Bridging science and engineering in education : endeavor of Science Council of Japan”

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- (Supplement to Nishimura's talk) Introduction of GSEE/Tokyo: activities of Tokyo University of Science
- (Theme)Bridging science and engineering

GSEE/Tokyo

- Tokyo University of Science has tradition of combining science and education: students of science and engineering majors can take courses for teachers' license of middle schools.
- Established in 1881 by physics graduates of University of Tokyo:"
- "Science leads to Conscience" 130th anniversary vision. Conscientious practitioners of science and technology.
- The activities of Center of Science and Math Education:

1) Symposia on science Olympiads
2) Physics Olympiad headquarter of Japan
3) Global science campus for gifted high school students : collaboration with IPN, Kiel University, Germany
4) Science Leaders Camp: one-week program for science teachers of high schools
5) One-week program for certificate renewal of high school teachers
6) Science Museum: collection of calculators, manual(Soroban), mechanical, electronic, computers
7) Museum of hands-on mathematics
8) Science Café, public lectures for kids, parents, citizens

GSEE/Tokyo (2)

- Cross-disciplinary courses bridging science+technology with other fields

  "Science as culture" open for students of all graduate schools; including science communication, science history, science philosophy, media, anthropological basis of science, science policy, patent issues, etc.

  "Science and technology literacy" open for undergraduate students of Basic Engineering:

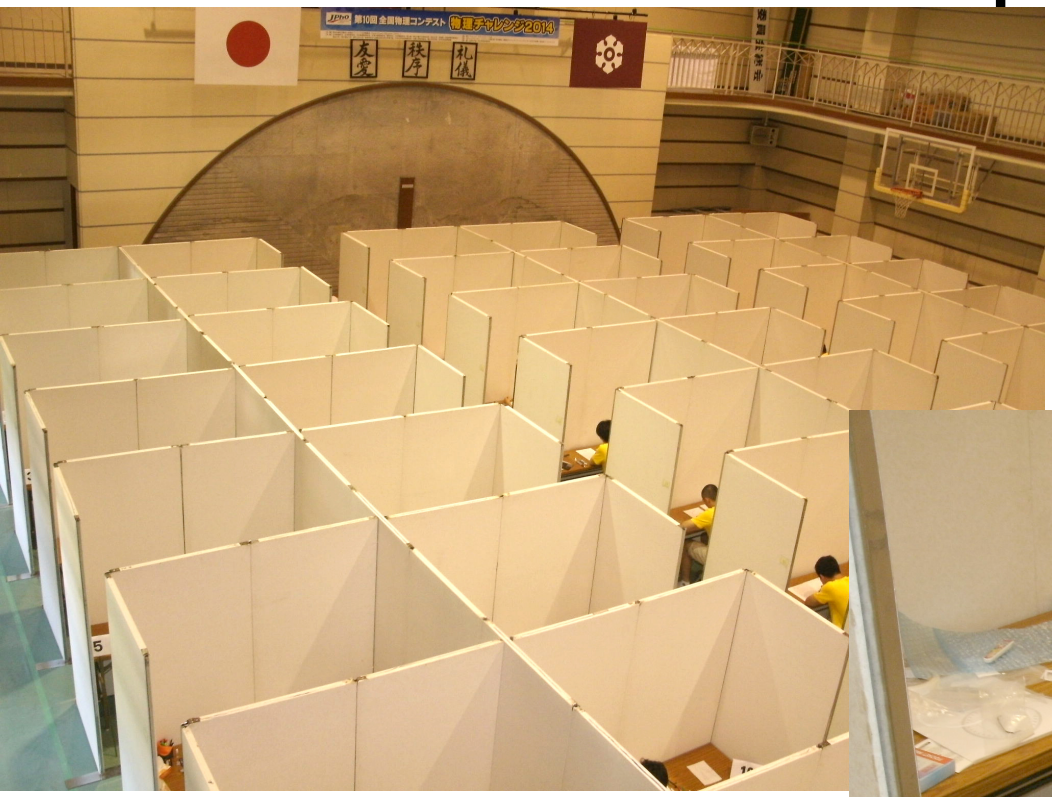
  "Science, Technology and Society" open for all students

Physics Olympiad Delegation

Preparation for IPhO

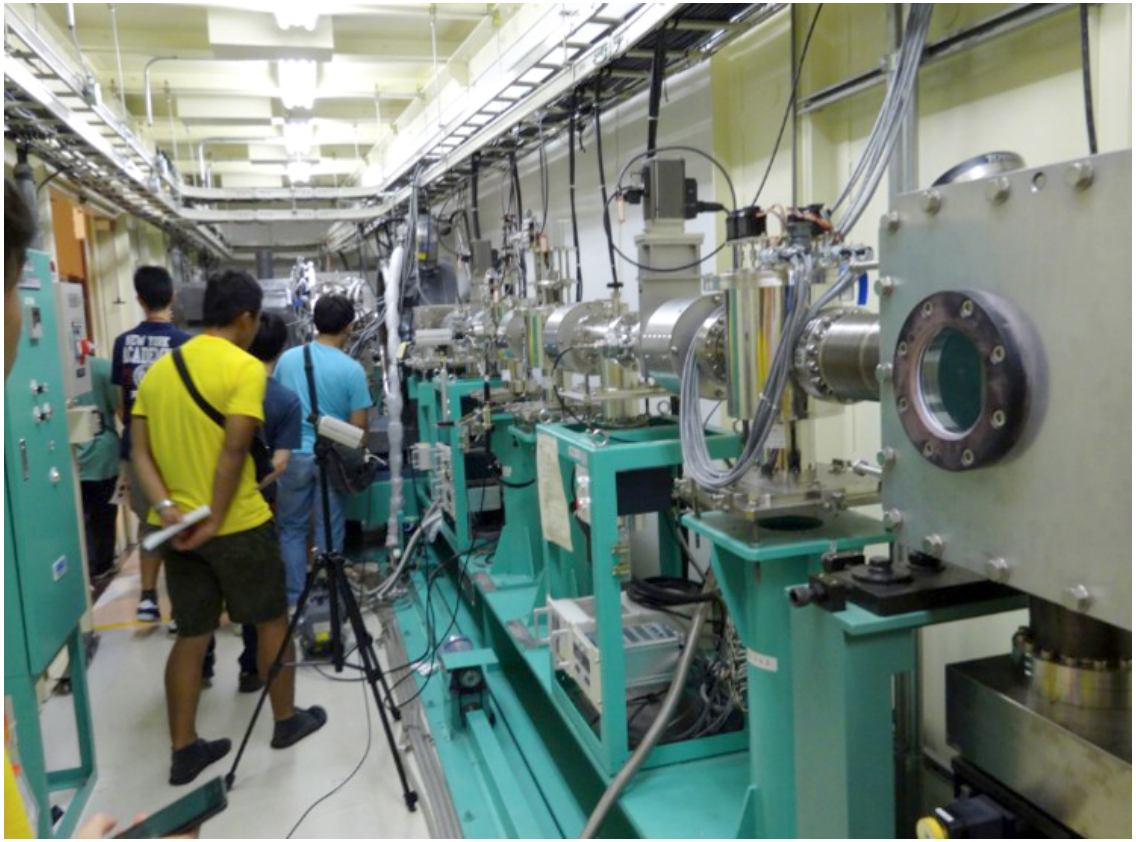
物理チャレンジ2014　　岡山県青少年教育センター閑谷学校　2014.8.19～8.22

Domestic Competition 2014



Physics live

Excursion to SPring8



Former Science Olympiad winners speak to high school students

Frozen bubble for kids

Hands-on mathematics

- Bicycle with rectangular wheels
- Pin ball game with binomial distribution
- Pentadron as basis of space-filling

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Quality of Higher Education

1. More than 55% of youth go to higher education. Intellect in the era of globalization. Big industry, High speed and long distance of traffic and communication, finiteness of natural resources and biosphere.

→ Need for examination of learning process (referential standard for education curricula

http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-21k100-1.pdf

2. Relaxation of control of university education by the ministry through university standard and examination in advance

3. Degradation of students' quality due to fewer number of subjects of the entrance exam

Science Council of Japan

May 2008: Request of MEXT to Science Council of Japan(SCJ) for consideration of quality assurance of higher education

June 2008: Inauguration of Committee of Quality Assurance of Higher Education in SCJ

July 2010 Reply to MEXT “on the Subject-Specific Quality Assurance of University Education”

Reply to MEXT "on the Subject-Specific Quality Assurance of University Education" July 2010

PART I: What frame the quality assurance can be done?

To support autonomous education improvement of individual universities through Referential Standard

PART II: What is the role of general education and common education?

Fostering citizenship, which enables collaborative work beyond the barrier of fields

PART III: University education is continued to professional career?

By constructing society which respects professional knowledge and skills

Quality assurance of university education, which fosters collaborative intellect of the 21st century

Referential Standard

There is not always a common understanding about the learning goals of a field even among experts in the field. So it happens that there are too many courses of special subjects, related to facts not to concepts or principles in the later part of college learning.

Science Council of Japan is now trying to find or verbalize the core concepts of each field of sciences: human sciences, social science and natural science and mathematics and engineering.

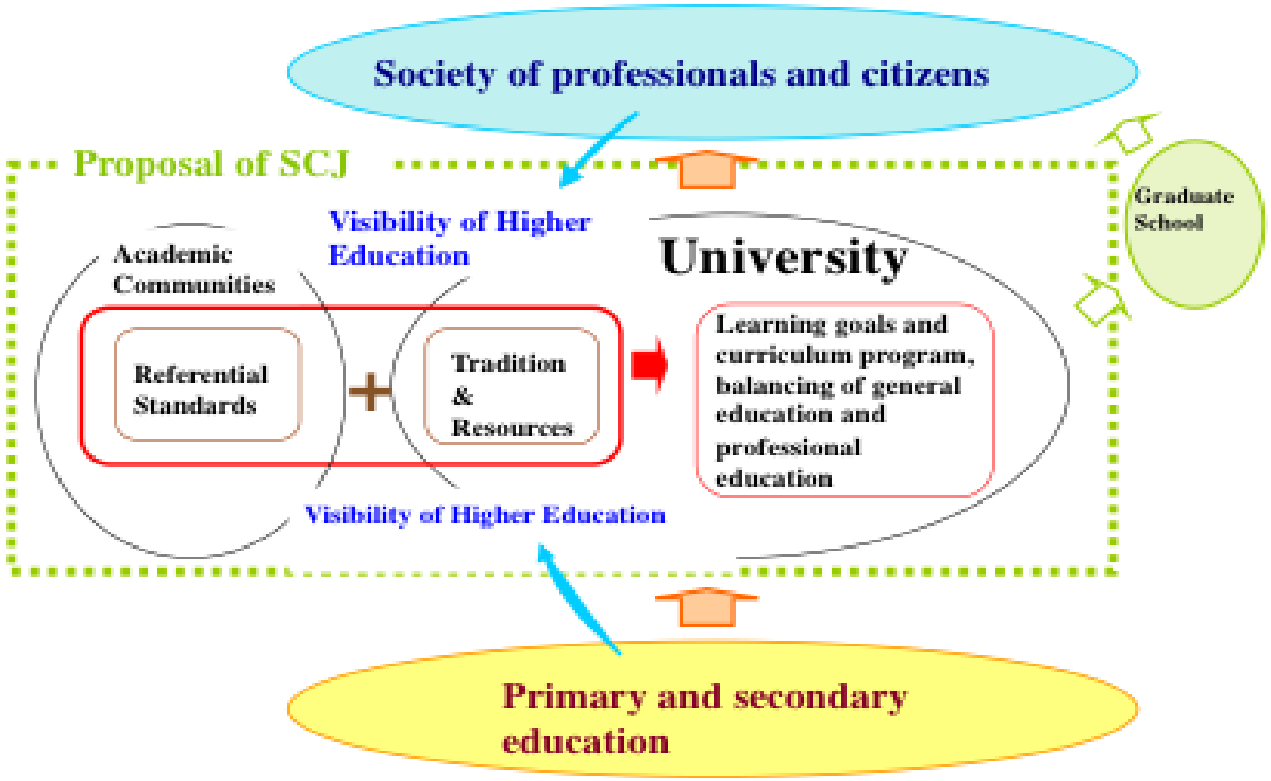
There may be diversity of the way of learning among colleges but the core concepts should be kept in common.

Main components of Referential Standard

1. Definition of the field and its characteristic

2. Basic knowledge for students
   （1）Basic knowledge and understanding
   （2）Basic skill proper and generic
   (3) Implication for citizenship and human being
3. Method of learning and evaluation
4. Bridging between field-specific education and general education for good citizenship

Referential Standard



Referential Standards

In 2012, Management , Language and Literature, Law.

In 2013, House Economy, Mechanical engineering, Mathematical science, Biology.

In 2014, Civil engineering and architecture, Economy, Materials engineering, Rural studies, History, Politics, Earth and planetary science, Geography, Cultural anthropology, Sociology, Psychology.

In 2015, Electric and electronic engineering, Social welfare, Agriculture, Informatics, Statistics.

On-going are Medicine, Pharmacy, Philosophy, Physics, Chemistry

Definition of the field in Referential Standard

- Linguistics and Literature: Language and literature are the basis of creativity of science and solidarity of mankind

- Law: Law is not just for legal management in the court but for managing community by formulation rules appropriate for the community,including families, local communities, workplaces, etc.)

- Economy: Science for rational distribution of materials and services for the purpose of the realization of happiness and welfare of the society

Referential standard is not the summary of presently on-going education but the goal of education, which is expected for our better society in the future.

The middle school education may be organized along the line for the goal of higher education.

Referential Standard of mechanical engineering

Definition of mechanical engineering

Mechanical engineering consists of epistemological science and design science related to machines with capability of converting energy and information into the forms, which give useful functions.

The underlying science is mechanics such as motion, force and so on and extended to materials mechanics (plastic and elastic dynamics), fluid mechanics, thermodynamics. As design science, system control, optimization, production planning etc.

Basic knowledge, basic capability, basic principles

Professional significance, significance as citizens

What is Engineering

- What to manipulate
- How to manipulate

Electric and electronic engineering

Energy and information by electronics

Mechanical engineering

Energy and information by machine

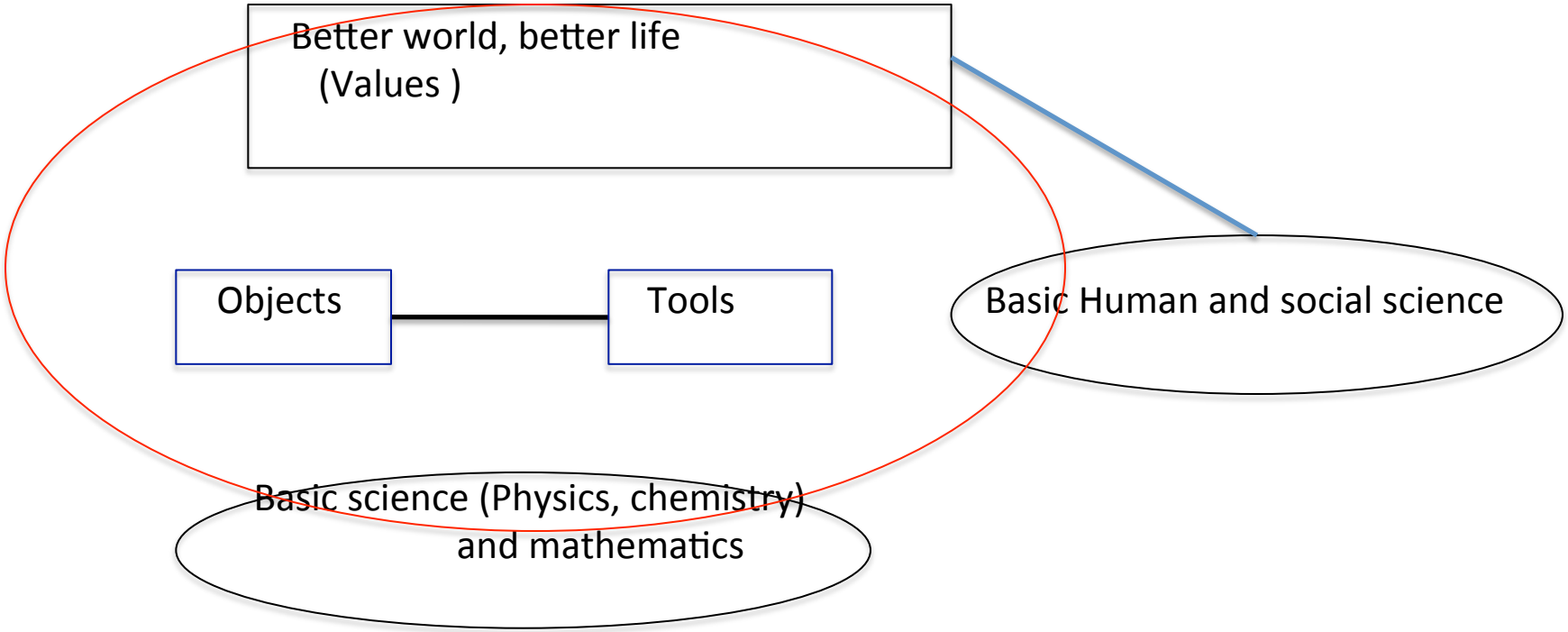
Materials engineering

Materials by synthesis, combination, etc

Civil engineering and architecture

Constructed environment by construction tools

Engineering



Engineering and science

- The frame of each discipline of engineering is same: goals and basic scientific knowledge are common and objects and tools are different.
- Human and social science for values or goals of technology
- The field of engineering is seldom referred in high school education in Japan. If the fundamental frame of engineering is known to high school students, they may be more motivated to science learning.

Significance for trans-discipline

- Clarification of discipline's mission and identity
- Open way to trans-disciplinary collaboration