Welcome to CSCL'05 workshop

Design and use of smart tasks in collaborative classrooms

Organized by Naomi Miyake

In collaboration with Hajime Shirouzu

- *Please come in front to discuss more easily. We may be a small group.*

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“Smart tasks” ?

- Some “tasks” work well in collaborative classrooms, as a good inducer of natural, productive collaboration
  - Nice to share them
  - Nicer if we could come up with design rules for making more

Aim of this workshop

- Collaboratively reflect upon tasks we use in our practice
- Identify “smart tasks,” which seem to work
- Extract commonalities

Schedule

- We will provide you with some examples
  - Let’s discuss whether they are “smart”
- May we solicit your contribution?

- Let’s discuss
  - Ideas for sharing
  - Ideas for design principles

Examples: **Five Smart Tasks**

1. How Far Does Light Go Project

   from WISE

2. Book Support Challenge

   from Learning by Design, Launcher task

3. Day Arithmetic Problem
4. Rolling Dice
5. Cutting Tapes

   from our project

WISE Project

Marcia Linn and her group at UC Berkeley

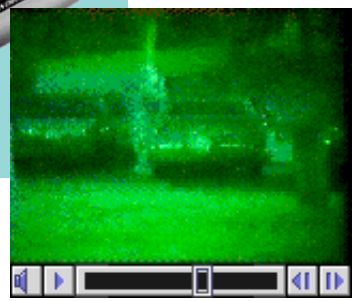
- Web-based Inquiry Science Environment project
- Middle school science class
- Curriculum covers heat, temperature and light
- Students work in pairs using computers as learning partners
- Emphasizes knowledge integration through controversy
  - Argumentation and debate enables students to actively construct an understanding of science and gain scientific skills

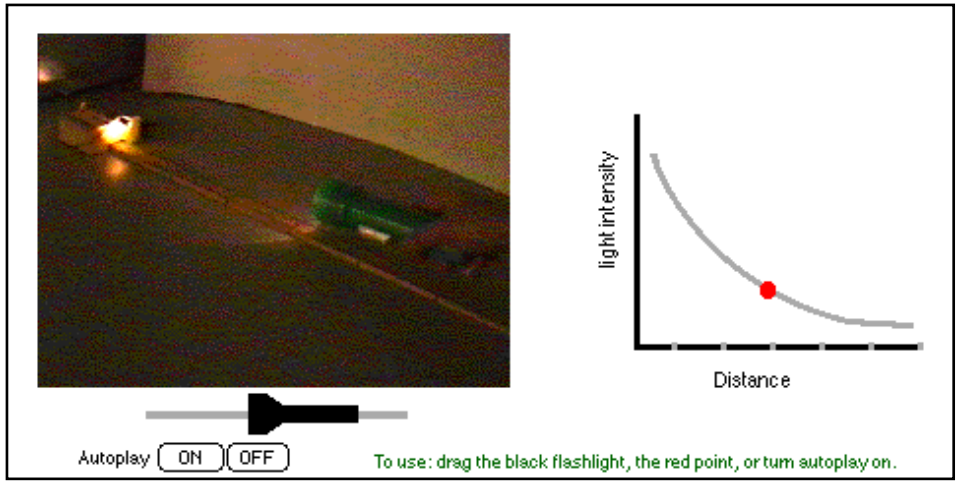
Smart Task 1: How far does light go?

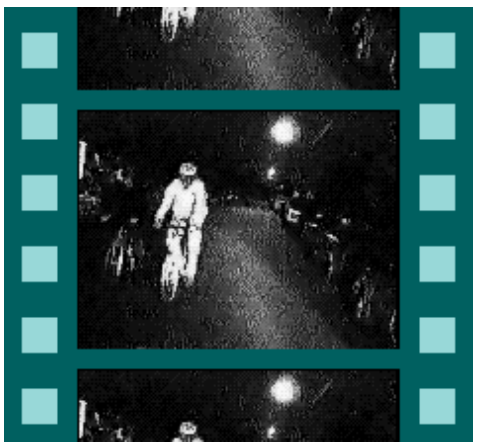
- A comparison of two theories:
  - Light dies out as you move farther from a light source.
  - Light goes forever until absorbed.

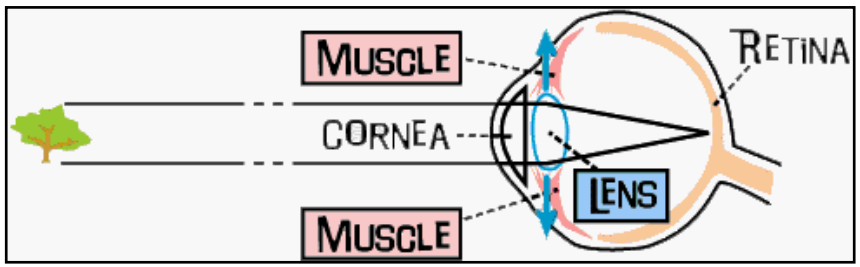
- Student activities:
  - Analyze, categorize, and create evidence
  - Create argument involving evidence and claims
  - Present and discuss their argument in class

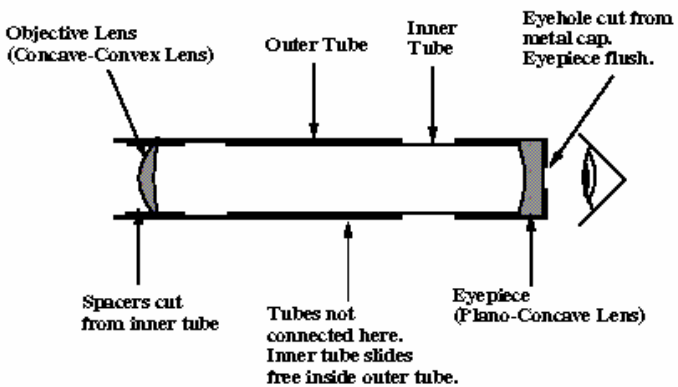

MOONLIGHT

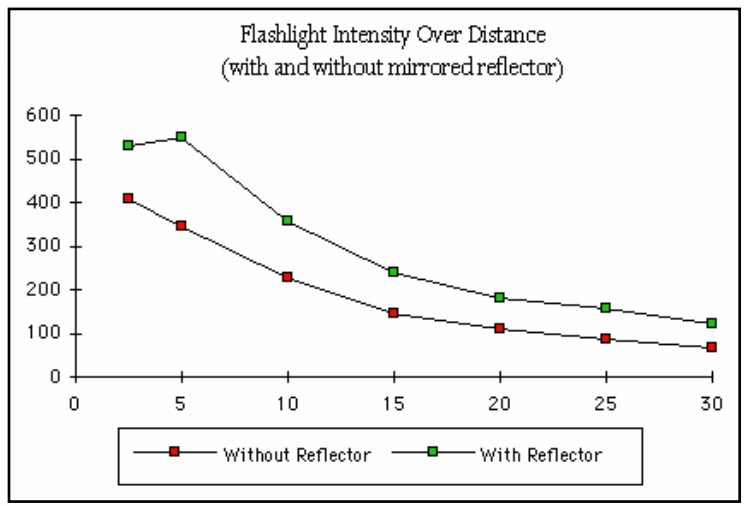



light intensity
Distance
Autoplay
ON
OFF
To use: drag the black flashlight, the red point, or turn autoplay on.

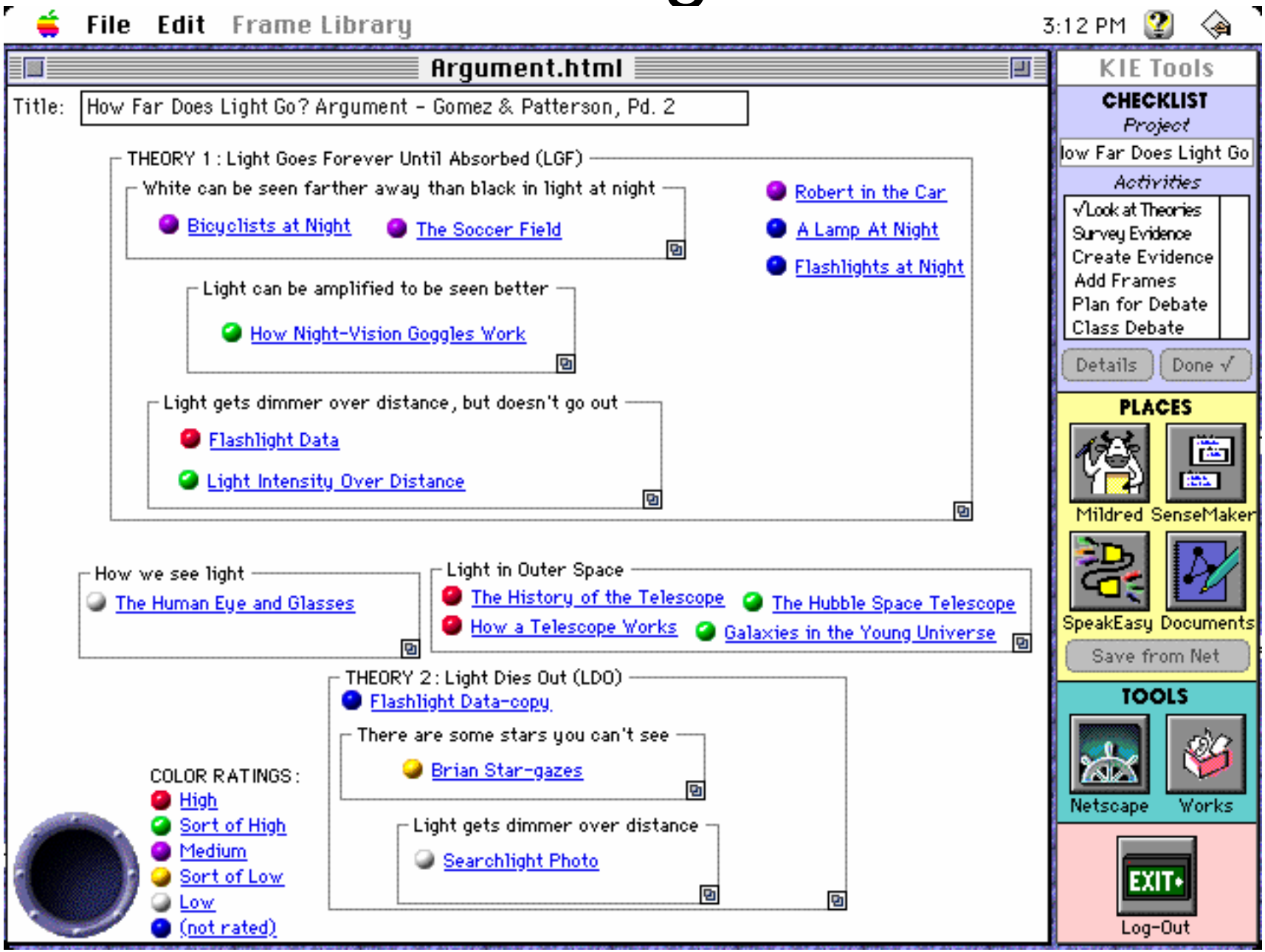



MUSCLE
CORNEA
MUSCLE
RETINA
LENS


Objective Lens
(Concave-Convex Lens)
Outer Tube
Inner
Tube
Eyehole cut from
metal cap.
Eyepiece flush.
Spacers cut
from inner tube
Tubes not
connected here.
Inner tube slides
free inside outer tube.
Eyepiece
(Plano-Concave Lens)


Flashlight Intensity Over Distance
(with and without mirrored reflector)
600
500
400
300
200
100
0
0
5
10
15
20
25
30
Without Reflector
With Reflector

SenseMaker Argument Editor




Light goes forever
Light dies out

Learning Outcome: Controversy at the heart of science

"At a certain distance, you cannot see the light at all, which means that the light died out."

"With like a telescope you're like seeing farther away. So the light would die out eventually because you can't see that so you have to look farther out to get the light that's farther out because it's died out before its got to us."

"You can see it closer with the [telescope] so obviously if you were closer you could see it. It's seeing it closer so you can see it."

(Linn, M. C., Bell, P., & Hsi, S. Using the Internet to enhance science understanding. *Interactive Learning Environments*, 1999.)

Learning by Design Project

Janet Kolodner and her group at Georgia Institute of Technology

- A project-based inquiry approach to science education for middle school where students learn science content and skills in the context of achieving design challenges
  - *"Vehicle in motion"* to learn about forces and motion,
  - *"Managing Erosion"* to learn about erosion and accretion…

Understanding the static as well as collaborative skill

- Collaborative learning requires skills like
  - borrowing ideas from each other and giving credit to each other
  - appreciating the value of collaborating across groups Iteration of design
- Science learning requires skills like
  - identifying and meeting criteria and constraints
  - iteration (because you don't usually get it right the first time)…

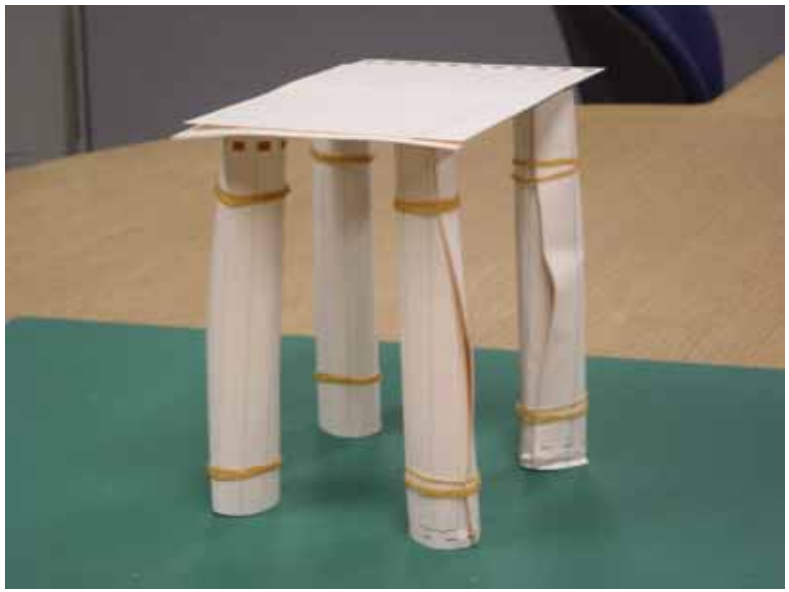
Smart Task 2: Book Support Challenge

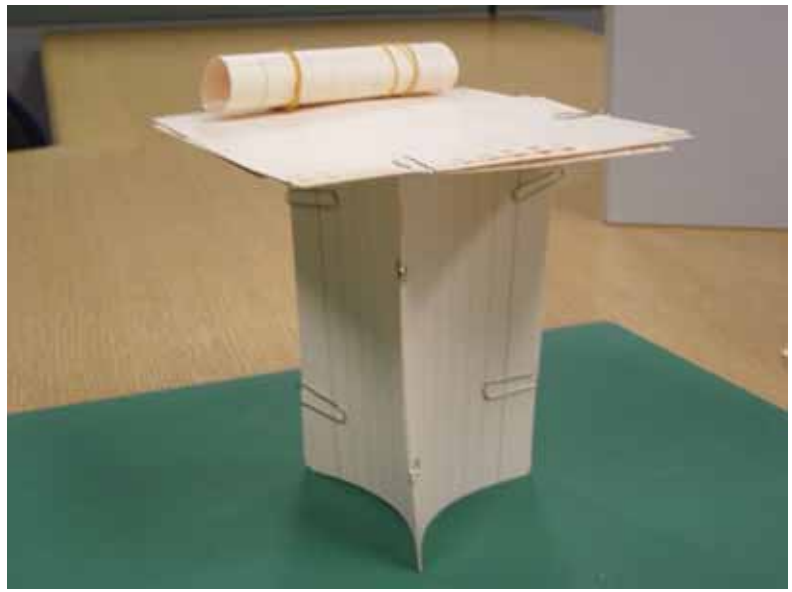
You've just taken a typing job to earn extra money. The boss needs the job completed immediately! But, a problem arises that you forgot your glasses and can't read the textbook on a low table.

In the desk drawer, you find index cards, rubber bands and paper clips. How can you quickly construct a book stand that will raise the book 3 inches closer to your nearsighted eyes?

- Activity 1: Each group constructs a stand in 10 minutes to share it with each other in the class by “gallery walk.”

- Activity 2: Each group redesigns the stand to do gallery walk again.





Learning Outcome

- “That group cheated our idea!”
  - A teacher takes this opportunity to let them know that scientists also uses each other’s ideas by giving “credit.”
  - Students also watch the movie, “Apollo 13.”
- LBD project provides with similar projects;
  - Oreo Cookie
  - Parachute…

  as a “launcher unit” for collaborative learning.

Understanding the construct of “schema”

- Requiring meta-cognition on his or her own cognitive processes
- Target: Undergraduate Cognitive Science courses

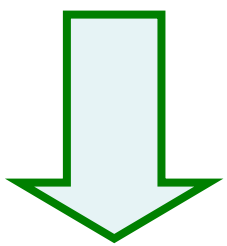
  24 classes (twelve weeks) in one semester

  This task is for freshmen as their first set of experience.

Smart Task 3:
"Day Arithmetic" problem

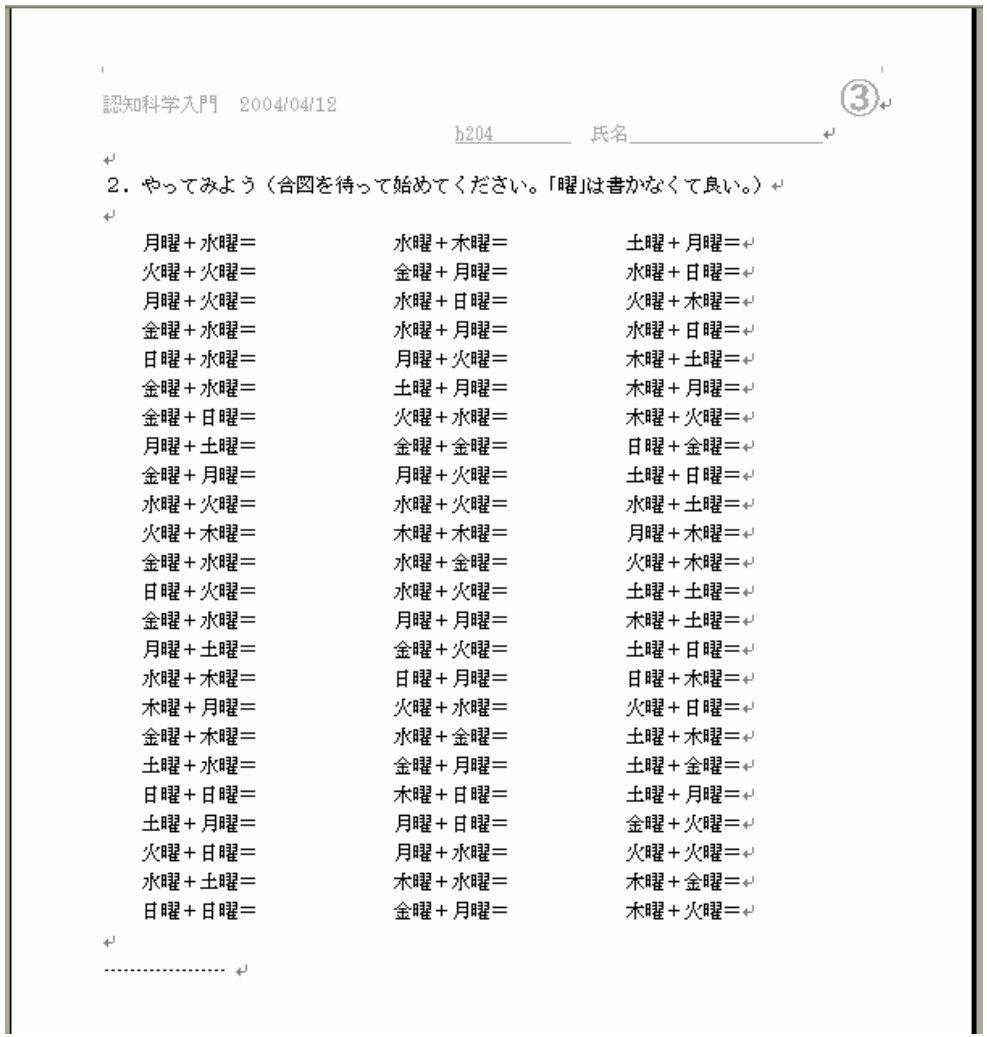
When Wednesday + Tuesday = Friday,
what is Tuesday + Friday?

- **What to do when asked to solve many of them?**
- **How to solve the problem, "m+b=?"**



What is a "schema"?

- Activity 1: Solve many problems



認知科学入門　2004/04/12　③

h204　　氏名

2．やってみよう（合図を待って始めてください。「曜」は書かなくて良い。）

月曜＋水曜＝	水曜＋木曜＝	土曜＋月曜＝
火曜＋火曜＝	金曜＋月曜＝	水曜＋日曜＝
月曜＋火曜＝	水曜＋日曜＝	火曜＋木曜＝
金曜＋水曜＝	水曜＋月曜＝	水曜＋日曜＝
日曜＋水曜＝	月曜＋火曜＝	木曜＋土曜＝
金曜＋水曜＝	土曜＋月曜＝	木曜＋月曜＝
金曜＋日曜＝	火曜＋水曜＝	木曜＋火曜＝
月曜＋土曜＝	金曜＋金曜＝	日曜＋金曜＝
金曜＋月曜＝	月曜＋火曜＝	土曜＋日曜＝
水曜＋火曜＝	水曜＋火曜＝	水曜＋土曜＝
火曜＋木曜＝	木曜＋木曜＝	月曜＋木曜＝
金曜＋水曜＝	水曜＋金曜＝	火曜＋木曜＝
日曜＋火曜＝	水曜＋火曜＝	土曜＋土曜＝
金曜＋水曜＝	月曜＋月曜＝	木曜＋土曜＝
月曜＋土曜＝	金曜＋火曜＝	土曜＋日曜＝
水曜＋木曜＝	日曜＋月曜＝	日曜＋木曜＝
木曜＋月曜＝	火曜＋水曜＝	火曜＋日曜＝
金曜＋木曜＝	水曜＋金曜＝	土曜＋木曜＝
土曜＋水曜＝	金曜＋月曜＝	土曜＋金曜＝
日曜＋日曜＝	木曜＋日曜＝	土曜＋月曜＝
土曜＋月曜＝	月曜＋日曜＝	金曜＋火曜＝
火曜＋日曜＝	月曜＋水曜＝	火曜＋火曜＝
水曜＋土曜＝	木曜＋水曜＝	木曜＋金曜＝
日曜＋日曜＝	金曜＋月曜＝	木曜＋火曜＝

Activity 2: Think collaboratively “What is the fastest way to solve the many problems?” and discuss the trade-off between memory and process loads.

Memory: Rote memorization

Table: Look-up tables

Rules: Rules like

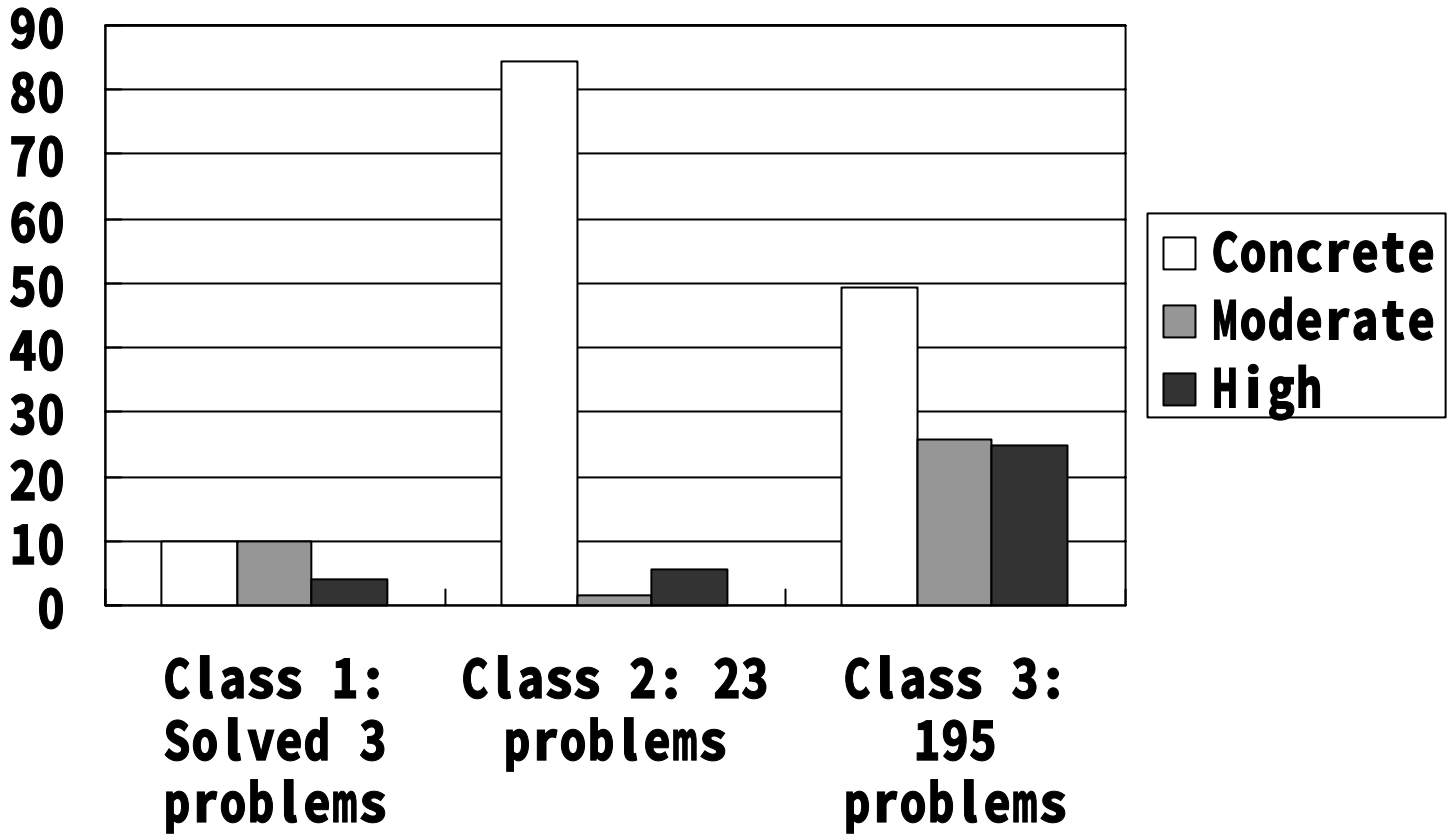
“To add a Sunday, the addend is the answer.”

“To add a Monday, choose the next day of the addend,”…

Activity 3: Create “Smart Tool” for Day Arithmetic

After all these activities, students solve the transfer problem, “m+b=?”

Learning Outcome:
Abstraction levels of summaries



Concrete experience is the basis for significant reflection.

Understanding the law of large numbers

Question: What does "The probability of getting ONE pip when you roll a die is one-sixth" mean?

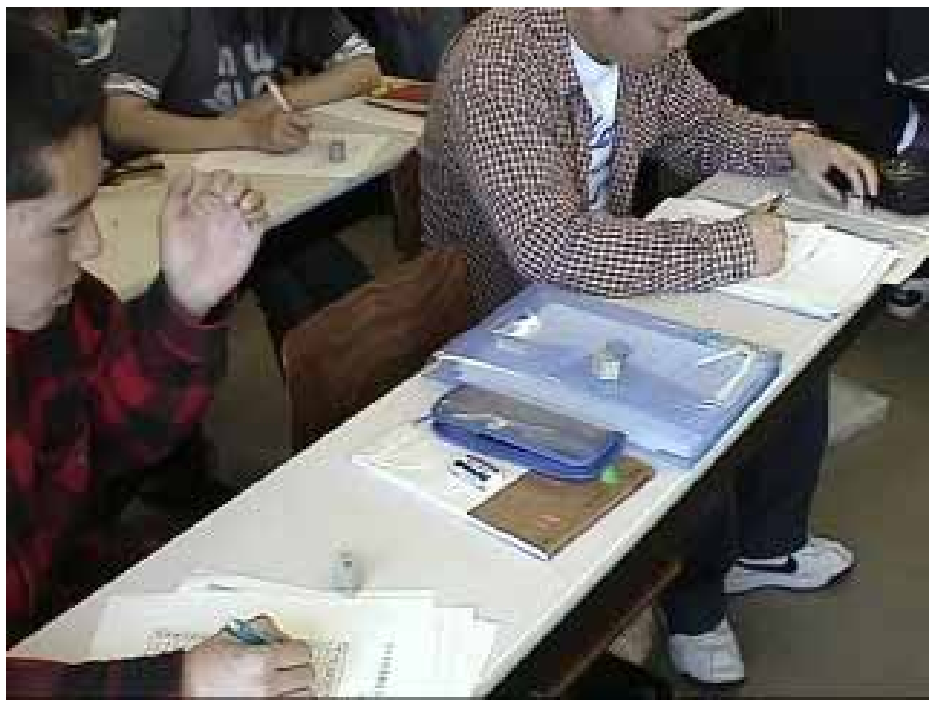
…Even a college student answers that you get ONE once per six rolls of a die.

Target: Undergraduate statistics courses

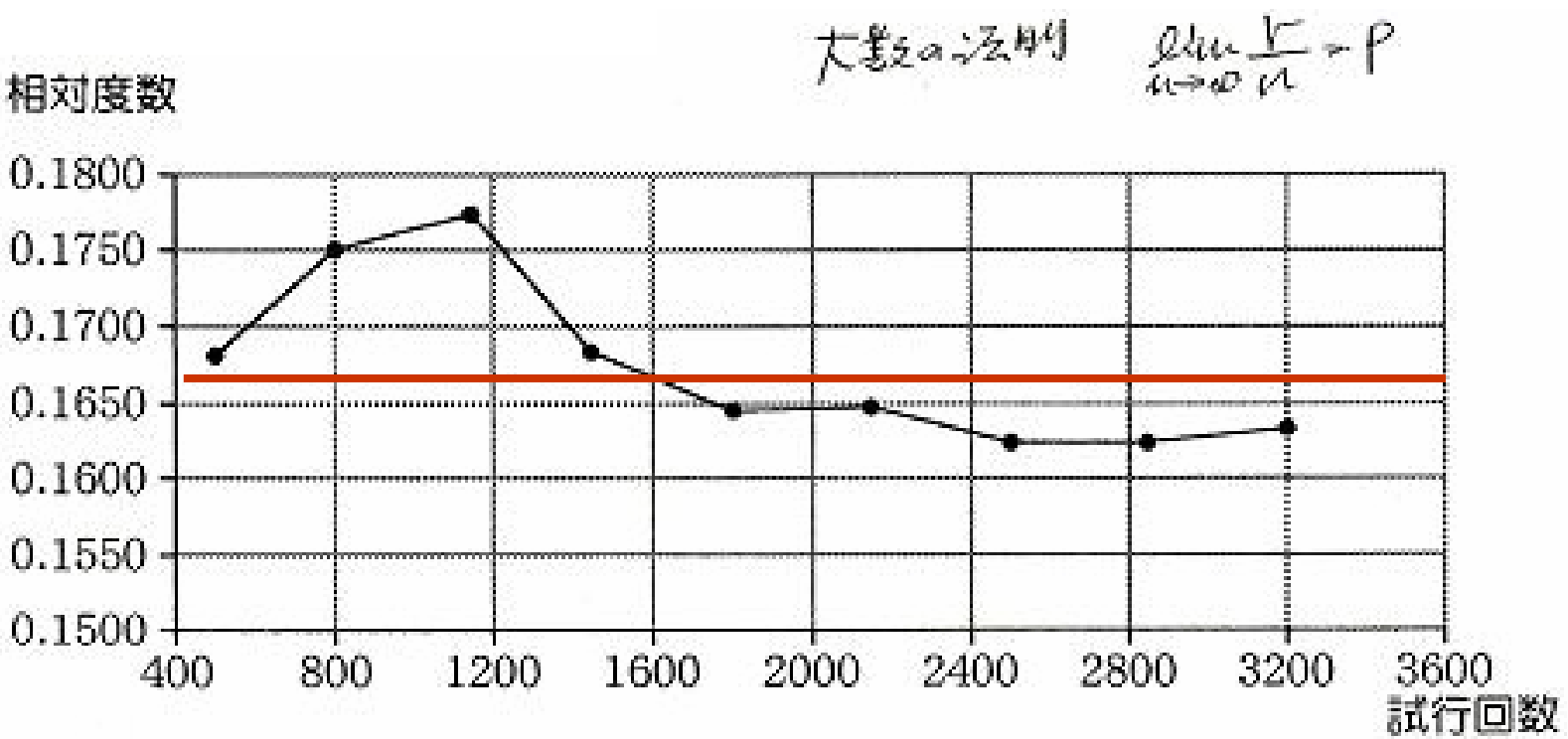
24 classes (twelve weeks) in one semester

Smart Task 4: Rolling Dice

- **Activity 1: Each student rolled a die 100 times and tallied his or her results.**

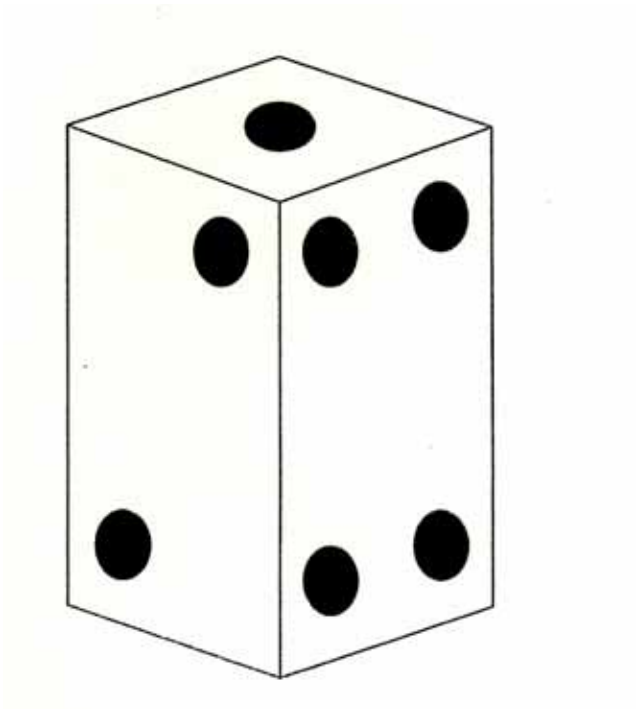


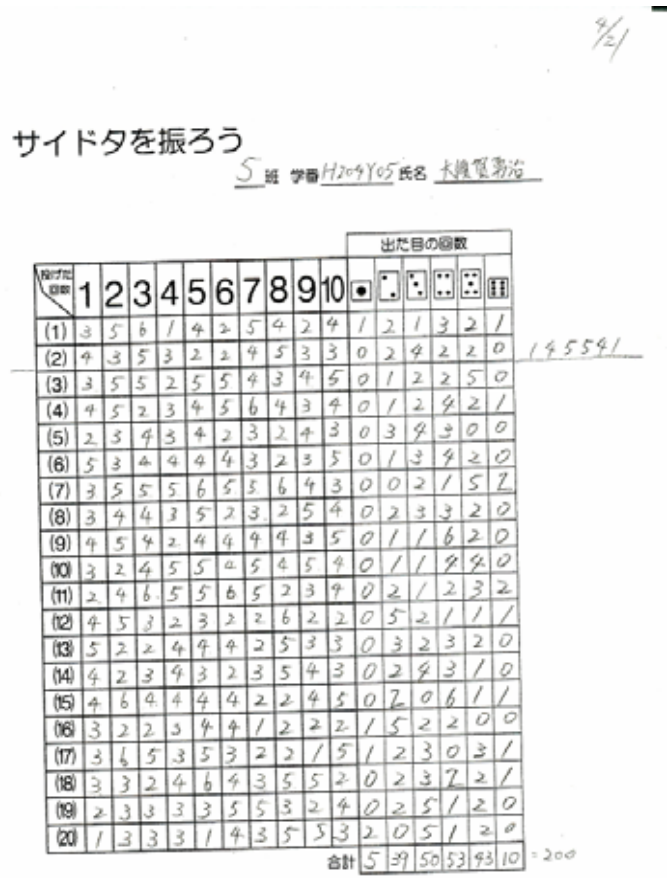
- **The class tallied the results to yield a histogram of over 3000 trials.**



Rolling Deformed Dice

- **Activity 2: Each student rolled a deformed die 200 times, which has four sides of 1.5 lengths of the other two.**





サイドタを振ろう

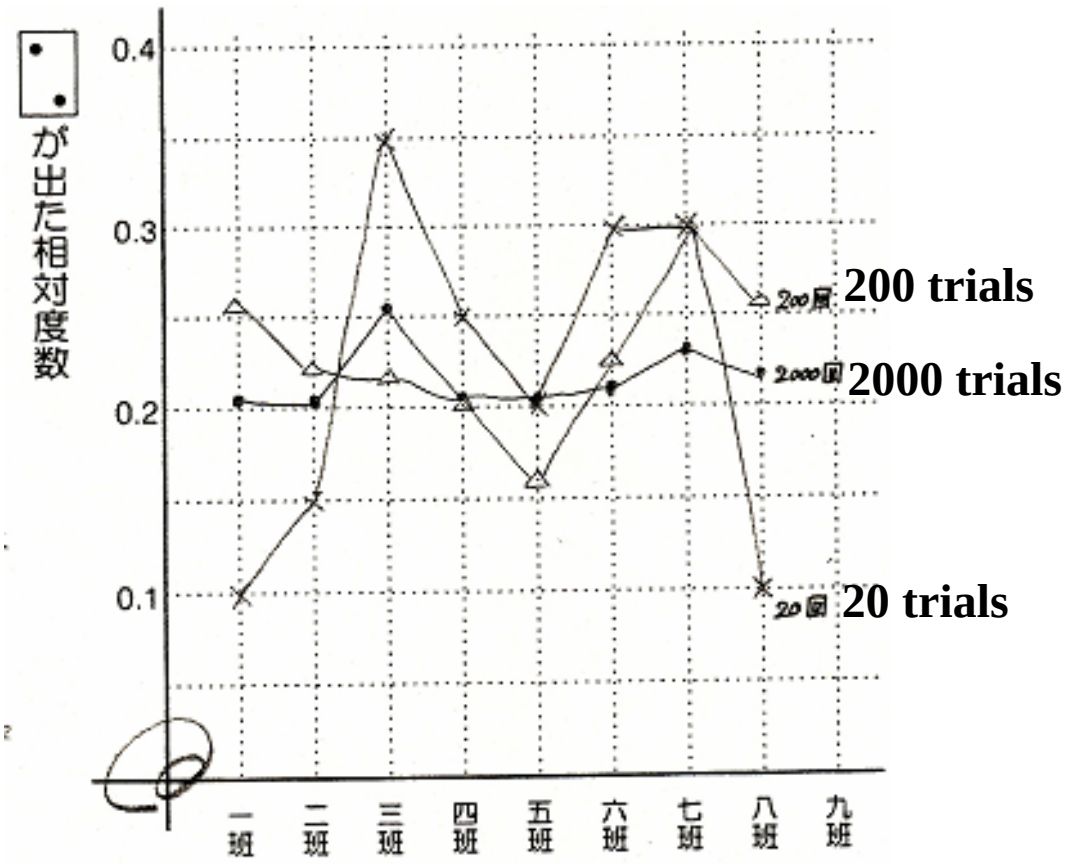
5 組 学番 H20ゲY05 氏名 大橋賀寿治

投げた回数	1	2	3	4	5	6	7	8	9	10	出た目の回数 ●	⁚	⁖	⁘	⚅
(1)	3	5	6	1	4	2	5	4	2	4	1	2	1	3	2	1
(2)	4	3	5	3	2	2	4	5	3	3	0	2	4	2	2	0
(3)	3	5	5	2	5	5	4	3	4	5	0	1	2	2	5	0
(4)	4	5	2	3	4	5	6	4	3	4	0	1	2	4	2	1
(5)	2	3	4	3	4	2	3	2	4	3	0	3	4	3	0	0
(6)	5	3	4	4	4	4	3	2	3	5	0	1	3	4	2	0
(7)	3	5	5	5	6	5	5	6	4	3	0	0	2	1	5	2
(8)	3	4	4	3	5	2	3	2	5	4	0	2	3	3	2	0
(9)	4	5	4	2	4	4	4	4	3	5	0	1	1	6	2	0
(10)	3	2	4	5	5	6	5	4	5	4	0	1	1	4	4	0
(11)	2	4	6	5	5	6	5	2	3	4	0	2	1	2	3	2
(12)	4	5	3	2	3	2	2	6	2	2	0	5	2	1	1	1
(13)	5	2	2	4	4	4	2	5	3	3	0	3	2	3	2	0
(14)	4	2	3	4	3	2	3	5	4	3	0	2	4	3	1	0
(15)	4	6	4	4	4	4	2	2	4	5	0	2	0	6	1	1
(16)	3	2	2	3	4	4	1	2	2	2	1	5	2	2	0	0
(17)	3	6	5	3	5	3	2	2	1	5	1	2	3	0	3	1
(18)	3	3	2	4	6	4	3	5	5	2	0	2	3	2	2	1
(19)	2	3	3	3	3	5	5	3	2	4	0	2	5	1	2	0
(20)	1	3	3	3	1	4	3	5	3	3	2	0	5	1	2	0
合計											5	39	50	53	43	10

145591

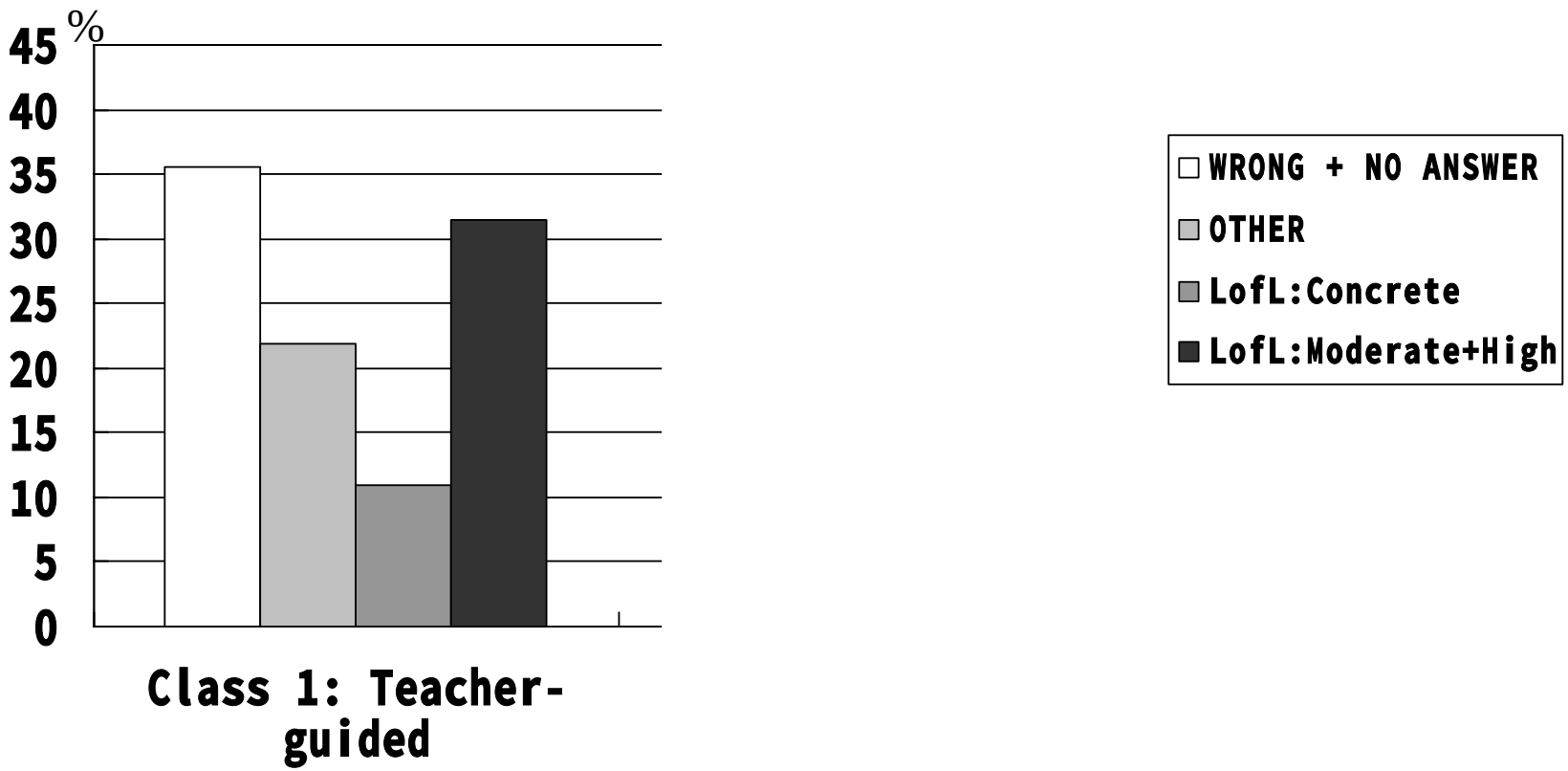
= 200

- **Each group tallied the results to compare those of 20, 200 and 2000 trials.**



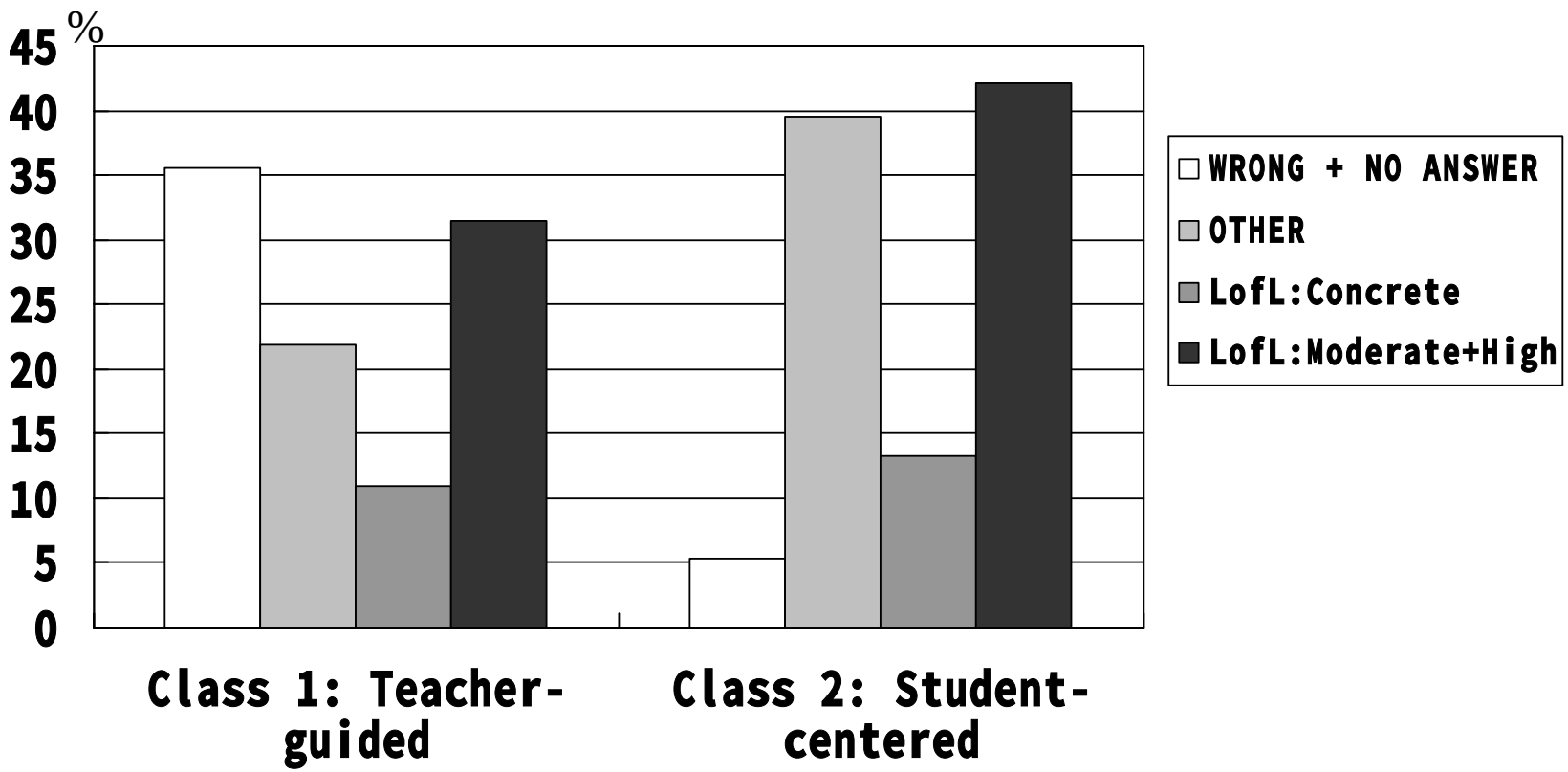
Learning Outcome

- **The misconception was changed.**
- **Levels of explanations at a term exam depended on the degree how students explained the results on their own.**
  - **In Class 1, over 35% students failed to tie their experience with LofL, answering incorrectly like "*p=r/n*."**



Learning Outcome

- **The misconception was changed.**
- **Levels of explanations at a term exam depended on the degree how students explained the results on their own.**
  - **In Class 2, over 40% students articulated the law of large numbers, and most of them never went back to wrong answer.**



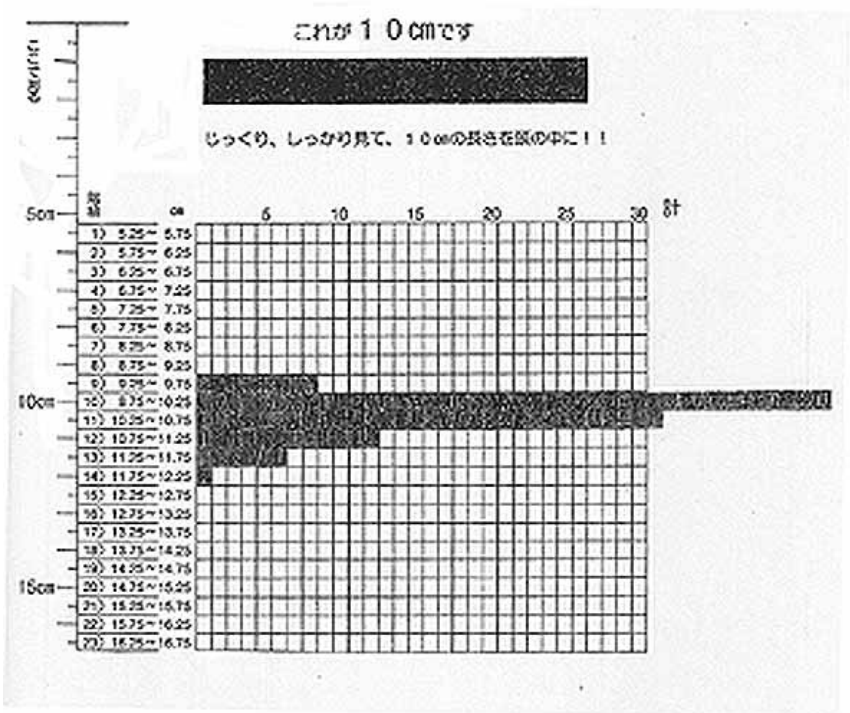
Understanding the normal curve and the central theorem

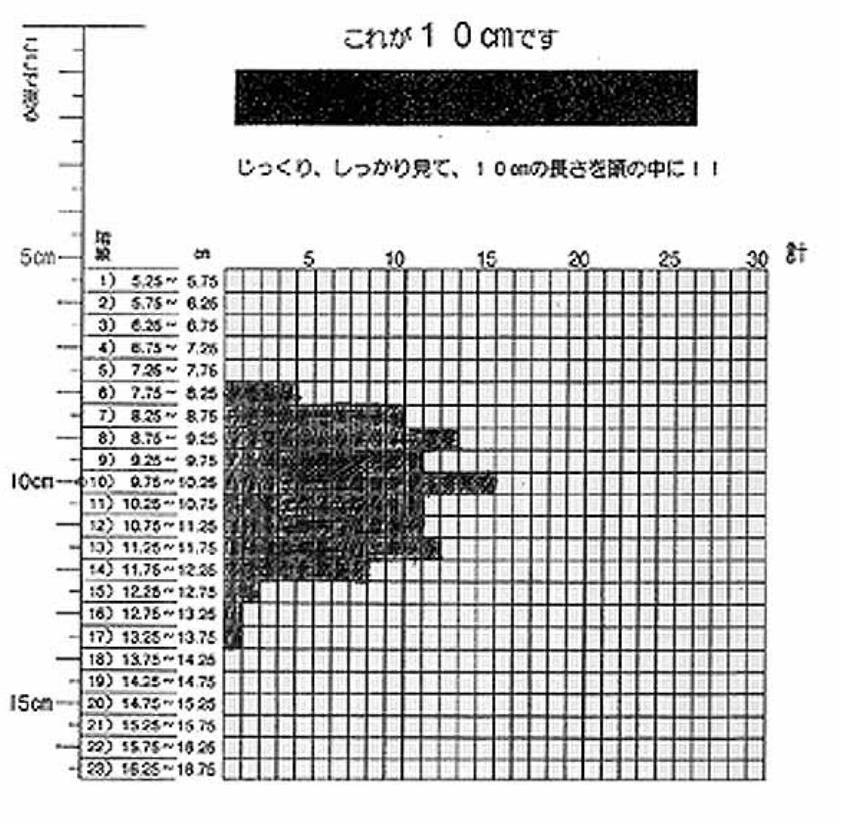
- Highly abstract, hard-to-teach concept
- Target: The same statistics courses

Smart Task 5: Cutting Tapes

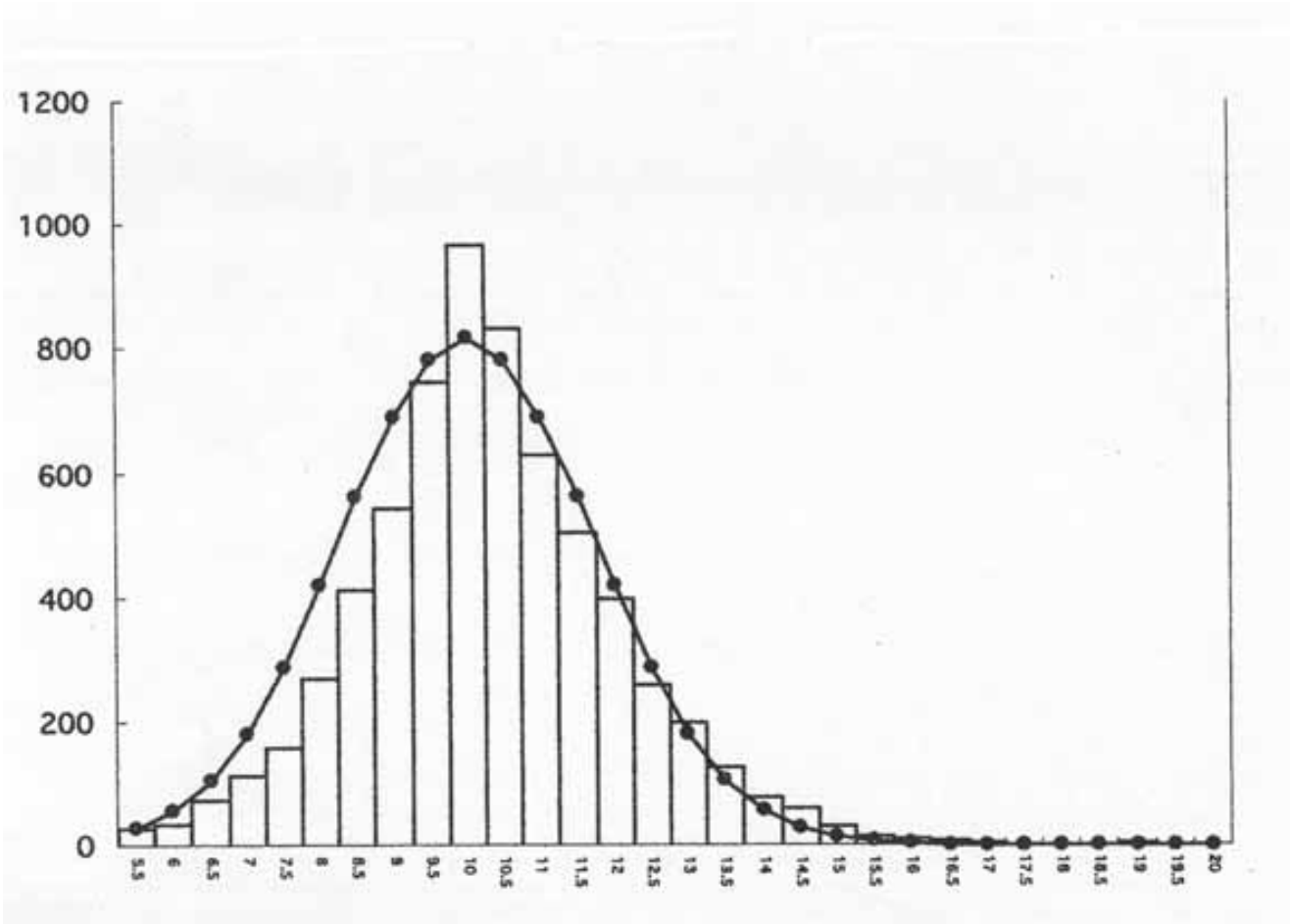
- **Each students was shown the length of 10cm, and asked to cut 100 tapes of “imaginary 10cm,” without seeing the model, from a roll of paper tape.**

- Each student individually tallied the 100 tape lengths to create own histogram, each of which comes out to have a unique shape.



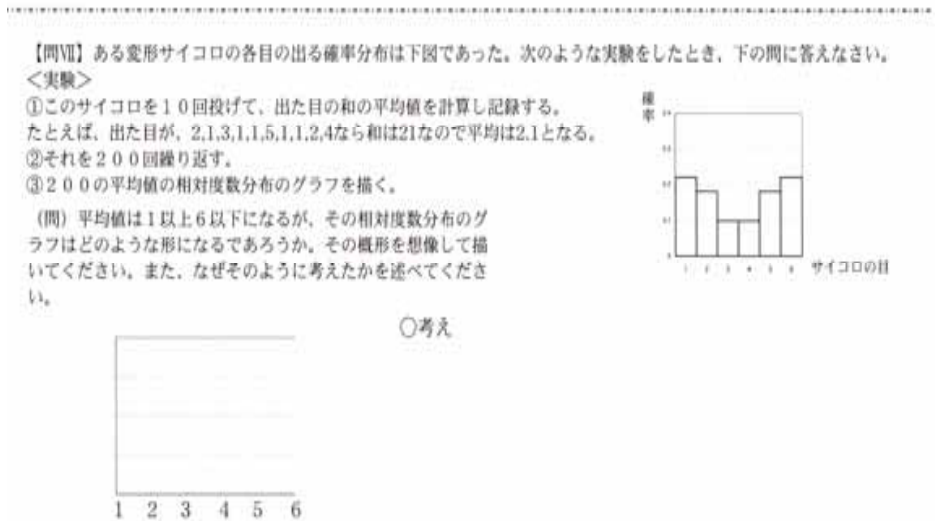


- **The class results of more than 6000 tapes came very close to the normal curve.**



Learning Outcome

- By reflecting on these graphs, the students formed a robust understanding of the concept.
- A series of activities of rolling dice, cutting tapes and the like helped
  - half of the students to appreciate the significance of trials of large number for probabilistic decision, and
  - one-third of the students to spontaneously gain the concept of the central theory of extremity.



【問Ⅶ】ある変形サイコロの各目の出る確率分布は下図であった。次のような実験をしたとき、下の問に答えなさい。

<実験>

①このサイコロを１０回投げて、出た目の和の平均値を計算し記録する。
たとえば、出た目が、2,1,3,1,1,5,1,1,2,4なら和は21なので平均は2.1となる。
②それを２００回繰り返す。
③２００の平均値の相対度数分布のグラフを描く。

（問）平均値は１以上６以下になるが、その相対度数分布のグラフはどのような形になるであろうか。その概形を想像して描いてください。また、なぜそのように考えたかを述べてください。

確率

サイコロの目

○考え

1 2 3 4 5 6

Discussion

1. Day arithmetic, dice, tape: Are they smart tasks?

2. Do you have, or can you think of other examples?

3. Any design principles?

Design principles: set 1

- engaging
- Soliciting collaboration
  - Not aggregation; dice? tapes? Or another type of collabration
  - But different approaches/interpretations to compare and integrate
- Chances for reiteration;

Design principles: set 2

- Importance of iteration
  - Something to go beyond the canonical answer
  - Involvement of critiquing phase to the collaborative outcome
- Importance of time frame
- Gradual introduction of higher levels of collaboration