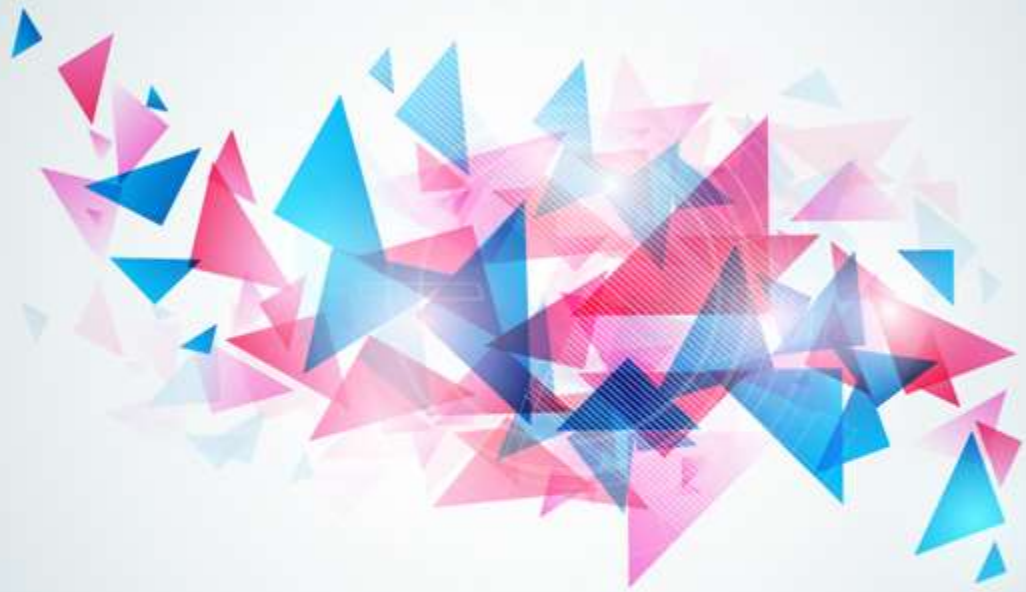


Engaging students' STEAM learning through hands-on making contest

Chair Professor Jon-Chao Hong
National Taiwan Normal University

Features of GreenMech

Since 2006 ~ Now

Make and Compete in one day

Based on STEAM

STEAM

世界機關王 GREEN MECH
World Forum For GreenMech Promotion

Science

Technology

Engineering

Art

Mathematics

- Jurassic Park

STEAM

Art

Enhanced

Engineering

Science

Mathematics

Technology

Apply

Goal

Assessment Criteria

1. Scientific and Mathematical Application
2. Scientific Method and Creativity
3. Pathway Diversity
4. Green Energy Resource
5. Green Technology Application
6. Design and Culture Creativity
7. Engineering Reliability
8. Assigned Material Application

Green Energy

1. Wind Power
2. Hydraulic Power
3. Rechargeable Battery
4. Solar Energy
5. Geothermal Energy
6. Ocean Energy
7. Biomass Energy

Green Energy

Bright Sparks
Hong Kong and Macau Lutheran Church Primary School

School name :
Hong Kong and Macau Lutheran Church Primary School
Team name : Bright Sparks

STEAM

Battle of Jimmy & Space Monkey

1. The first off the big bang to use force **WATER RESOURCES**
2. 6 Off absorb the essence of the sun and moon to the use of **solar energy**
3. 4th off, 24 off, 32 off using the **magnetic force**
4. 23 about using the **wind**
5. 2 off , 3 off, turn off the fourth , level 5 , 8 off, 13 off , 18 off, 19 off, 23 off, 27 off, 31 off, 34 off used **rechargeable batteries**

世界機關王
GREEN MECH
World Forum For GreenMech Promotion

C^3 = Culture X Character X Creativity Development

E^2 = Environment & Engineering

SP Chart

TOP 3

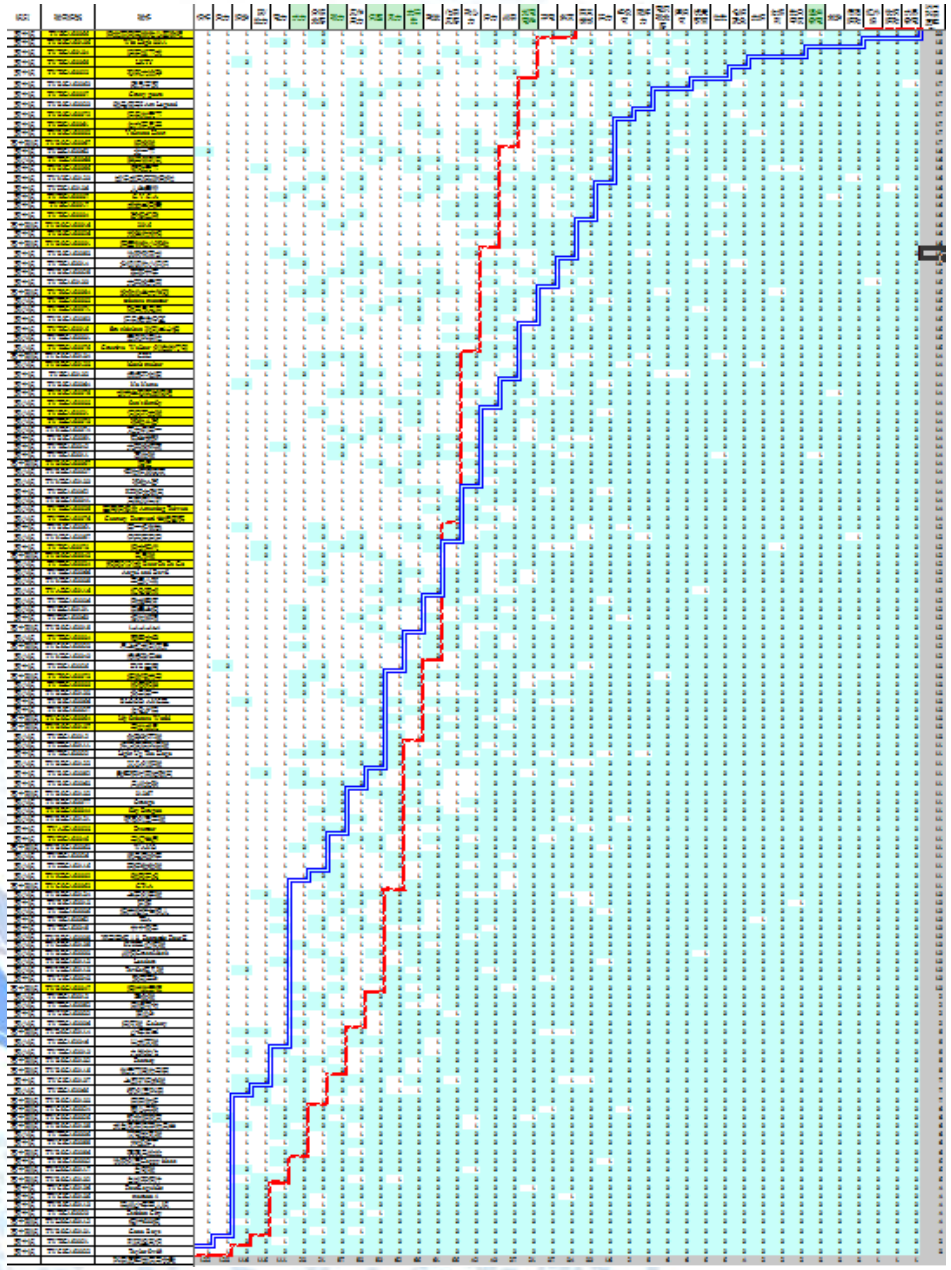
Most Popularly Used

1. lever
2. gravity
3. elasticity

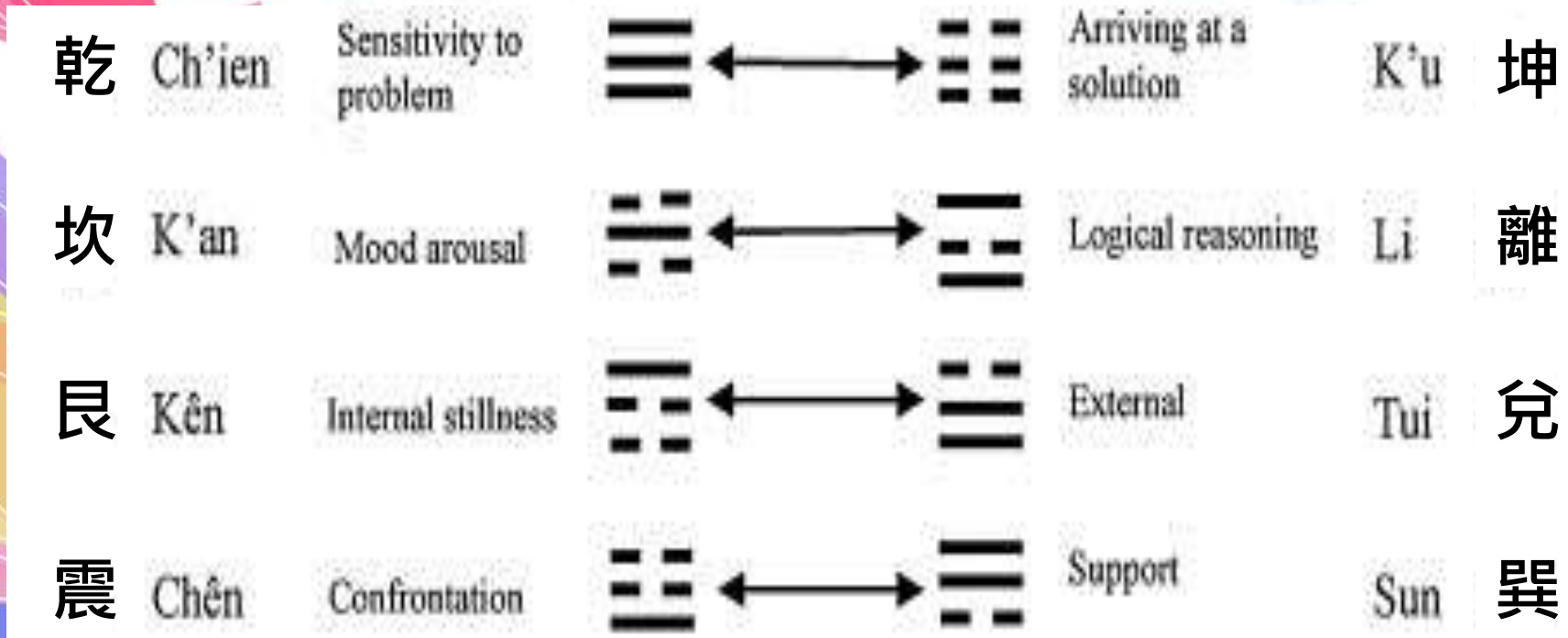
TOP3

Most Creatively Used

1. infrared
2. Simple harmonic motion
3. acid base battery (e.g. lemon battery)

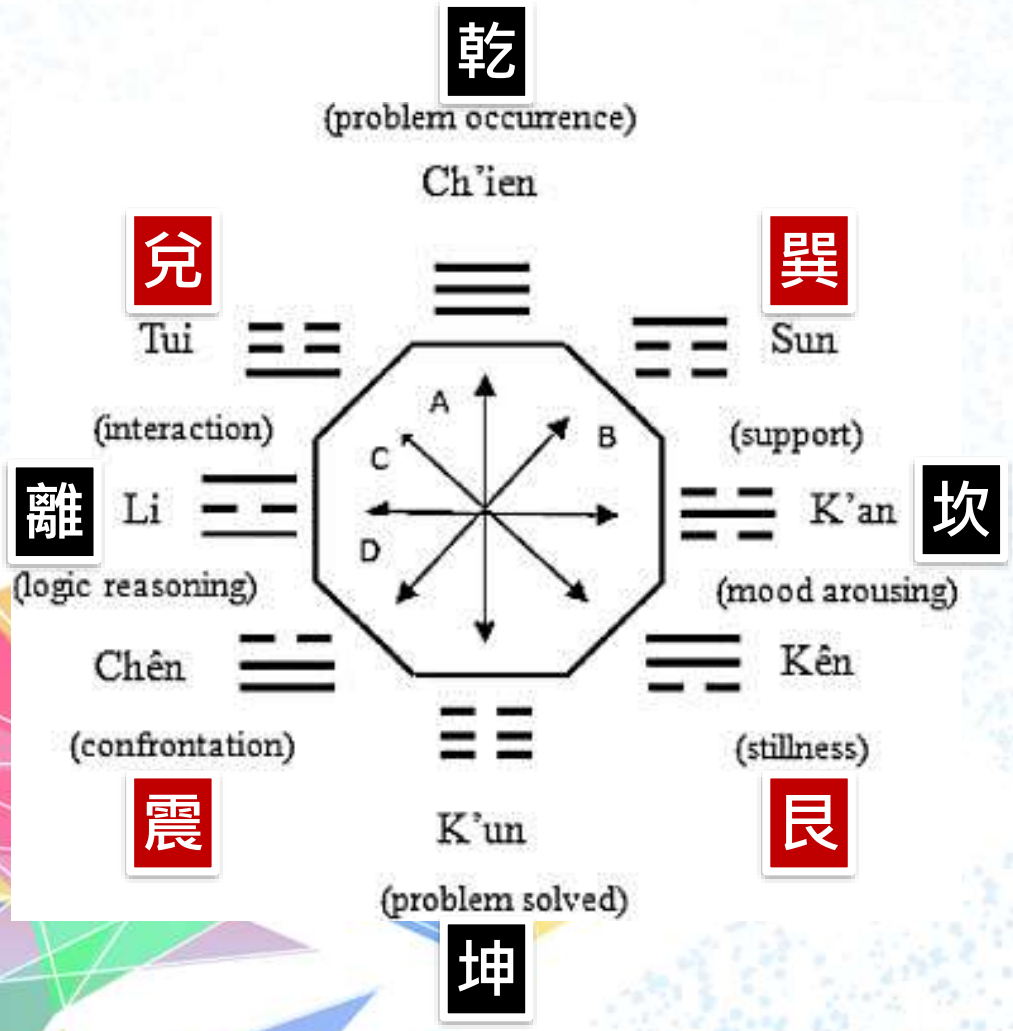


Applying the BaGua to revitalize the creative problem solving process during a goal oriented contest



Hong, J. C., Hwang, M. Y., & Tai, K. H. (2013). Applying the BaGua to revitalize the creative problem solving process during a goal oriented contest. *Thinking Skills and Creativity*, *9*, 120-128.

Applying the BaGua to revitalize the creative problem solving process during a goal oriented contest



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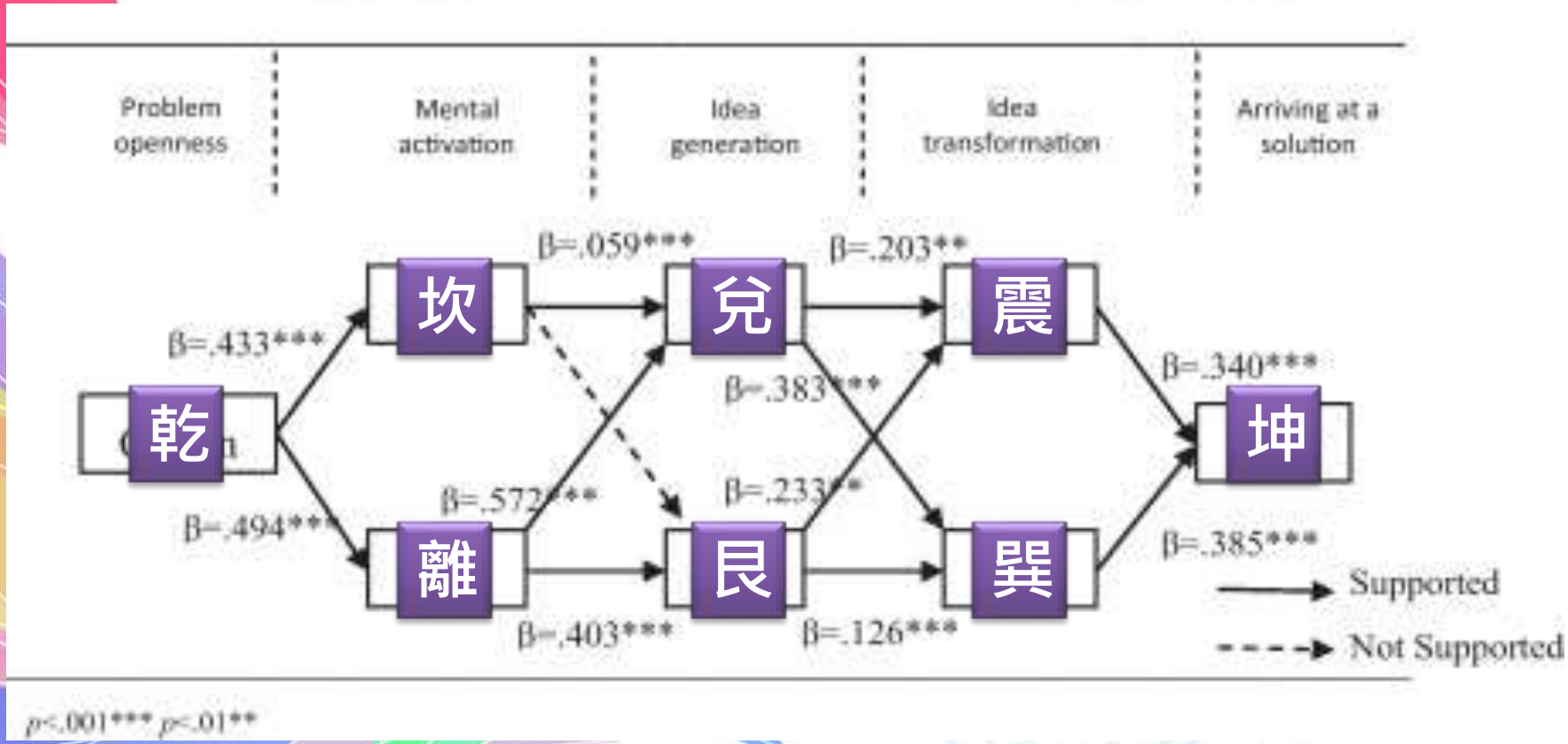

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PowerTech

Science and Technology Hands-On Creation Contest for Youth

PowerTech
Science &
Technology Hands-
on Contest for Youth

Mimi-Com
Miniature Competition
Elementary school, Junior high school

Remo-Con
Remote Control Contest
Junior high school, Senior high school

Learning Contents

Mathematics

- Geometric primitives, Counting, Multiplication, Decimals, Fractions and ratios, Recognition of quantities, Graph construction and interpretation, Angles.

Science

Tool usage

- Power, and velocity, Constant speed, acceleration, and deceleration, Work and energy, Force, gravity, and friction, Doppler effect, Fundamentals of electricity, Weight scale and moment computation.

Technology

- Component coordination, Application of physics and math to create functions.

Engineering

- Solve uncertainty problems e.g. controllability, flexibility, reliability, safety, and efficiency during transitions, and dynamic operation.

Art

- Cultivate sense of culture, aesthetic, and humanities .

Features of PowerTech

Science and Technology Hands-On Creation Contest for Youth

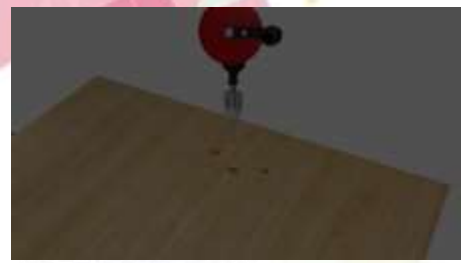
Since 1999 ~ Now

Make and Compete in one day

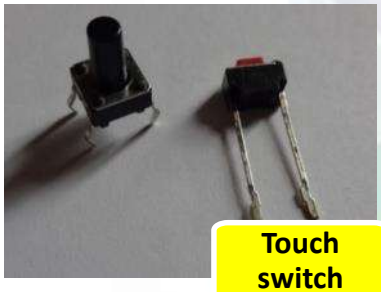
Based on STEAM

Basic Tools for General Making Skill

- MOOCs Intro
- Sawing a curve
- Oval-shaped drilling



Battery case



Touch switch

Glue gun

Hand saw / coping saw

Motor

Gear Set

Fiberboard

Hand drill

Popsicle sticks

INTRO & MAKING TIME

Types of Competition




- Tug-of-War
- Relay Racing
- Form design

[redacted]

Form Design Evaluation

Criteria	feature	Index	Description
Aesthetics	aesthetics (visual appreciation)	color	In harmony with color, colorful
		symmetry	Adaptable scale of shape, symmetry and harmony
Material Usage	optimum use	Eco-material	Eco-material, cheaper material
		Material property	Amplify the characteristic of materials to multiple use
Simulation	reality	Likeness	Outlook imitation
		Liveliness	The moving could show out the characteristic of designated animal
Performance	work flowing	Manual sophistication	assembly perfectly with manual dexterity
		moving smoothly	moving without bottle-neck
Additional devices	unique	added function	Adding functions e.g. an auto-timer into some base.
		extra function	e.g. sound or light effect

hands-on problem solving

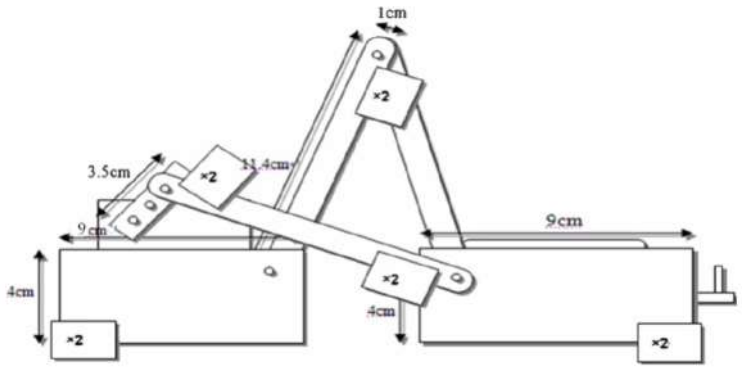
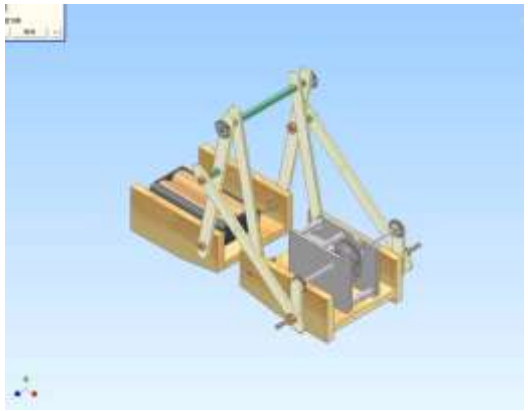


Fig. 4 Mechanism of wooden crawling worm



Crawling worm unable to move freely

Too much friction

Too little friction

Parameter to be improved: Speed
Parameter to be avoided: Weight

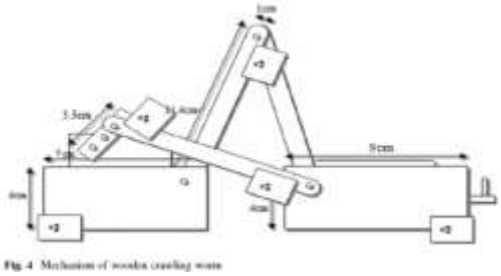
Contradiction

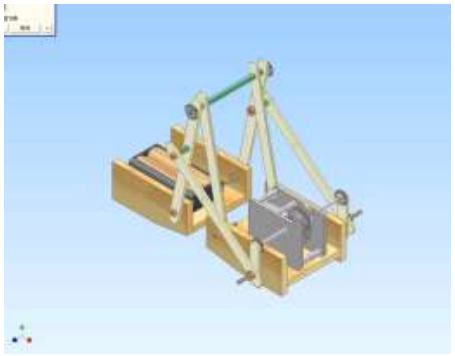
1. Extraction: Decrease component weight
2. Inversion: Smoothen surface with sandpaper

Problem solved

Developing physics concepts through hands-on problem solving- A perspective on a technological project design

hands-on problem solving





Transmit parts assembly

Motors

Battery Test

Gear assembly

Power and transmit assembly

Bug main body assembly

Wood board line marking & sawing.

Popsicle sticks hole drilling

Bug body assembly

Gravity adjustment

Base supports assembly

Heavy objects assembly

Tail wing assembly

Front part of bug assembly

Rear part of bug assembly

Progressive Problem Solving structural assembly check, straight moving error correction

Accomplished

International Exhibition
for Young Inventors

International Exhibition
for Young Inventors

6 Invention Categories

Disaster Management

Green Technology

Education and Recreation

Safety and Health

Food and Agriculture

Technology for Special Needs

International Exhibition
for Young Inventors

伸縮好睡學童椅




新自拍神器

Inventor(s)

Po-Chen Yen
Tai-Hsiang Wang

Inventor(s)

Yi-Wei Chao
Bo-Tung Kao
Huei-Shiang Wang

太陽能WiFi 定位智能垃圾桶

[redacted]

Inventor(s)

Chia-Hung Lin
Yen-Ting Liu
Jone-Wei Shen


ANALYSIS
Water tank


KAIDA (JAPAN)
Rescue Robot Arm


THAILAND
Safety Wheelchair


2015
IEYI
TAIWAN
The 11th International Exhibition for Young Inventors
November 16th - 18th 2015

Assessment Criteria

International Exhibition
for Young Inventors

1. Creativity
2. Appearance
3. Operability
4. Marketability &
   Environmental Friendly
5. Presentation
6. Overall

Hands-on learning

Stout, D., Toth, N. Schick, K., & Chaminade, T. (2008)

Neural correlates of Early Stone Age toolmaking: Technology, language and cognition in human evolution.

Philosophical Transactions of The Royal Society B Biological Sciences, 363, 1939-1949.

- **The use of whole-brain magnetic-resonance imaging can visualize changes in the brains of individuals.**

- **The study results show an increased activation of ventral premotor and inferior parietal elements of the parietofrontal praxis circuits in both the hemispheres and of the right hemisphere homologue of Broca's area. The observed patterns of activation and of overlap with language circuits suggest that toolmaking and language share a basis in more general human capacities for complex, goal-directed action.**

Hands-on learning

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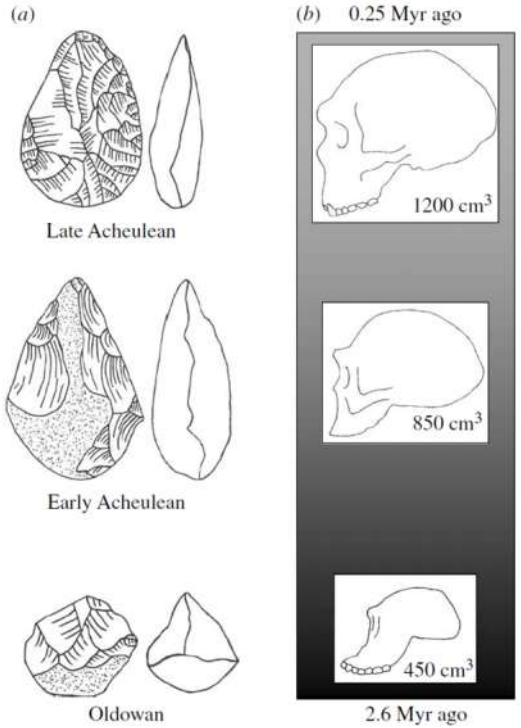

Figure 1. Early Stone Age (*a*) technological and (*b*) biological change. Elements drawn after Klein (1999).

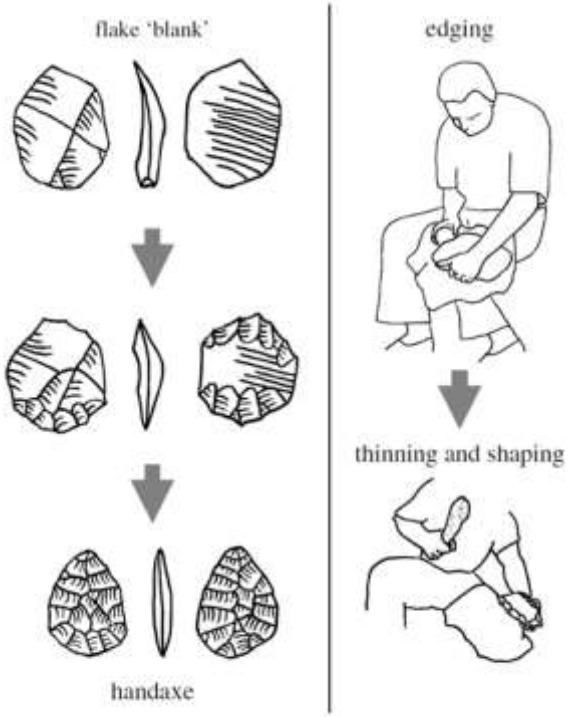

Figure 2. Acheulean toolmaking. Elements drawn after Inizan *et al.* (1999).

Hands-on learning

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Neural correlates of Early Stone Age toolmaking: Technology, language and cognition in human evolution.

Philosophical Transactions of The Royal Society B Biological Sciences, 363, 1939-1949.

- **From this evolutionary perspective, understanding the brain bases of complex tool-use and toolmaking emerges as a key issue for cognitive neuroscience.**

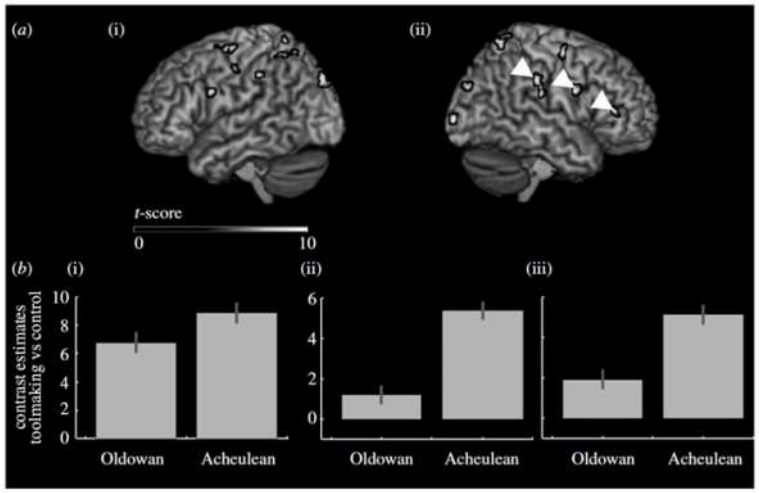

Figure 4. Main effects of expert toolmaking. (*a*) Lateral renders of brain activation ((i) left and (ii) right) during expert Acheulean toolmaking (see table 2). (*b*) Estimates for the contrasts Oldowan versus control and Acheulean versus control at the peak of the (i) supramarginal, (ii) ventral precentral, and (iii) inferior frontal clusters in the right hemisphere (white arrows on the right hemisphere render).

Hands-on learning

Stout, D., Hechi, E., Khreisheh, N., Bradley, B., & Chaminade, T. (2015)

Cognitive Demands of Lower Paleolithic Toolmaking.

Cognitive Demands of Lower Paleolithic Toolmaking.
Doi:10.1371/journal.pone.0121804

- **The study develops empirical methods for assessing the differential cognitive demands of Paleolithic technologies, and expands the scope of evolutionary hypotheses that can be tested using the available archaeological record.**

Hands-on learning

Stout, D., Hechi, E., Khreisheh, N., Bradley, B., & Chaminade, T. (2015)

Cognitive Demands of Lower Paleolithic Toolmaking.

Cognitive Demands of Lower Paleolithic Toolmaking.
Doi:10.1371/journal.pone.0121804

- **Stone tools provide some of the most abundant, continuous, and high resolution evidence of behavioral change over human evolution, but their implications for cognitive evolution have remained unclear.**
- **We investigated the neurophysiological demands of stone toolmaking by training modern subjects in known Paleolithic methods("Oldowan", "Acheulean") and collecting structural and functional brain imaging data as they made technical judgments about planned actions on partially completed tools. This corroborates hypothesized cognitive control demands of Acheulean toolmaking, specifically including information monitoring and manipulation functions attributed to the "central executive" of working memory.**

Hands-on learning

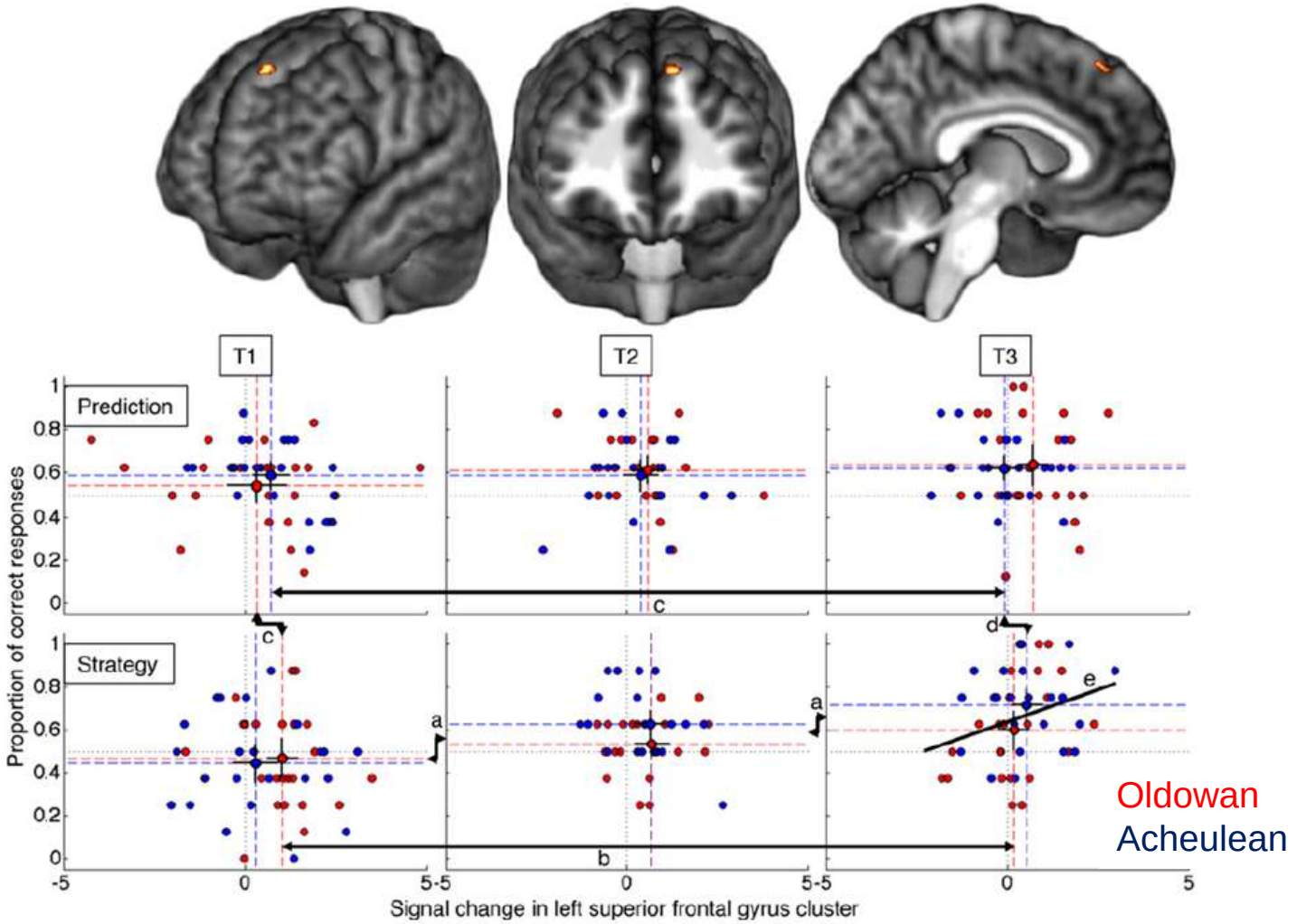

Fig 2. Location of the significant 3-way interaction in left SFG (top) and the relation of fMRI signal change to task performance (bottom). Arrows *a*—*d* indicate significant pairwise differences across time and tasks. *e* is a regression line (r = 0.294).

Hands-on learning

Stout, D., Hechi, E., Khreisheh, N., Bradley, B., & Chaminade, T. (2015)

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Doi:10.1371/journal.pone.0121804

- **Results show that this task affected neural activity and functional connectivity in dorsal prefrontal cortex, that effect magnitude correlated with the frequency of correct strategic judgments, and that the frequency of correct strategic judgments was predictive of success in Acheulean, but not Oldowan, toolmaking.**

Promoting students' Engagement in HSTC

1. Promote student engagement
2. Change parents' attitudes
3. Promote peer collaboration
4. Enhance expansive learning and creativity

Hong, J. C., Chen, M. Y., & Hwang, M. Y. (2013). Vitalizing creative learning in science and technology through an extracurricular club: A perspective based on activity theory. *Thinking Skills and Creativity*, *8*, 45-55.

General Technology Skills

1. Material processing

- Hand tools
- Electric power tools
- E-control tools

2. Parts assembling

- Gear sets
- Lever
- Motors

Declarative Knowledge

EX: Transmission Design

- Attributes of adhesive
- Power transmission and function of four bar linkage

Procedural Knowledge

- Assembly the gear set
- Make and glue the transmission crank

Three Stages of Maker

knowing what

Eyes-on

knowing why

Minds-on

knowing how

Hands-on

Thank You for Listening !

WeChat ID:
tcdahong

LINE ID:
tcdahong

tcdahong@gmail.com