Design Thinking for Future Schools

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The great advances in information and communications technology (ICT) since the emergence of computers in the 1960s, followed by the widespread adoption of personal computers in the 1980s and the advent of the Internet in the 1990s, have made the use ICT virtually indispensable. As the economy and society have evolved along with these changes in technology, there have been transformations in consumer awareness and social values that have triggered a shift from product-oriented (*monozukuri*) to system-oriented (*kotozukuri*) ICT designs, and this accounts for the enormous demand seen today for customer-oriented service design. Yet, surprisingly, adoption of ICT by schools—where children that will lead Japan in the future learn has lagged behind that by society as a whole. This realization motivated the Japanese Ministry of Internal Affairs and Communications to launch the Future Schools Promotion Project in 2011. In this paper, as a participant in this project, I will highlight some of the onsite design initiatives in which Fujitsu worked with teachers to build better schools for educating future generations through the use of ICT. I will also describe the Design Thinking for Future Schools Project in which the use of optimal ICT resources is incorporated into fully evolved classes for educating future societal leaders.

1. Introduction

Information and communications technology (ICT) became part of the infrastructure of many industries in the 1960s, and this resulted in a level of relatedness among customers, workers on the shop floor, and management that brought about many novel innovations. The advent of the Internet in the 1990s improved the interaction between management and customers and brought them closer together. This had the effect of accelerating decision-making for both the customers and management, which led to reorganization of the divisions and changes in employee work style. At first, ICT design focused on the human-ICT interface and was primarily concerned with aesthetic appeal, user-friendliness, intuitiveness, and a product-oriented (*monozukuri*) approach. It later shifted to a system-oriented (*kotozukuri*) approach, focusing on three-way relatedness among customers, workers on the shop floor, and management. Consider a retail system as an example. The designer must focus on three elements of the business—the front and back areas of the stores, the distribution centers, and the headquarters. The designer must also consider customer and employee satisfaction as well as overall efficiency of the operations. This means that the scope of the design must optimize a range of variables affecting the business as a whole: the hardware used at each site, the interface with people, the design of the physical location, how to deal with workers and employees, how to take care of customers, and so on. In other words, the relationships among multiple system-oriented elements (*kotozukuri*) must be optimized, and the design must contribute in a positive way to operation.

The focus here is on the relationship between management and design. Many recent business and management related books have the words "design thinking" in the title. The use of this term suggests an emphasis on thinking of design as a process. Design thinking essentially consists of three processes—awareness, idea generation, and refinement. While the range of each one may vary depending on whether the design is product- or system-oriented, the design

processes themselves are exactly the same. Let us consider these processes in greater detail.

1) Awareness process = observation of situation in the field
- Go to actual sites and observe what is going on there.
- Formulate hypotheses for dealing with problems discovered through observation.
- Test hypotheses and create a narrative for solving problems.

2) Idea generation process = generation of ideas for problem solving
- Generate ideas in line with the narrative.
- Repeat prototyping on basis of generated ideas so that design concept in alignment with the narrative begins to take shape.

3) Refinement process = creation of final draft plan for product, service, organization, management, etc.
- Create final prototype on basis of design concept.
- Verify final prototype is consistent with the narrative.
- Finalize plan as a narrative that resonates with customers, shop workers, and management.

Note that "narrative" is used here to mean the desired problem-solving. The final resonant narrative is the plan for implementing the solution.

One thing to note regarding these three processes is that, when end users and designers work together, not only products and services but organizations and management themselves can also be addressed by the design process.

The increasing diversity of people making up society and of societal values has reduced the effectiveness of the traditional approach of introducing products on the basis of quantitative assessment of markets and users and the effectiveness of statistical analysis. Under these conditions, a more effective approach is to get users involved in the design process, working with designers to come up with new products. This results in products that get to market faster and facilitates ongoing testing and upgrading. A key element of this approach is the creation of a narrative that describes the penetration of markets with products that resonate with potential customers by giving them exactly what they want. A resonant narrative also improves the design of organizations and management. In this design process, it is important that management beliefs are conveyed and instilled in the minds of customers and employees so that the transformation is accepted as a promise to fulfill in line with the resonant narrative.

This paper discusses "Design Thinking for Future Schools," a project to create ideal schools for future societal leaders, to create ideal classes for educating future citizens (services provided by schools), and to rethink ICT requirements in order to achieve ideal schools and classes.

2. Project background

Most major innovations throughout history—the invention of the steam engine, semiconductors, and so on—were preceded by a big technological breakthrough. However today, with the almost complete penetration of society by ICT, a new business model has emerged. This model is exemplified by such products as the iPod and iTunes, which were created through a process in which businesses were optimized to provide what users wanted as a service.

Not too long ago, people conventionally bought music CDs in stores, downloaded the music to a PC, and transferred it to a portable player. At the time, this behavior made perfect sense, and many people obtained their music this way without thinking much about it. However, a growing awareness that this sequence of actions was overly complicated eventually led to innovation in the delivery process. In other words, innovation can spring from widespread awareness, so we expect much innovation to come from design thinking. This process of becoming aware is an important element of design thinking.

Fujitsu Design has been developing a range of workshop methods since 2009 to stimulate design thinking to unlock innovation. One of the initiatives was an exploration of the design thinking awareness process and focused on developing a workshop scheme for creating narratives in collaboration with users. In 2011, a group of teachers were recruited to test a new model in a series of demonstration trials with the idea of further refining the scheme. They taught at Kamakura Elementary School, which is attached to Yokohama National University, and were grappling with a class design research project of their own. That was the background from which we started the Design Thinking for Future Schools Project.

3. Project structure

Let us start with an overview of the process structure of the 2011 project.

1) Awareness process = field observation of learning at the school
- Designers spent several days observing activities at the school.
- A workshop was held to discuss with teachers the observations and awareness gained.
- A narrative was created on the basis of the awareness and the problems raised during the workshop.

2) Idea generation process = design of model class based on narrative
- Designers worked with the teachers to generate ideas in line with the narrative.
- Prototyping was repeated on the basis of the ideas to create a class concept based on the narrative.

3) Refinement process = drafting of final design for model class
- A final draft design for a model class was created on the basis of the class concept.
- The project was wrapped up with the production of a resonant narrative.

Now let us take a closer look at the project by detailing the process steps.

4. Awareness

Japanese society has changed enormously over the past three decades, but the field observations revealed that elementary schools are pretty much as they were when the designers attended elementary school. They had changed little over the years. Elementary schools are charged with teaching students the basics of being a good member of society. This means that, if the expectations for students are little changed over the past three decades, there is a problem.

4.1 Workshop to elicit awareness of teachers

The designers organized a workshop based on the premise "because we live in unsettled times, it is more important than ever that we grasp the true meaning of things (products and services) and are able to act independently on the basis of our own vision." The purpose of the workshop was to identify the problems in the school that the teachers may have at one point had been cognizant of but had become less aware of due to mundane everyday school activities.

The designers were attempting to uncover ideas that would help them assemble a class design research narrative that would clarify the direction in which Kamakura Elementary School should evolve, including how classes should be taught. The workshop addressed four key points.

1) Shedding preconceived stereotypes of participants

The designers prepared material designed to stimulate discussion among the teachers while enabling them to grasp the original meaning of "product-oriented" and "system-oriented." The material comprised two collages that featured symbolic representations of familiar food items, clothing, and shelter as well as aspects of different cultures. As they discussed the images, the teachers gradually clarified their ideas about how the individual is related to self and family and society from the different ways they perceived the images and their own backgrounds. As they went through this exercise, the teachers become aware of many things that were done so frequently and so routinely that they had been put away in the back of their minds and largely forgotten.

2) Finding hidden problems

To bring out the problems hidden away in the teachers' minds, the designers focused on facilitating the discussion rather than on asking for conclusions. This is in contrast to the goal of typical day-to-day office meetings, which is to come up with a conclusion within a set time-frame, and to the idea that a good meeting is one in which each party yields a little in order to achieve a compromise. While the goals and results of meetings are generally easy to understand, the conclusions are likely to be far from what they should be. If the conclusions are converted into a narrative, they should fall within the expected range without creating any big surprises. Awareness linked to innovation arises from dialog, so carefully scrutinizing dialog to make sure no point is overlooked is exceedingly important.

3) Visualizing problems

To preserve the statements of the participants, the designers enlisted several people to document the proceedings while also recording them. Since the designers were not looking for conclusions per se but rather for the true thoughts and feelings that emerged

during the discussions that could be converted into a narrative, one designer was tasked with acting as a neutral third party.

4) Preparing review sheets

After the workshop was over, the participants were asked to fill out review sheets while everything was still fresh in their minds. These sheets provided critically important documentary evidence for converting the discussion and proceedings into a narrative.

The workshop was broken up into three sessions.

First session: The teachers talked about the relationship between themselves and society. The goal was for them to articulate and visualize common shared values that they thought were important (philosophy).

Second session: The teachers exchanged views about the direction Kamakura Elementary School should take in the years ahead. The goal was for them to convert the values they thought important into a narrative (strategy).

Third session: The teachers discussed what they could do to nurture their students so that they would grow up to be well-rounded citizens. The goal was to visualize the elements needed for class design (tactics).

4.2 Narrative creation based on ideas and awareness of problems learned through workshop

The narrative they created explicitly detailed the direction they wanted to pursue in the future. It was based on the values they shared and included the actions to be taken to pursue that direction. Thus, the participants agreed upon specific everyday actions to be taken to realize an organizational vision combining philosophical, strategic, and tactical elements. The Instructional Design Research Group that was organized in 2012 on the basis of the workshop articulated a "Vision for the Future Kamakura Elementary School":

1) Nurture strengths needed by society in the future (philosophy)

- Nurture human skills rooted in common humanity: teachers should nurture students so that they develop well-rounded identities, enabling them to get along well with others in society.
- Nurture diversity among students: teachers should promote diversity among students and foster the development of citizens who can create and support new values.

2) Promote student learning and clarify teacher role (strategy)

- Nurture human skills rooted in common humanity: teachers should sincerely relate one-on-one with their students, experience things along with their students, and endeavor to shape students into well-rounded members of society.
- Nurture diversity among students: teachers should not only teach standard knowledge but also lead activities exposing students to new experiences.

3) Support student goal setting and teacher class design (tactics)

- Nurture human skills rooted in common humanity: teachers should design class activities so that students can set their own goals through classroom interaction in which all students participate.
- Nurture diversity among students: teachers should introduce various perspectives and should design class activities that elevate student thinking and present challenges that cannot be easily met.

5. Idea generation

Once the awareness process was completed, the teachers who had participated in the workshop showed "a renewed awareness and organization of mundane things that had waned or receded in memory." Unless truly unexpected things happen, this awakening or renewed awareness of the more mundane things that go on around us is certainly a step in the right direction toward innovation.

In the idea generation process, an actual class prototype was designed on the basis of the narrative (philosophy, strategy, and tactics) that had been created. **Figure 1** illustrates the process of implementing the designed prototype class in comparison with the conventional process of implementing integrated curriculum classes.

The advantages of the prototype class approach are that it is based on analysis of data collected in the classroom, encompasses a vision of all students in the class, and implements specific activities that about 40 students can do on their own. The prototype class itself may be thought of as the design thinking process. The question arose as to how teachers should facilitate classes for fourth-grade students to help them increase their awareness, come up with ideas, and act on their

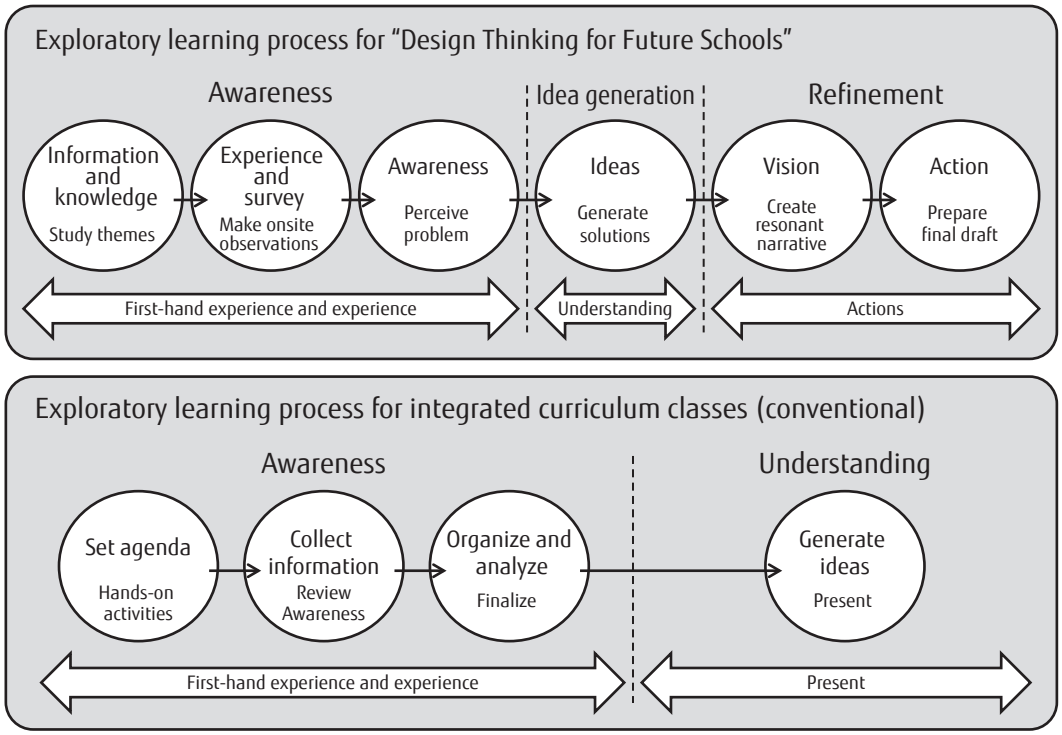

Figure 1
Process configuration for prototype classes and integrated curriculum classes.

ideas. The teachers continued this trial-and-error process until they completed the prototype class.

Since children learn not only in school but also outside of school, the nurturing of children's relatedness to the community is very important. Moreover, by assigning class themes related to Kamakura, the teachers gained the understanding of the parents and the cooperation of people in the community due to the community's empathy with the narrative. No matter what the teacher wants to teach his or her students through experience, it is through the eloquence and passion of a narrative that new challenges are introduced to the world.

The prototype class progression that was implemented in one of the fourth-grade classes during 2011 is briefly outlined here.

In the "information and knowledge" phase, students learned about "virtual water" with the cooperation of Patagonia Inc., which has a branch office in Kamakura. They learned, for example, that it takes 15 497 liters of water to produce one kilogram of beef, 909 liters of water to produce one kilogram of corn, and 11 000 liters of water to produce one pair of blue jeans.

Since the human body is 60% water, people on average need five liters of water a day. The students quickly came to understand why early human civilizations tended to develop along rivers. Moreover, roughly 97% of the water on earth is salt water in the oceans—a mere 0.0001% is fresh water available for consumption, i.e., to sustain the Earth's 5.6 billion inhabitants.

In the experience and survey phase, the students, now well aware of the importance of water, said they wanted to use their outside class time to search for the source of water in Kamakura. The Nameri River flows approximately 6 km through Kamakura and thus provided an excellent field trip from the source of the river to where it empties into the sea at Yuigahama Beach (western side of the river) and Zaimokuza Beach (eastern side of the river.)

Realizing this would be an effective device for teaching his students about virtual water, the teacher was very successful at guiding his students through the lesson. For the field work assignment, the teacher divided the students into six groups and had them explore the upper reaches, the middle reaches, and the lower reaches of the Nameri River.

During the awareness phase, the groups made presentations to the class. One thing the students learned from these presentations, which focused on the upper, middle, and lower parts of the river, was that the water was clean enough to drink at the headwaters but become increasingly polluted downstream as it approached the sea as a result of household effluent, dumped garbage, and other sources of pollution. A follow-up field work assignment was to investigate the causes of the pollution that were evident even to fourth graders. The students even volunteered to interview some of the people who lived along the river.

The emphasis in the idea phase is to visualize problems and organize them. Regardless of the importance of water per se, the students began generating ideas for making adults more aware of the river pollution problem.

In the vision phase, the whole class created a shared narrative, "Water Spirits: Just Think how the Water Feels!" Each student designed a T-shirt interpreting this theme. Individual ideas based on a common philosophy were visualized by the students and were reflected on the T-shirts.

Finally, in the action phase, the students organized and put on an open school event called "Mana Biba." In addition, 38 of the 40 students talked with the mayor of Kamakura about how the Nameri River could be cleaned up. Wearing their theme T-shirts, the students articulated a clear and confident vision during their meeting with the mayor and consistently related the narrative.

6. Refinement

The issues to be addressed in completing the final draft design for a model class were to clarify which steps in the prototype class process should include ICT and what kind of ICT to use. Although ICT is a convenient tool and its use can be learned in a computer class, using it incorrectly can lead to failure. The designers thus concluded that literacy—how to use ICT tools—should be taught to students.

Another issue related to the classroom concept that needed to be addressed in the final design plan in addition to the integrated curriculum was the expanded use of ICT in Japanese language studies, math, science, social studies, and other classes. The final issue is the incorporation of topics that will deepen dialog among students.

The processes for the final draft plans for the model science and social studies classes are illustrated in **Figures 2 and 3**. These model classes were

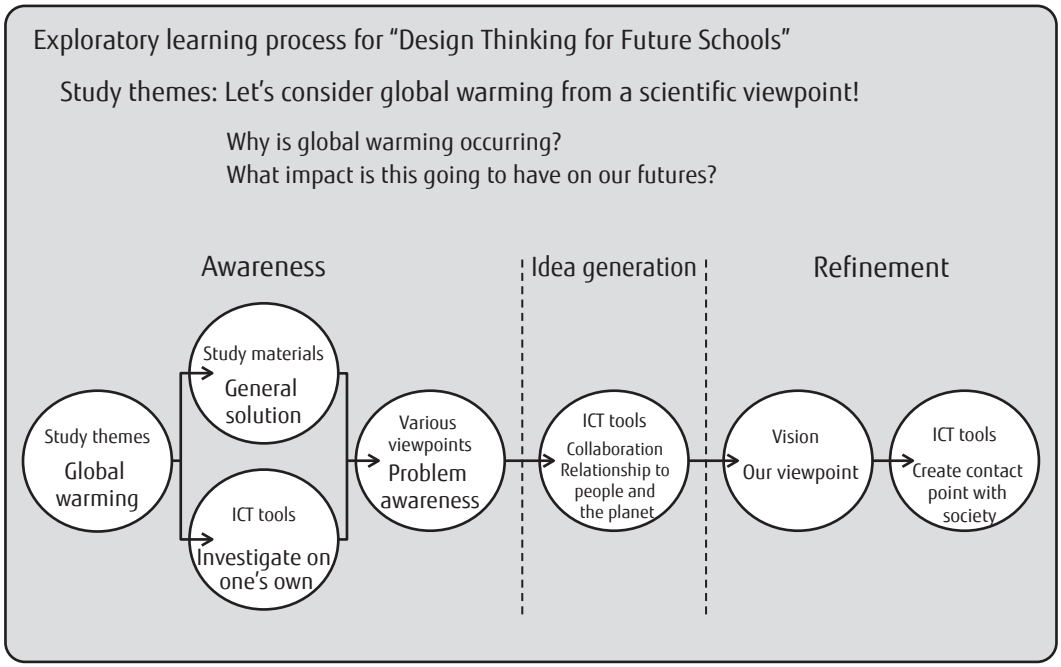

Figure 2
Science prototype class structure (using ICT).

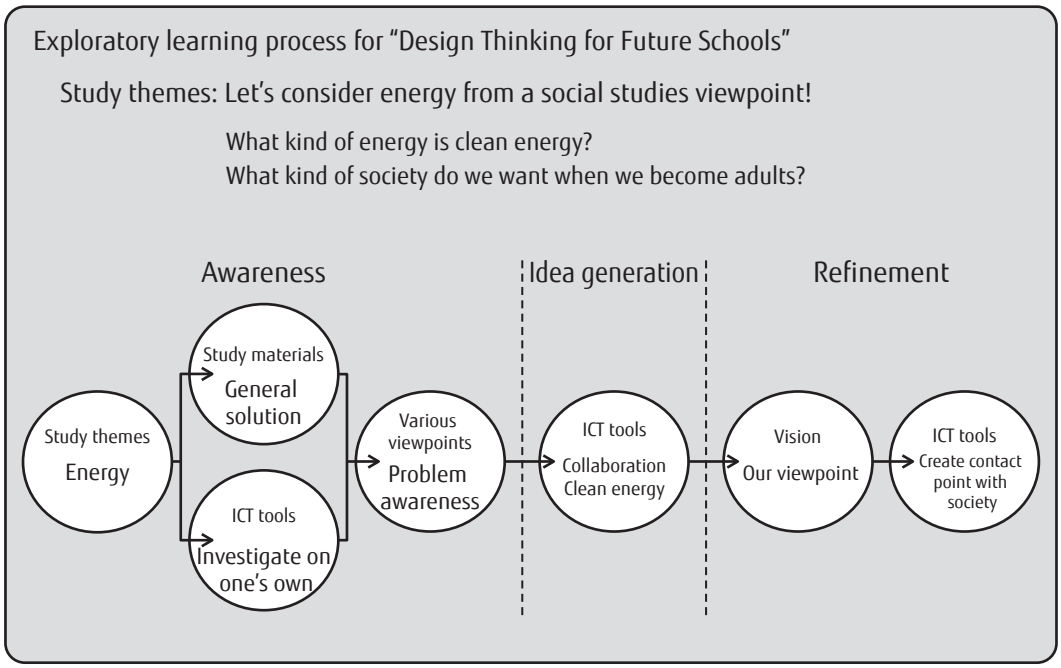

Figure 3
Social studies prototype class structure (using ICT).

prototyped in the second and third terms of 2012 and, after further evolution, are now part of the curriculum. Most notably, the composition of the classes has been broadened with the inclusion of ICT tools to obtain information about the "information and knowledge," "experience and survey," and "awareness" phases (Internet search tools), ICT tools to deepen discussion among the students, and ICT tools to publish the final results reflecting the views of the students to the world at large (social media). **Figure 4** illustrates the indicators of information literacy, which is defined as three levels of learned competency ("skill levels") of younger students in the use of ICT: ability to access and use computer resources, ability to understand media, and ability to communicate.

The final draft of the model classes was completed, and the classes were held for three months between September and December in 2012 for 6th grade students. The themes were "global warming" for the science classes and "energy" for the social studies classes. The students in these classes were able to obtain information from a wide range of sources by actively using ICT. Online meetings with experts unaffiliated with the school were arranged. These experts helped the students deepen their perspectives on the themes and to develop their own strong viewpoints that would not be easily influenced by the opinions of others. On top of that, each class came up with a unique idea (i.e., a philosophy of behavior) related to the theme for the class.

7. Cultivating innovative human resources

We have demonstrated that, through the Design Thinking for Future Schools Project, the ingenuity of teachers as guides can stimulate the thinking and actions of fourth grade elementary school students in the design thinking process. The thinking process required of business and management can thus be incorporated at the elementary education level to begin developing the skills required by future managers and leaders of society at an early stage.

Figure 5 presents a pyramid of the competencies required by management. This figure is commonly used in management training and other courses. Knowledge and experience on the bottom tier have been fairly well covered over the years in regular schools. But the second and third tiers—interpersonal skills and thinking skills—have proven harder to quantitatively measure and teach in a systematic way even in Fujitsu's own

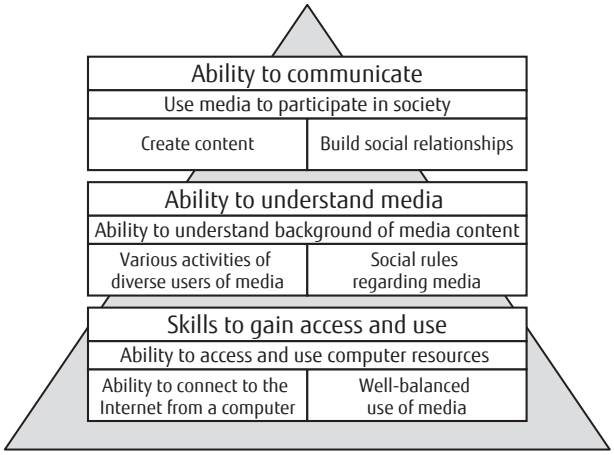

Figure 4
Competencies required for younger students to use ICT.

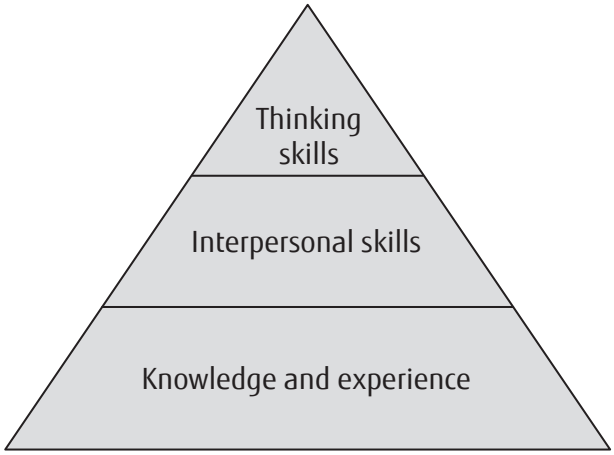

Figure 5
Pyramid of competencies required by management.

human resources training seminars. These traits are thought to be closely linked to an individual's spiritual development, which is age-dependent, and are either learned (or not learned) at an earlier stage of character formation.

We have seen that interactive and thinking processes are critical aspects in the prototype class. Interpersonal skills are enhanced by developing tolerance to a wide range of thinking through dialog and interaction with many people, and thinking skills are honed by having to explain your own thoughts and ideas. It is self-evident that regularly exercising the thinking process from a young age will improve one's thinking skills. Improving these two competencies should help produce citizens who are not only more comfortable in dealing with people from different cultural, environmental, and historical backgrounds but also should help produce people who are more innovative and creative.

8. Conclusion

The mission of ICT designers is to work in collaboration with technicians and engineers to develop superior ICT-based products and services. However, at today's schools, where ICT is underutilized, unless the goal is to use tools, there is no way of implementing inductive improvement. This suggests that only deductive improvement, transformation, and innovation approaches are effective.

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Mr. Takeda is currently engaged in the development of human resources and business planning strategies.