Evaluation of ILDs in secondary school physics in Japan

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Contents

- Activities of Advancing Physics Research (Kyoto)

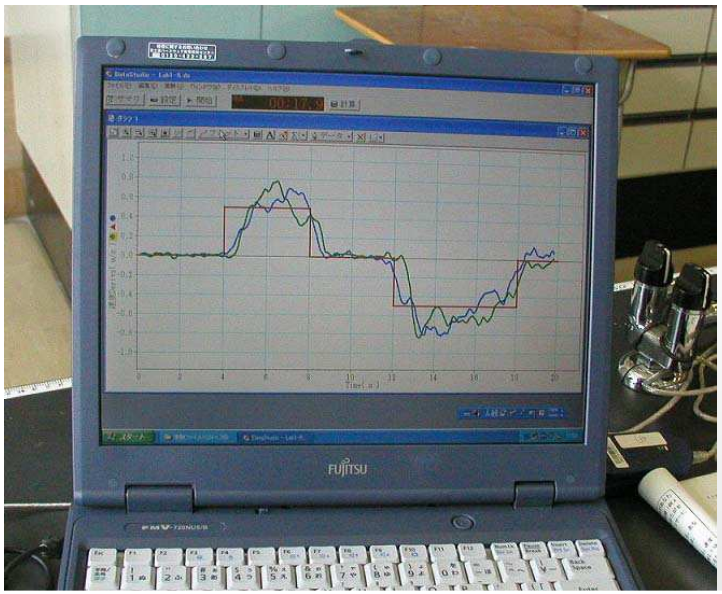
- Evaluation of the curriculum introduced to the ordinary physics
  - Abstract of the curriculum and results and problems over 3 years

Activities

Advancing Physics Research

Developing curriculum and materials of active learning

- Focusing on materials of Physics Education Research (2006)
- Researching introducing ”RealTime Physics(RTP)” of Sokoloff et al. (extramural course in 2007)



Difficulties of introducing RTP to high school physics

Features of RTP

Based on group experiments and discussions

- Impossible to prepare a dozen of sensors at each school
- Difficult for one teacher to manage all sensors and advise experiments of groups

Focusing on ILDs (Interactive Lecture Demonstrations)

Research plan of Advancing Physics Research

- 2009
  - Translating prediction sheets and teachers' guides
  - Checking contents of ILDs
  - (Evaluating the concept of mechanics of students of the ordinary course)
- 2010
  - Introducing ILDs to the ordinary curriculum at each school
  - Analyzing the results of the introduction
- 2011
  - Developing the curriculum on the considerations of the results of 2010

Process of ILDs

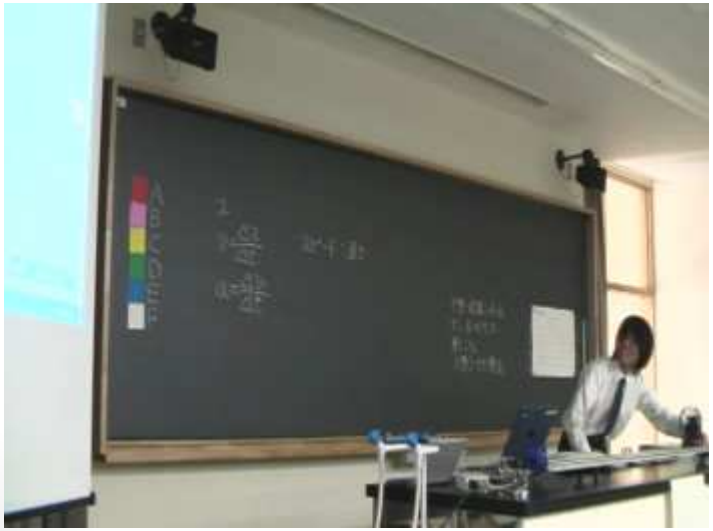
Predicting individually and writing it down <u>prediction sheet</u>

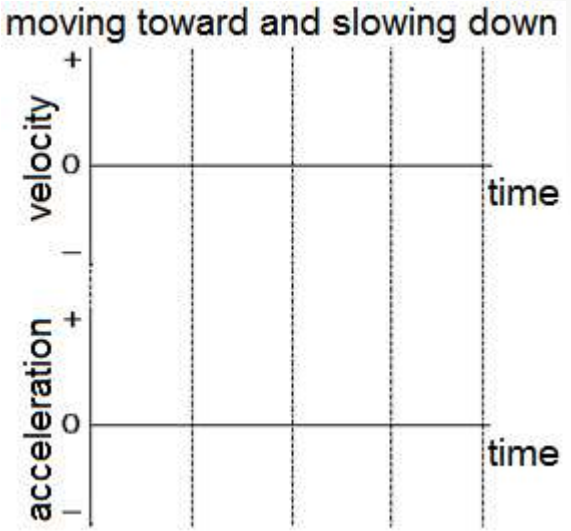
↓discussion

Discuss among class after discussion among group (the way of discussion is different at school)

↓demonstration

Writing down <u>result sheet</u>





Mechanics 2 ”Motion of carts”

<u>Demonstration 6:</u> A cart is subjected to a constant force in the direction <u>away from</u> the motion detector. Sketch on the axes on the right your predictions of the <u>*velocity-time*</u> and <u>*acceleration-time*</u> graph of the cart after it is given a short push <u>toward</u> the motion detector (and it released). Sketch velocity and acceleration detector, comes momentarily to rest and then speeds up moving away from the detector.

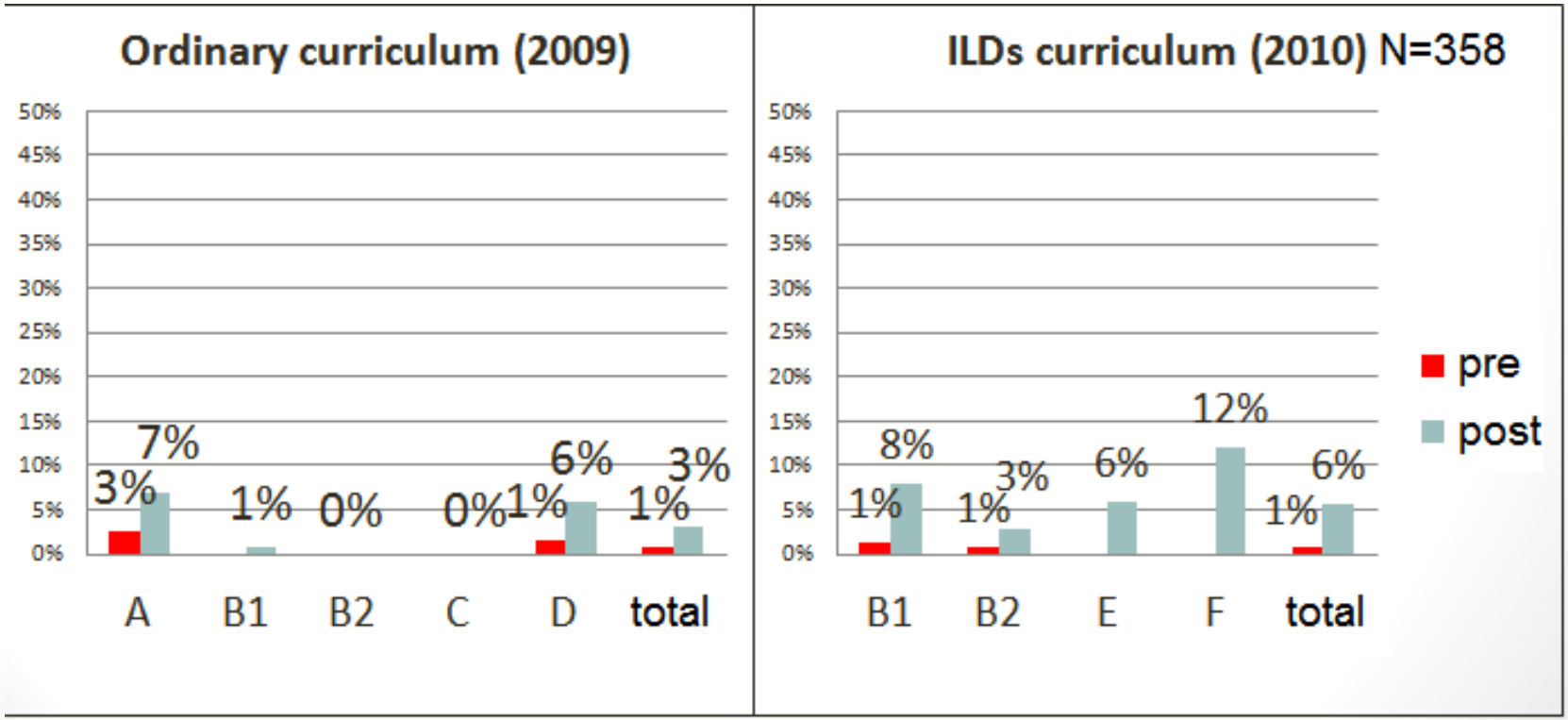
Introduction ILDs to curriculum

A1 high school (3 hours per week)

1 pre test
2 vector (1 dimension)
3 ILD Mechanics 1
4 physical quantity
5 position, velocity, composition of velocities
6 relative velocity
7 acceleration 1
8 ILD Mechanics 2-1
9 ILD Mechanics 2-2
10 acceleration 2
11 gravity acceleration, projective motion
12 force, Fuck's law
13 composition and decomposition of forces, balance of force, Newton's law3
14 Newton's law 2
15 Newton's law 1&2-1
16 gravity and mass
17 Newton's law 1&2-2
18 friction 1
19 ILD Newton's Law 1&2-1
20 ILD Newton's Law 1&2-2
21 ILD Newton's Law 3
22 friction 2, air resistance
23 pressure, buoyancy
24 Composition and decomposition of forces acting a rigid body 1
25 Composition and decomposition of forces acting a rigid body 2
26 post test
27 moment of force 1
28 moment of force 2

Results of evaluation of force concept in 2010

- Surveying the concept by taking Force and Motion Concept Evaluation (FMCE)



Percentage of correct answer

Analysis of introducing ILDs to the ordinary curriculum

- Problems
  - Students do not get used to discussing with each other through only ILD activity.
  - Students are not engaged in predicting and discussing, because the ILD activity were independent of examinations.

Practice in 2011

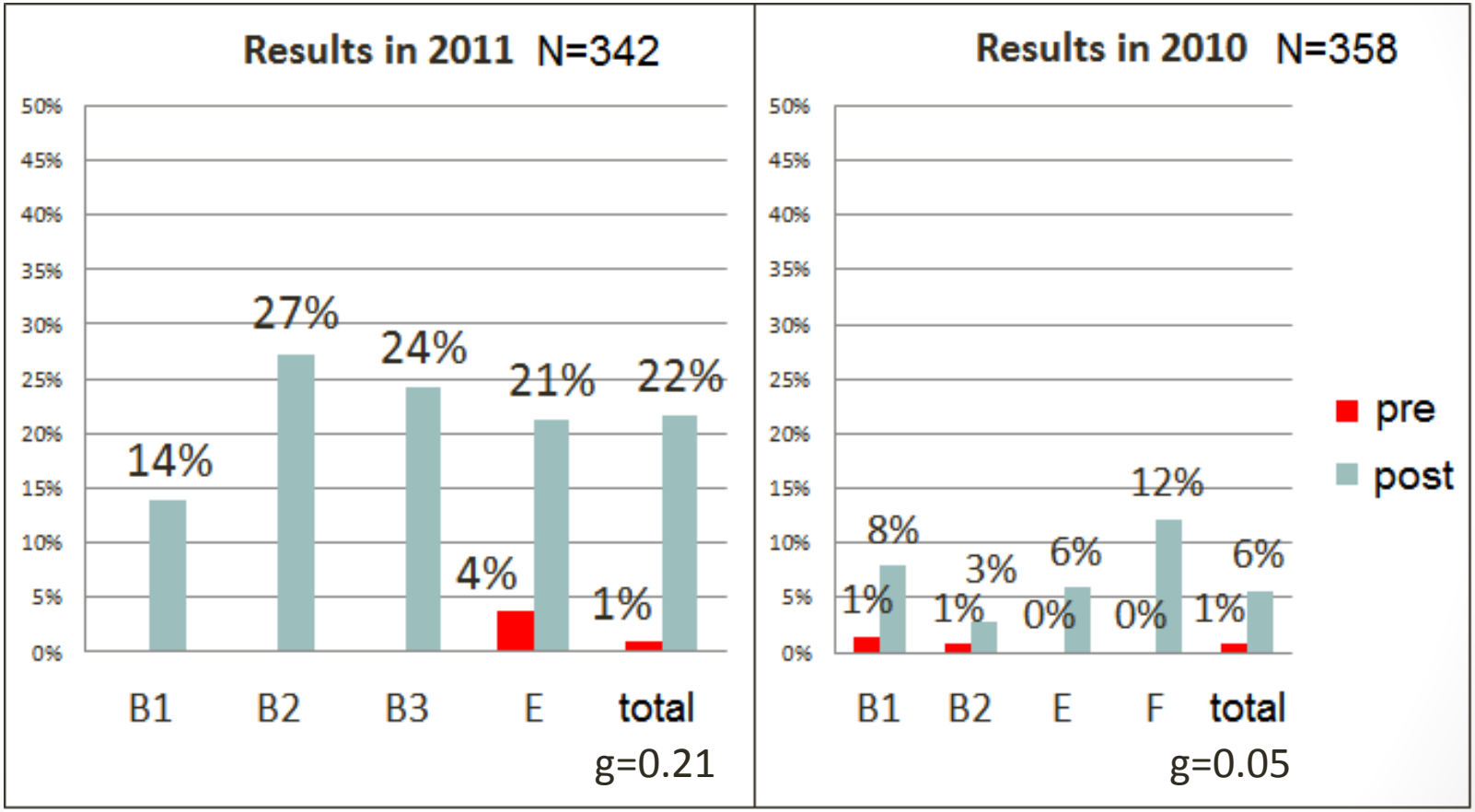
- 3 schools (5 teachers)
  - A school: 3 hours per week, 40 students
  - B school: 3 hours per week, 44 students x 8 classes (3 teachers)
  - E school: 3 hours per week, 41 students x 2 classes

Improvement points are as follows from consideration on 2010:

- Discussion through whole curriculum
- Handing on homework for establishing concept
- Similar problems with ILDs are asked each examination

Results of evaluation of force concept in 2011

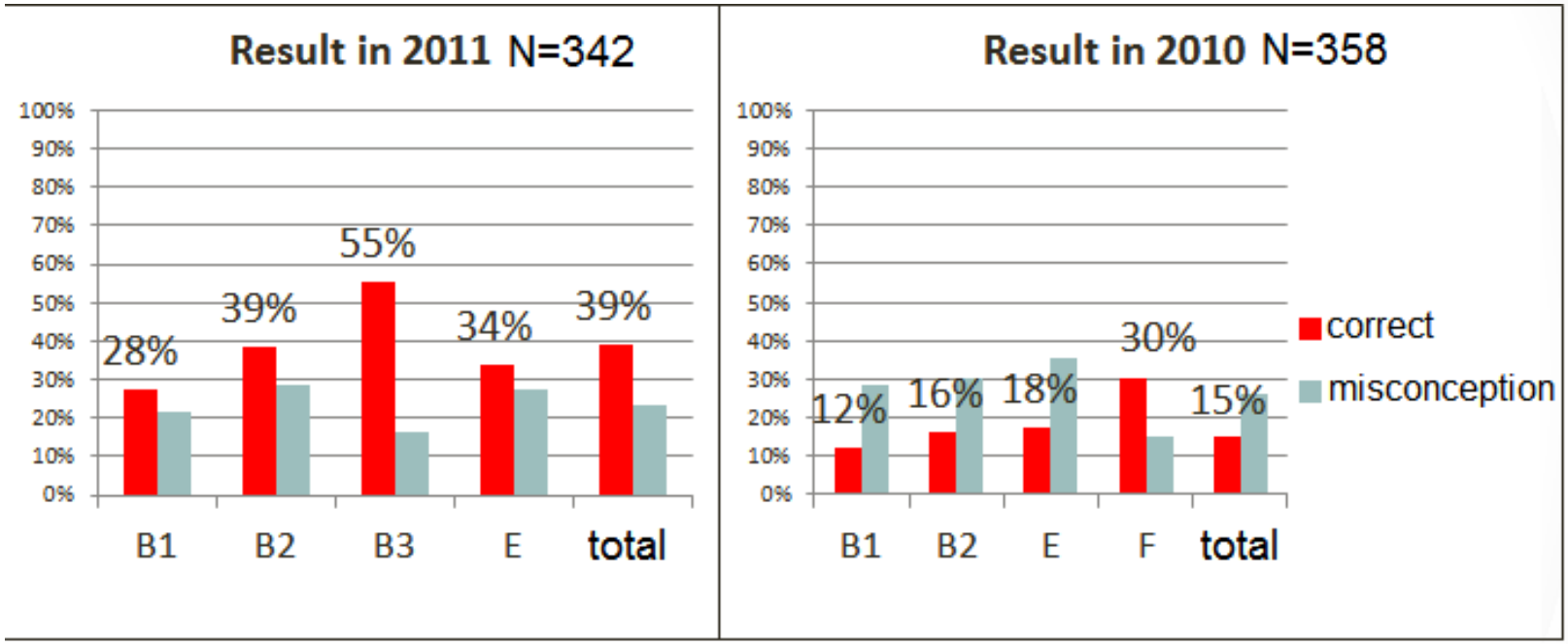
The percentage of correct answer (force concept)



Normalized gain: $g=\frac{(\text{post})-(\text{pre})}{100-(\text{pre})}$

Evaluation of acceleration

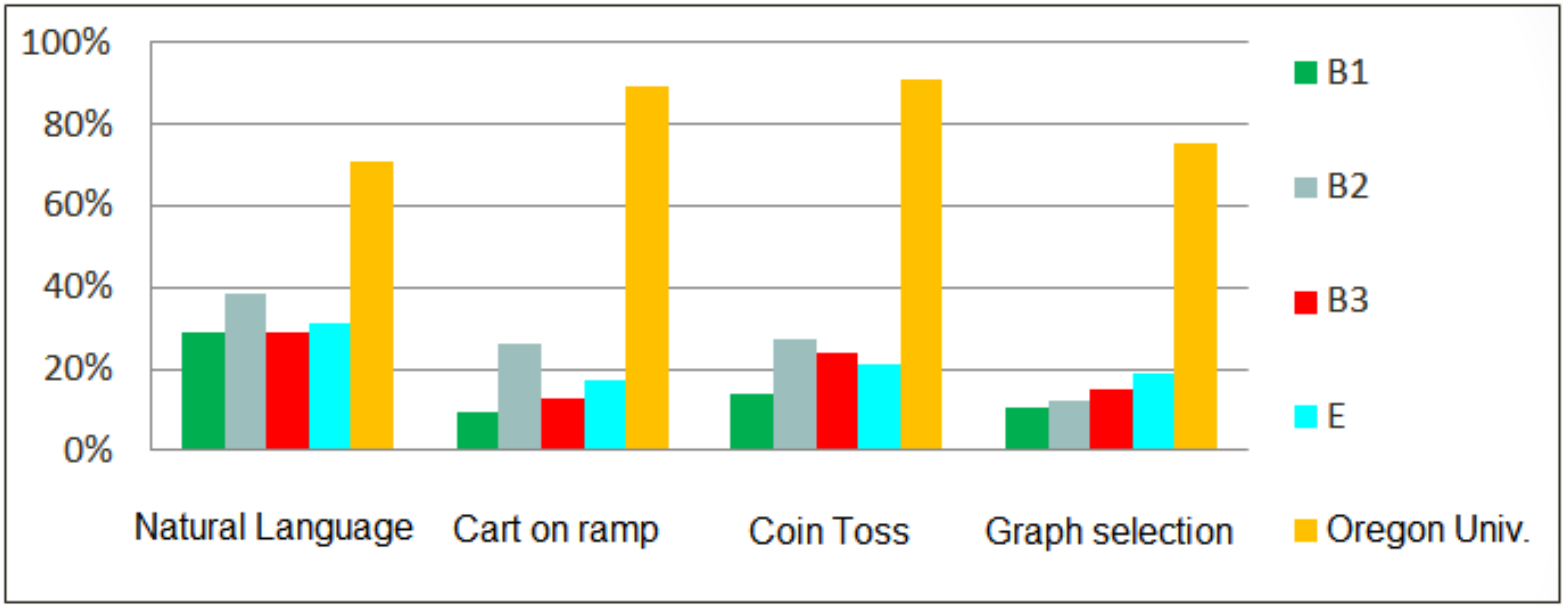
the percentage of answer



- B3 class got high percentage of correct answer
  - In ILDs class they learned the direction of acceleration by writing down arrows

Result of evaluation of force concept

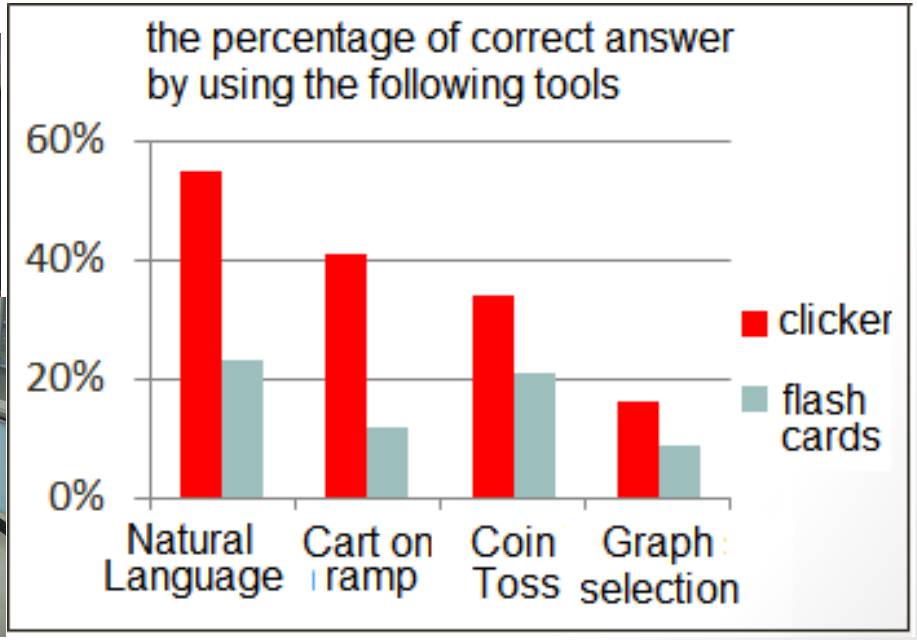
The percentage of correct answer in 2011



- Numbers of students who were able to establish force concept increased
- Although, the value of increase is much smaller than that on Oregon Univ

Results in 2011

- Prediction and discussion through whole curriculum
- Focusing on students' individual prediction
- Focusing on explaining the results of demonstrations by themselves not by teacher
- Students using clicker more actively discussed than those using flash cards



Conclusions and problems

- Conclusions
  - Prediction and discussion among students are crucial for establishing concept
  - Motivating students is also crucial (homework, examination)

Conclusions and problems

- Problems
  - Taking post test after some months
  - Developing curriculum for freshman in Japan