

Computational thinking in the Japanese Curriculum

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Co-workers involved in the improvement of the teaching guidelines.

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Information Education on Newest Japanese Curriculum Standards

- **Enhance Statistics Education** through the all school levels
- Systematic Information Education **for all** through the all school levels
- Primary School: Experience Programing in Academic Subjects
- Junior high school: In technology and home economics classes, in addition to conventional measurement and control, added programming using a network.
- **Senior High school: Use programming to find and solve problems in the new subject "Information I"**
 - **Connection: Statistics Education links "Information I" and "Mathematics I"**
 - **Extension: We prepared elective subject "Information II" including data science. Information II works with Math B.**

Society5.0
proposed from Keidanren

keidanren site:

<https://www.keidanren.or.jp/en/>

"Society 5.0"

5.0



1.0
Society 1.0

hunting society



2.0
Society 2.0

agricultural society



Society 3.0

industrial society

3.0

4.0



Society 4.0

information society

[内閣府作成]

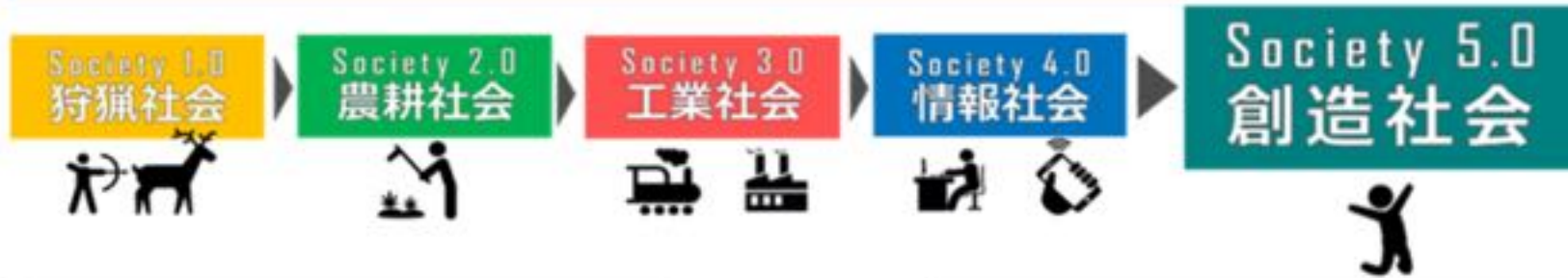
Digital Innovation

- Digital innovation will significantly change the way society operates in terms of individual lives, government, industrial structure and employment.
- Data and AI can be used to do various things. Therefore, it is important to use technology for what purpose.

What is Society 5.0?

- Digital technology and data should be used to create a society where people can pursue diverse lifestyles and happiness.
- What is strongly required of human beings in the future are "imagination" that will change the world and "creativity" that will realize them.
- Society 5.0 is the "creative society".

This is Society 5.0 (創造社会)



課題解決

価値創造

- 情報社会（Society 4.0）の特徴が一段と顕著に
- 定型業務はAI・ロボットが代替
- 組織・人材のAI-Ready化が必要
- 社会の多様な課題やニーズに応えることが求められる
- 多様な想像力とそれを現実にする創造力が価値を生む

Society 5.0 as the society for creation

- Information Society known as Society 4.0 become more sharpening
- Formal-standard Job will be alternated by AI and Robot
- Organization and Human Resource have to change the AI-Ready
- Enable to manage various tasks and necessity and solve
- Produce new value through future imagination variously and realize it creatively

Human Resources for Society5.0

- Many routine tasks can be replaced by AI or robots, which will greatly change the image of the people they are looking for.
- We need human resources who can find problems by themselves and solve them by using AI.
- It is also important to be able to exercise leadership in diverse groups.

Basic ideas for Newest National
Curriculum Standards
(Course of Study) in Japan

Unpredictable Society

- Knowledge, Information and Technology increase their roles and necessity for activity in any areas of societies.
- Societal changes such as informatization and globalization ongoing beyond human prediction through the acceleration of the changes of Knowledge, Information and Technology.
- Any children who will select any job and life in their future, will be influenced by the societal changes which will be increased the acceleration on the unpredictable situations.

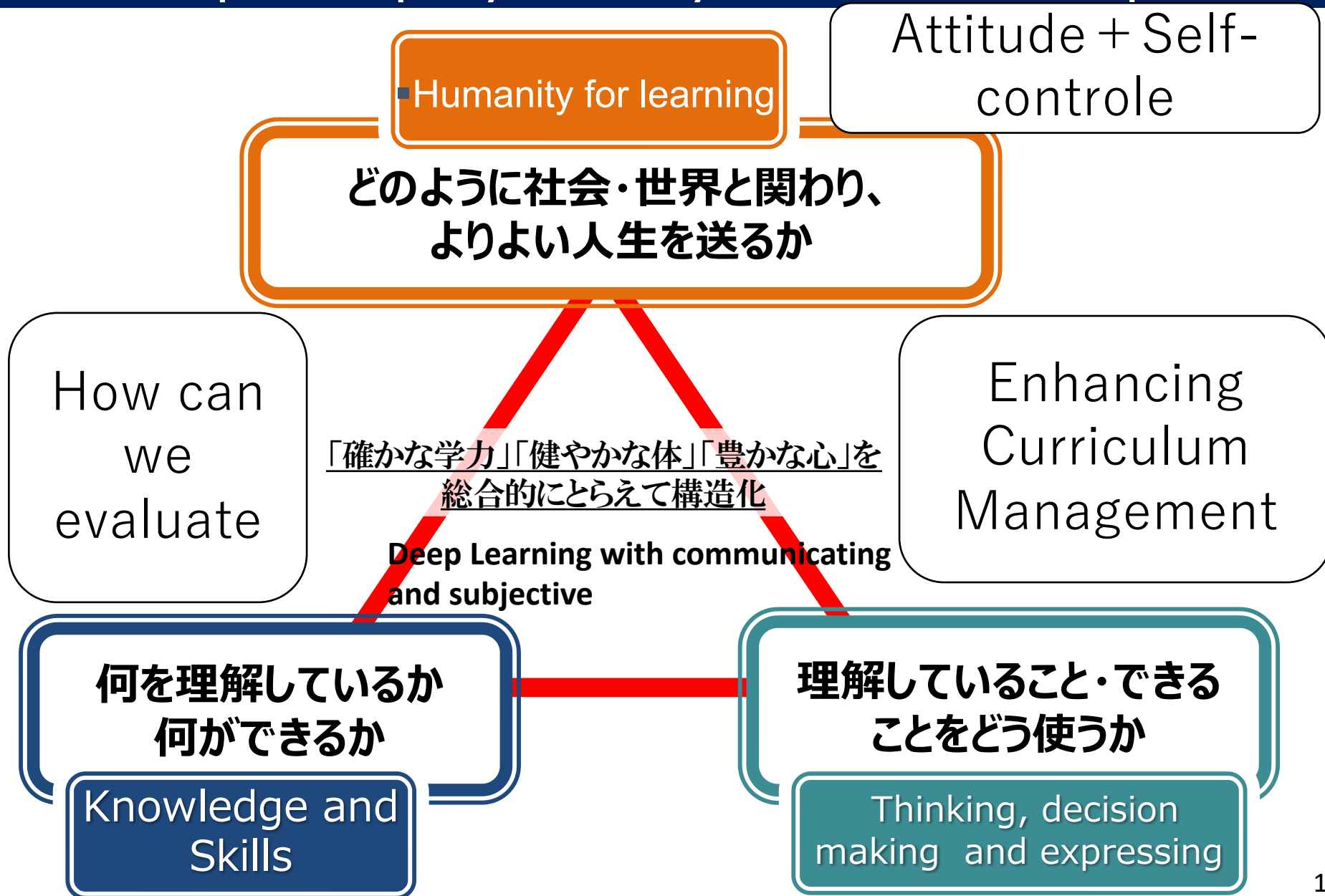
Strangeness of human race

- Human can have the idea by themselves with having objective for seeking the better society and life by utilizing their sense furtively.
- Human can produce **understandable and reasonable solution** depending on the objective with **collaborating others** in various context.
- For producing, human can summarize their ideas for unknown tasks based on their understanding the information and find the necessary expressions for others.
- Human can **search the necessary information** depending on the objective **by setting the objective itself** for themselves under their understanding the situations on mixed diverse contexts in their environments.

What should be improved.

- What they become in able to. (competency)
- What do you learn?(Organization of Curricula)
- How they learn. (teaching academic subjects)
- How we support every students under their different stages of develop. (based on the development)
- What they are acquired. (assessment)
- What shall we need for implementations (strategy)

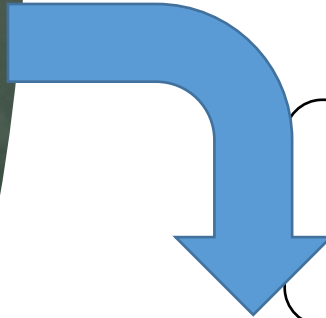
Three pillars of quality and ability that should be developed.





Teaching

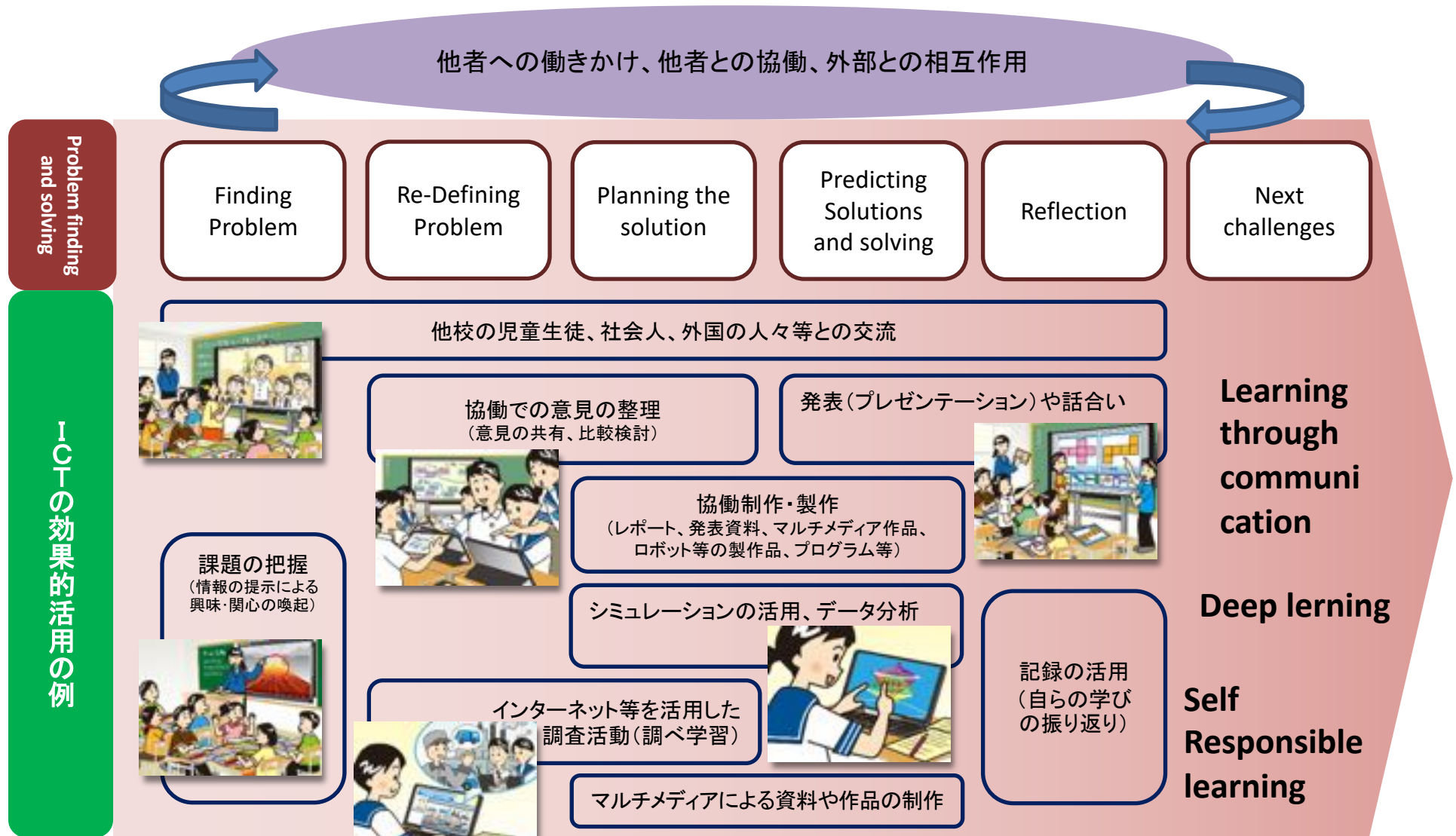
Paradigm shift



Learning



Utilizing ICT on the leaning process for Active Learning



※総則・評価特別部会第4回(平成28年1月18日)資料における整理

上記のプロセスの全てに当てはまる活用

個に応じた学習

遠隔教育

家庭学習・反転学習

障害の状態等に応じた指導

留意すべき点

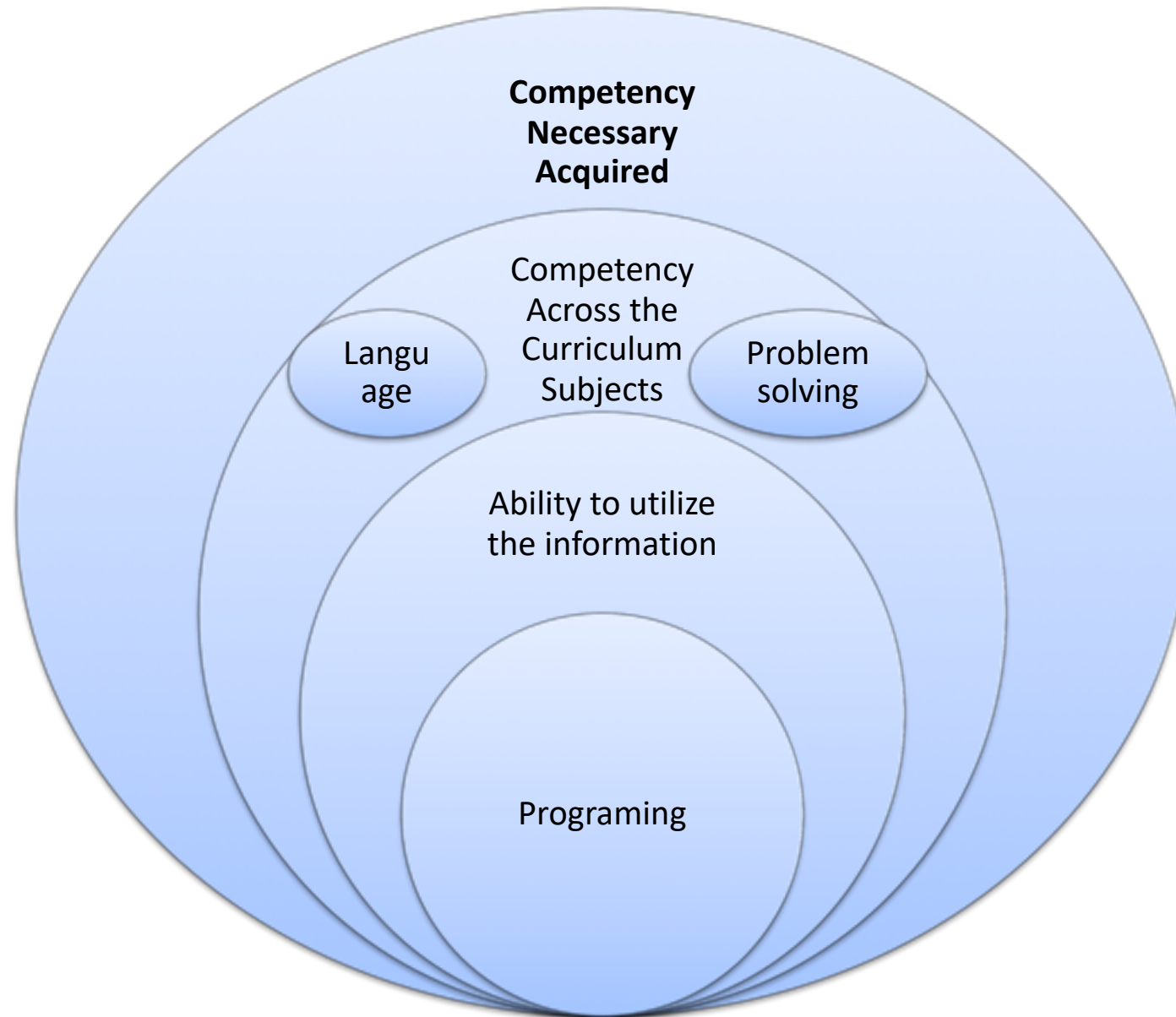
- ✓ 各プロセスと活用例との対応は例示であり、上例に限定されるものではないこと
- ✓ 学習活動のつながりと学びの広がり(例えば、対話的な学びが起こりつつ、深い学びや主体的な学びも実現されていること)を意図した、単元の構成の工夫等が望まれること

Scientific Understanding of Information

- Understanding role of mediational means which are the bases of utilizing information, and understanding basic theories and methods for assessing and improving the utilizing information
- Elementary School
 - Appropriate understanding of mediational means
 - Basic operations and programing on the academic subjects
- Junior high School
 - Basic information processing, Network for informatics communication
 - Measuring and controls, Interactive-bidirection programming by using network
- Senior high school
 - Problem finding and solving, Designing information, Programming, and utilizing the data

Appropriate using by knowing the mechanism

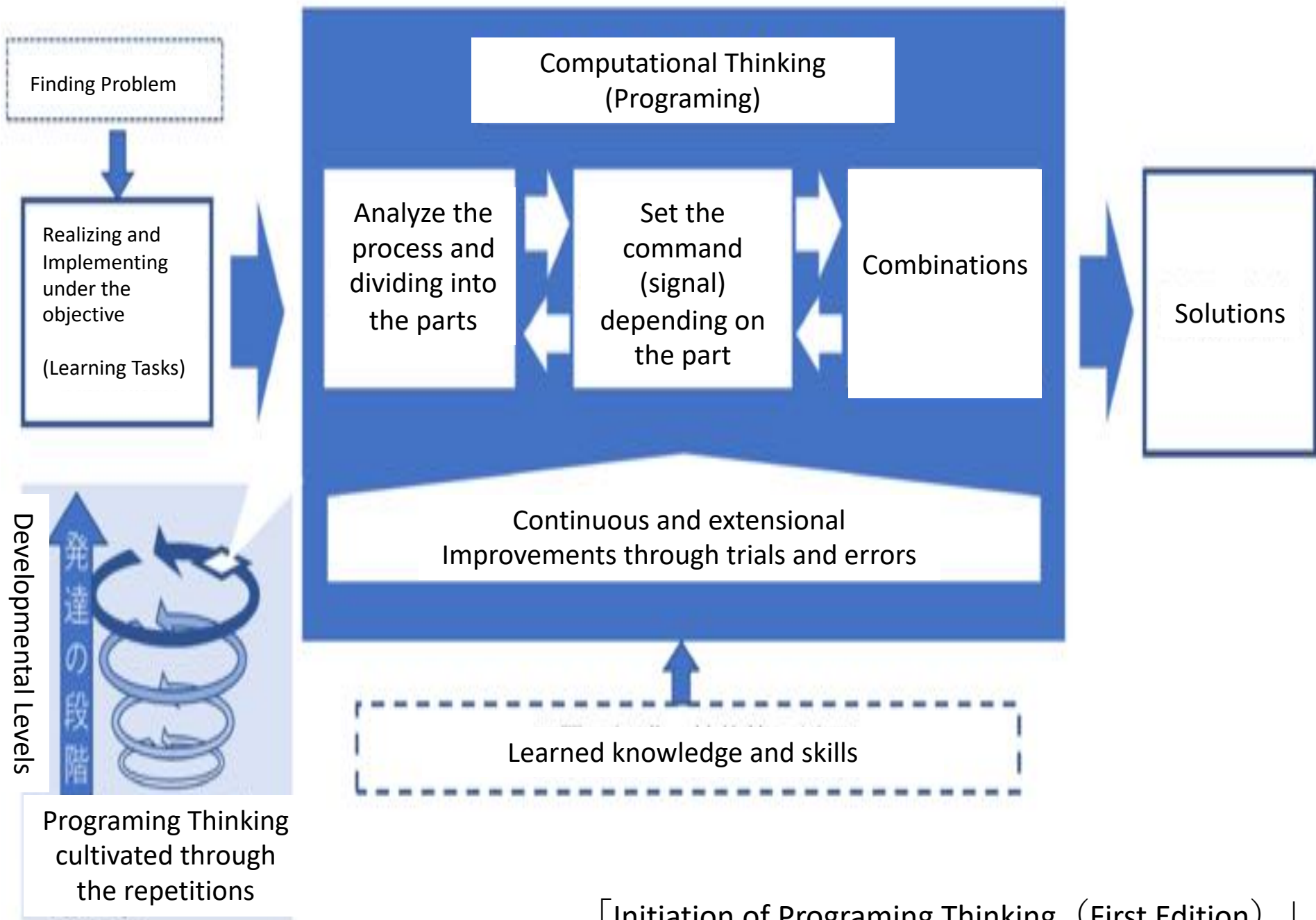
Position of Programming



図は小学校学習指導要領総則などから整理したもの



Utilizing computers are necessary for any activities in future society



「Initiation of Programing Thinking (First Edition)」

Information Education depending on the developmental levels



Primary School



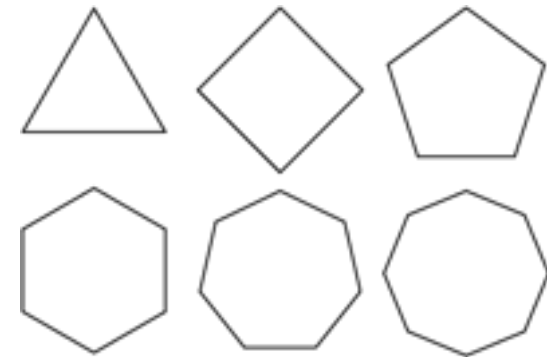
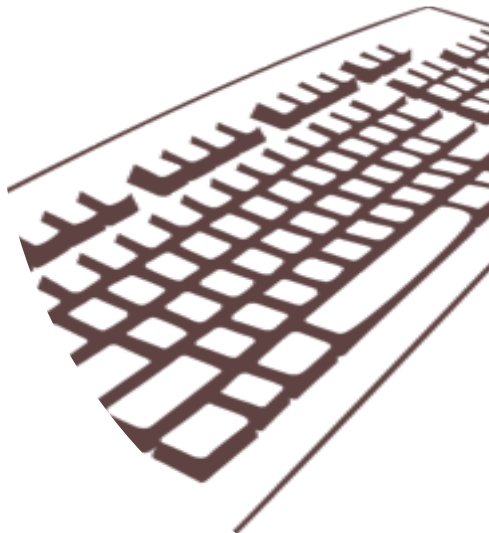
Junior High School



Senior High School

Primary School

- Teaching depending on the levels
- Well Balanced Teaching
- Well Sequenced Teaching during 6 years



Categories of Learning Activity on Programing

A Implementations of units on the exemplar in the national curriculum standards

B Implementations in subjects on the national curriculum standards, not exemplified

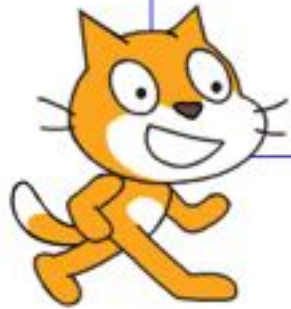
C Implementations on the school curriculum beyond the subjects on national standards

D Selectable subject such as a kind of club-activity within the school curriculum

E Using school but beyond the school curriculum

F Opportunity of the out of schools

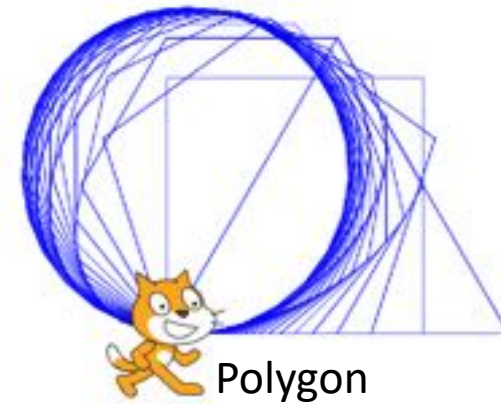
Properties of Polygon



Procedure

Walk straight
Tern 90 degree
Walk straight
Tern 90 degree
Walk straight
Tern 90 degree
Walk straight
Tern 90 degree

Math



Programing

Improved

```

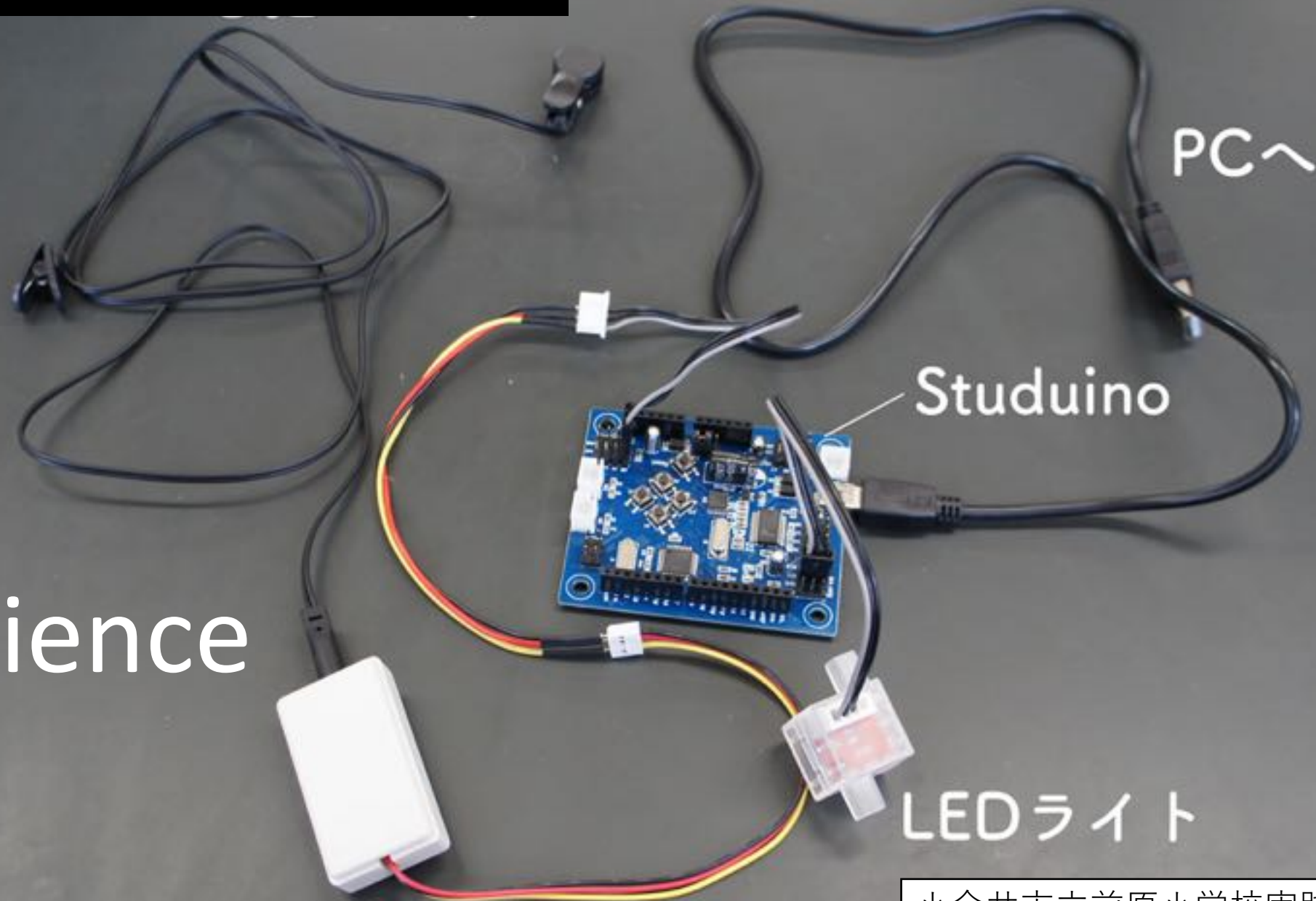
a  キーが押されたとき
  消す
  ペンを下ろす
  200 歩動かす
  90 度回す
  200 歩動かす
  90 度回す
  200 歩動かす
  90 度回す
  200 歩動かす
  90 度回す
  
```

```

b  キーが押されたとき
  消す
  ペンを下ろす
  4 回繰り返す
    200 歩動かす
    90 度回す
  
```


Heart Rate sensor

Science



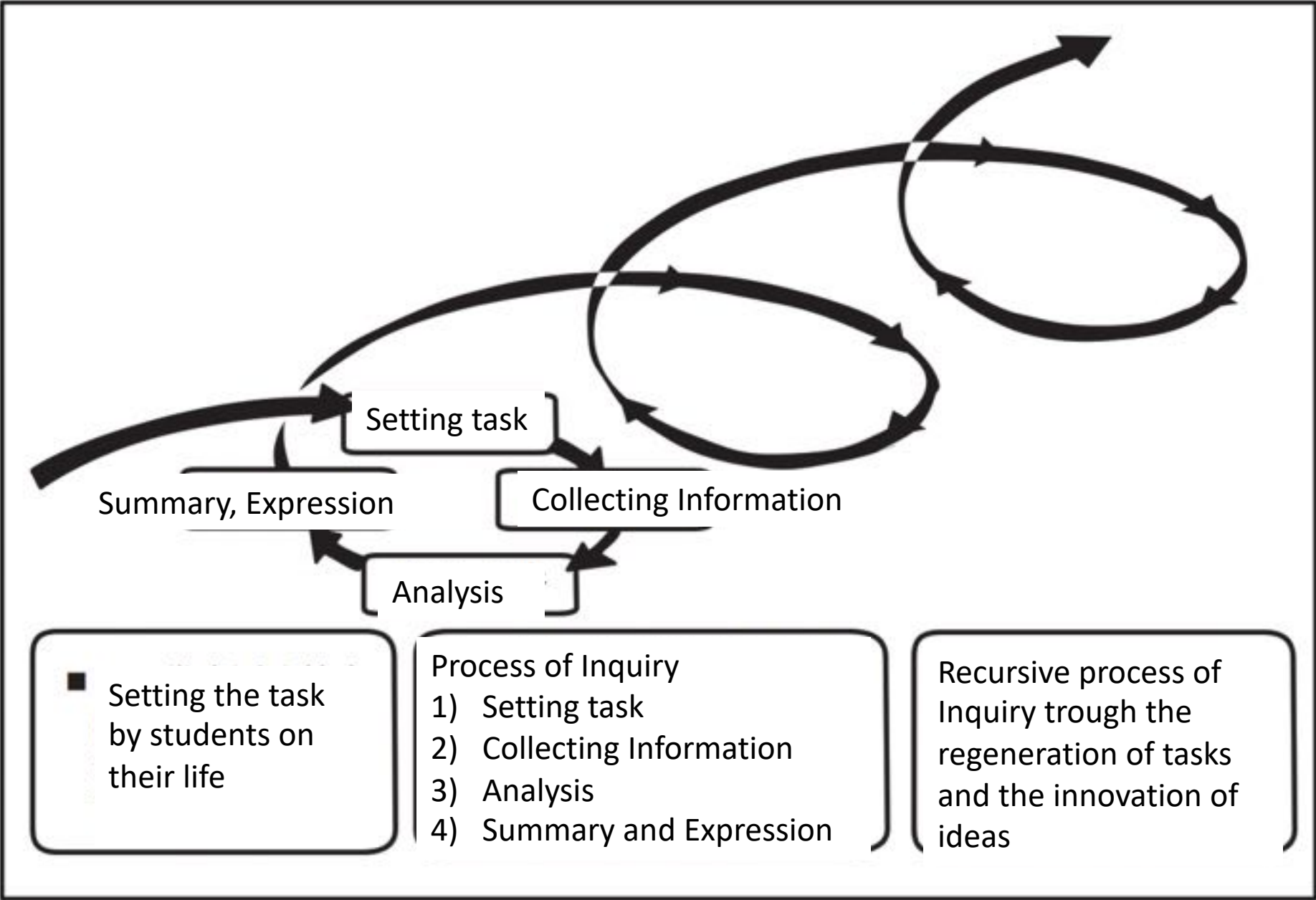
Time for Inquiry Activity



What is ongoing in the Auto Bending Machine ?

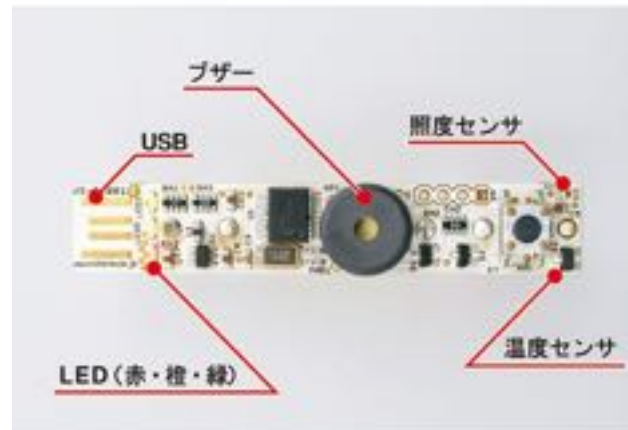
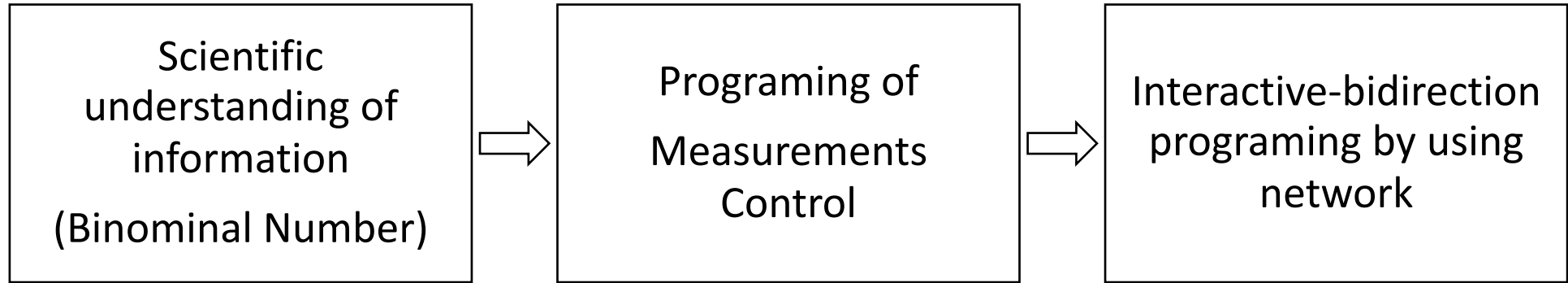
- Be run by a program
- The program is in the machine.
- an order that causes a machine to do what a person thought
- efficiently sequenced
- familiar program
- a program that maintains a lifeline
- Use of AI, big data and robots
- (Light) Life becomes more convenient
- (Shadow) misuse of programs, defending
- What is humanness?
- What can only human beings do?
- How do you live as a human being?

The process of students learning on Inquiry Learning

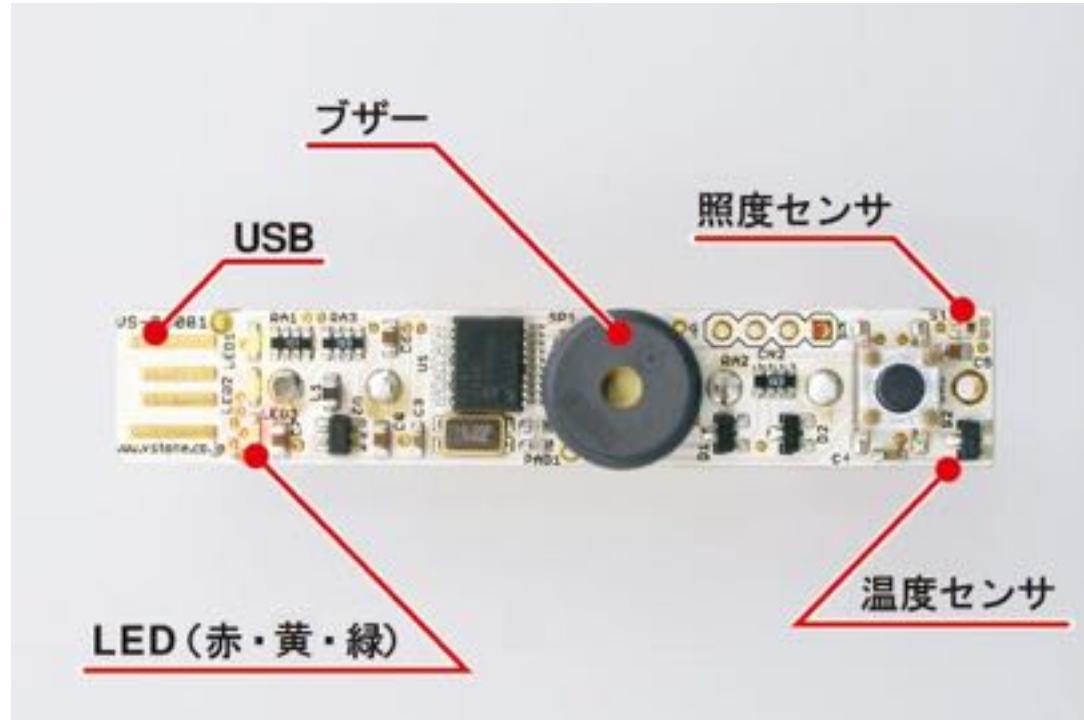


Joiner High School

- Teaching at the technology area, mainly
- Scientific understanding of information
- Simple programming

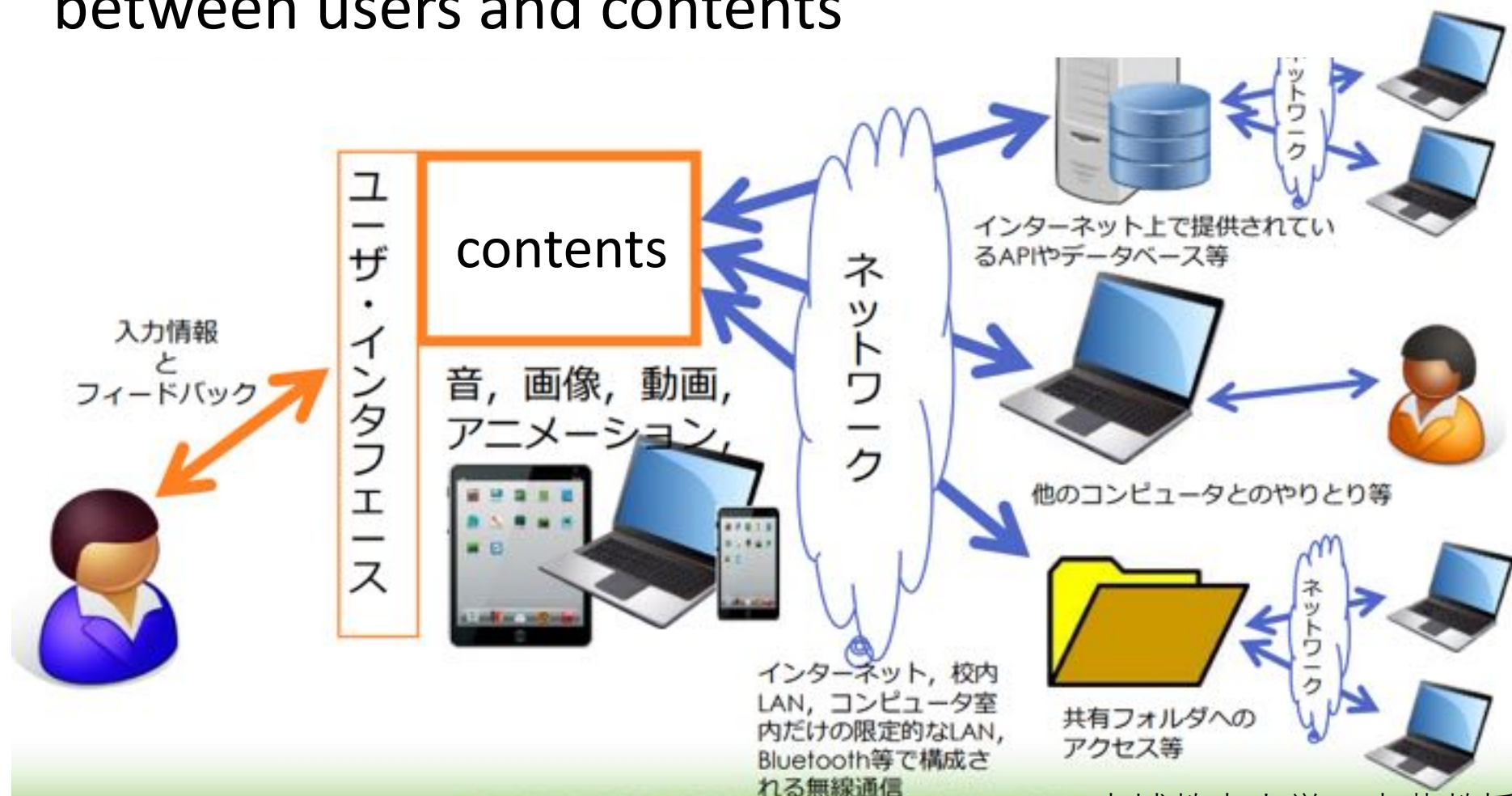


Programing of Measurements Control



Interactive-bidirection Contents by using Internet

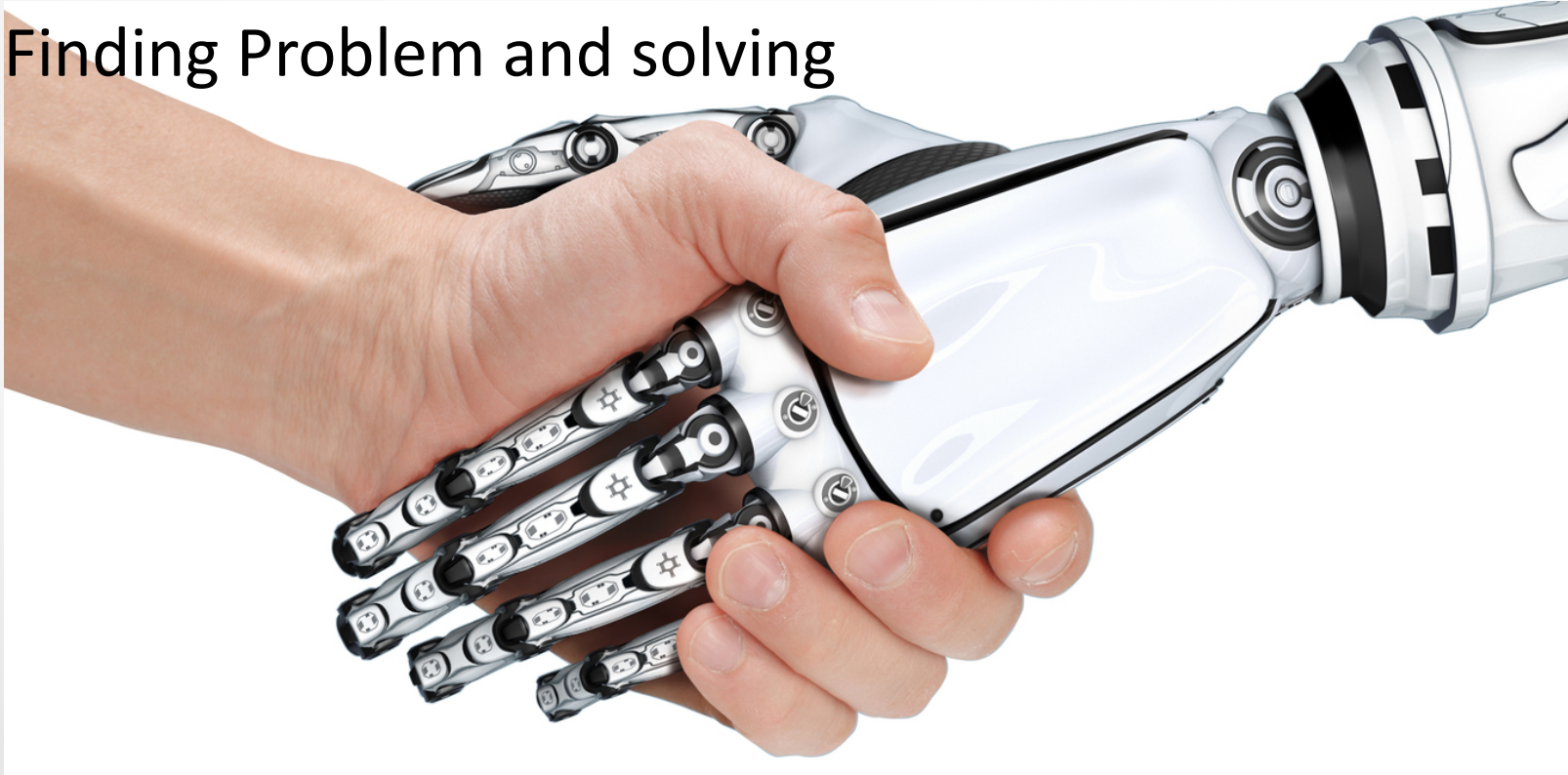
Exchange Information with bidirection between users and contents



Senior High School Information I

Necessary Competency as a Citizen

Finding Problem and solving



Concept of
Information Design

Computer System
Network
Programing
Working with Data

Senior High School, Information II

Competency to find higher problems and solutions

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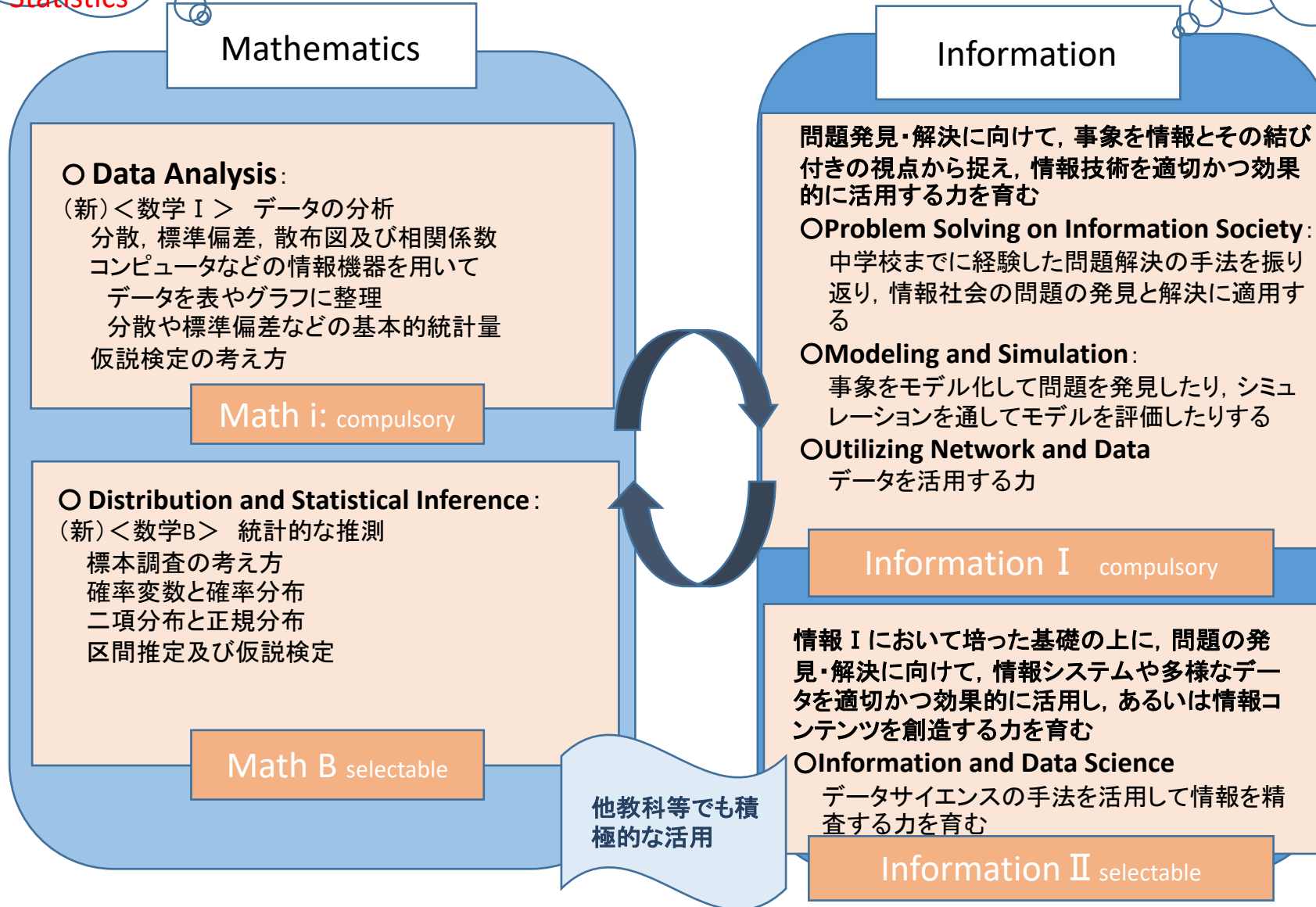
Changing Society
Changing Competency
Utilize Information Design

Programing the System
Data Sciences
Machine Learning and AI
Inquiry and Creation of Value

High School Mathematics Enrichment of Statistics Education

Basic
Knowledge and
Skills for
Statistics

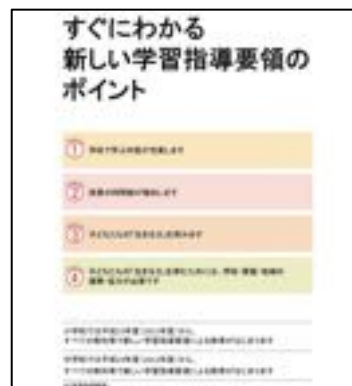
Utilizing
Statistics



I (2) Desingning Communication and Information

- Information design means the basic design knowledge, representation skills with technology which promote the appropriate communication and problem solving under the clear objective and intention as for understandable for others and operational by others.
- Information design is necessary ways of thinking for utilizing Algorism, Programing, Network and Data
- Through the concreate experience of making posters and Web pages, develop the practical competency such as accessibility, usability, universality, colure and architect, and logic and so on.

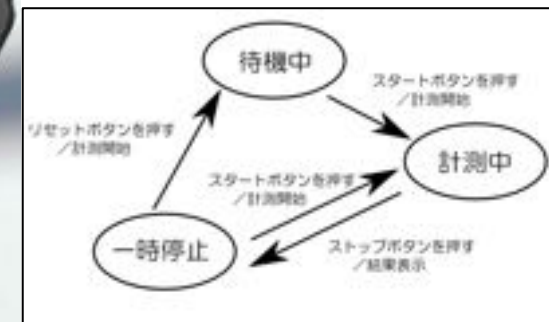
Representation



Functions



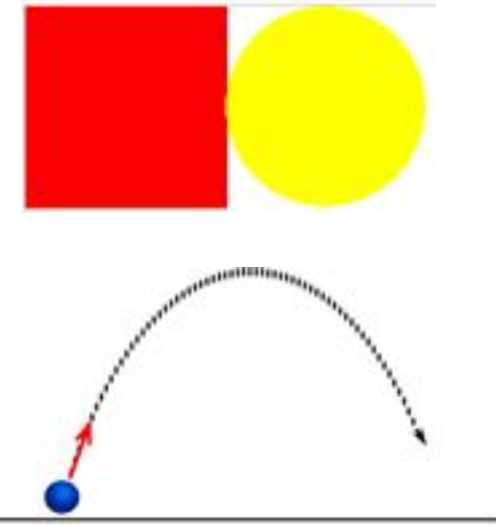
Logic



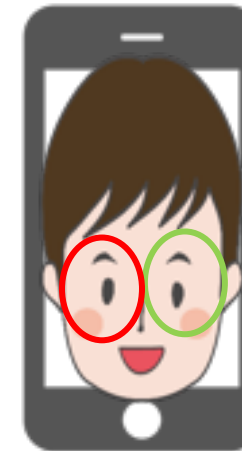
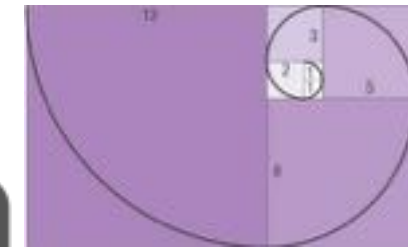
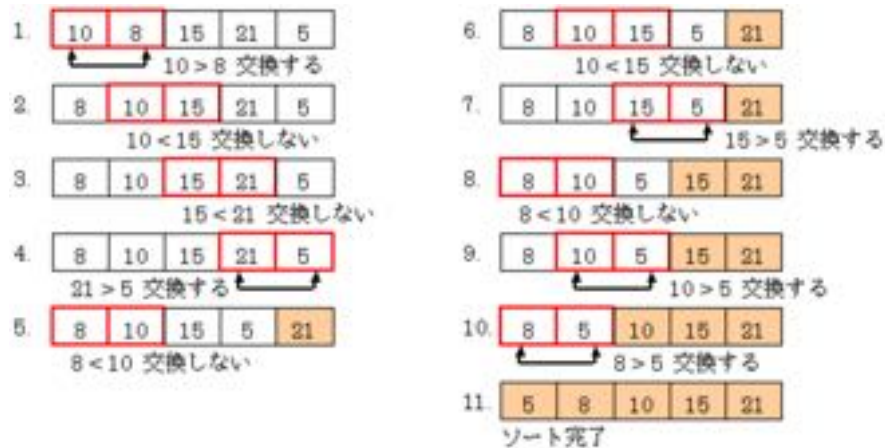
ストップウォッチの状態遷移図

I (3) Computer and Programming

- Computer system and functions
- Inner representation and Digitizing Error
- Modeling and Simulations
- Various Expressions of Algorithm
- Preferring appropriate programming language
- Teachers and students chose the language
- Structured language with a set of functions
- Network is learned at Junior High school



(Ex)Rearrangement (Sorting)



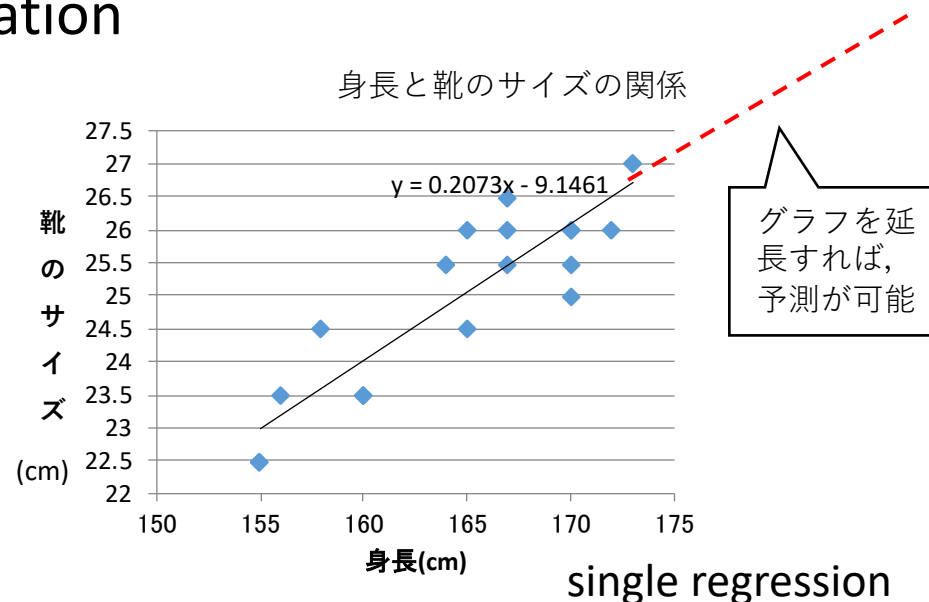
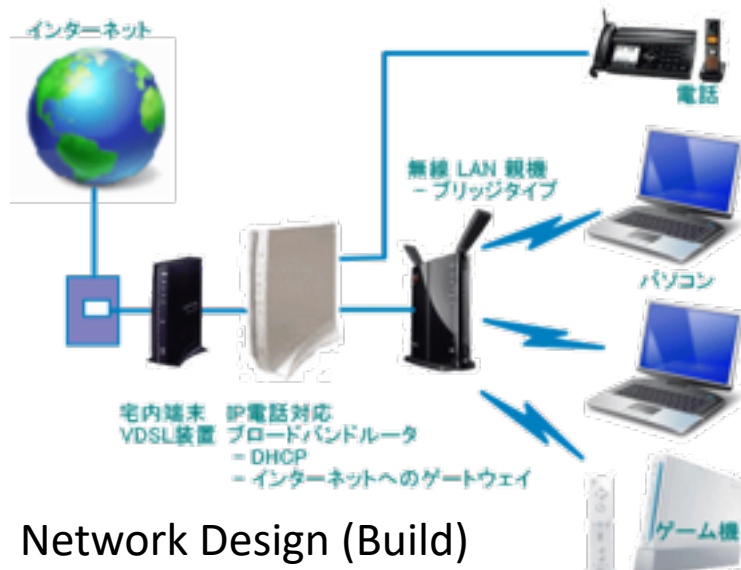
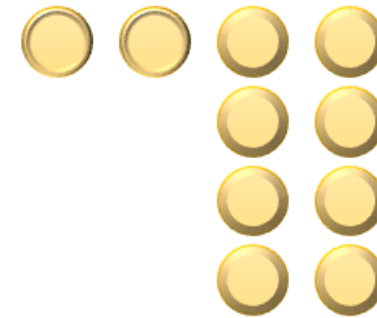
Learn through programming, learn programming, and utilizing programming

I (4) Information Communication Network and Utilizing Data

- System and protocol on the Network
- Designing the local network
- Security with both cable and wireless
- System for storing, managing and offering data
- System for service and using
- Collecting, arranging and analyzing data
- Data handling of different format or levels of scaling
- Qualitative and quantitative data
- Statistical treatment and interpretation

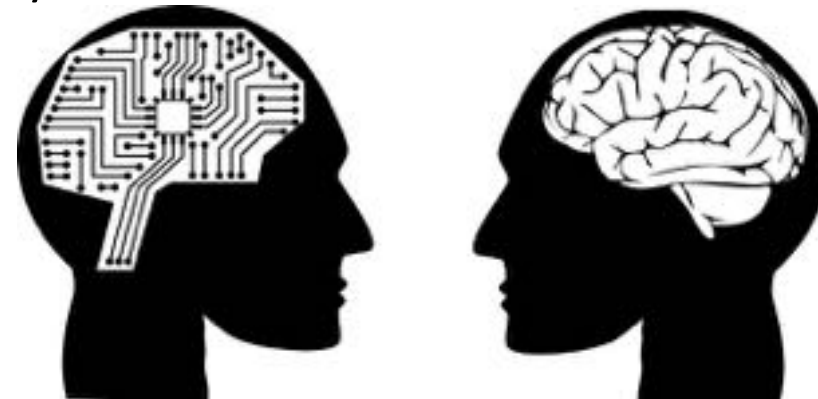
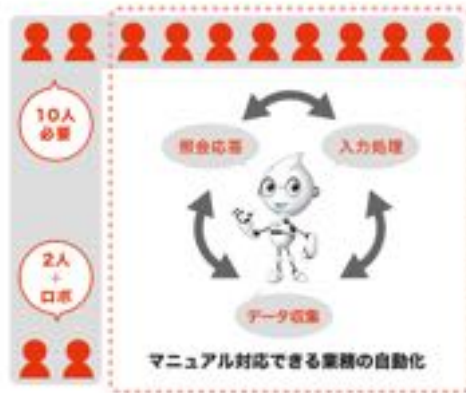
Test for comperison

表2回 裏8回



Ⅱ (1) Progress of Information Society and Technology

- Reflect on Information I (1)~(4)
- Initiation of Information Ⅱ (2)~(5)
- Development of Information Technology and Society
- Utilizing Laws with understanding and objective
- Considering Future Information Technology and Society
- Distinguish the roles of Information Technologies and human roles.
- Changes of Human Roles, Interagency and Jobs
- Changes of Human Competencies
- Utilizing Information Technology Appropriately



Progress of IT→Changing Society→Changing Necessary Competencies→continuous learning

II (2)Communication and Contents

- Utilizing Information Design on Infomatics I (2)
- Considering combination of appropriate mediational means for the form of communication depending on the objective and situation
- Develop, evaluate and revise the contents
- Acquiring to post the contents with considering the influence and effects, and evaluate and revise them
- Using self and mutual assessment by using the assessment standards such as rubric



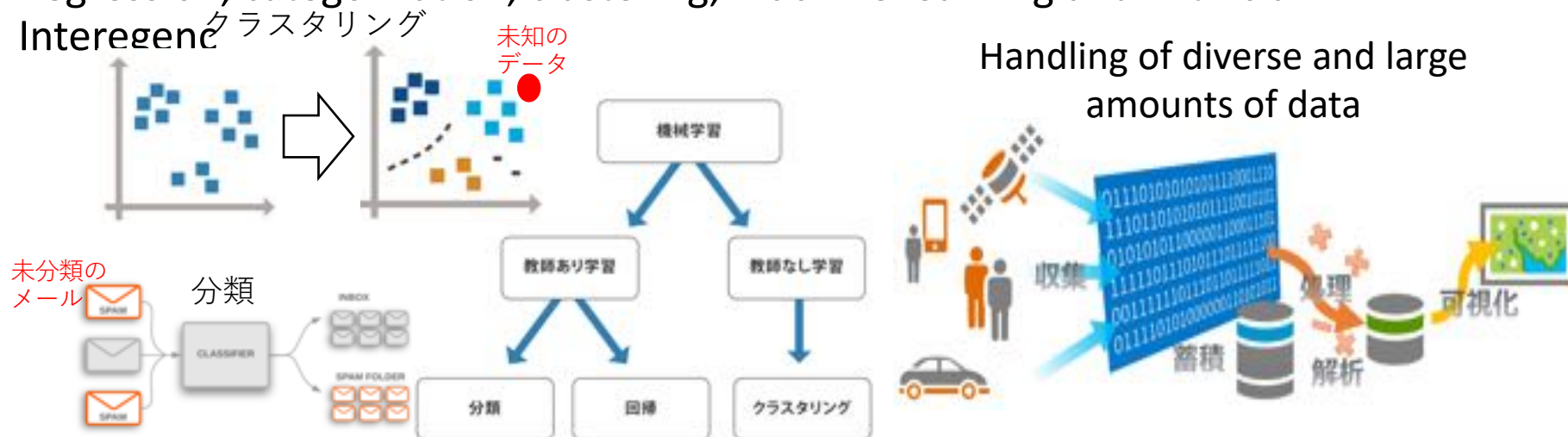
CLI → **GUI** → NUI → OUI

Utilizing Designing → appropriate assess. → Self-reliance/esteem, and self control/regulation

II (3) Information and Data Science

- Significance of utilizing big and various data
- Role of Data Science in Society
- Data analysis by using data science
- Modeling the phenomena by using data for predications and relations
- Evaluate the conclusions
- Improvements of model, computation, interpretation, and representation
- Data collection, arrangements and formatting
- Treatments of lacking value and out layer, reliance and confidence
- Regression, categorization, clustering, machine learning and Artificial

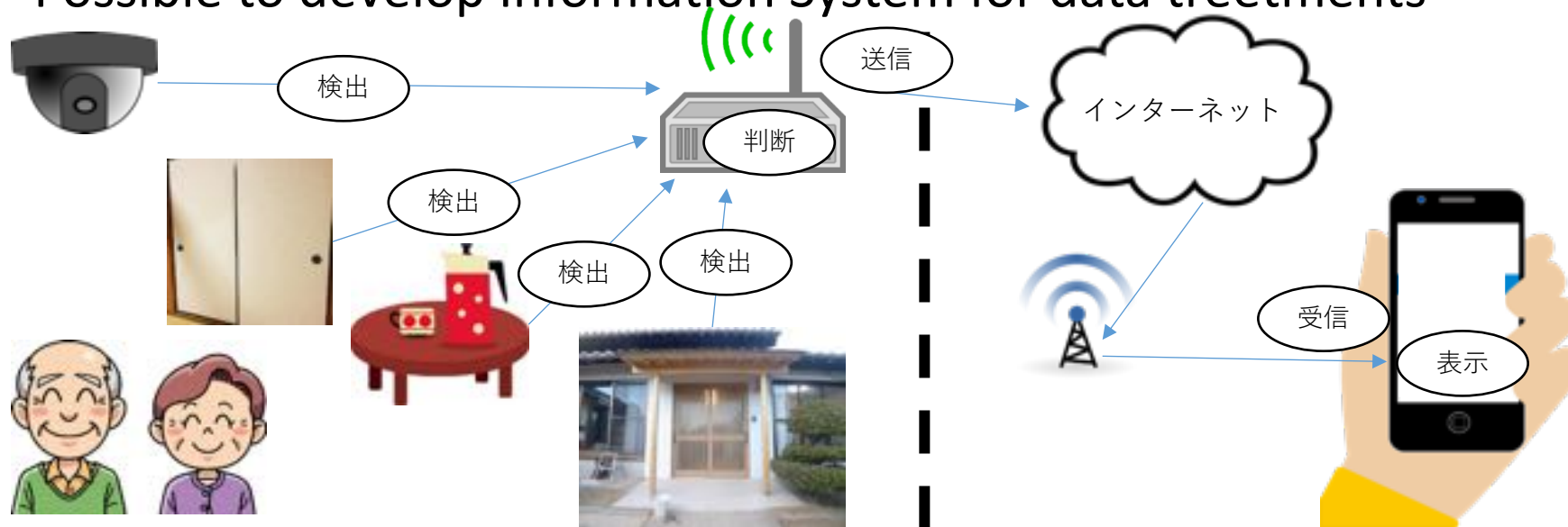
Data
Analysis
↓
Modeling
↓
Prediction
↓
Machine
Learning
↓
AI



※メールの分類にはベイズ統計などが使われている

Ⅱ (4) Information System and Programming

- Understanding Information System and its effect and influence to the society
- Necessary condition of system: Its analysis, dividing, designing, explaining, and project managements
- Cording and Testing of the Divided Information Systems and Integration
- Assessing and improvements in process
- Possible to develop Information System for data treatments

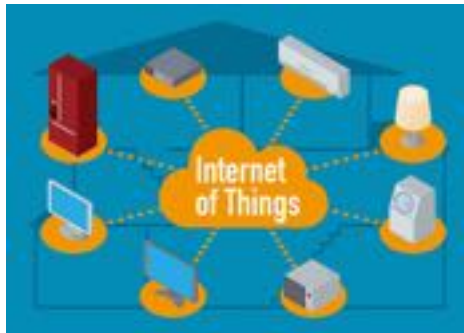


Designing System→Dividing→Cording→Integration. Total managements

II (5) Inquiry of Problem Finding and Solving by utilizing Information and Information Technology

- Basic System of Computer and Information System and Using
- Using established Simulations, Systems and Outside-Technology
- Utilizing Information Skills for Communication
- Contents Developments, Combination, Virtual, Augmented & Mixed Reality, and Projection Mapping
- Utilizing Information Technology for data handling
- Data handling and combining for problem solving
- Information Society and Technology
- Considering the changing society by using AI and changing necessary competency and jobs
- Multi tasks
- Developing the attitude which produce new Value through innovation.

Inquire
↓
Utilize
↓
New Value



Teacher Training

西暦	Info. I	Info. I textbook	Info. II	Info. II textbook	National test(検討中)	Achiv. test (検討中)
2018	研修資料 作成				問題募集 検証	
2019	各都道府県 で研修の 予算請求		研修資料 作成		問題募集 検証	
2020	研修実施	検定	各都道府県 で研修の 予算請求			
2021	研修実施	採択	研修実施	検定	実施大綱	
2022	授業開始	使用開始	研修実施	採択		
2023			授業開始	使用開始	実施要項	実施要項
2024					大学入学 共通テスト 情報 I	大学入学 個別テスト 情報 I・II

For Imprementing Curriculum

