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# Using Research Results on Student Feedback to Reflect on and Enhance Teaching and Learning

Workshop on Teaching and Learning  
Dept. of Computer Science & Engineering, CUHK

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# Content



1. Student feedback
2. Some literature results
  - Computer Science, Engineering or Science Education
3. Clicker & peer instruction experience in a statistics Course



# Student Feedback

# Student Experience Questionnaire



- Administer to all undergraduate programmes @ CUHK
  - Year 1 & Final Year (3 year cohort)
- Two parts, 16 constructs, 33 questions
- Part 1: Students' Capability Development
  - 7 constructs, 14 questions
- Part 2: Teaching & Learning Environment
  - 9 constructs, 19 questions
- All questions are on 5-point scale
  - From “strongly disagree” to “strongly agree”.

## *... Student Experience Questionnaire*



- The 7 constructs for “Capability Development”
  - Critical thinking
  - Creative thinking
  - Self-managed learning
  - Adaptability
  - Problem solving
  - Communication skills
  - Interpersonal skills and groupworks


## *... Student Experience Questionnaire*



- The 9 constructs for “Teaching and Learning Environment”
  - Active learning
  - Teaching for understanding
  - Feedback to assist learning
  - Assessment
  - Relationship between teachers and students
  - Workload
  - Relationship with other students
  - Cooperative learning
  - Coherence of curriculum

# ... Student Experience Questionnaire




**The Chinese University of Hong Kong**  
**Student Experience Questionnaire**  
**(Reflections on your undergraduate programme)**

The Centre for Learning Enhancement And Research (CLEAR) conducts this survey on behalf of Programmes and the University to find out about your experience as an undergraduate student. The term "teaching staff" refers to the professors, instructors and tutors who taught you at this University. Your comments are kept strictly confidential, and research reporting will be on overall data at an aggregate level.

**Instructions**

Use BLACK/BLUE ball pens to fill up the oval completely: Right ● Wrong ☹ ✖ ✗

**Please choose the most appropriate response to each question.**

— strongly agree (SA)     — agree (A)     — only to be used if a definite answer is not possible (0)  
 — disagree (D)     — strongly disagree (SD)

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**Your Programme**

This questionnaire is to collect your comments on your study experience in your programme.  
 My undergraduate programme is: \_\_\_\_\_

In which year of the programme are you studying now?  
 First Year     Final Year     Other, please specify: \_\_\_\_\_

**Critical thinking**

	SA	A	0	D	SD
1 I have developed my ability to make judgements about alternative perspectives	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2 I have become more willing to consider different points of view	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Creative thinking**

3 I have been able to come up with new ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4 I have been encouraged to apply my own ideas in my studies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Self-managed learning**

5 I take responsibility for my own learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6 I am more confident of my ability to pursue further learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Adaptability**

7 I have learnt how to adjust to change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8 I have become more willing to accept new ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Problem solving**

9 I have improved my ability to use knowledge to solve problems in my studies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10 I am able to bring information and different ideas together to solve problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Communication skills**

11 I have developed my ability to communicate effectively with others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12 I have improved my ability to convey ideas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Interpersonal skills and groupwork**

13 I have learnt to work effectively in a group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14 I feel confident in dealing with a wide range of people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Active learning**

15 My teaching staff use a variety of teaching methods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16 We are given the chance to participate in class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Teaching for understanding**

17 The teaching staff try hard to help us understand the course material	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18 The course design helps us understand the course content	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Feedback to assist learning**

19 When I have difficulty with course materials, I find the explanations provided by the teaching staff useful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20 There is sufficient feedback on activities and assignments to ensure that I learn from the work I do	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

▲ Please turnover ▲

▲

**Assessment**

	SA	A	0	D	SD
21 The programme uses a variety of assessment methods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 To do well in assessment in this programme I need to have good thinking skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23 The assessment tested my understanding of key concepts in this programme	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Relationship between teachers and students**

24 The communication between teaching staff and students is good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25 I find teaching staff willing to help in answering questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Workload**

26 I manage to complete the requirements of the programme without feeling unduly stressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27 The amount of work I am expected to do is quite reasonable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Relationship with other students**

28 I feel a strong sense of belonging to my class group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
29 I frequently work together with others in my classes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Cooperative learning**

30 I have frequently discussed ideas from courses with other students out-of-class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31 I have found that discussing course material with other students outside classes has helped me to reach a better understanding of the material	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Coherence of curriculum**

32 I can see how courses fitted together to make my programme coherent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33 Course learning outcomes are in line with the aims of the programme	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

A What are the best aspects of your programme?  
 \_\_\_\_\_  
 \_\_\_\_\_

B Which aspects are most in need of improvement?  
 \_\_\_\_\_  
 \_\_\_\_\_

34 You are a/an:     Local student     Mainland student     International student

35 Which faculty do you belong to?  
 Arts     Business Administration     Education     Engineering  
 Law     Medicine     Science     Social Science  
 Other, please specify: \_\_\_\_\_

36 Which College do you belong to?  
 Chung Chi     New Asia     United     Shaw  
 Morningside     S.H. Ho     CW Chu     Wu Yee Sun     Lee Woo Sing

37 Where have you lived this academic year?  
 Campus hall of residence     Off campus

38 What is your cumulative GPA?  
 3.300 or above     3.000 – 3.299     2.999 or below     Not Applicable

▲ Thank you for completing this questionnaire ▲

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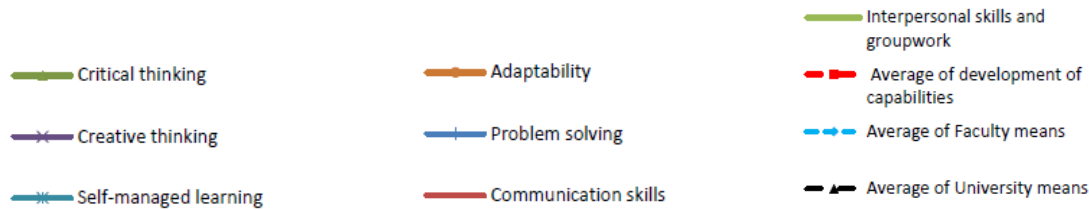
# SEQ: Computer Science 1



## Development of Capabilities

FIRST YEAR

FNAL YEAR



Note: The SEQ was not conducted for the programme in 2005 and 2007.



# SEQ: Computer Science 2



## Teaching and Learning Environment

FIRST YEAR

FNAL YEAR



- |                               |  |                                    |                               |
|-------------------------------|--|------------------------------------|-------------------------------|
| — Active learning             | — Assessment                                 | — Relationship with other students | — Average of T&L environment  |
| — Teaching for understanding  | — Relationship between teachers and students | — Cooperative learning             | — Average of Faculty means    |
| — Feedback to assist learning | — Workload                                   | — Coherence of curriculum          | — Average of University means |

Note: The SEQ was not conducted for the programme in 2005 and 2007.

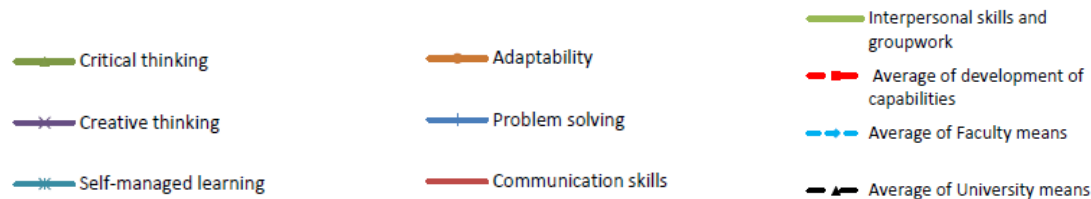
# SEQ: Computer Engineering 1



## Development of Capabilities

FIRST YEAR

FNAL YEAR



Note: The SEQ was not conducted for the programme in 2004, 2006 and 2008.

# SEQ: Computer Engineering 2



## Teaching and Learning Environment

FIRST YEAR

FNAL YEAR



- |                               |  |                                    |                               |
|-------------------------------|--|------------------------------------|-------------------------------|
| — Active learning             | — Assessment                                 | — Relationship with other students | — Average of T&L environment  |
| — Teaching for understanding  | — Relationship between teachers and students | — Cooperative learning             | — Average of Faculty means    |
| — Feedback to assist learning | — Workload                                   | — Coherence of curriculum          | — Average of University means |

Note: The SEQ was not conducted for the programme in 2004, 2006 and 2008.

# Student feedback: MSc in CS



*Taught Postgraduate Programme Questionnaire (Post-TPQ) 2013  
MSc. in Computer Science*

**Taught Postgraduate Programme Questionnaire (Post-TPQ) 2013**

**Part I: Feedback Profiles for Students**  
 Number of students: 92  
 Number of Respondents: 88  
 Response rate: 95.7%

**Please note:**  
 n : Number of responses  
 Mean : Average of responses  
 St. Dev. : Standard deviation of responses  
 SA : Strongly agree (value of 5)  
 A : Agree ( )  
 0 : Only to  
 D : Disagre  
 SD : Strongl

No	Item	n	Mean	St. Dev.	SA	A	0	D	SD
<b>Knowledge / Professional</b>									
I am satisfied with the know									
1.	Artificial Intelligence								
2.	Computer Systems								
3.	Emerging Software T								
4.	Information Technolo								
5.	Multimedia Technolo								
6.	Theoretical Computer								
7.	Effectively resolving p problems								
8.	Project management in industry								
9.	Others, please specify: - Computational - Computational Finance - Cryptography - Data mining - Data mining, Security - Project Did not specify								

*Post-TPQ 2013 - CSC* *CLEAR*

*Taught Postgraduate Programme Questionnaire (Post-TPQ) 2013  
MSc. in Computer Science*

No	Item	n	Mean	St. Dev.	SA	A	0	D	SD
<b>Job Related Skills</b>									
The programme equipped me with the skills and confidence to:									
10.	identify workplace based problems								
11.	find relevant references to support problem investigations								
12.	analyze system problems								
13.	make judgments about alternative perspectives								
14.	apply appropriate knowledge to solve problems								
15.	provide innovative and practical								
16.	present the problem and solution customers, end-users or senior m								
17.	communicate effectively with ot								
18.	participate effectively as a team member								
19.	take up leadership opportunities								
20.	adapt solutions to reflect social, env for the real, health and safety, con siderations								
<b>Teaching and Learning Environment</b>									
I found that:									
21.	there was timely feedback on act assignments								
22.	staff were available to assist my outside the classroom								
23.	the programme used a variety of assessment methods								
24.	the programme used assessments that tested my understanding of key concepts								
25.	the workload was reasonable								
26.	I was encouraged to participate in group- based learning activities (e.g. projects, small group discussions)								
<b>Programme Design and Management</b>									
Considering the design and structure of this prog									
27.	the knowledge and skills acquired are useful for my work								
28.	I was able to enrol in my desired courses								
29.	the programme broadened my understanding in my discipline								
30.	Overall, I am satisfied with the programme								
31.	I would recommend this programme to others								

*Post-TPQ 2013 - CSC* *CLEAR*

Data For Computer Science  
Use Only

# Challenges:



- Communication skills
  - I have developed my ability to communicate effectively with others
  - I have improved my ability to convey ideas
- Workload
  - I manage to complete the requirements of the programme without feeling unduly stressed
  - The amount of work I am expected to do is quite reasonable
    - Motivation



# Some Literature Results: Computer Science, Engineering, Science Education

# Challenges:



*“... Professors told by countless panels ... We must strengthen our coverage of fundamentals; teach more about ‘real world’ engineering design and operations, including quality management; cover more materials in frontier areas of engineering; offer more and better instruction in both oral and written communication skills and teamwork skills; provide training in critical and creative thinking skills and problem-solving methods; produce graduates who are conversant with engineering ethics and the connections between technology and society; and reduce the number of hours in the engineering curriculum so that the average student can complete it in four years.”*

*(Felder et al., 2000)*

# Recommendations on Instructional Methods



- Relevant to engineering education
- Can be implemented within the context of the ordinary engineering classroom
- Most engineering professors should feel reasonably comfortable with them after a little practice
- Consistent with modern theories of learning and have been tried and found effective by many educators



# Seven Recommendations:



- R1: Formulate and publish clear instructional objectives
  - Make the objectives as detailed as possible
    - Articulate clear learning outcomes
- R2: Establish relevance of course material
  - Use examples familiar to students
    - Use socially-relevant projects (Buckley *et al.*, 2004)
      - Solicit projects from local organizations in need
        - Focus energies on customer requirements and design
        - Effective communication

## *... Seven Recommendations*



- R3: Balance concrete and abstract information in every course
  - Concrete: facts, observations, experimental data, applications
  - Abstract: concepts, theories, mathematical formulas, models
  - Intersperse concrete illustration and applications throughout a theoretical development

## ... *Seven Recommendations*

- R4: Promote active learning in the classroom
  - Intersperse discussion
    - Small group short discussion (2 to 5 minutes) whenever suitable (Windschitl, 1999)
  - Peer instruction (Crouch & Mazur, 2001)
    - Use student response system (clicker) plus group discussion
      - In Engineering (Van Dijk, 2001)
      - In Science (Deslauriers *et al.*, 2011; Wieman *et al.*, 2010).
    - Curse of knowledge (Wieman, 2007)

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69, 970–977.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *Science*, 332, 862–864.

Van Dijk, L. A., Van Der Berg, G. C., & Van Keulen, H. (2001). Interactive lectures in engineering education. *European Journal of Engineering Education*, 26(1), 15–28.

Wieman, C. (2007). APS News—The back page. The "curse of knowledge" or why intuition about teaching often fails. *American Physical Society News*, 16(10).

Wieman, C., Perkins, K., & Gilbert, S. (2010). Transforming science education at large research universities: a case study in progress. *Change: The Magazine of Higher Learning*, 42(2), 6–14.

Windschitl M. (1999). Using small-group discussions in science lectures: A study of two professors. *College Teaching*, 47, 23–27.

## ... *Seven Recommendations*



- R5: Use cooperative learning
  - Explain to students what you are doing and why
  - Assign some or all homework to teams of 3-4 students
  - Form teams that are heterogeneous in ability level
  - Assign team roles that rotate with each assignment
    - A manager
  - Promote positive interdependence
    - A person to report, all team members get the same grade
  - Provide an escape mechanism for teams having severe difficulties
  - Start small and build
    - My failure experience
  - ...

## ... *Seven Recommendations*



- R6: Give challenging but fair tests
  - 10-15% covers the more challenging material
  - Minimize speed as a factor in performance on tests
  - Do not test skills that students have not had a chance to practice
  - ...
- R7: Convey a sense of concern about the students' learning
  - Celebrate students' achievement
  - Let students participate in learning and performance assessment
  - ...



# Clicker and Peer Instruction Experience in a Statistics Course

# The course



- Elective course (year 2 or 3)
- Student background: major or minor statistics
- Major topics: nonparametric methods on
  - Single sample location
  - Two sample location
  - Dispersion
  - Multi-sample location problem
  - Two way layout
  - Measure of association
  - Regression
- Class size: 50 to 65

# Small group discussion: failure experience



## ■ Objective

- Engage students in self-reflection
- Consolidate understanding on basic concepts

## ■ Activity

- Group discussion before mid-term examination
- Each student identified a problem (eg. topic don't understand)
- Group discussion to solve each student's problem



# Difficulties



- Many students did not ask questions
  - Understood the topics covered
- Talking but no discussion
  - Class discussion did not fall in the perceived norm of science learning
- Heavy involvement of professor to motivate discussion in each group
  - Not feasible in large class (say > 50)
- Group discussion was not effective in teaching science ...

# Clicker



- Clicker project launched in Science in 2008
- Objective: to engage students and to enhance interaction
- A student response system
  - students' responses on multiple choice questions are shown instantly





Question: When the median of a data set is centered around zero, the exact distribution of the sign test statistics is

**A**

not known because sign test is a distribution free test

**B**

normal

**C**

binomial



Question: When the median of a data set is centered around zero, the exact distribution of the sign test statistics is

**A**

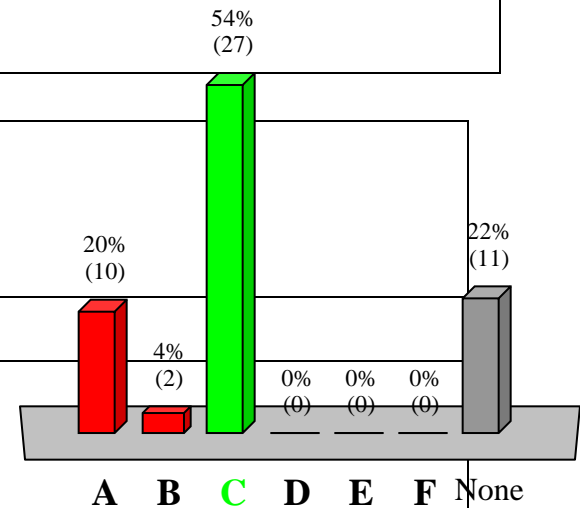
not known because sign test is a distribution free test

**B**

normal

**C**

binomial



# A modified structure of group discussion

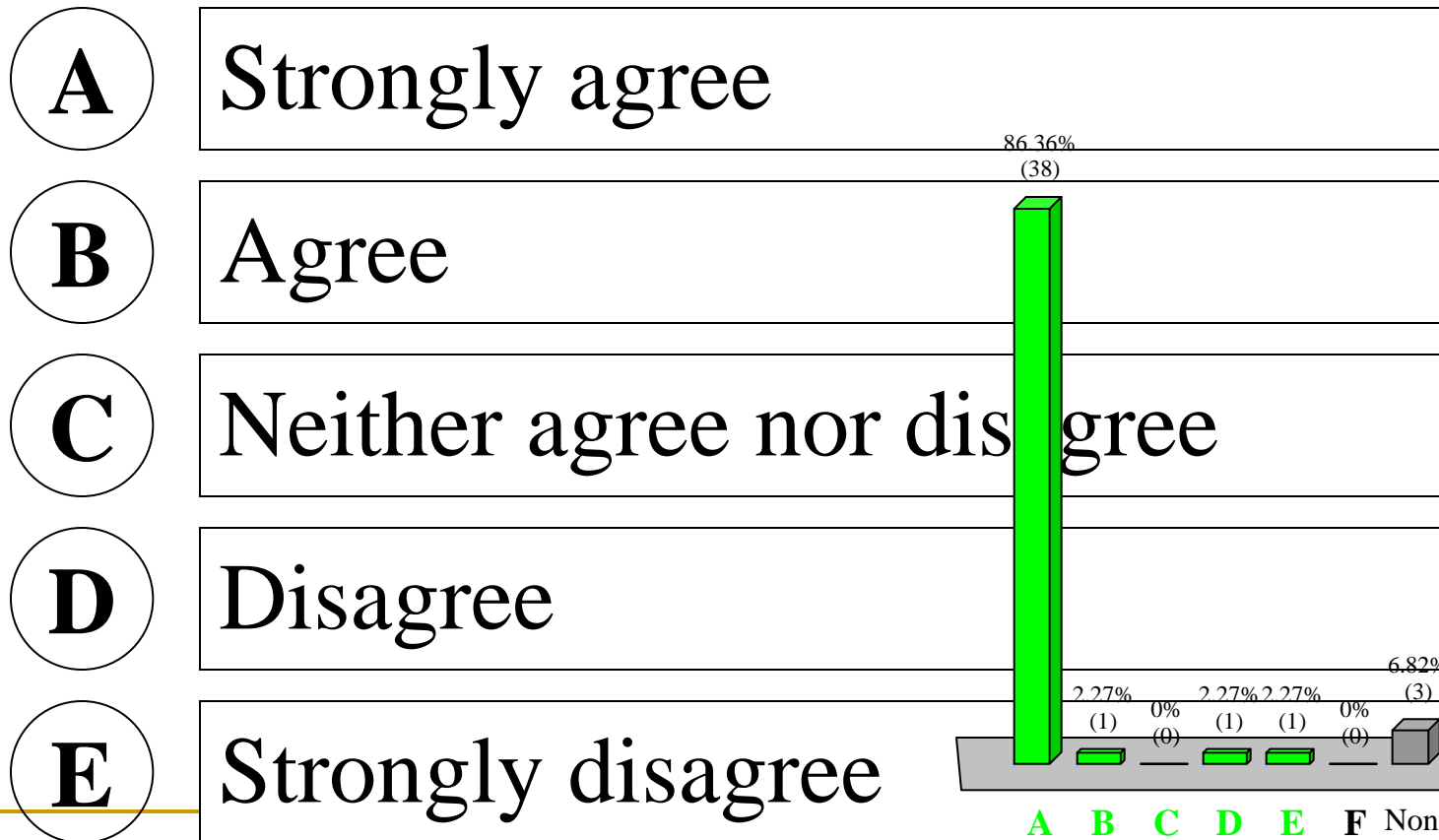


- Group discussion
  - Same format as before
- A set of clicker questions to initiate the discussion
  - On important concepts
  - Common difficulties
  - Common misunderstanding
- A format of **peer instruction**

# Well received by students



**Q10:** Do you agree that today's activity of using clickers can better engage students in class?



# Effect of clicker session on discussion

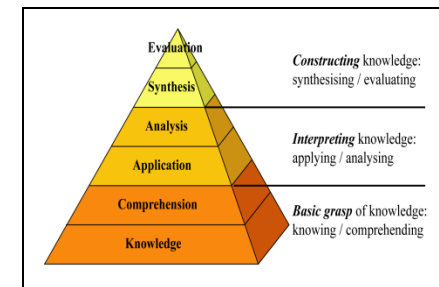


- Active discussion
  - Willing to ask questions
    - Gain in-depth understanding after the self-reflection in clicker questions
    - Other students also do not know the correct answer
  - Keen to find reasons to support their correct answers
    - Even though it might be a guess
- The clicker atmosphere continues
  - Students see the benefits of deviating from norm
- Do not need the professor to motivate discussion
- Group discussion became effective
  - Even when class size is not small

# One step forward: construct knowledge



- To engage students to “construct knowledge”
- Ask the group to solve a set of advanced problems
  - Relevant to topics to be covered in later chapters
- Topics covered in the first half of the course
  - One sample location
  - Two-sample location
- Problems for students to solve
  - Two sample dispersion
  - Multi sample location



*Bloom's Taxonomy (Bloom, 1956)*



# Result



- Most groups can tackle the problems well
  - Can construct statistical procedures that are very close to the “optimal” solution in the literature
- Probing may be needed for 1 or 2 groups lagging behind
- Teacher’s affirmation on their reasonable points is important
  - Even though their suggested solutions may not be optimal

# Issue on Coverage



- *“Most studies of clicker use agree that when time is spent on clicker activities there is usually a decrease in content coverage.”* (Caldwell, 2007)
- Not the case in the “non-parametric” course
  - The activity use ~15% of the class time
- Pace of the 2<sup>nd</sup>-half: very fast
  - Solid background
  - Misconception cleared
  - Students are well-prepared to construct knowledge
- Students become more responsive in the entire course

# Learning enhanced



- Marks in final examination (2006-2011)
- Class sizes (from 53 to 65)

	Mean (06-08)	Mean (09-11)
Pedagogy set	Discussion	Clicker, Discussion
Class mean	71.5	81.5
Lowest score	34.3	40.6

# Satisfaction increased



- Course evaluation results (2006-2011)
  - 6-point scale
  - Class size (from 53 to 65)
  - Department average in parentheses

	Mean (06-08)	Mean (09-11)
Pedagogy set	Discussion	Clicker, Discussion
Course effectiveness	4.73 (4.47)	5.31 (4.67)
Teaching effectiveness	5.03 (4.73)	5.46 (4.75)

# Recent new initiatives (since 2012)



- Use “Intersperse Discussion”
  - Ask students to form groups to have 3-5 minutes discussion, every 20-30 minutes, say
  - Use frequently in the first half of the course
    - To consolidate concepts
- Students provide responses in groups
  - Use the class response system (uReply) that supports text input
  - Use response sheet
- uReply

[http://ureply.mobi/Desktop\\_teacher.php](http://ureply.mobi/Desktop_teacher.php)



uReply report for session  
393

Question number: 5  
Question text:

Total answered response(s): 16

### Respondents list

Total response(s): 16

8 (11m)	11 (151CM)
Toss a coin Toss a coin 100 times	coin tossing is a bernoulli trail. number of getting heads in tossing 100 coins follows binomial distribution
15 (hi auntie)	GUEST_636 (GUEST_636)
Bernoulli Trial:toss a coin Binomial distribution :toss a coin n times	You can either succeed with prob p or fail with prob 1-p  Coin throwing: T or H
Group 12 (William)	7 (Chan Ka kit (7))
Football PK Coins	Bernoulli trial: coin toss Head/tail
group 2 (1009603581)	Group 3 (Group 3)
bern: coin tossing for one time bin: no. of heads in 10 coin tossing	Example of bernoulli: tossing a coin. Binomial: tossing a coin for n times (n>1)
group 4 (group 4)	Group 6 (Group 6)
shuffling throw three coins	Bernoulli trial is tossing a coin once. Binomial trial is tossing a coin many time.
13 (13)	5 (5)
	bernoulli: tossing a coin once binomial: repeat tossing a coin for n times
1155015253 (Chau ka po)	Group 9 (Group 9)
Bernoulli trial: flipping a coin	Bernoulli trial: toss a fair coin. We have probability of success of 0.5 Binomial distribution: Toss a fair coin 10 times. Each trial is independent to each other.It follows b(10,0.5)
Group1 (Huang rui)	Group 10 (Group 10)
Throw a coin once, let the success event be the 'head' Do it n times and it's a binomial	Flipping a coin For bernoulli, flip the coin once and p is the probability of getting a head For binomial, flip more than once

# Learning further enhanced



- Marks in final examination (2006-2011)
- Class sizes (from 53 to 65)

	Mean (06-08)	Mean (09-11)	2012 N=55
Pedagogy set	Discussion	Clicker, Discussion	Clicker, Discussion, Int-discussion
Class mean	71.5	81.5	84.3
Lowest score	34.3	40.6	50

# Satisfaction further increased



- Course evaluation results (2006-2012)
  - Department average in parentheses

	Mean (06-08)	Mean (09-11)	2012 N=55
Pedagogy set	Discussion	Clicker, Discussion	Clicker, Discussion, Int-discussion
Course effectiveness	4.73 (4.47)	5.31 (4.67)	5.43 (4.81)
Teaching effectiveness	5.03 (4.73)	5.46 (4.75)	5.67 (5.00)

# Reference:



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**Q & A**

**Thank you very much**