- Analytic
- Analog

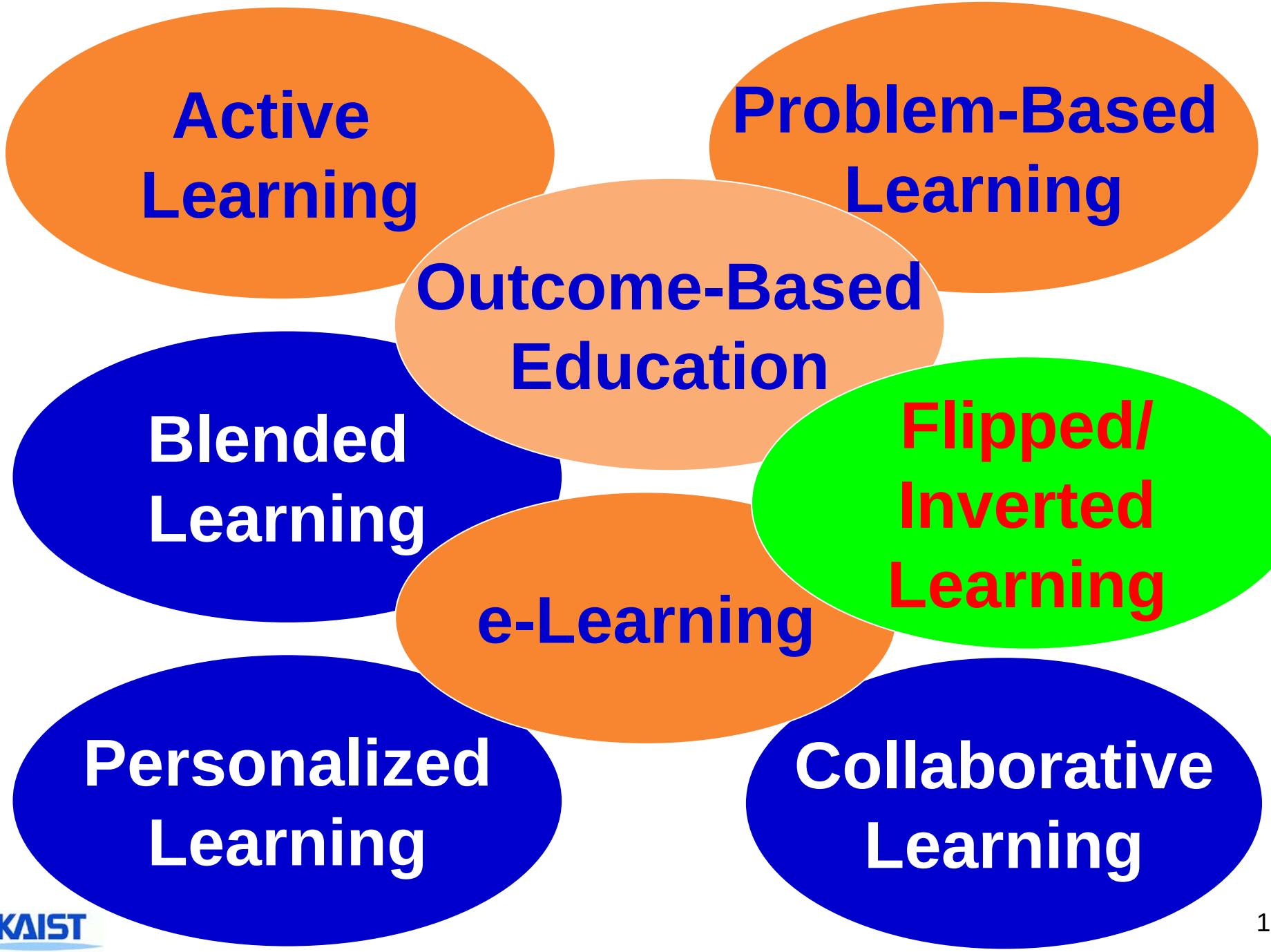
- One-Way
- Lecturing-Centric

- Passive
- Individual
- Repeat/Imitating/Memorizing

New

- Student-Centric
- Synthesizing
- Digital

- Bi-Directional
- Interactive(Discussion, Q&A, Problem Solving, …)
- Active, Student Participation, Self-Learning
- Group/Team Learning
- Creative Problem Solving


Active Learning
Problem-Based Learning
Outcome-Based Education
Blended Learning
Flipped/ Inverted Learning
e-Learning
Personalized Learning
Collaborative Learning

Why not so successful for replacing or improving lecturing?

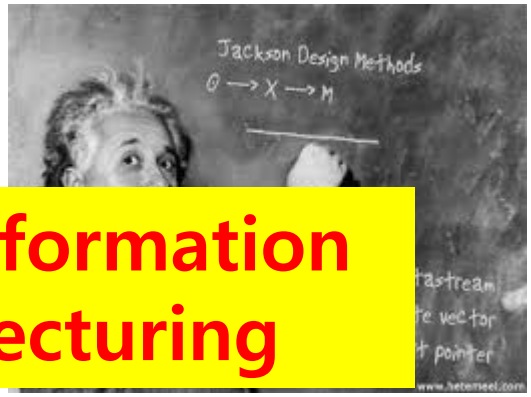
Because most class hours are consumed for lecturing.

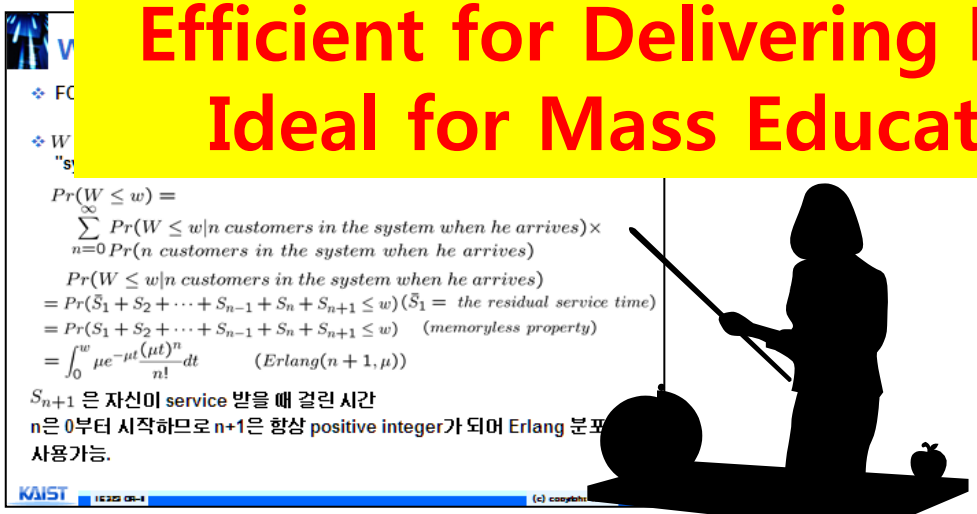
Lecturing is the most convenient for professors.

PowerPoint is too Powerful! …

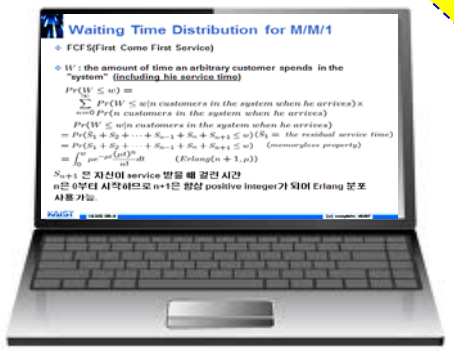
PowerPoint?

Efficient for Delivering Much Information
Ideal for Mass Education & Lecturing





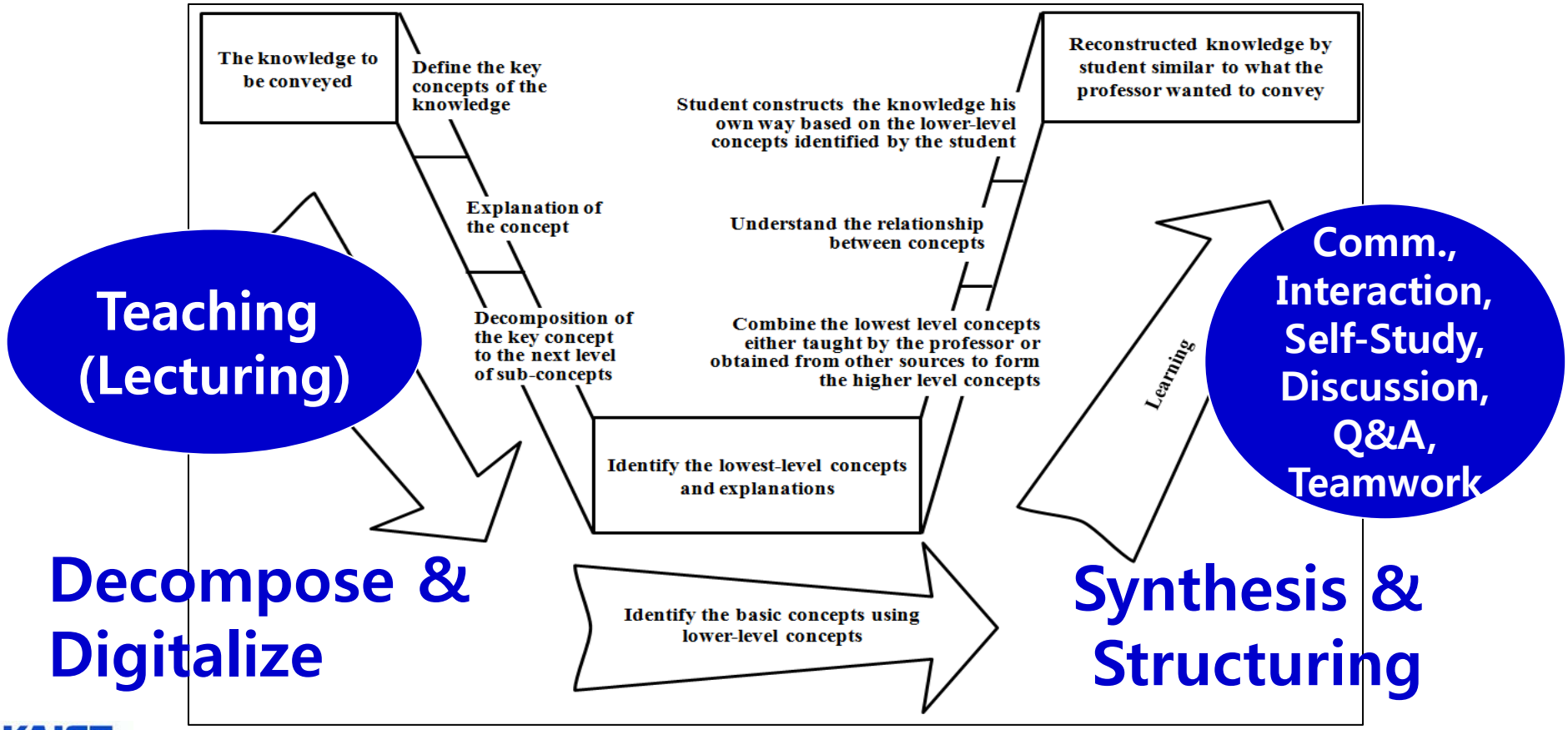
Cognitive Overload



Former President, Nam P. Suh, 2011

University Agenda

Teaching & Learning Processes + Proper IT
➔ Education 3.0 Initiative, Dean



RENAISSANCE
Simple,
Effective

Don't Lecture

in a "class"

Send lecturing to Internet!

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What in a class?

Anything but lecturing!

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Education 3.0 Class Model

Interactive Class

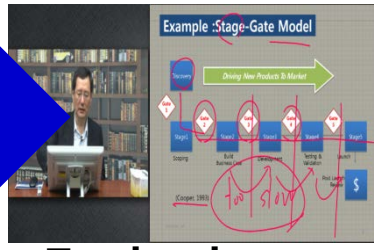
No Lecturing

Problem-Based, Collaborative, Active

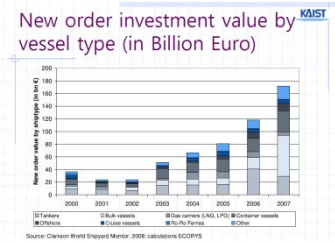
Flipped

Online Self-Learning

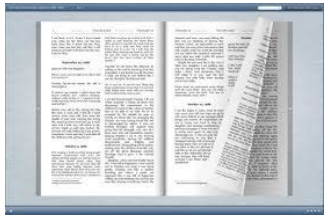
Lecture Video



Lecture Slides



Textbook



Quiz & HW

Q&A,
Information Sharing,
Social Network Services

Virtual Lab

Interaction in Class

Q&A	Discussion	Team Learning/ Task	Interactive Exercise	Evaluation	Presentation	Labs

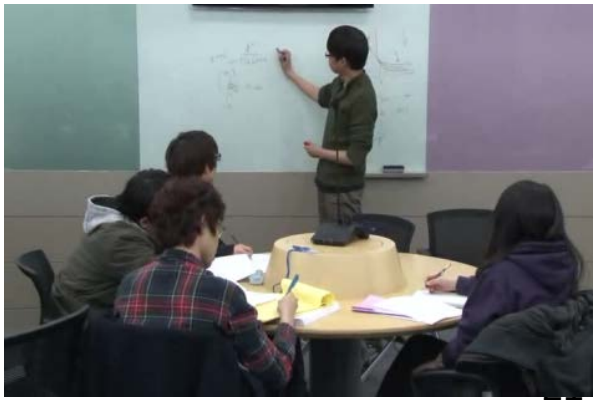
Online Interaction

QuierySearch	Interactive Watching	Q&A	Inform. Sharing	Discussion	Authentification	Evaluation

Team Learning + TA Support

Interactive Teaching & Learning in Class

- Quizzes
- Q&A
- Review & Summary
- Interactive Problem Solving
- Discussion
- Group Learning/Discussion/Project
- Labs



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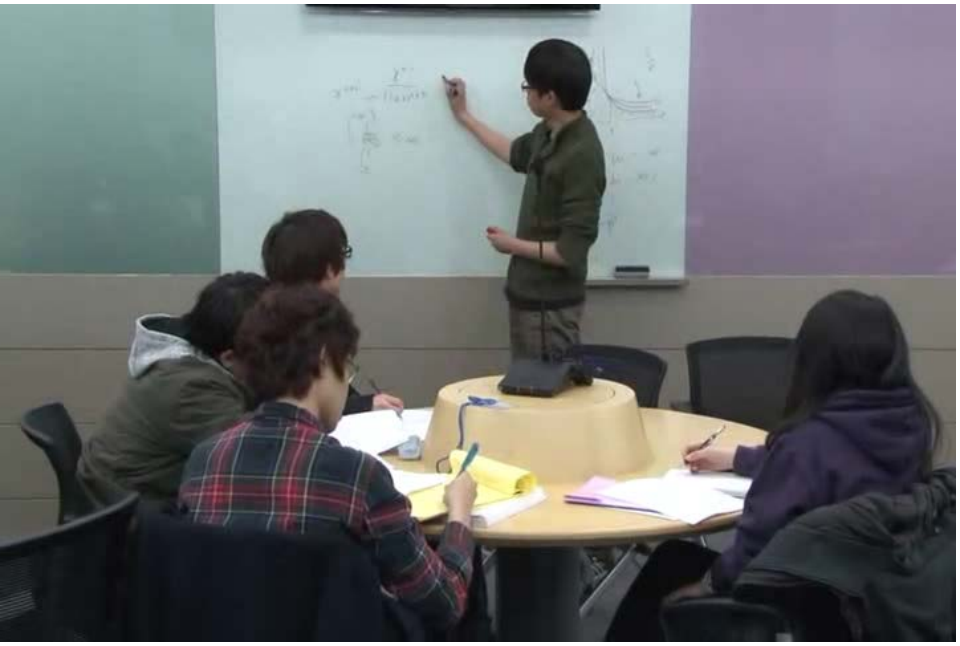
Changes for Interaction

- Assume self-study of lecture videos, quizzes, & problem sets before coming to the class
- Max 48 Students/Class – 2 Sessions for 100 Students
- ½ Class Hours: One Class/Week
- 6 Students/Group
- 1 TA for each 15 students: 2~4 TAs/Class
- More TA roles in classrooms
- Individual professor consulting
- New Interactive Classrooms

Interactive Classrooms



4 Classrooms in Spring 2013 ➔ 8 More in 2013

Hybrid Classroom

Edu 3.0 Interactive Teaching & Learning + Lecturing

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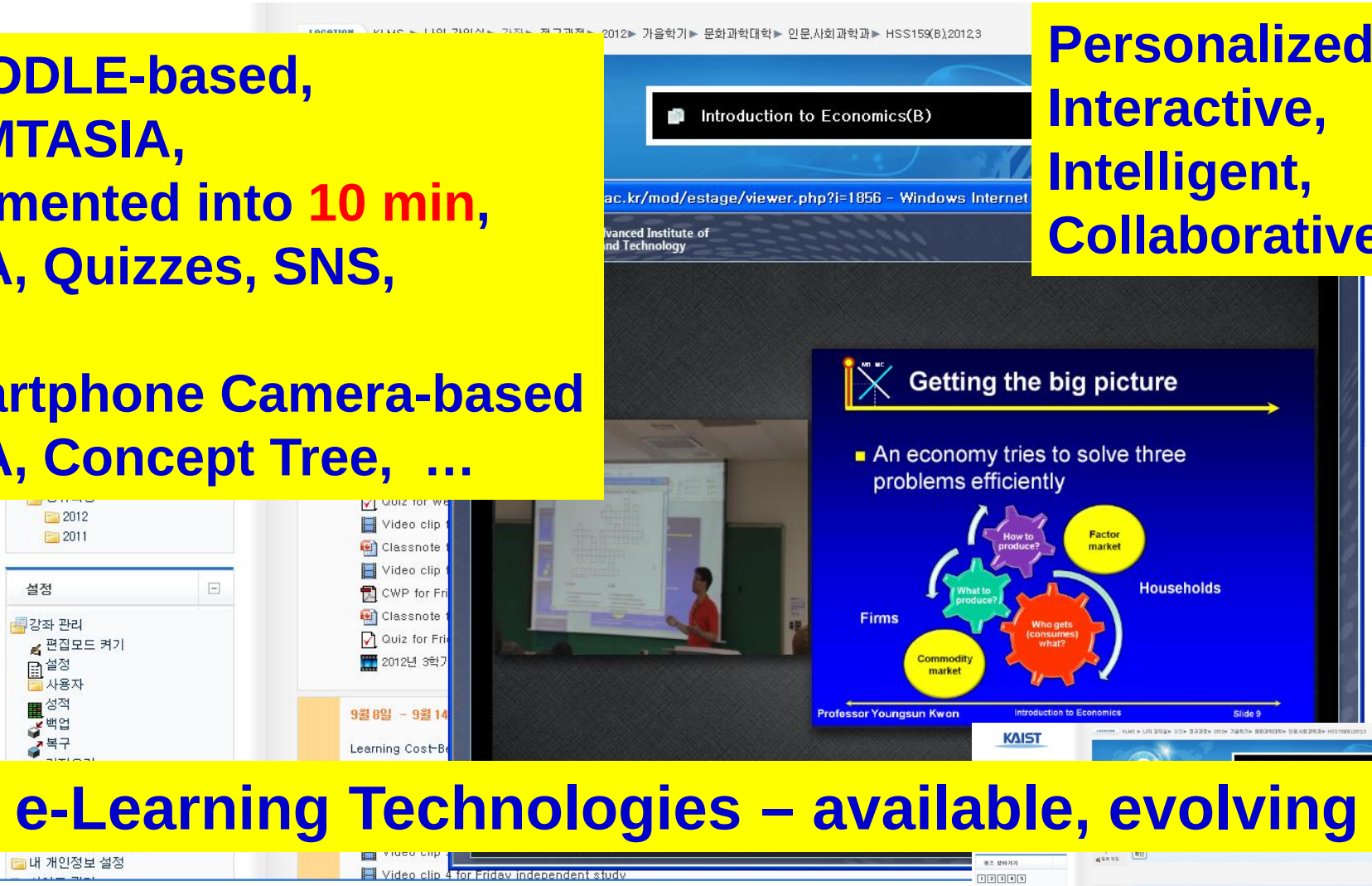
Online Self-Learning System: e-Learning

MOODLE-based,
CAMTASIA,
Segmented into 10 min,
Q&A, Quizzes, SNS,

Smartphone Camera-based
Q&A, Concept Tree, …

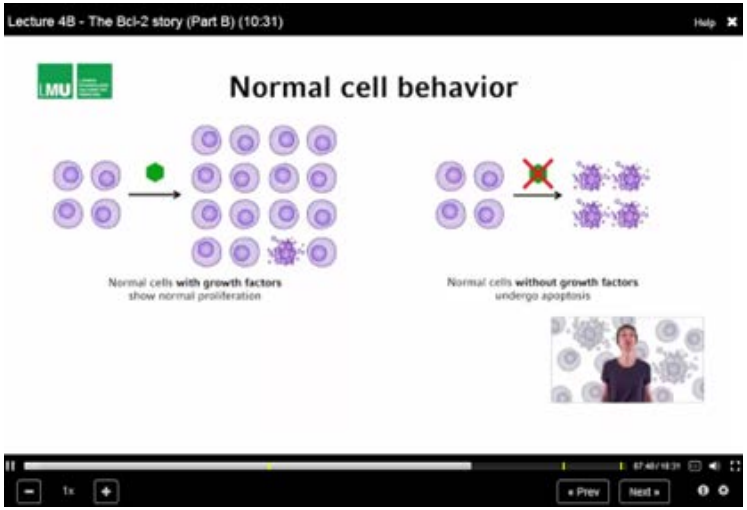
Personalized,
Interactive,
Intelligent,
Collaborative



e-Learning Technologies – available, evolving

Self-Studio & CAMTASIA

Professor office/home
– noise, poor lighting



Make a simple studio
at each department

Large-Enrollment Classes?

- **100 Students ➔ 2 Sessions**
- **100 Students in a Traditional Classroom**
  - 3 Students/Group

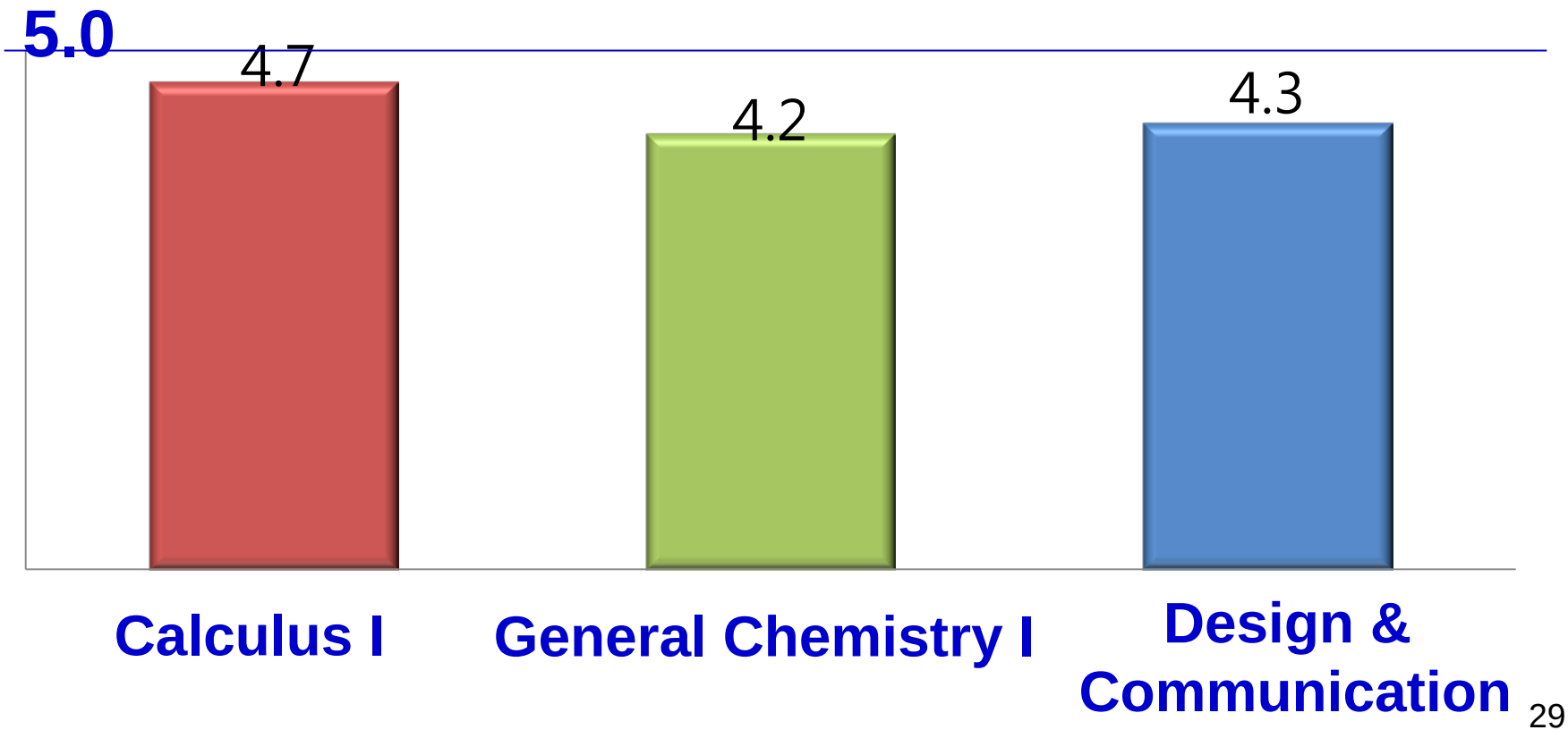
Effectiveness?
Justified?

Spring 2012

Overall Satisfaction

Pilots for Freshmen

Satisfied with Education 3.0 classes and will take such classes again.



Spring 2012

Comparing University Class Evaluation

Education 3.0 Classes vs. Lecturing Classes

	Education 3.0 Class	Conventional Lecturing Classes			
		Number of Classes	Average	Lowest	Highest
Course 1	4.62	7	4.18	3.74	4.40
Course 2	4.31	9	3.98	3.41	4.44
Course 3	4.21	0	NA		

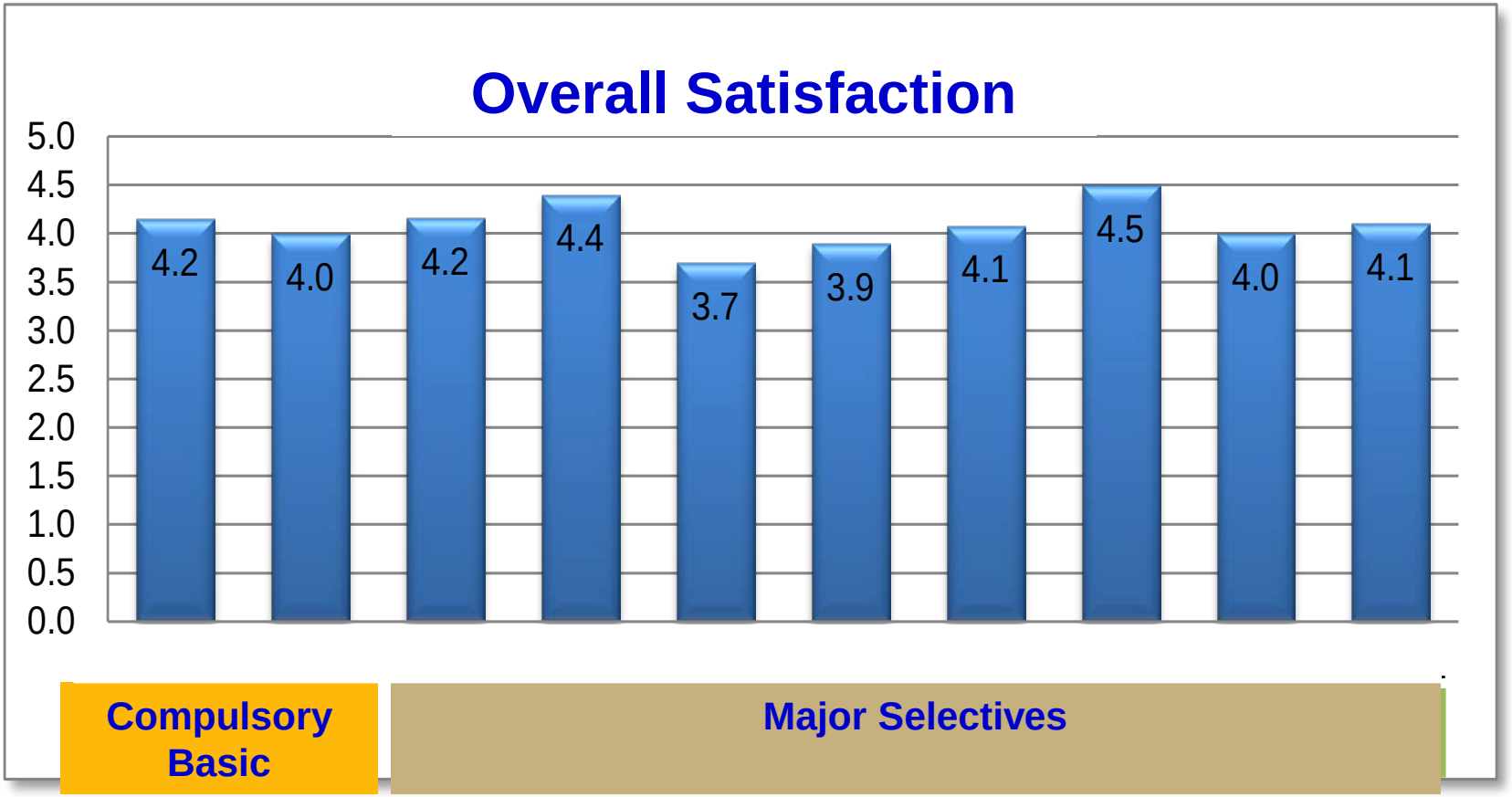
Note

- Education 3.0 Classes have 40~43 students/class.
- Conventional classes have more students, 66~171/class.
- Larger conventional classes tend to have higher evaluations.

Fall 2012

Overall Satisfaction: 4.1

(N= 242, AVE=4.1)

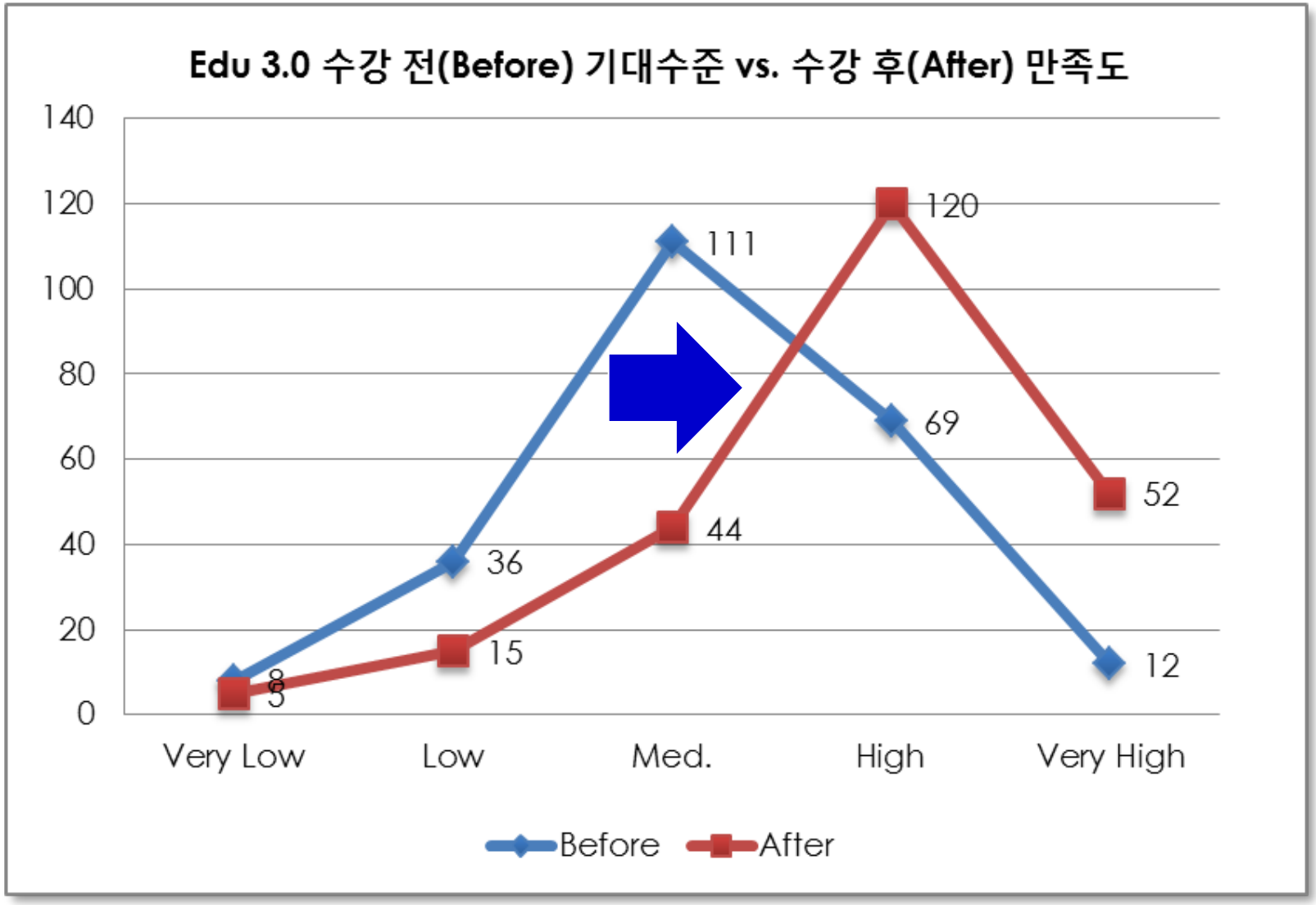


(1=very low, 5=very high)

Most Results Similar to the Feedback in Spring 2012.
More Slides in English for Feedback Analysis will come soon …

Fall 2012

Initial Expectation vs. Final Satisfaction

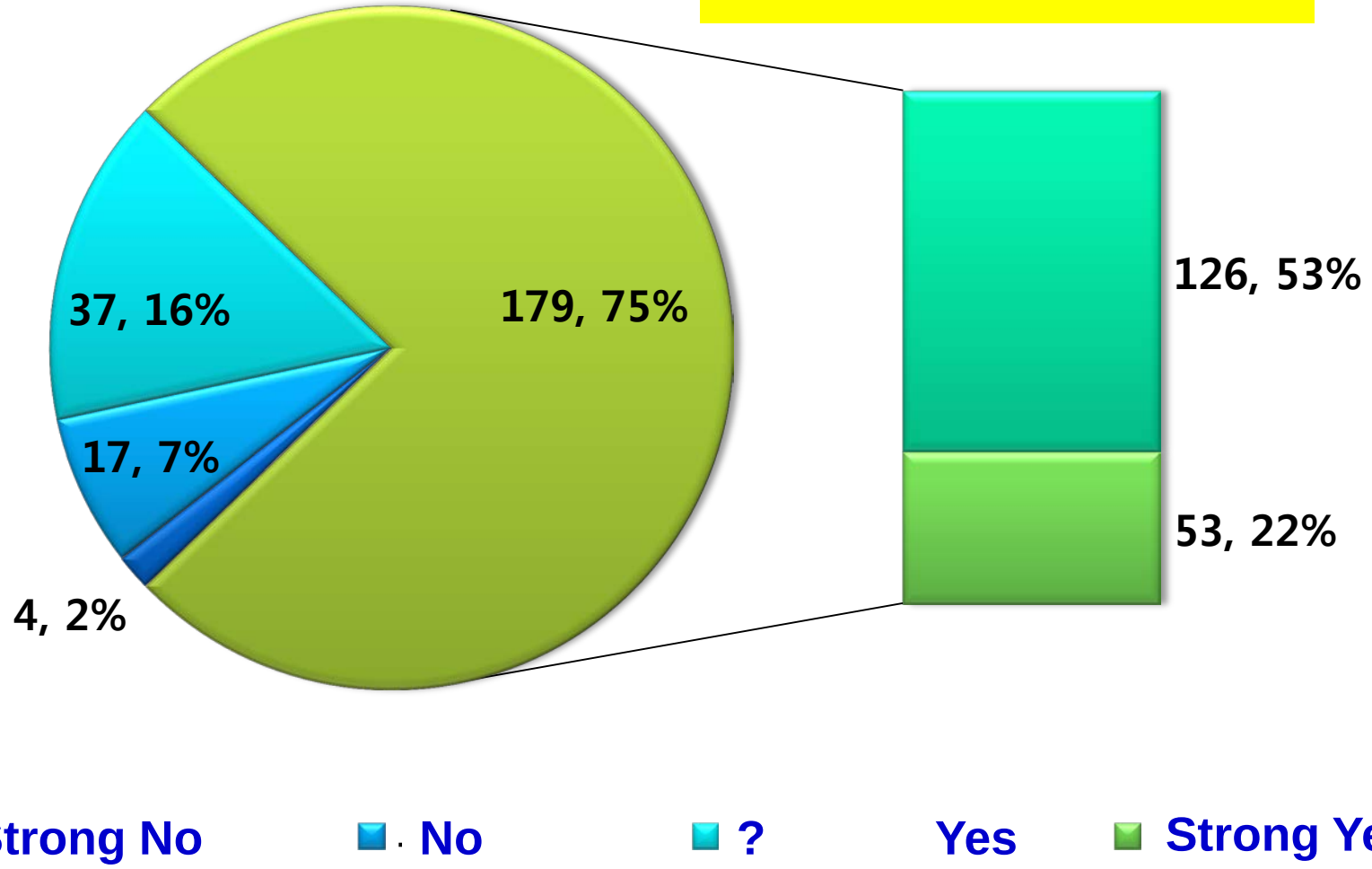


(N=236, Before AVE=3.1, After AVE=4.0)

Fall 2012

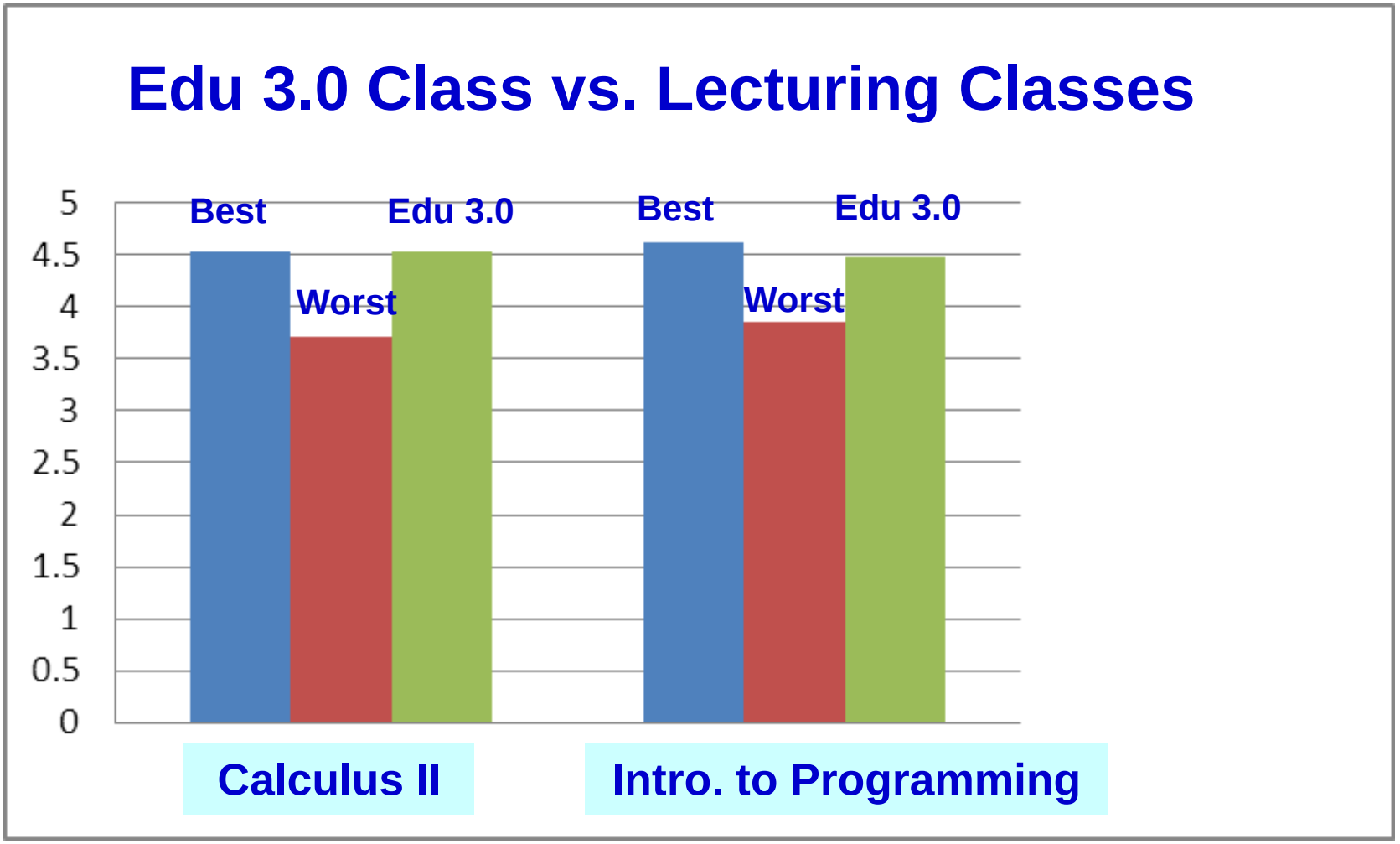
Will you take Education 3.0 class again?

75% - Retention



Fall 2012

Comparing University Class Evaluations



1st of 10 classes

3rd of 12 classes

Fall 2012

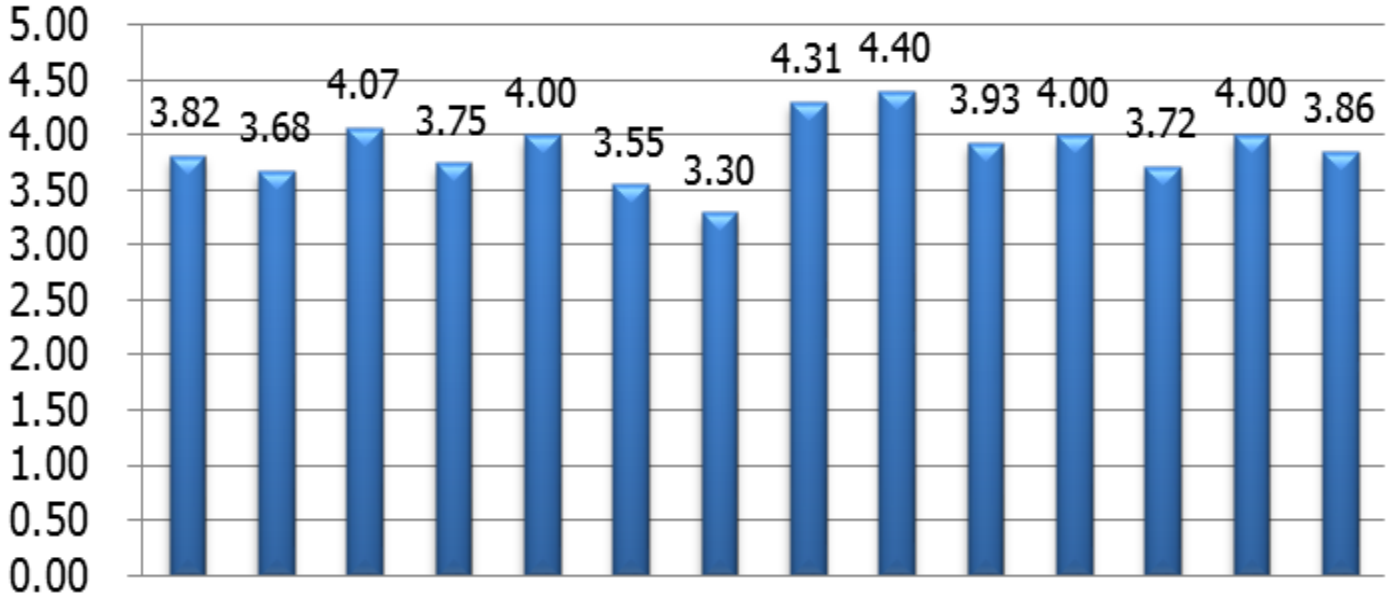
Additional Comparison to Other Classes

- **Introduction to Computer Programming**
  - **Mid & Final Exams**: **3rd** of 12 classes

- **Calculus II**
  - **Mid Term Exam**: **10 points higher** than average of other 9 classes

Spring 2013

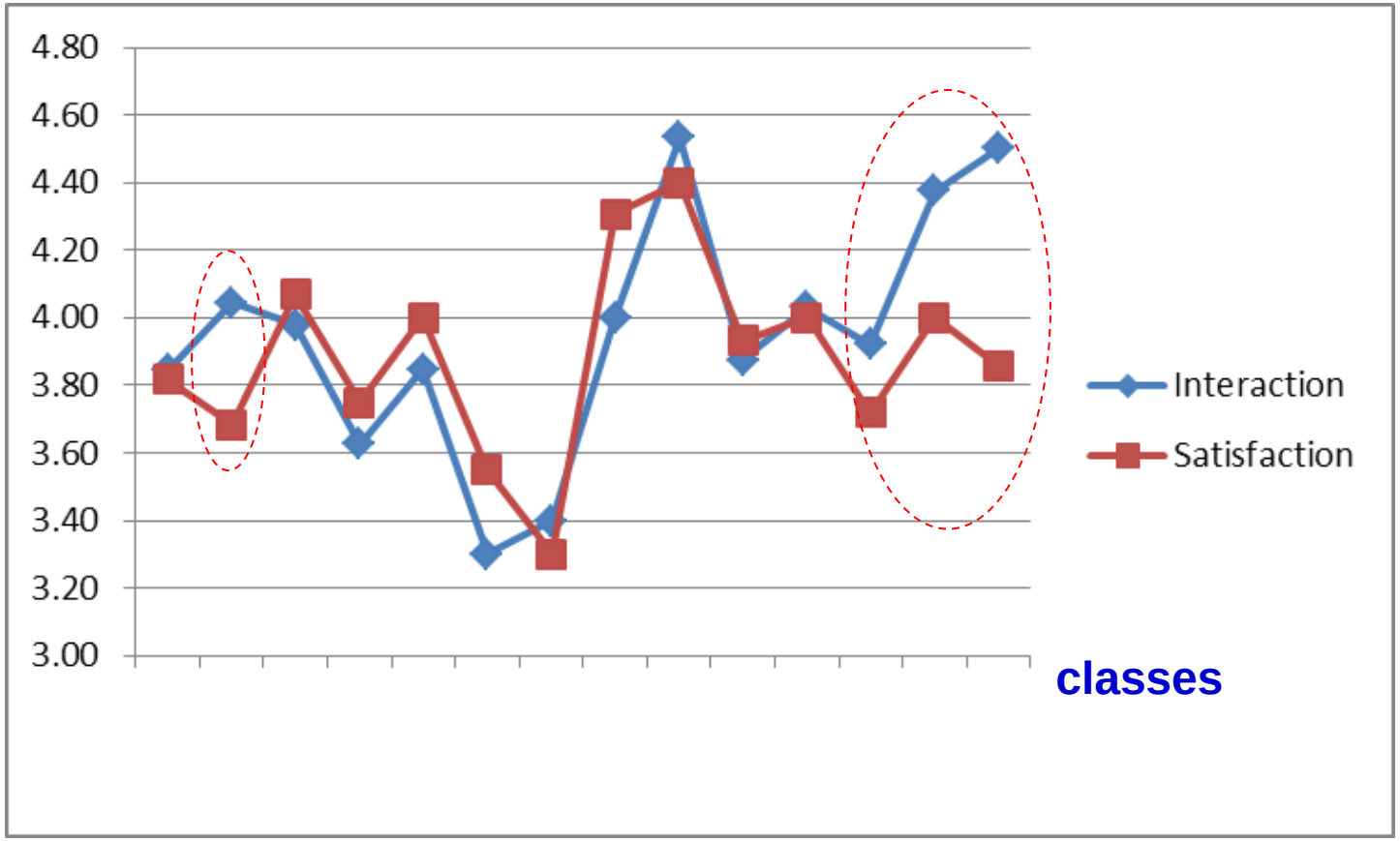
Overall Satisfaction: 3.9



- Total 18 courses, Survey responses for 14 courses
- Some courses still made lecturing ➔ Low satisfaction
- Need quality control!

Quality Control!

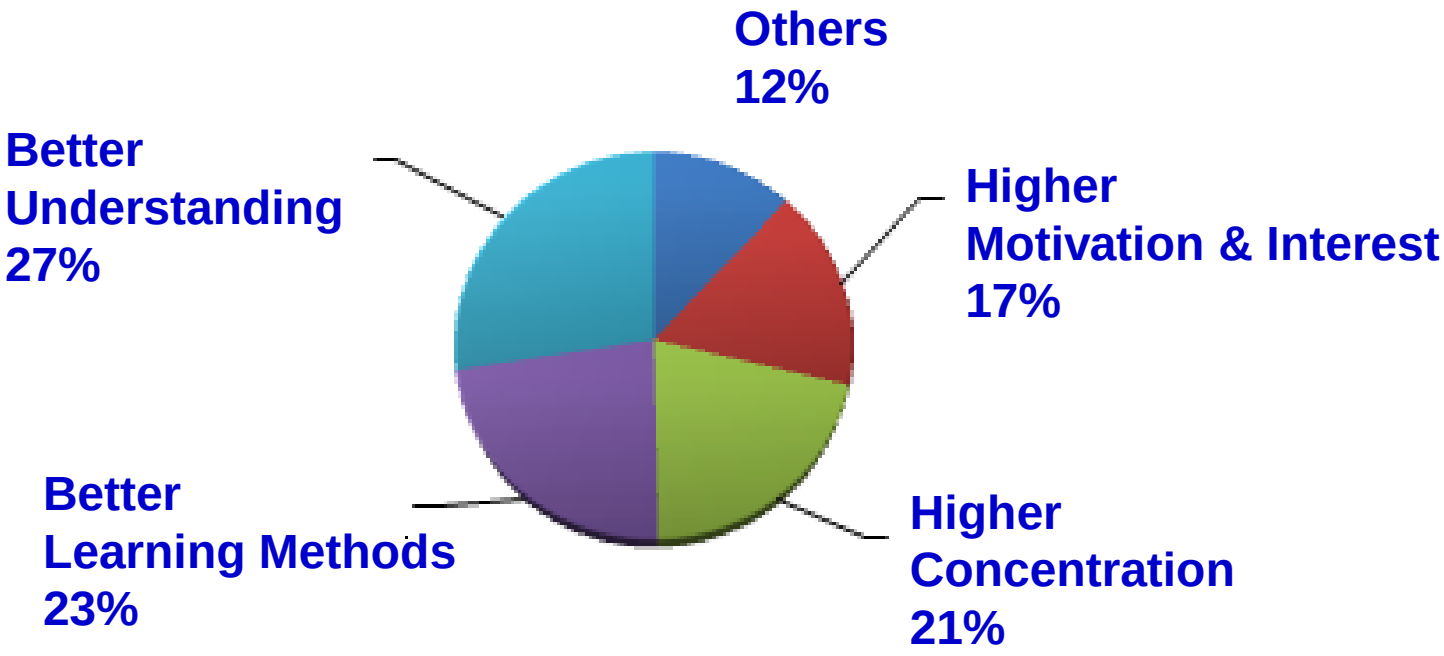
Interaction vs. Satisfaction



- More Interaction tends to result in Higher Satisfaction.
- Some exceptions: Need training for interactive teaching

Changes in Learning Methods & Habits

71% of students reported changes in their learning methods & habits



Others

- better time management
- learning habits
- preparing for classes and discussion
- collaborative learning with students

Education 3.0? - Students

- Student-participative, self-learning, next generation education
- Class for enjoying with TA and friends
- Dynamic, energetic, interactive class
- New approach for studying
- Advanced educational method optimized for communication
- Communication with the professor after self-study
- Combination of online and offline classes
- Multidimensional & multidirectional, not vertical & one-way
- Smart class enabling active participation. Active communication and synergetic as compared to old, one-way, and enforcing methods
- Inducing self-study. Innovation!

Education 3.0? - TA

과목	Response Text
A	▪ Make students, TA, and the professor do their own missions well
B	▪ Students, TA, and the professor work together
C	▪ Better task allocation between students, TA, & professor ▪ 100 times better than conventional lecturing!
E	▪ Maximize student participation and self-study
D	▪ Highly student-participative
F	▪ New Approach! Likely succeed!
G	▪ More active communication! ▪ All actively participative!

Professor Feedback

- Succeeded in making students experiencing the process of discovering and developing ideas in bioinformatics for themselves
- Students became to directly communicate with the professor and TA, and learned ways of thinking
- Self-studying, independent, in-depth study, applying the learned
- Proud in spite of difficulty in the first trial
- Initial large time investment for making lecture videos and online quizzes. Expect to save the time by reusing them in the next class
- Need to improve continuously by collaborating between lecturers and Edu 3.0 staff

Case 1: Introduction to Biology

- **Required to submit summary of lecture videos each week to promote self-study**
  - Easier than summarizing by reading a thick textbook
  - Better understanding & reflection by summarizing in his own language
- **Maximize TA help**
  - **1 TA for each group**
  - TAs: graduate students, + **honor 3rd & 4th year undergraduates ➔ better networking, learning by teaching**
- **Maximize group discussion for concept learning & problem solving**
- **Each group makes a video of "biological dances" ➔ understanding and motivation**
- **Absolute evaluation ➔ Motivation. Higher achievement**

Case 2: Calculus I & II

- Lecture videos pre-study
- Extensive online exercises
  - Use Pearson's problem DB/contents
- Group problem solving and discussion in class
- TA roles in class
- High achievement and satisfaction

CASE 3: Introduction to Programming

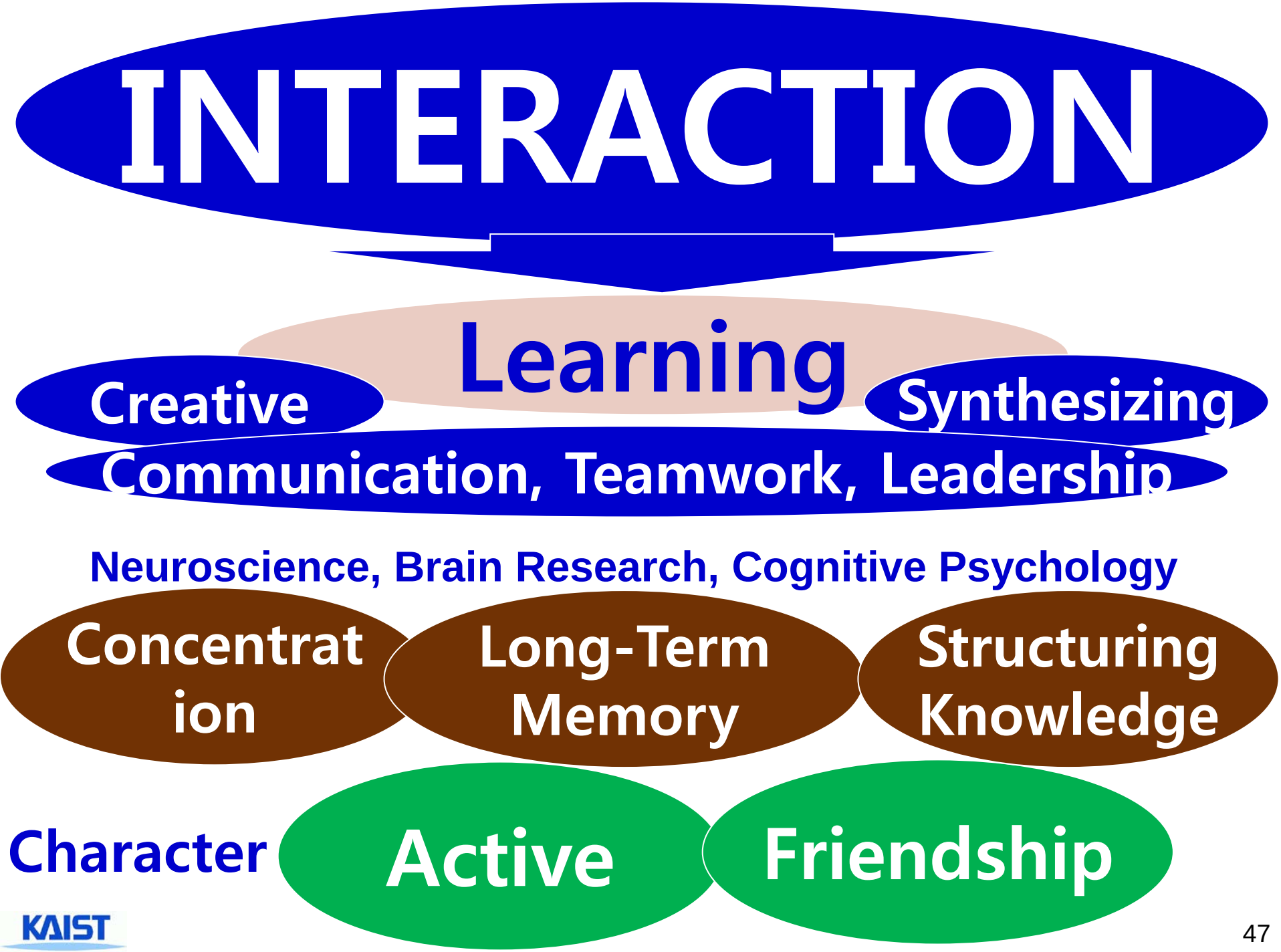
- **Programming assignments in class for a group (2 or more)**
- **Important**
  - **self-study of lecture videos before class**
  - **Culture of participation and interaction**
- **Class activities should be closely associated with lecture videos.**
- **Group management is important. – no free riding!**
  - Grouping, Periodic regrouping, **Peer Reviews**
- **Should motivate students to participate**

Case 4: Bioinformatics

- 15 min Quizzes only for one of three class hours
- Need a TA for each group
- Q&A and group discussion in class
- Productive lecture recording in a self-studio

- Significantly higher level/difficult questions
  - Past: questions on simple concepts
  - Now: More advanced questions

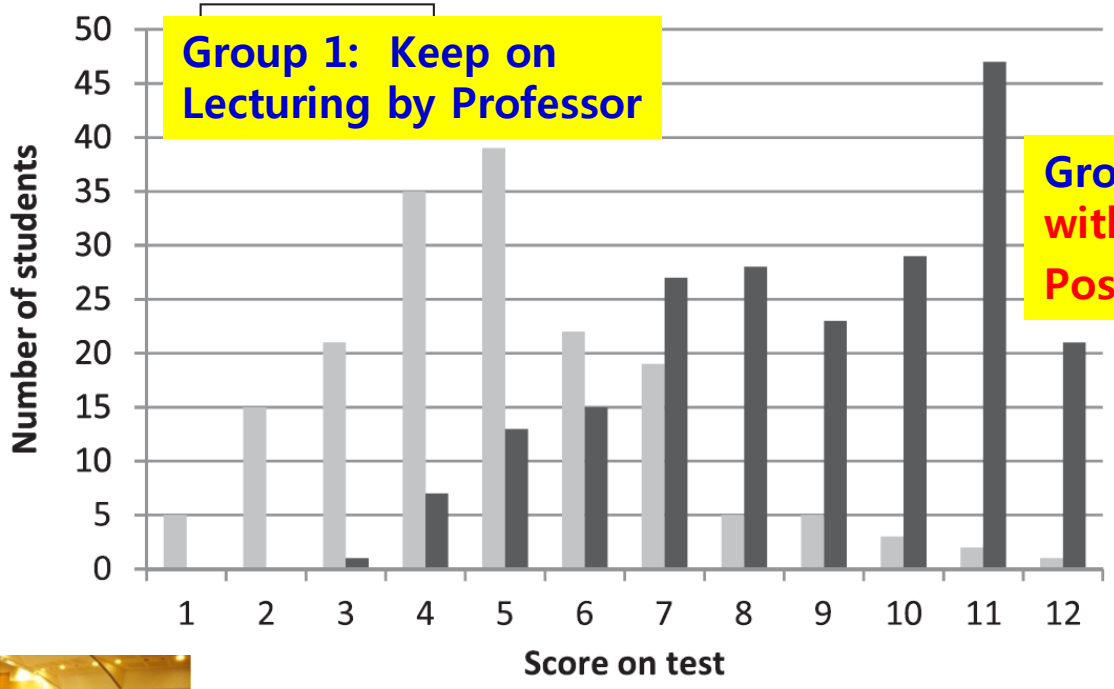
Sustainable!
Even Better!
Just Begun!


INTERACTION
Learning
Creative
Synthesizing
Communication, Teamwork, Leadership
Neuroscience, Brain Research, Cognitive Psychology
Concentrat ion
Long-Term Memory
Structuring Knowledge
Character
Active
Friendship

Do you need more Scientific Evidences?

- L. Deslauriers, E. Schellew, and C. Wieman, "Improved Learning in a Large-Enrollment Physics Class", Science Vol. 332, May 2011

Science
AAAS



Group 2: Interactive Class without Lecturing,
Postdoc for Coordination

Basic Physics – Large Class (> 300 students), Conventional Lecture Hall, For 11th week, divide the class into two groups. Take the same exams of 12 problems

Future

2017 (5 Years) Vision

University Long-Term Plan

Government Funding: $1 million

Donation: $9 million

- Year 2013: 60 Classes, 8 Interactive Classrooms

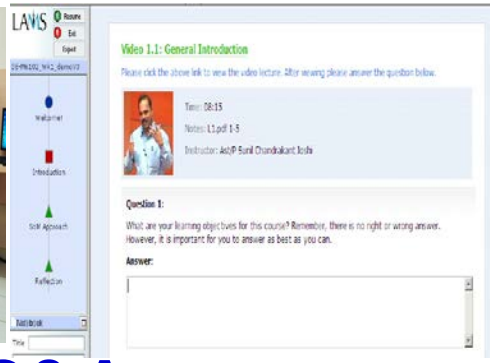
- 30% of Classes (800) ➔ Edu 3.0
- Basic Compulsory Courses: 50%~100% Edu 3.0 Classes
- 60 Education 3.0 (Interactive) Classrooms

- Training New & Promoted Faculty
- Credit for Faculty Promotion

NTU (Nanyang Technical University)

- **80 Lecture Rooms ➔ "Interactive Classrooms" + …**
- **Planned a New Building Construction**

- **Recording all classes**
  - Centralized monitoring recording
  - Used for Self-Study



- **Online Collaborative Teaching(LAMS) – Q&A**
- **Promoting interactive classes – Flipped Learning**

MOOC(Massive Open Online Courses) & OCW(Open Courseware)

Coursera

edX

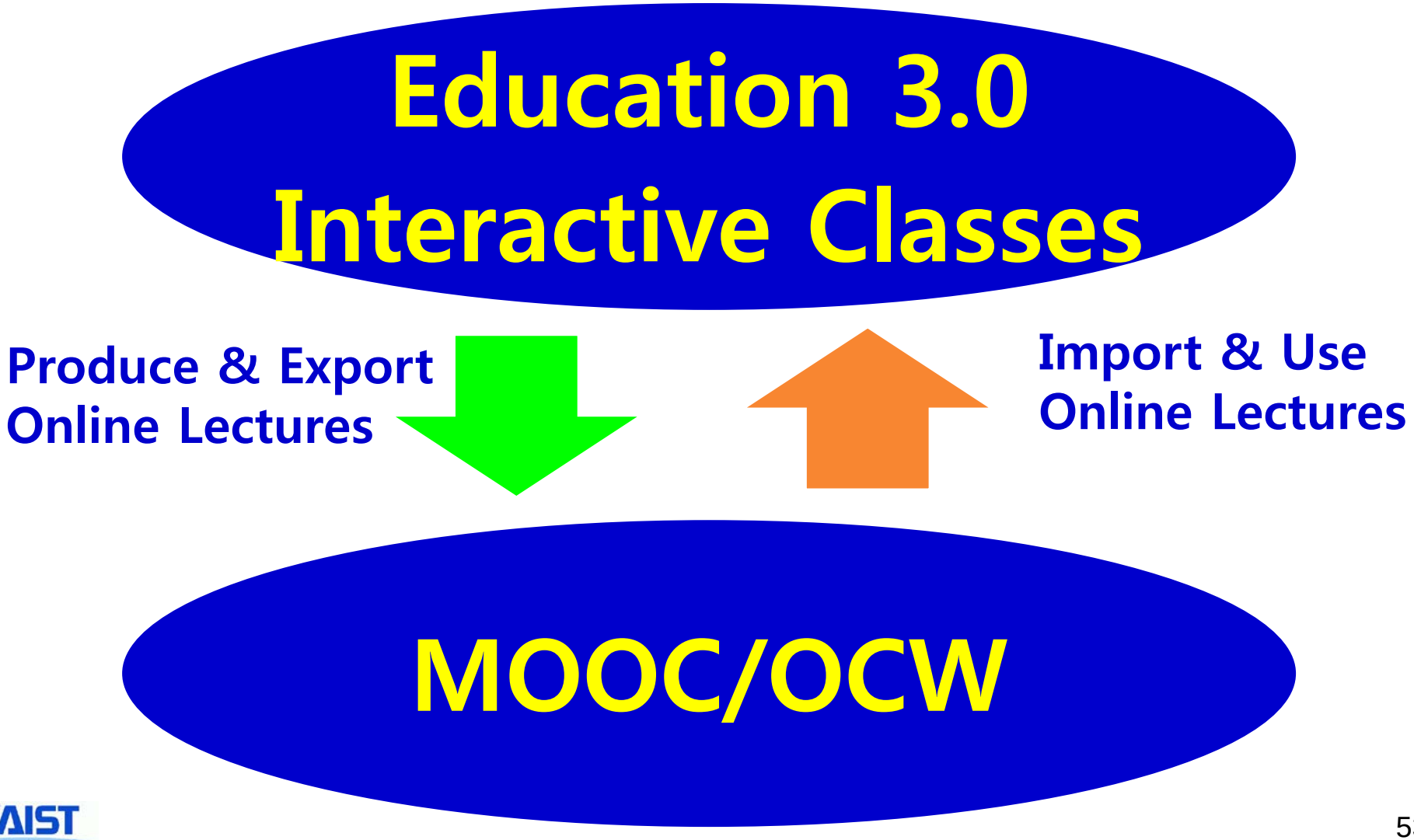
OCW

+ Flipped

Interactive Classes

- **Interactive Exercises**
- **Discussion, …**

A Strategy for MOOC/OCW



What should we share and connect?

"Lecture Networking"

- e-Learning/MOOC/OCW

Classroom Networking

- Interactive

Classroom Networking for Virtual Classrooms

High-Speed Educational Network
Multivision, Audio, …

- **Interactive classrooms need 50% more space**
- **Joint interactive class with other universities**
- **Remote team learning/teamwork**

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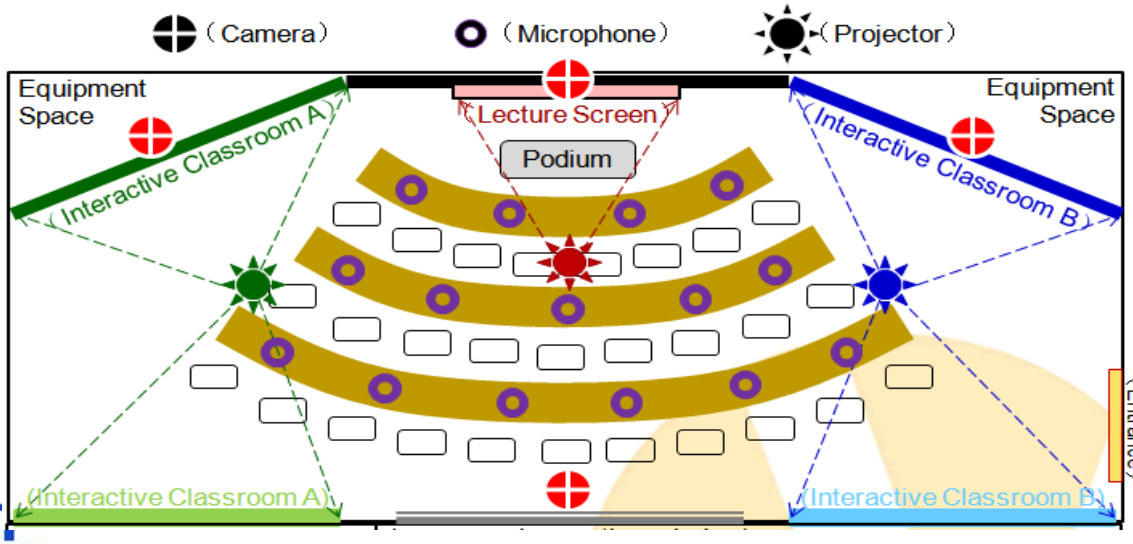
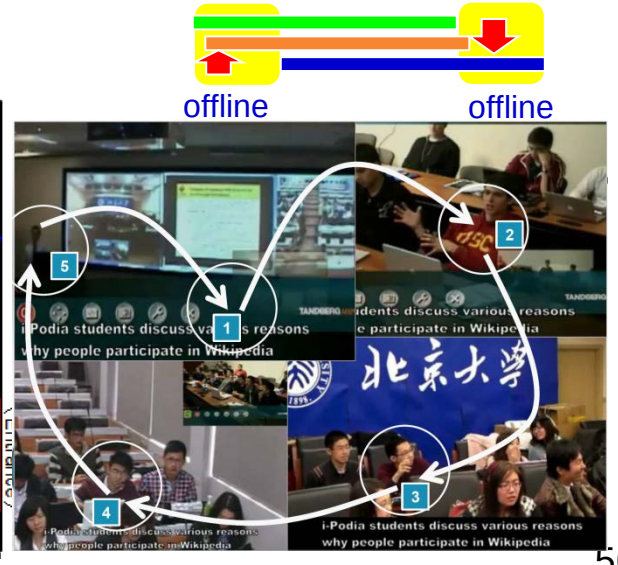
iPodia Consortium for Global Learning

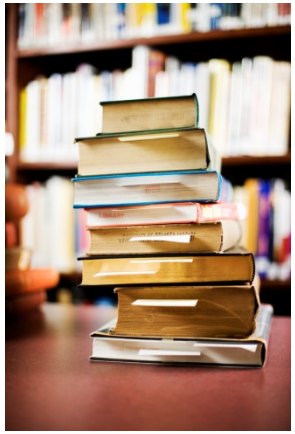
- **Online Global Lecturing or Interactive Classes**
- **Founded in 2012**
  - USC+Peking Univ.+ National Taiwan Univ. +Technion+ RWTH Aachen Univ. + IIT-B +KAIST
- **Pilot Class in Spring 2013: "Principles & Practices of Global Innovation"**
  - Stephen Lu (USC), James Morrison (KAIST), Yang Wang (PKU)
  - 20+20+20 Students for Global Student Group Learning
  - **Interactive** Class+Online Lecture: Flipped, **"Education 3.0"**





Your accumulated pain indexes
KAIST

Future of Lectures ➔ Just a Learning Contents



Video "Text"book

Offline Classes without Lecturing are more important. – Interactive! Participating!

Lecturing will leave classrooms!

Lecturing should leave classrooms!

We may not need Lecturing!

Make students think!

Make students do!

Send lecturing to Internet!

- "Online video textbooks"

KAIST

Revival of Heliocentric Theory

BC 3C — 16C — 17C

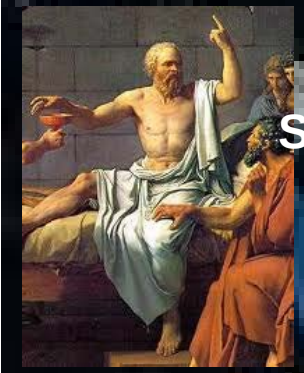
Geocentric Theory

Samos — Copernicus — Galilei — Kepler

Revival of Interactive T&L

BC 4~5C — 14C — 21C

Lecturing — Prussian Standards



Socrates

Blackboard,
OHT, PowerPoint,
Internet,
e-Learning, …

?

Confucius

SCIENCEphotoLIBRARY

Thank you!