Method of e-Means/Infrastructure for Information Design Oriented Quality Training of Mathematics Teacher

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Abstract

Japan is in the course of conforming its system, including education, to the new structure and concepts of *well-being*. Teacher training is regarded as training designer of educational well-being which leads students to their present and future well-being. This theme becomes practical by means of "digital power", that is e-means/infrastructure. I have been developing the method of e-based teacher-as-designer training, through my practice of assigning students e-based mathematics information design practice in regular mathematics education course. The prime elements of the method are: information design task assignment, web-based education system, subject/essence-oriented, performance-as-task-result evaluation, self-contained structure of course.

1. Introduction

In Japan, a culture where both individuality/diversity and competency are strongly oriented is on the way to be formed. "Conforming the existing to the new situation" is subjected in every field.

In case of education, this subject takes forms as:

(a) Inquiry into the meaning of "well-being" in such a culture where both individuality/diversity and competence are strongly oriented.

(b) Design of the study course where students are disciplined to the type of ability: (1) creating/ developing a well-being for the public (*ability for the good producer*); (2) creating her/his own well-being (*ability for the good consumer*).

I propose a *well-being* of education and corresponding design action. To be close, I discuss a method of quality education at a traditional mathematics teacher training course, in the following frame :

(1) Destination : Quality education which educates "quality mathematics-education (Destination is *metastructured* !)

(2) Criterion/indicator of "quality mathematics-education" : Being well-designed from the standpoint of *information design*

(3) Amplifier of power of information design : e-means/infrastructure

(4) Method for achievement : Course/class design; Design of a web-based education system, and best use of it

The reason of this frame is :

(1) The problem of "quality of mathematics education" is reduced to that of "quality of information design". (Indeed, education is information design.)

(2) Mathematics is, by nature, hard to be learned.
(3) Traditional communication media are weak/poor for mathematics education. (Indeed a prime constraint on quality-oriented mathematics education is this.)
(4) *"Breakthrough by power of IT"* holds as a strategy.

And it is the situation of *"IT revolution"* that makes this reasoning hold.

Distinguishing characteristic of this study/research is :
(1) "Web-based education system" is subjected in combination with "quality education" (as a requisite of "quality education").
(2) The "quality education" in this combination is of metastructure in the sense that : *quality education to output quality educator, where "e-means/infrastructure strengthened" is a requisite of "quality"*.
(3) "Quality" is reduced to "information design".
(4) The study/research is based on sizable (long term) practice.

And the general subjects of "education method" to which this study contributes implications are :
(1) *"Education as information design"*
(2) *"Teacher training as designer training"*
(3) *"Consistent information process"* (So should be the information design for quality education.)
(4) *"Process where e-means/infrastructure functions in its best sense"* (So should be the education over e-means/infrastructure.)
(5) *"Complex system"* (So is the (quality) education.)
(6) *"Workload of e-means/infrastructure-strengthened instructor"*

The above idea started growing at me around the end of 1980s especially when I got to have the *Macromedia Director* (*"Macromind Director"* is the name at that time). The subject is : "*To enable genuine-mathematics teaching by introducing learner-friendly - though mathematically genuine - expressions, which information design activity strengthened by new media power can yields.*" And I have been practicing design of multimedia teaching material (since the end of 1980s) and web-based instruction (since 1995). There the idea of "information design over multimedia" led to the idea of "webpage as platform of rich contents". I think now is the right time to report my practice.

In the followings, I use *"information design oriented e-education"*, or simply, *"e-education"* as an abbreviation of "information design oriented education which is actuated in the form of e-means/infrastructure-strengthened". And, accordingly, I use *"information design oriented e-educator"*, or simply, *"e-educator"* in the meaning of "one who is qualified to do e-education".

Remark : The interest in e-means/infrastructure as teaching/learning media here is from the standpoint of "quality education (information design)", not "broad/remote education".

2. Subject

2.1 Target and Outcome

I target "quality course of mathematics education (quality training of mathematics teacher)", and reduce this "quality" to "information design strengthened by e-means/infrastructure" in the sense that :

- Education is information design.
- In our situation, information design becomes actual in the form of "e-means/infrastructure strengthened".

What I inquire and practice is :

- Method of *course design for quality education*
- Method of *conforming e-means/infrastructure to quality education*

"Designer raising" is a prime standpoint of this quality education. It is achieved by making students learn the aforesaid method themselves. (*Metastructured* !)

2.2 Research Method

The method of the research/study/practice is as follows :

(1) Make the method be practical/concrete
- Course, task-assignment, instruction/evaluation
- e-education system

(2) Narrow the target down
- Mathematics education classes in teacher training college
- e-education system as
  (a) Web-based instruction/learning system
  (b) Server system of private space where student achieves her/his work in the form of webpage

(3) Sizable enough to be coherent
- All the mathematics education classes, and more, which I am in charge

(4) Giving priority to covering a sizable unit of real course and seeing the prospect of the method, over practicing analytical research.

2.3 Conceptual Framework

2.3.1 "Designer" - personal trait/ability needed in the new stage

We are facing a highly individuality/diversity-oriented society to come. In this new era, our way of living deeply depends on our ability for being positive, independent and competitive, preparing for what to come, and creating our own solutions for new types of problems. Not floating in the flow of individualization/diversification, but grading one's own personality up by making *"differentiating oneself from others"* a strategy -- This becomes an image of *"establish one's independence"* in the era to come.

The demands today's educators are responsible to answer are those of a changing/challenging society. And "abilities required to be well-being in changing/challenging society", one of which is "trait/ability of designer", become the goal of today's education. (Here, "changing/challenging" means: "not allowed to be peace in the existence, obliged to develop a new direction", "disadvantage changes to

advantage", "business chance calls at newcomers", "the seeds from which our future grows are pursued".)

We use the word "designer" to express, ideally, a person who can do "designing a total solution", for which the following traits/abilities are required : To see a matter in perspective; Introducing structure/frame/module/flowchart ("from global to local"); To simulate a solution with strictly logical calculation; To do effective presentation; To use IT in a best way toward the given, as means/infrastructure for work, realizing high quality and remarkable effectiveness.

"Designer" implies "good problem solver". A designer, as an inquisitive, investigative person, seeks to identify needs and seeks innovative solutions. In idea development process, a designer collects, analyzes and interprets facts, while realizing her/his own adaptation and progress. Intuition and imagination must be paired with technical skill. Indeed, it is a designer's trait required for conceiving a product-out which is sound, working, and welcome.

2.3.2 Teacher training course - metastructured "designer raising"

When "designer raising" becomes a general direction of education, "designer raising" becomes metastructured in the case of teacher training course -- "raising designer of 'raising designer'".

2.3.3 Scheme of "quality education"

Here I consider "quality education" with Fig.1. In this sense, "quality educator" implies "e-educator". (That is, unable to be a quality educator without being an e-educator.)

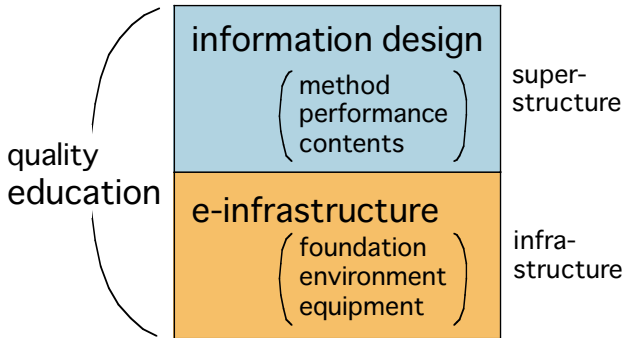


Fig.1

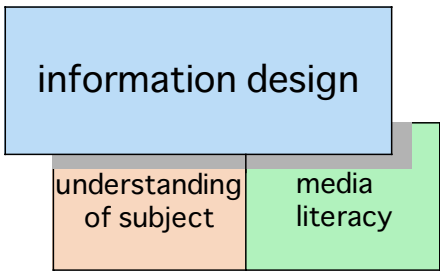


Fig.2

2.3.4 Information design - specialty discipline

Information design holds on (1) sound understanding of subjects and (2) media literacy. Media literacy alone is not the ability of information design (Fig.2). In particular, in teacher training course, which is metastructured quality education, students discipline themselves for the information design of this sense.

3. Method of Quality Education

3.1 Reduction of "Quality" to "Information Design"

Education is a process of information. Indeed, that *the aim of the education is attained* means that *the information aimed at is completed*. Therefore, constructing and performing education is regarded as act of information design.

The domain of *"education as information design"* is as follows :

(1) Preparation/improvement of course means/infrastructure (facility/equipment/ device, media, e-education system)

(2) Course design

(3) Class making, which, as information design, consists of :

- Making of script, contents, performance
- Expression of concept/idea/subject, problem, explanation, instruction
- Terminology, visualization , animation

3.2 Web-based e-education system

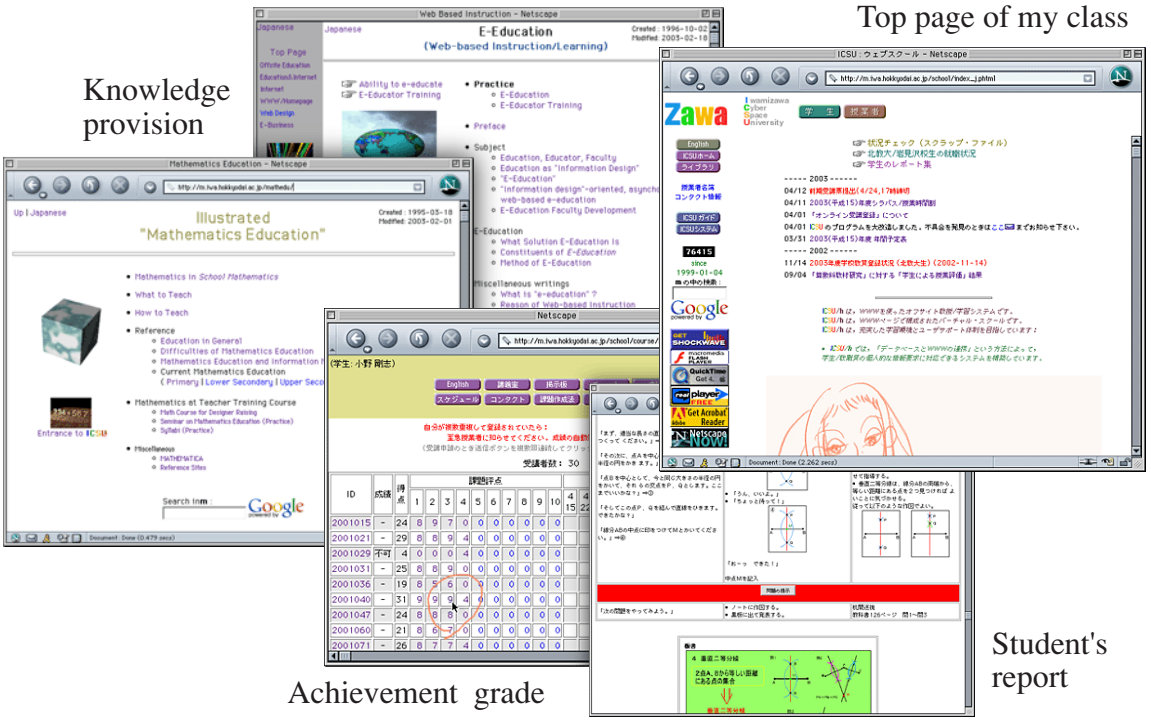
A prime e-means/infrastructure for actuating "quality education" is the web-based e-education system of : dynamic webpage creation; web-enabled database. It becomes almost uniquely determined, as to (1) structure, (2) function/tool-set, and (3) appearance (user-interface). Especially, it becomes to consist of following two levels :

(a) Course Level

- The level which is visible to users (students, instructors)
- Student's private home in the server, as working space :
  - Knowledge management
  - Exhibition of achievement
  - Making contents used at mock class performance
- Knowledge (self-teaching contents) server

(b) Administration Level

- Management of course/student
  - Registration (students, instructors, courses)
  - Preparation of course (content, members)
  - Recording course progress (member interaction, results)



Aims, method, characterization of system, and contents design are related in such a way as the former determines the latter.

3.3 Course Design

3.3.1 Applied to regular course

The method is applied to standard (traditional) course/curriculum. That is, scholarly (or specialized-subject-based) course of mathematics education is the main. E-education-related subjects are instructed in each course as applications. It is not required to install specially new course/classes.

Indeed, I am rather doubtful that such education programs as are designed from department-oriented or course-structure-oriented standpoint would work. It tends to go exhaustive about contents and, therefore, the education becomes shallow and diffuse, which is not a way to make students gain real power.

An appropriate way of discipline of information design is to make regular instruction/learning on traditional academic specialized field embody "task achieving (problem solving)", because

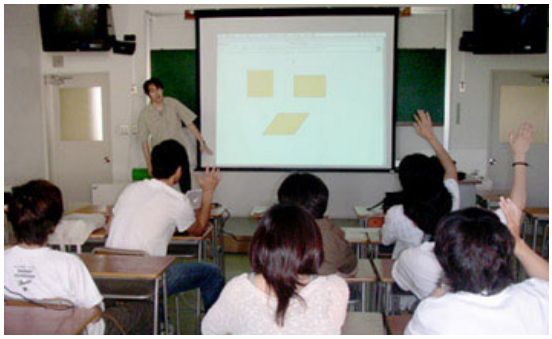
- Information design itself is an integration of information design of various types/levels. So the subject in the task should be so deep that this integration becomes realized.
- The subject should be authentic, or else materials are collected at opportunity and students set themselves to work just for the sake of task -- this is not a discipline of real power.

What we do as information designer training is not to teach about "information design", but to make students regularly do "information design".

Furthermore, to make regular instruction embody "discipline of information design" leads to an improvement of the instruction itself. It is genuinely an improvement in the sense of enrichment, not to change the instruction to a different thing.

Lecture

Students present teaching scripts (web contents) they made



Students make mock of class

3.3.2 Self-contained

In particular, each course is made self-contained:

where the left pattern shows : "moving up to higher grade" and "piling courses", from red to blue. This should be changed to the right one, where each course is "self-contained" -- from red to blue. The right is an image of the ideal parallelism between "moving up to higher grade" and "piling self-contained courses".

Remark : "Upper stage" should not easily be relied on just to put off making present stage practical.

3.3.3 Prefer "narrow and deep" to "wide and shallow".

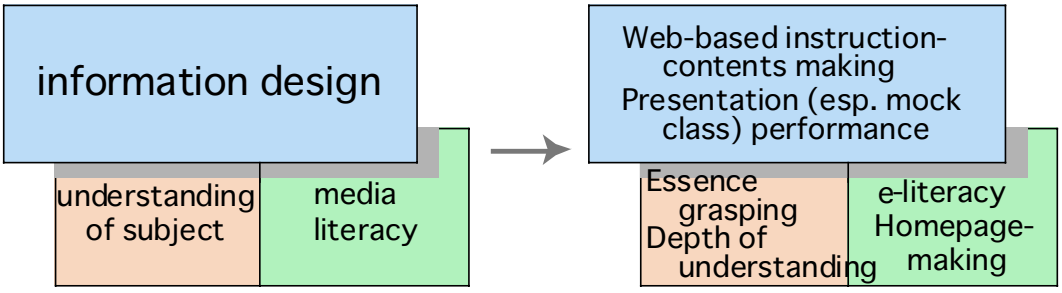
As personal trait, "generative", "transferable" and "self-support" are aimed at in this course.

3.4 Instruction

3.4.1 Information design oriented

(1) Make students understand : (a) education is a practice of information design; (b) objectives of information design is to make others become able to accept/understand the meaning/essence of the subject; (c) aptness of design depends on receivers.

(2) Realize the scheme of information design in the fallowing way :



That is, emphasis is put on the importance of understanding the meaning/essence of subjects and accumulation of experiences of e-education performance : Web-based contents making and presentation; To improve student's communication skills by making them experience various tools.

3.4.2 Oriented to task-achievement, problem-solving

(1) Tasks assigned to students contain followings as elements :

- Given a subject, to intend to understand its meaning/essence
- To design lecture as a structured entity

- To make web-based teaching contents
- To perform presentation in style of : Mock class; Demonstration/explanation

(2) Assigned task/problem is so designed as the process of achievement/solution becomes of integrated structure.

3.5 Evaluation

(1) Effective work procedure
(2) Degree of understanding subjects (meaning/essence)
(3) Quality of information design : design of web-based teaching material (to communicate theories/ideas/facts); design of presentation (logic, structure, performance)
(4) Media literacy for information design : Use of e-means to contents making and teaching
(5) Lecturing skills/techniques

4. Conclusion

In order to target "quality education" in a practical/operational way, I reduce it to a well-being of “information design”. And, in our situation, this "well-being" becomes close to "e-means/infrastructure strengthened". Indeed, it becomes definite soon that we cannot be a quality educator without being an e-educator.

Quality education becomes metastructured in the case of teacher training course, in the sense of “quality education for training quality educator”. It is actuated in such a way as both instructor and students best-use e-contrivance.

Ability to do quality education is an integration of various types of ability, from academic specialty to IT. An adequate way of raising such ability is to make regular instruction embody such task working (problem solving) as contains *information design with best-use of e-contrivance*. Here subjects of task become authentic. And the mathematics education course is the right place to do it.

The method accords to my standpoint of general discipline, that is, "designer raising". Here "designer" means "person who can do designing a well-being as total solution". It is the trait/ability which is required in a highly individuality/diversity-oriented society we are now facing.

5. References

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