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Masakata OGAWA, Tokyo University of Science

# MULTI-SCIENCE PERSPECTIVES AND IMPLICATIONS FOR SCIENCE EDUCATION: REFLECTIONS FROM JAPAN'S EXPERIENCES

# TODAY'S TALK

- My Fundamental Stances and Concern to science education
- Cultural Studies in Science Education (CSSE)
- Rika: Elementary Science Japanized
- Issues on Education of Indigenous science in general

# MY STANCES AND CONCERN

# MY STANCES TOWARD SCHOOL SCIENCE AS AN EDUCATOR

- I want to see ‘school science’
  - From the education side, not from the science side
- I want to stand at the learners’ side,
  - not at the science side
- I want to see (subject matter) science
  - as a sub-culture of the western modern
  - as a foreign culture

# MY MAJOR CONCERN:
## ONCE ‘SCIENCE’ BE A FOREIGN CULTURE,

- How should we teach/learn school science?
  - without injuring or denying, but with respecting and sharing learner’s own non-western worldview and identity
  - without committing to Scientism?

# CULTURE STUDIES IN SCIENCE EDUCATION (CSSE)

# NOW, CSSE VISIBLE

- Several Review Papers (in SSE, JRST)
- Special Issues and/or special section appeared in major research journals (SE, JRST, IJSE…)
- Chapters in Handbooks
- Monographs
- Specific professional journal (Cultural Studies of Science Education)
- PhD theses and Master’s theses appeared in various institutions and countries

# MAJOR RESEARCH FOCUSES IN CSSE (1)

- Culture-sensitive science education research
  - Learners (Marginalized)
    - Aboriginal, Non-western, Immigrant, Under-represented, Urban-Minority, Female, Multi-ethnical learners ….
  - Contents
    - Indigenous sciences, Traditional knowledge, Traditional Ways of knowing….

# MAJOR RESEARCH FOCUSES IN CSSE (2)

- Contexts
  - Daily Life World, Place-based, Languages, Sustainability, Globalization, Diversity and Equity, Gender, Transformation, Identity, Values…
- Teaching/Learning Methodologies in Science Classes
  - Border Crossing, Multi-science Perspective, Collateral Learning, Worldview Education, Science Learning as Foreign Language Learning

# PERSONALLY INSPIRED BY

- Science and science education are cultural enterprises which form a part of the wider cultural matrix of society and that educational considerations concerning science must be made in the light of this wider perspective. (Maddock, M.N. 1981, Science Education : An Anthropological viewpoint, p.1)
- Examining reports and papers on the science education cases for aboriginal peoples (Papua New Guinea, African regions, Canada, Philippines, Indonesia, etc)

# IDEAS

- Teaching ‘science’ as a foreign culture for non-westerners (Ogawa, 1986)
- Should ‘science’ in science education be ‘western science’ alone? (Ogawa, 1989)
- Science education in a multi-science perspective (Ogawa, 1995)
- Four-eyed fish: An ideal for non-western science educator (Ogawa, 1996)
- A stratified amalgamated multi-civilization model (Ogawa, 2002)

# [SCIENCE] IN MULTI-SCIENCE (PLURALISTIC) PERSPECTIVE (A SUPERORDINATE CONCEPT)

- Science: A rational perceiving of reality
  - 'Rationality' is not necessarily a 'universalist rationality,' but a rationality found within the cultural context of use
  - 'Perceiving': both 'the action constructing reality and the construct of reality'
- Who's [science]? Who's reality?

# WHO'S [SCIENCE]?

- (scientists' science)[Western Modern science]
  - A collective rational perceiving of reality, shared and authorized by the community of 'scientists
- (community's science)[Indigenous science]
  - A culture-dependent collective rational perceiving of reality, shared with the community people
- (individual's science)[Personal science]
  - A rational way of knowing the natural world, which is unique to each individual

A 'pluralistic,' and not 'relativistic' account of natural phenomena (Aikenhead, 2000)

# INDIGENOUS SCIENCE (IS) VS. INDIGENOUS KNOWLEDGE (IK)

- Indigenous Knowledge (IK) can be comparable with Scientific Knowledge (SK), but IK is tends to be evaluated and valued from the validity in SK
- IS is perfectly different enterprise from WM science
- IS covers much broader arena than what is named IK

# SCIENCE CLASSES FROM THE MULTI-SCIENCE PERSPECTIVE

- An arena where various kinds of [Science] are at work simultaneously
  - Science Teacher
    - [Western Modern Science] (Scientists' science)
    - Teacher's [Indigenous Science] + [Personal Science]
  - Students (with various cultural backgrounds)
    - [Indigenous Science]+[Personal Science]
  - Resource Persons (Elders)
    - [Indigenous science] + [Personal Science]

# THE IDEA OF MULTI-SCIENCE PERSPECTIVE

- Serving as a tool for deliberating pedagogical ideas for teachers (not only science teachers..)
  - In principle, every kind of [science] can be ‘appreciated’ and ‘respected’ in science classes,
    - Not necessarily means each of them should be valued equally
    - Differential valuing and weighting possible
    - Decisions should be left to respective teachers’ hands

# SO, MY QUESTIONS ARE

- How are the other types of [science] than WM science (Scientists' Science) at work in Japanese Rika classes, especially in elementary school level?
- What kinds of relationship are visible among them?
- Caution: In Japan, teacher and students share a kind of common [indigenous science].
  - (Foreign-origin students in Japan is 1.5 %)

# RIKA:
# SCHOOL SCIENCE JAPANIZED

# JAPAN: CONTEXTS OF RIKA

- 6-3-3-4 system (with 9 years' compulsory)
- School Science (Rika) Programs
  - Elementary (3rd -6th) : Lower-Secondary (7th – 9th) : Upper-Secondary (10th -12th)
- Medium of Instruction : Japanese
- Teachers
  - Elementary: General Elementary Teachers (93%) and science major teachers (7%) ;
  - Lower and Upper Secondary: Science teachers

# Fact Sheet on Science Teachers in Japa

| | Elementary School | Lower-Secondary | Upper-Secondary |
|---|---|---|---|
| **No. of Schools** | 22693 | 10955 | 5313 |
| **No. of Students (thousands)** | 7133 | 3615 | 3407 |
| **No. of Teachers (thousands)** | 418 | 250 | 244 |
| **Students/School** | 314 | 330 | 641 |
| **Teachers/School** | 18.4 | 22.8 | 45.9 |
| **Students/Teacher** | 17.1 | 14.5 | 14.0 |
| **No. of S-Teachers (thousands)** | 28.9 | 32.7 | 31.5 |
| **S-Teachers/School** | 1.27 | 2.98 | 5.93 |
| **Students/S-Teachers** | 246.8 | 110.6 | 108.2 |

**Calculated from MEXT 2007 Statistics**

# OVERALL OBJECTIVES OF ELEMENTARY RIKA IN THE COURSE OF STUDY

- Rika aims at fostering pupils to:

- Commune with Shizen,
- Perform observations and experiments,
- Acquire ability of problem-Solving,
- Acquire the feeling of loving Shizen,
- Understand natural things and phenomena realistically, and
- Acquire the scientific view and scientific way of thinking.

# SHIZEN?(1)

- Natural world without being affected by human activities
- Original meaning of ‘Shizen’ in Japanese
  - ‘Under the state of unaffected by human activities or human art,’ or ‘spontaneously’ (adverb)
- Adopted as the translation word for ‘Nature’ in 1890s. (not an adverb, but a noun)
- Two different meanings are mixed into one word, ‘Shizen’

# SHIZEN? (2)

- Shizen is neither a total sum of collection of natural things and phenomena, nor a total link of concrete objects, but a COSMOLOGY constructed by each of the Japanese with a common feature among the Japanese. (Minamoto, 1985)

# OVERALL OBJECTIVES OF ELEMENTARY RIKA

Science

Loving Shizen

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# HISTORICAL CHANGES OF ELEMENTARY RIKA OBJECTIVES

Historical changes in elements in the overall objectives of elementary Rika in Course of Study

| Elements \ Year of Promulgation | 1891 | 1900 | 1941 | 1947 | 1958 | 1968 | 1977 | 1989 | 1998 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|
| Kansatsu (Observation) and Jikken (Experimentation) | X | X | X | X | | X | X | X | X | X |
| Knowledge of natural things & phenomena | X | X | X | X | X | X | X | X | X | X |
| Scientific views & ways of thinking | | | X | X | | X | | X | X | X |
| Problem-solving abilities | | | | | | | | X | X | X |
| Scientific attitudes (Shizen Ninshiki) | | | X | X | | X | | | | |
| Relationship between science and daily life | X | X | | | X | | | | | |
| Abilities of & attitudes toward exploring Shizen | | | | X | | | X | | | |
| Attitudes toward learning directly from Shizen | | | X | | X | | | | | |
| Feelings of communing with Shizen | | | X | X | X | X | X | X | X | X |
| Feelings of loving Shizen | X | X | X | X | X | | X | X | X | X |

# ‘LOVING SHIZEN’ AS AN RIKA OBJECTIVE

- Involved in the objectives of Rika, which was first introduced in elementary school in 1891
  - About 120 years, Japanese people have learned science and ‘Loving Shizen’ simultaneously in elementary RIKA program
- ‘Loving Shizen’ is serving as an aspect of Japanese Indigenous Science within elementary Rika classes

# Three Components of Actual RIKA Class

**‘Science’**

**Education**

**‘Scientific’ Observation, Experiment**
**(Links to Theories, Hypotheses, etc)**

**Science Education**
**(Guided by the Japanese People’s Idea of Western science)**

**‘Neo-Science’ Education**

**‘Pseudo-Scientific’ Observation, Experiment**
**(No Links to Theories, Hypotheses, etc)**

**RIKA**
**(Guided by Japanese View of Shizen)**

**Education of “Loving Shizen”**

Science Teachers’ Unawareness of the Heterogeneity
Science Teachers’ Belief in ‘What is treated in Rika is Science.’

# NEO-SCIENCE EDUCATION

# WHAT IS NEO-SCIENCE EDUCATION? (1)

- Activities that model ‘science’ are not actual ‘science’
  - ‘pseudo-observation’ and ‘pseudo-experimentation’
  - Not to achieve theoretical abstraction or hypothesis-testing ;  (without sciencing)
- Pupils enjoy activities without the spirit of science, though they believe they are mimicking the spirit of science

# WHAT IS NEO-SCIENCE EDUCATION? (2)

- Enjoying such performance (doing experimentation and observation) in itself  is one of ‘their’ main aims
- ‘Neo-Science’ education is popular in Rika classes
- Few teachers aware of this ‘pseudo-scientificity’.

# EDUCATION OF ‘LOVING SHIZEN’

# “LOVING SHIZEN” IN RIKA CLASSES (1)KANSATSU

- Observation (Scientific)
  - Object should be separated from the Observer
- Kansatsu : Contemplate
  - Psychological distance between object and the observer is getting closer and closer and ultimately, coming into the one, non-separable
- Teacher asks students to ‘observe’ something, it easily turns out to Kansatsu

# “LOVING SHIZEN” IN RIKA CLASSES (2)DISSECTION

- Dissection (Kaibou)
  - After the class of dissecting flogs or fish, students  do not throw them away into the garbage can, but bury them into the ground and even pray for them
- Teachers encourage and promote such activities

# “LOVING SHIZEN” IN RIKA CLASSES (3)EXPERIMENTATION (JIKKEN )

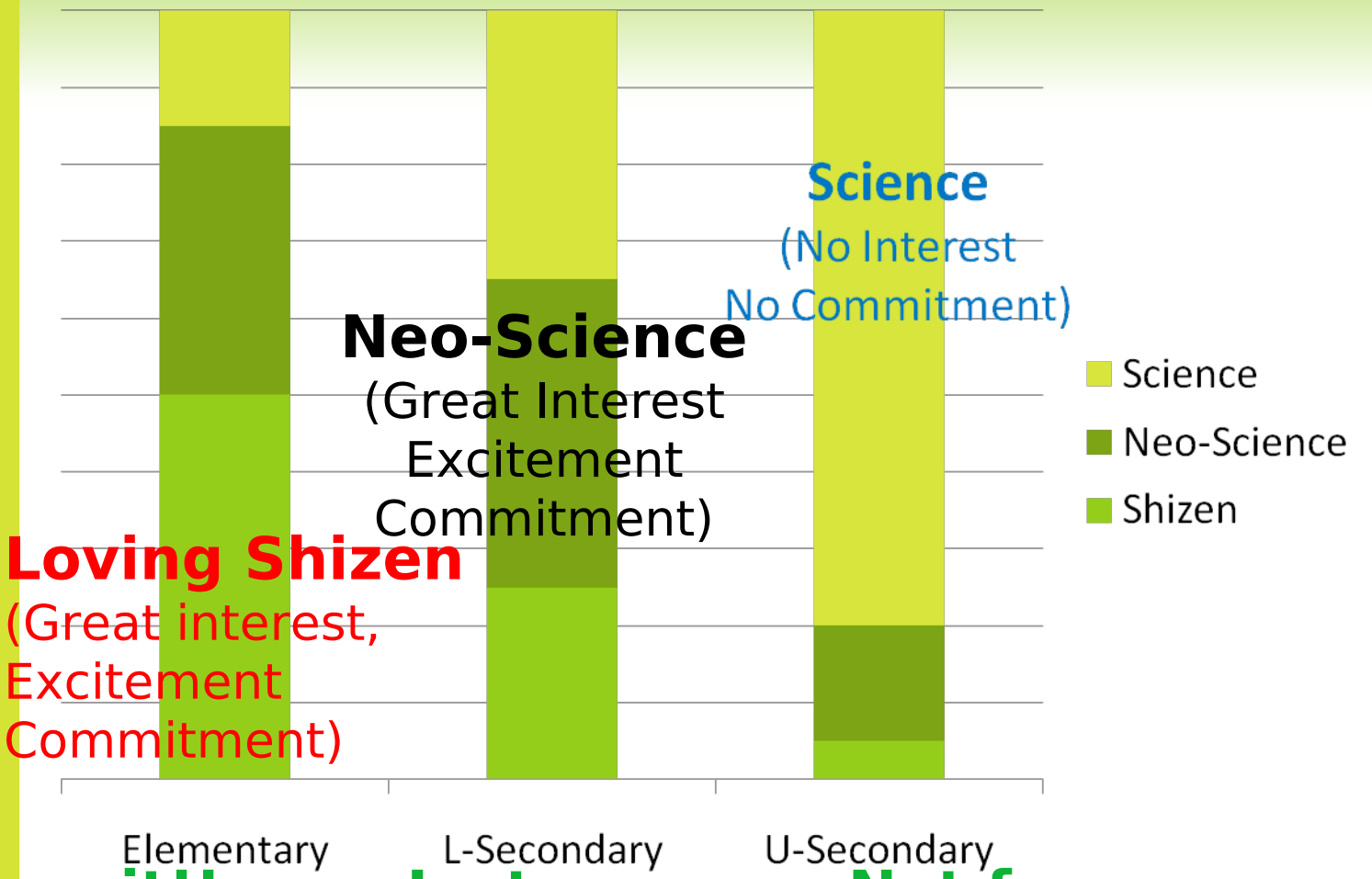
- Effects of Light on Plant Growth (5th graders)
  - Students facing a dilemma when their cultivated kidney bean seedlings need to be ‘sacrificed’ into the light-off condition
  - Do the Experiment (objective of science) vs. Love of their respective seedlings (objective of ‘loving Shizen’)
  - (Science teachers need to prepare for coping with the dilemma ….)

# EDUCATION ON ‘LOVING SHIZEN’

- A type of cosmology education, identity education, values and moral education co-exist (with different ways of instruction from those of science teaching)
- Not Limited within Rika classes
  - ‘Loving Shizen’ is pursued wherever appropriate settings (Life Skills Classes, Integrated Learning Activities, Social Studies, Moral and Ethics, etc)
- Subject matters and contents are set by the criteria of Science Education, not by that of “Loving Shizen” in RIKA classes, but it emerges occasionally and when necessary

# STUDENTS' RESPONSES

# RELATIVE RATIO OF STUDENTS' PREFERENCE ON RIKA COMPONENTS



# WHY SUCH JAPANIZED SCHOOL SCIENCE DEVELOPED?

# ULTIMATE GOALS OF ELEMENTARY SCHOOLING (ORIGIN)

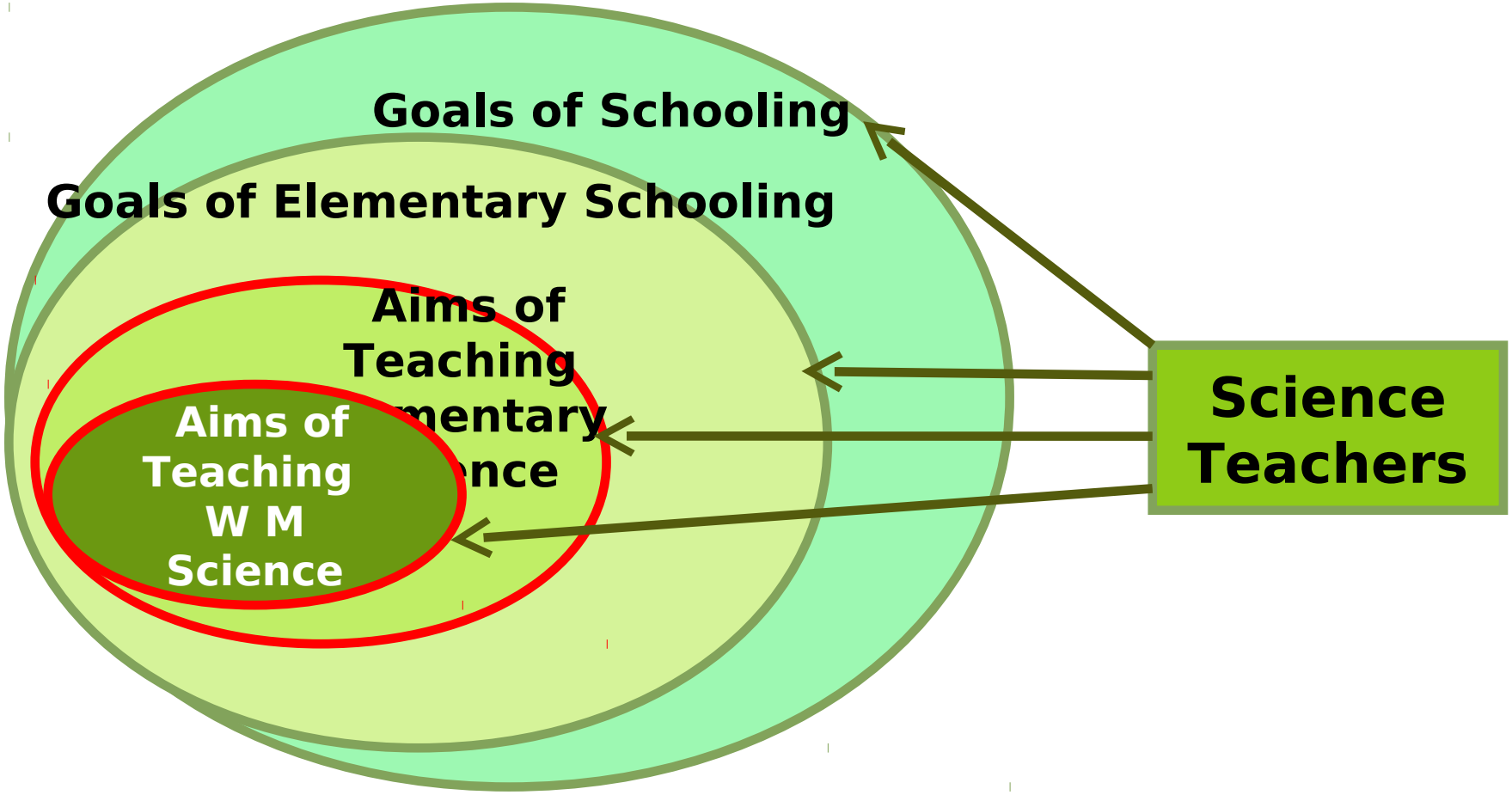
- Moral, Values and Character Education
  - by (Japanized) Confucian Tradition
- Education for the Nation
- Acquisition of Knowledge & Skills for Daily Life

‘Holistic development as a human’
(‘Bildung’ and Herbartian theory of education
imported from Prussia in 1890s)

# TRADITION OF JAPANESE ELEMENTARY SCHOOLING

- Human Development through the Processes of Teaching/Learning of Subject Matters
  - 'Character Building' has been the primary aim of elementary schooling
  - Much more emphasis on moral, values and character education than on acquiring 'Knowledge and Skills'
  - 'Elementary teacher' has been required to be a '(we)man of character' or a 'moral (we)man' rather than a '(we)man of knowledge'

# SCIENCE CLASSES ARE FAR BEYOND TEACHING W M SCIENCE ALONE




e Teachers Need to Realize and Persuade All of the These Aims Simultan

# EVEN IN RIKA CLASSES

- Priority
  - Development as a human (through learning Rika)
  - Knowledge acquisition should be the second
- Valuing
  - Moral education, Cosmology education,  and Identity education within Rika program

# SPIRITS OF ‘BILDUNG’ STILL ALIVE AMONG CONTEMPORARY RIKA TEACHERS

- What I have been keeping in my mind is ‘educating humans’ or ‘formation of healthy individuals’ through teaching the subject Rika. (Ueno, 2006, p.19)
- Rika is one of the school subjects that serves as ‘educating humans’ based upon Japanese original views of Shizen, views of culture, and views of humans. (Ishii, 2006, p.17)

# RIKA IS QUITE UNIQUE SCHOOL SCIENCE, BUT…

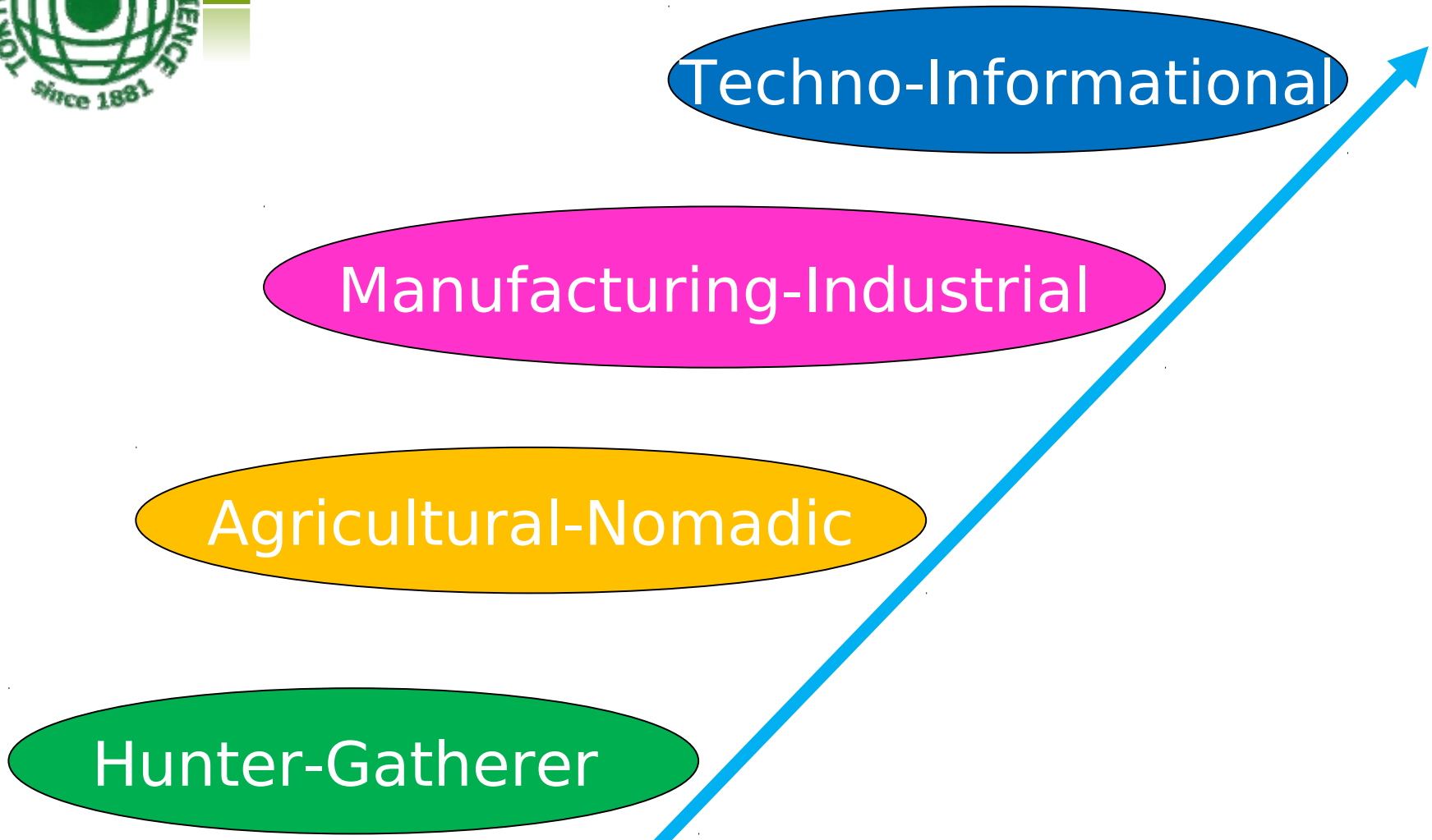
- Results of PISA and TIMSS have been showing Japanese students' higher performance in science
- Despite this heterogeneity and the students' lowest motivation toward learning Rika (science)..
- Miracle, Magic or Mystery? An Issue Not Yet Resolved….
- At least, "Loving Shizen" does not seem to inhibit students' performance in learning western modern science

# IMPLICATIONS

- ‘School science’ is possible to include something beyond ‘teaching/learning WM science.’
- The aims of ‘School science’ should be set under the goals of schooling.
- Quality (elementary) science teachers also need to
  - cope with other factors than ‘teaching WM science’
    - Ex. Developing ‘Human’ in Japan
    - Ex. Indigenous sciences (Loving Shizen in Japan)

# BACK TO THE ISSUES ON EDUCATING INDIGENOUS SCIENCE, IN GENERAL

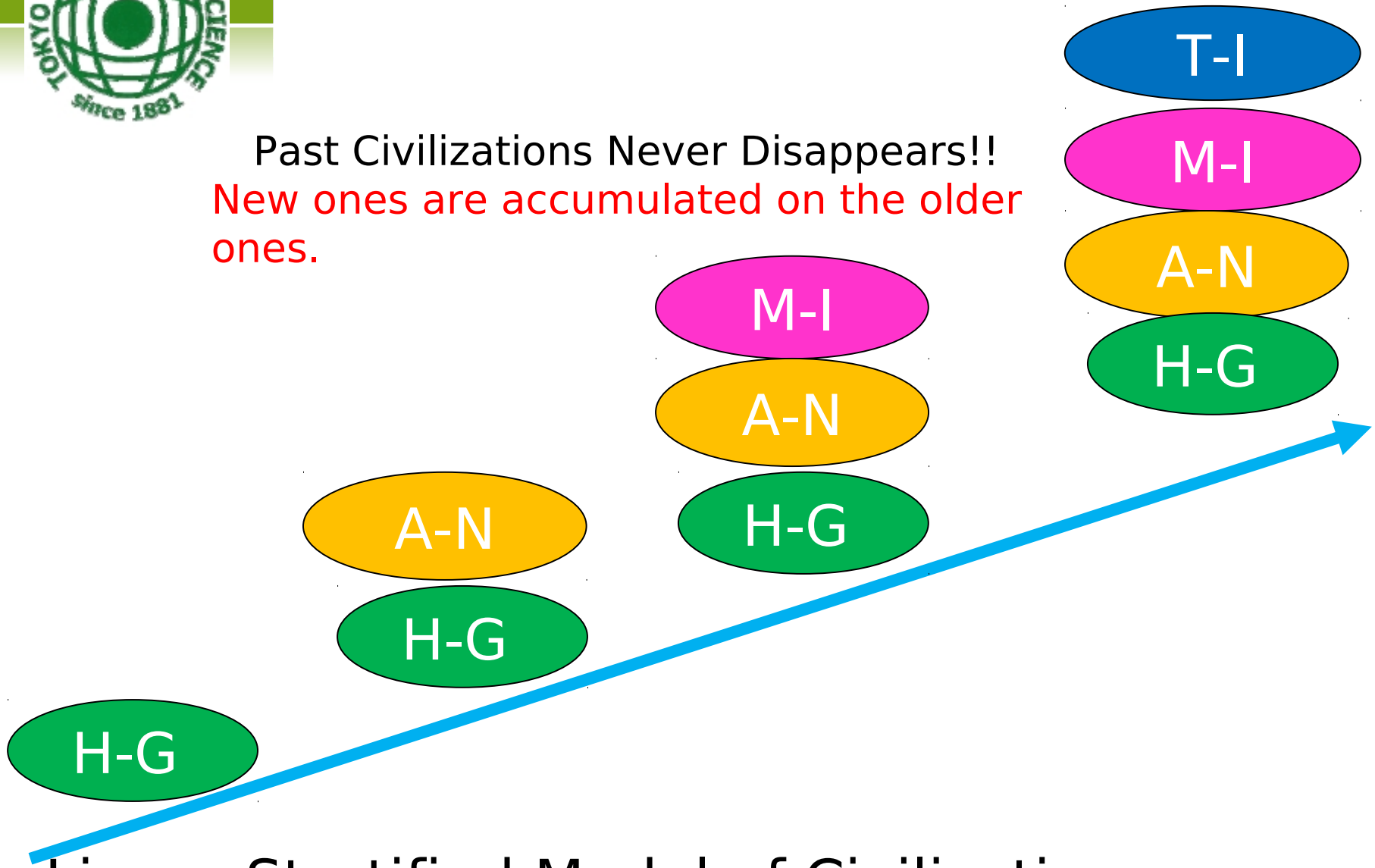
# INDIGENOUS SCIENCE: PAST OR PRESENT?




Typical Linear Model of Civilization Development

Past Civilizations Never Disappears!!

New ones are accumulated on the older ones.

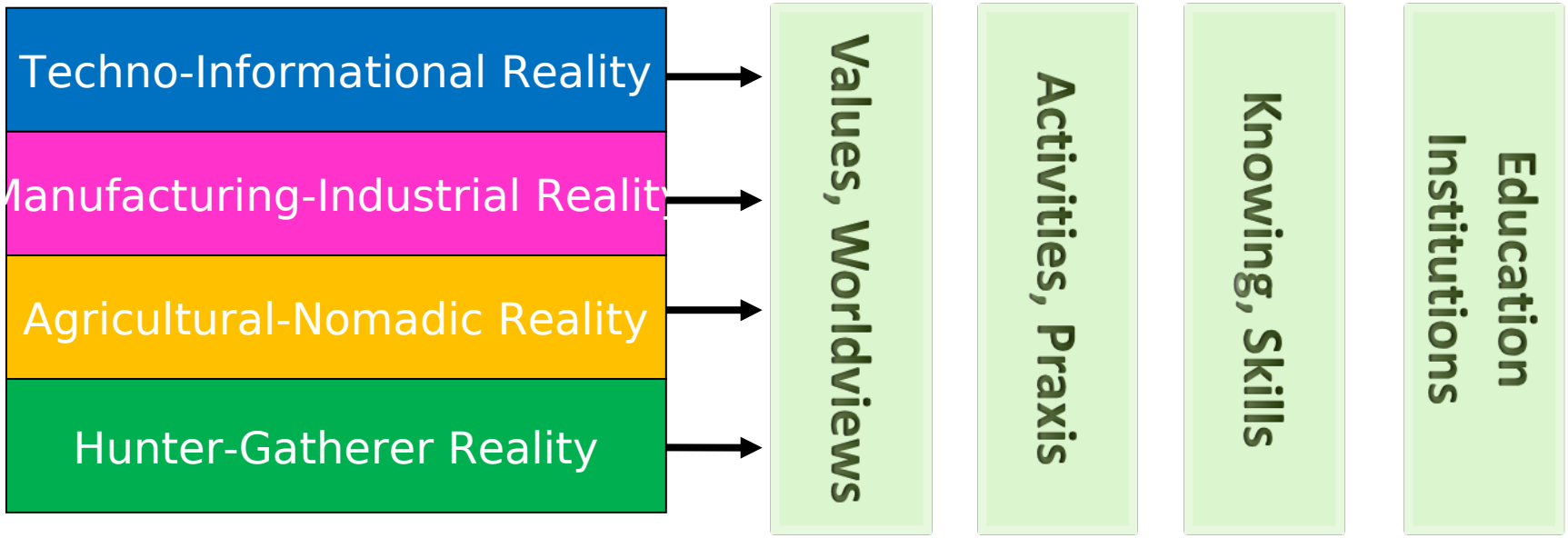



# Linear Stratified Model of Civilization Development

# AN EXAMPLE OF AMALGAMATED REALITY IN CONTEMPORARY JAPANESE WAYS OF LIFE

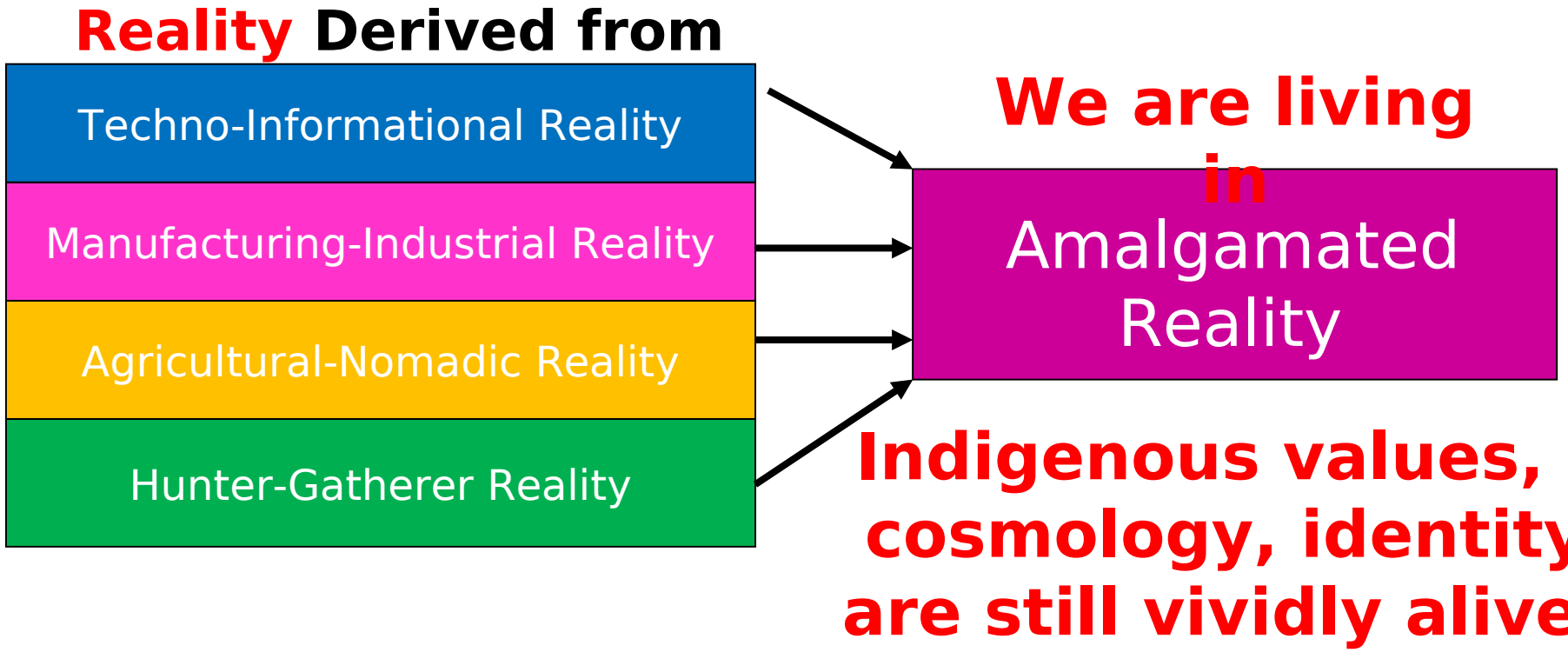
- A fisherman's ways of life working at Lake Biwa
  - Fishing (Hunter-Gatherer)
  - with Motor-Boat (Manufacturing-Industrial)
  - Equipped with GPS, (Techno-informational)
  - still Praying Gods in the Lake, (Hunter-Gatherer)
  - Guided by Indigenous Weather-forecasting, based on Significant Changes in Micro-Climate (Hunter-Gatherer)

# Stratification of Components Specific to Each Stage of Civilization



# A Stratified Model of Amalgamated Reality for Contemporary People

(Ogawa, 2002 modified)



# NOT PAST, BUT PRESENT

- **Indigenous Science**
  - Not as a past perceiving reality,
  - But as a present perceiving (stratified and amalgamated) reality (with different kinds of precedent values, cosmology and identity)

# WHO IS RESPONSIBLE TO EDUCATE INDIGENOUS SCIENCE?

# EDUCATING ‘W M SCIENCE’ & ‘INDIGENOUS SCIENCE’ (1)

- **Teaching Separately**
  - WM Science
    - in school science (and mathematics, home economics, health education etc)
  - Indigenous Science
    - in other education settings (other school subjects or out-of-school settings)
    - With Instruction modes for values education, moral education, identity education, cosmology education etc

# EDUCATING ‘W M SCIENCE’ & ‘INDIGENOUS SCIENCE’ (2)

- **Teaching Simultaneously within school science classes or other school activities**
  - Teachers need to be prepared for different kinds of instruction modes simultaneously (Just as Japan’s Rika case)

# WHICH IS BETTER OR APPROPRIATE?

# IT'S TEACHER'S OWN PROFESSIONAL DECISION AND RESPONSIBILITY


# THANK YOU FOR YOUR ATTENTION