

Information Education in Japan: Current Status and Future Directions

Yasushi KUNO*

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1 Agenda

- Information Education in Japan
 - History and Current Status (briefly)
 - Many Problems (briefly)
 - Why Information Education? (briefly)
- Activities Toward the Future
 - New curriculum proposals
 - Evaluation / University entrance exams
 - Educational programming languages / environments

2 Information Education in Japan (history)

- until 1990s: "to be carried out in each subjects"
 - no teacher training
 - a little computer topics in math (programming)
 - ==> not effective
- Mext recognizes importance of information
- Mext's research committee ==> report (1997)
 - Goals for infomatics education
 - New subject area in highschools: "Information"
- Goal: Abilities to survive "Information Society"
- Practical ability toward information usage
 - Appropriate usage of information media/equipments
 - Collect/judge/represent/process/create information on its own
 - Output information with receiver's status in mind
- Scientific understandings of information
 - Know various properties/principles of information
- Social participation to information society
 - Understand roles and effects of information
 - Understand needs for "information morals" and responsibility
 - Willingness to participate in creation of ideal society
- Teaching guidelines for "information" subject area (1999)
 - 3 subjectes: Joho A/Joho B/Joho C
 - All contains three goals (Practice/Science/Social), with different weights
- Problems...
 - Blurred distinction (A/B/C names, same goals)
 - Class hours: 2 unit (minimum)
 - Joho A: easy subject (not mentioned in Mext committee)
- New subject started in S.Y. 2003
- Next teaching guidelines ... announced in 2008
 - Two subjectes: "Science of Information", "Society and Information"
 - Descendant of "Joho B"/"Joho C" respectively
 - Easy subject "Joho A" dropped
- How about in elementary and junior-high schools?
 - Japanese school: strongly subject area-based
 - No "information study" subject in elementary / junior-high schools
 - junior-high "technology and homework" contains some ICT education (hours are not enough; no "information expert" teachers)
 - Mext says that all subject should participate in information education, but actually not realized
- How about in universities?

*Faculty of Business Sciences, University of Tsukuba, Tokyo

- "General information education"
- Some universities teaches principles and systematic curriculum
- Other (many) colleges simply teaches usage of MS-office

3 Strong and Weak Points of Japan

□ Teacher Problems

- Large teacher needs when new subject started
- Gave licences to science/math teachers with 15-days training (14,000 teachers in total, in 2000-2002)
- Non-professional teachers: could only teach software operatin
- Many teacher posts are still occupied by such teachers

□ Ignorance Problems

- Managers'/Govrnments' idea: "information" is just a computer school and not important
- Leads to insufficient resource allcation and (maybe) neglection
- Doesn't recognize problems even when what is taught is not as what the next teaching guidelines defines

□ Problem of No choice for students

- Mext says: students should choose which subject to take according to their interests
- Actually, most school teaches opens one subject, so no choice
- "Joho A" (easy subject) was the majority (80 percent)

□ Teacher problems (2)

- Minimum class hours ==> many teachers teach both information and other subject
- Albeit teachers, part-time license to unrelated subjects' teachers (e.g. Art, Music, ...)

□ Non-uniformity Problem

- Elementary and junior-high: Some scool invest many hours while others "none"

- Newcomers are highly varied: from "well educated" to "nothing" ==> have to start from scratch at each school
- Boring to well educated, too high hurdle to ignorant

□ Varied general information education also at universities

- In total, no "bottom line" in the knowlege/skill levels achieved by school education in Japan
- Excess variability continues in citizens...

□ GOOD: Social aspects were stated as educational goal from the start

- How to behave in information society
- How to communicate with others
- (How much of the goals achieved is another problem)

□ GOOD: Focus to creation (group problem solving, presentation)

- What we lack most in Japanese schools
- (Western schools includes such curriculum traditionally)
- (How much of the goals achieved is another problem)

4 Why Information Education?

□ The reason we need infomatics education should not be forgotten

□ Basic premise: today is "infomation society" in that...

- Information technologies are ubiquitous
- People place more and more values to information (contents, experiences)

□ Young people joining to our society needs basic understandings on information and infomation technology because...

- They have to work on many jobs (> 10) throughout their life and most of those jobs (many nonexistent today) requires IT.
- In today's society, all citizenz should posses basic understandings on what are ITs and what they can/cannot archieve, so that they can make appropriate decisions on their own.

□ NOTE: both are on "education for every people"

- IT experts are of course needed and information education should prepare foundations toward this direction.
 - However, "information fluency for citizens" should be the primary goal (my opinion).
- Japan problems: many professionals do not understand importance of IT and software development skills; they regard those as "what they can purchase with money".
- e.g. Many Japanese corporation do not hire IT professionals; they only expect some "nice" specification emerging from IT company.
 - The result is low-quality software requirement specification, low-quality and high-cost information systems.
 - Good-quality software developers in Japan are rare because many customers cannot evaluate quality and just jump into "cheap and low quality" solutions.
 - Currently Japanese corporations are acting in Japan's local economics, but in the next era of globalization...
- To overcome the problems, we should raise "basic information knowledge levels" for all people (my opinion).
- In summary:
- We should promote information education to young people because they will need those to live.
 - We should promote information education to young people because appropriate level of IT understanding for every citizens are mandatory; otherwise Japan will not survive the next era.

5 Information Curriculum Proposal for the Next Decade

- IPSJ primary and secondary educational committee have been interested in Highschool "Information Study" subject from its start.
- We have published curriculum proposal in the form of "experimental textbook" in advance each time Mext designs and publishes official teaching guidelines
 - In 2012, we have published our new version of "experimental textbook" targeting next decade guidelines (expected around 2016).

□ Our basic principle:

- Configuration: mandatory subject "Joho I" + elective subject "Joho IIB" (current "mandatory with choices" had many drawbacks).
- "Joho I" focuses on basic principle — carefully choose what it should contain. However, "programming experiences" should be included anyway.
- "Joho IIB" contains more detailed scientific contents. Difference of problem solving (Joho I: social problems and solution process; Joho II: algorithmic/complex problems).

□ Belows are brief overviews of each subject.

5.1 Joho I

□ Information and Its Representation

- definition of information, nature of information, information society
- information and media, analog/digital, representation of various information
- information transmission / expression, designing presentation

□ Computers and Networks

- structure of computers and its operation principle, software / application
- basic algorithm elements, programming language description
- network structures / principles, security, mail and Web

□ Communication and Information Morals

- communication, media literacy
- information morals / ethics, trade-offs, dilemma
- law and individual responsibilities, intellectual property
- copyright law, protection of personal information

□ Information Society and Problem Solving

- characteristics of information society, information systems w/ examples
- problem solving process, gathering / analyzing information
- execution and evaluation, PDCA-cycle

5.2 Joho IIB

□ Computers and Networks

- computers and information processing — computers as information processors, roles of software, communication with computers
- network and communication — protocol layers, routing, error control, compression / expansion, network algorithms
- information systems and information technology — modeling information systems, requirements and specification, system development process

□ Problem Solving and Computers

- algorithms and software — algorithm definition, roles of programming languages, control structures and procedures
- algorithmic problem solving / problem definition and algorithm — data structures, procedural structuring / abstraction
- modeling and simulation — role of models, various modeling techniques, simulation implementation and practice

□ Managing Information for Problem Solving

- storage and management of information and database — why storage?, database concepts and functions, roles of database on problem solving
- problem solving processes / techniques — problem discovery, problem solving, role sharing, recoding / evaluation / improvement

□ Information Society and Information Technology

- information society and information systems — roles of information systems, safety and crimes, lights and shades
- human and computers — cognitive property of humans, user interface, effects of information society over humans
- information and occupation — occupation / engineer ethics, various occupations, teamworks, project management

□ In summary:

□ Joho I

- Mandatory subject, basic bottom-line for future citizens

- Balance — technology (incl. programming) and socials

□ Joho II

- Elective subject, more technology-oriented (for future engineers)
- Detailed network technology, detailed programming (more on algorithm), database and data management
- Social part: more of developer's side, HCI, engineer ethics, PM

6 "Information" University Entrance Exams

□ For any subject, proper evaluation method is mandatory.

- Japan's specific situation: no common graduation exam for highschool ==> university entrance exam conveys such roles
- Major subject area (national language, math, English, science, social studies): "center exams" forms common basis
- No such method for "information" yet — no "center exam", few universities set question on "information"
- RESULT: "information is unimportant subject area" (many teachers' / school managers' recognition)

□ JNSG — Joho Nyuushi (Information Entrance-exam) Study Group (2011.1-)

- Develop "standard information exam problem set" as common evaluation criteria.
- Promote "information exams" for more university to include in their entrance exams.
- Mock entrance exams for year 2013, 2014, 2015 so that more students / teachers would recognize information as major subject area.

□ Problem set #001 — made public on Oct. 2012

- Part 1 — common questions (8 questions)
- Part 2 and 3 — science of information
- Part 4 and 5 — society and information

□ Part 1 — common questions: various related materials; both multiple-choice and written questions

- (1) difference among analog and digital.
- (2) definition of "digital" (written question).
- (3) question on security (require understanding of why some activity is prohibited).
- (4) organizing e-mail messages (actual experiences will help).
- (5) wiring of LAN (actual experiences will help).
- (6) question on information ethics (require understanding of reasons).
- (7) question on matters enabled by computers / networks (require understanding of essential component for each case).
- (8) question on information coding (actual experiences will help).

	student whole	
number	47	89
highest	90	99
lowest	16	16
average	34.1	53.0

100-9	10
90-81	9
80-71	11
70-61	6
60-51	2
50-41	6
40-31	7
30-21	19
20-11	10
10-0	0

□ Part 2 — Programming

- Program lines are response alternative ==> choose those line-by-line and compose correct program
- Traditional form: complete-the-blank questions (could be answered by memorizing)
- We would like to see the "real" programming ability.

□ Part 3 — Database

- Small fraction of students will actually learn database (relational mode, SQL, ...)
- Our question will readily be answered if students have experiences with spreadsheet data processing (or maybe with just thinking on the fly).
- We would like to stress importance of data manipulation.

□ Part 4 (and Part 5; which were not included here) — Society and Information

- Reading long sentences on specific theme (related to social aspect of information)
- Both reading / comprehension abilities and knowledge related to "society and information" (e.g. security, copyright, network technology, information systems) are required

□ Prompt report: mock exam using set #002 on May 18, 2013.

- Levels of set #002 are similar to set #001 (as we expect).
- About 80 attendans (half of them are highschool students)

□ In Summary:

- JNSG are proposing "information" university entrance exams.
- Conducting mock exam on 2013, 2014, 2015.
- GOALS: establish standard evaluation criteria for "information", promote presence of "information" subject area.

7 Programming Education: Reasons and Points

□ Programming were mandatory in old-age computer education because:

- There were no ready-made application software.
- One had to craft one's own program to achieve something important.
- In those ages, programming classes were ubiquitous.

□ Today, one need not program because software are readily available.

- In spite of the fact above, we believe that programming should be mandatory in information education.
- Other countries (UK, USA) moving in this direction.

□ The reasons we should teach programming:

- to understand essence of computers and its universality.
- Knowledge of application are not general ones and also outdates quickly, while programming principles do not change.
- One should know how to "create new thing" with computers.

- Making things are attractive topics for students.

□ However, we should be aware on the past failures and be careful not to repeat them again:

- Using unsuitable language for education (e.g. BASIC and LOGO are very old languages and has large gap on learning)
- Concentrating on programming language syntax and teaching them one-by-one (we should concentrate on writing actual, fun-to-make programs).

□ Following three points should not be missed:

- GOAL: "experience programming to come into contact with the essence of computers."
- SHOULD: choose appropriate language / environment according to students' interests and concerns.
- HOW: "create and observe what children conceived," "children approach the lessons by thinking on their own."

7.1 Educational Programming Environment

□ Traditional Languages (BASIC, LOGO, ...) *could* be used for education, however...

- Many obstacles ==> need careful workarounds (by experienced teachers)

□ New Educational Languages:

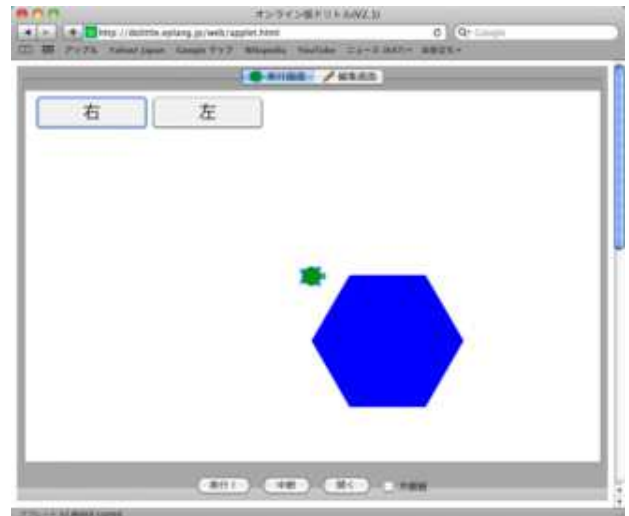
- Far less obstacles which trap children
- Appropriate environment for various concerns / needs (examples below)

7.2 Dolittle

□ Educational, Japanese-based, O-O language (Kanemune and Kuno)



- Japanese ==> could be used for pre-English age pupils
- Turtle graphics (from LOGO) — good starting point for children
- Object orientation — various useful parts can be programmed
- Text-based ==> smooth transition to traditional language

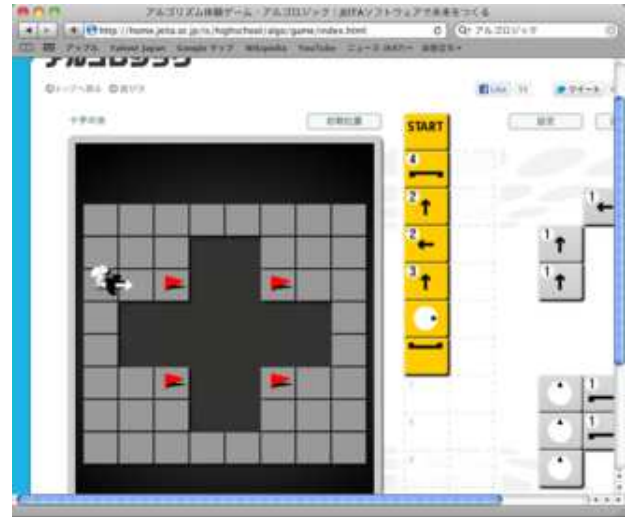


7.3 Scratch

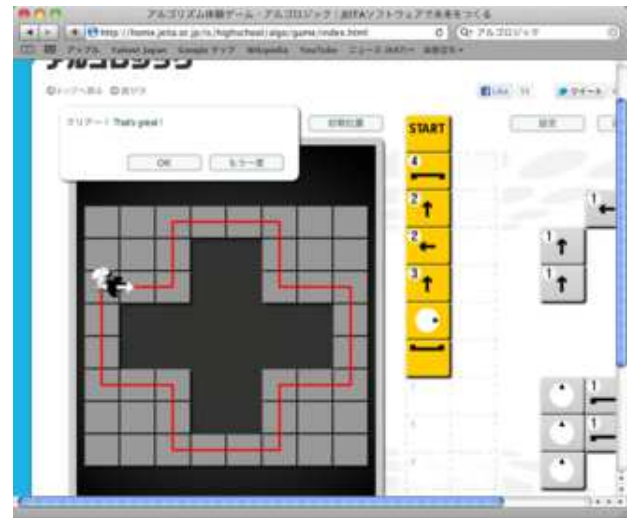
□ Programming Environment from MIT (successor of Squeak eToys)



- Block-based ==> no text typing, no syntax error
- Many workshops, materials, on-line sites and communities.
- (Mext also developed block-based environment called "programmin")



- Moving robot on grid-plane using block-composed programs
- GOAL: take all "flags" placed on some of the places
- Success if all flags are cleared; emphasis on short program ==> strong taste of puzzles / games
- A kind of "gamification-based" programming education?

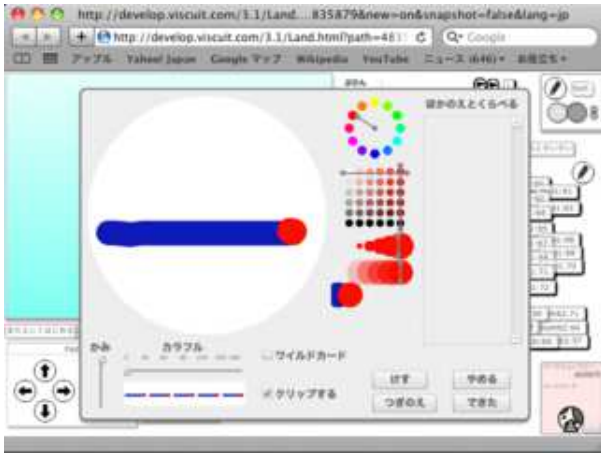


7.4 Algologic

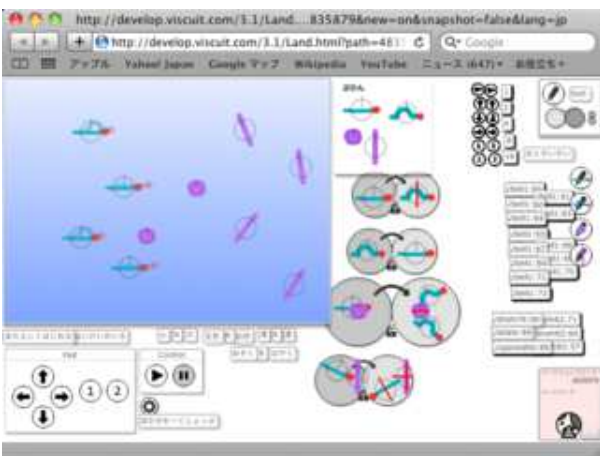
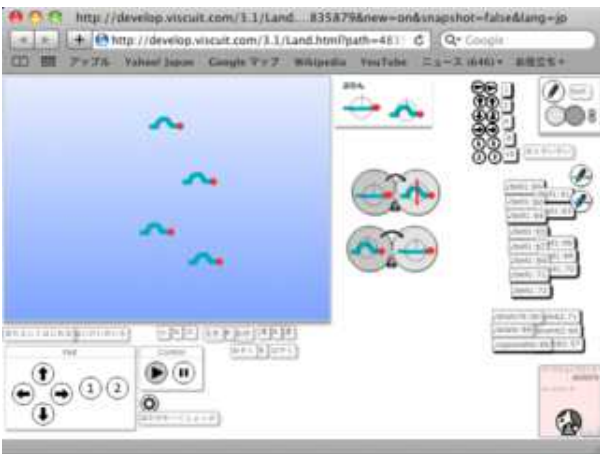
- Block-based virtual robot programming by Oyama (JEITA)

7.5 Viscuit

- Rewriting-based program on freehand drawings by Harada (NTT Labs.)



- No text / instruction, only pictures ==> OK for preschoolers
- Simple "glass" (rewriting rule)-based program can make various interesting movement ==> basic characteristic of computers.
- Aesthetic perspectives (handwritten pictures, colors, movement)
- (often used in workshop-like setting)



7.6 Status of Practical Applications of Programming Education

- Highschool — included in "Joho B" (old teaching guidelines) and "Science of Information" (new ones),
 - However, those subjects are minor (around 10 to 20 percent).
- Junior Highschool — mainly by some ambitious teachers
 - Subject of technology includes "measurement and control" materials ==> many corporation sells program controlled toy cars w/ sensors.
 - Most technology teachers have weights on wooden / metal crafting
- Elementary School
 - No regular school curriculum for programming
 - Local government-based clubs, NPO-based after-school class, etc. (e.g. Viscuit-Juku, TENTO programming school, ...)
- In summary:
 - Development of many ambitious programming environments are under way.
 - Needs for programming education is becoming widely known.
 - However, ordinary teachers are too busy in other problems.
 - Also, they are reluctant to teaching programming because most of them have not majored in sciences.

8 Review of Agenda

- Information Education in Japan
 - History and Current Status (briefly)
 - Many Problems (briefly)
 - Why Information Education? (briefly)
- Activities Toward the Future
 - New curriculum proposals
 - Evaluation / College entrance exams
 - Educational programming languages / environments