

Communication between Living and Scientific Knowledge as Chance Discovery

Yumiko Nara

The Open University of Japan
2-11 Wakaba, Mihama-ku Chiba City 261-8586 Japan
narayumi@u-air.ac.jp

Abstracts. Knowledge of living means information that people have obtained from their daily lives, and skills and wisdom that they have acquired through everyday experience or tradition. This paper aims to clarify three issues: (1) the uniqueness of living and scientific knowledge, (2) the significance of communication in these two kinds of knowledge, (3) the potentiality of a double helix structure for the two types knowledge in chance discovery, i.e. collaboration between lay subjects and specialists. These tasks were approached through theoretical and empirical research using concrete data obtained from a questionnaire and a case study. As a result, specialists and lay subjects were found to have outstanding knowledge in mutually different contexts even though they had limitations; solutions to problems were obtained through collaboration using mutual knowledge that was obtained on an equal footing.

Keywords: knowledge of living, scientific knowledge, lay subjects, specialists, communication, collaboration.

1 Introduction

We spend our everyday lives with various and abundant knowledge gained from living. Knowledge of living (LK) consists of information that people have obtained from their daily lives, and skills and wisdom that they have acquired through everyday experience or tradition. Scientific knowledge (SK), in this paper, is defined as knowledge gained through working in science.

LK and SK seem to have been treated separately in the fields of science and policy making. They might have been adapted for modern and present-day societies to deal with issues separately, and developed by promoting separation from individual standpoints such as the views of teachers and students, specialists and citizens, and producers and consumers.

We have recently been exposed to more complicated problems in society. Moreover, the stakeholders have also been diversified. It is therefore necessary to find new ideas and methods of solving problems related to various types of stakeholders and communication between various values, various standpoints, and different kinds of knowledge is now needed. This communication seems to have become especially important in solving problems such as those concerning the environment, consumers, communities, security, and safety.

There are three main aspects in the relationships between LK and SK: (1) Lay subjects include existing SK in their daily lives. (2) Lay subjects working in science or specialists positively implement SK that is needed in their daily lives, even in helping to create new SK. (3) Lay subjects contribute to solving problems using their LK equally with SK.

Ordinary lay subjects in these three aspects are regarded as “trustworthy participants” within the framework of solving problems who use their LK as one form of chance discovery. This can be expected to function as double helical processing between LK and SK. The double helix model, for the process whereby we discover a chance (as a new opportunity), was conceptualized by Ohsawa (Ohsawa 2001; 2003) and has been applied and developed in various kinds of cases. Subjective data (human) and objective data (from data mining systems such as KeyGraph) work together, each progressing spirally toward finding and creatively reconstructing ideas. It is difficult to obtain chance neither by only machinery view nor by only human view; same relationship could be applied to SK and LK.

Based on the above, this paper discusses three issues: (1) the uniqueness of LK and SK, (2) the significance of communication between LK and SK, and (3) the form and potentiality of the double helix model in chance discovery, i.e., the cooperation of LK (ordinary lay subjects) and SK (specialists) with concrete data obtained from a case study and a questionnaire.

2 Approach toward Knowledge of Living and Scientific Knowledge

2.1 Studies on and Practice in Relationship between Science and Technology (S&T) and Society

Japan has been entering a new era as a knowledge-based society. The subsystems in this society, such as industry, academia, government, and citizens are under great pressure to change with this innovation. According to The Third Science and Technology Basic Plan of the Japanese Government (March 2006), innovation is described as advanced scientific findings and technical inventions combined with human insights that evolve and generate new ideas, methods, or devices that are valuable to society and the economy.

The role and impact of science and technology (S&T) have also been evolving in a complex manner. Our lives have certainly been enriched by access to abundant knowledge and technologies. Some of these, however, despite being developed and used with the best of intentions, have unintended consequences, creating major social problems. As a result, scientific and technological developments are a growing source of concern even though they are essential parts of our society. Under such circumstances, we must not only take advantage of S&T but also construct a new relationship between them and society based on various values at the individual, local, national, and global levels.

Science and technology is the main research area where such problems are explored. The Japanese Society for Science and Technology Studies (JSSTS) was established with the aim of providing a forum for genuine cross-disciplinary, critical, and

constructive academic studies into questions related to S&T and society. There are also international societies such as the Society for Social Studies of Science (established in 1976) and the European Association for the Studies of Science and Technology (in 1981). Science and technology for society involves solving social problems, and managing society smoothly (Horii 2006). The Research Institute of Science and Technology for Society (RISTEX), for instance, promotes practical research, and formulates networks with various stakeholders to solve social problems.

There have been significant approaches to communication between different types of knowledge. Communications between specialists and citizens are called “science communication” or “science and technology communications”; some studies that have tried to implement these have also been conducted in Japan. Support by the government given to science and technology communications began in 2005. There are also some programs such as the “Science and Technology Interpreter Training Program (The University of Tokyo)” and the “Communications Design Center (Osaka University). “Science cafés” were held at 21 locations initiated by the Japan Society for the Promotion of Science in 2006, and their number has been increasing throughout the country. Research on skills to promote S&T communications at educational sites (primary through to higher education) has also been done (Chiba 2007).

2.2 Conceptualization and Uniqueness of LK and SK

Science involves work to acquire systematic knowledge based on certain rules, which is called scientific methodology. A certain kind of objectivity and rationality are guaranteed by SK, which enables close examination with scientific methodology. However, LK has a certain subjectivity and irrationality in the sense that it has not been obtained through examination with scientific methodology. This is one of its most typical peculiarities, which is in contrast to SK.

Science tries to approach problems from the viewpoint of researching and understanding objects; fields related to living such as policy of science are not exceptions either. The problems are arranged from a viewpoint, which the object should be examined from. The problems for LK, on the other hand, appear at the actual living site. The knowledge that is used to understand and solve the problems is also created at the actual living site. The problems are understood from the standpoints of individuals who actually live there.

SK is unique in three respects: (1) As SK has demonstrated its strong influence in contributing to modern civilization and society, it tends to be treated as entire knowledge. (2) Only things that are systematized and shared by using scientific methodology are included in SK. (3) The ranges of problems being investigated by scientific methodology is expanding, and contains numerous things. SK is subdivided, specialized, and it is very difficult to look at the whole.

LK has three features: (1) LK is important knowledge and wisdom concerning one’s life experienced by all people. They cannot live without it. (2) LK is based on individual experience. It is difficult to generalize one’s LK to others. It is also difficult to express one’s LK with words. Consequently, LK tends to be personal, and is seldom shared among others. (3) As daily life consists of overall activities (working, consuming, nursing, child raising, cooking, resting, etc.) and elements (monetary resource, time, space, interpersonal resource, etc.) that maintain one’s life as it adjusts

to environments, LK is also formulated with overall elements related to such activities. Moreover, one individual understands the whole.

2.3 Significance of Communication between LK and SK

It is difficult to cover both forms of knowledge within the same context when these differences in features are singled out. LK and SK have actually been treated separately, especially in modern society. The whole of society is currently structured by extremely detailed sub-systems that divide work and activities. It has become more difficult to understand or assess others' work or activities. It is not easy for non-specialists to access and understand the work of specialists. Even when specialists and non-specialists discuss the same problem, LK is not easily understood by the former. The relation between specialists and lay people is that between people who teach and those who are taught. The more SK has been produced, the greater the separation between specialists and lay people has become.

There is a model of communication that characterizes this phenomenon called the "deficit model", which is based on the idea that as citizens lack knowledge about science and technology, it is important for specialists to give them accurate knowledge that is easy for them to understand. According to the deficit model, the reason ordinary people feel anxious and are opposed to social problems such as the acceptance of nuclear power plants is only because they are ignorant about science and technology. If accurate knowledge were given, unease and repulsion would be reversed, and people would accept them without any emotional fuss. The "Public Understanding of Science: PUS" was advocated based on this idea. However, the deficit model actually came to be criticized strongly in the mid 1990s; it was too simple to enable the views and actions of people to be understood who were encountering social problems at real sites such as those experiencing bovine spongiform encephalopathy (BSE) or genetically modified products (Wynne 1995). As a result, interactive conversation and communications came to be more valued and a movement involving "Public Engagement with Science and Technology" (PEST) appeared (Hirakawa 2003).

Furthermore, specialists and lay people have outstanding knowledge in mutually different contexts even though they have mutual limitations. The possibility of approaching and solving problems in our complex world might occur if they faced each other on an equal footing, and used their mutual knowledge to complement that of each other. The communications between the two kinds of knowledge, i.e., LK and SK, may fulfill such expectations.

3 Examination into Potentiality of Communication between LK and SK

3.1 Questionnaire to Lay Subjects

This section discusses an examination into the potentiality of communication between LK and SK assessed with some empirical data. First, the views of lay and specialist subjects toward LK and SK as well as their relationships had to be obtained. To clarify this, the author conducted a social survey with a questionnaire.

Index of Main Variables

The 10 main statements (a–j) subjects had to respond to were:

- a. Scientific developments have more of a positive effect on human beings than negative.
- b. Scientific developments have contributed enormously to my daily life.
- c. Statements by scientists and professionals are credible.
- d. There are still many things in life and society that cannot be solved, even by applying scientific knowledge.
- e. Knowledge acquired through actual experience is in fact more important to human beings than that acquired through scientific methods.
- f. Knowledge that is useful in daily life and that used in science are quite different.
- g. Scientists and professionals should value the knowledge from the general public or ordinary citizens and apply that to their studies.
- h. The general public or ordinary citizens cannot argue with what scientists and professionals say.
- i. Statements by scientists and professionals are too difficult to comprehend.
- j. Statements by scientists and professionals have had no effect on my life.

They were asked the same question for each of the statements, i.e., “How much do you agree with the following statements? (‘Strongly Agree’, ‘Somewhat Agree’, ‘Somewhat Disagree’, or ‘Strongly Disagree’) Circle one for each statement.”

Outline of Survey

This survey was carried out within the following six-part framework: (1) The population and subjects were males and females who were 20–69 years old and lived throughout Japan. (2) The questionnaire was returned by mail, and (3) the sampling ledger was the NOS list. In the entire country, subjects were sampled randomly according to sex, age, and population percentage. (4) The number of useable samples was 1,050. (5) The survey period was February 13–29, 2008. (6) The organization implementing the investigation was the Nippon Research Center. The basic attributes of the respondents were as follows. Females comprised 54.6% of the subject and males 45.4%. Ages (average 45.65 years old) ranged from 20–29, (14.1%), from 30–39 (23.5%), from 40–49 (21.1%), from 50–59 (20.3%), and from 60–69 (20.9%).

Status Quo of Views by Lay Subjects toward LK and SK

Only the results for frequencies of variables have been listed in Table 1 due to space limitations.

The results revealed that lay subjects accepted SK as essential to improve their quality of life. At the same time, almost 80% of respondents felt that the statements by scientists and professionals were too difficult to comprehend; this reveals how necessary and important it is for specialists to give lay people accurate knowledge in simple form that they can clearly understand. If just this finding were focused on, it would remain as PUS based on the idea of the deficit model.

However, we had to focus on other reactions by respondents, i.e., the confidence they had in their LK. They thought that knowledge acquired through actual experience was in fact more important to human beings than that acquired through scientific methods, and they even felt that scientists and professionals should value the knowledge obtained from the general public or ordinary citizens and apply this to their

Table 1. Views of lay subjects toward LK and SK

	(%)			
	Strongly Agree	Somewhat Agree	Somewhat Disagree	Strongly Disagree
a. Scientific developments have more of a positive effect on human beings than a negative one.	12.0	58.8	26.3	2.8
b. Scientific developments have contributed enormously to my daily life.	16.1	64.1	18.4	1.4
c. Statements by scientists and professionals are credible.	3.4	56.0	37.5	3.0
d. There are still many things in life and society that cannot be solved, even by applying scientific knowledge.	38.4	53.2	7.8	0.6
e. Knowledge acquired through actual experience is in fact more important to human beings than that acquired through scientific methods.	16.4	58.1	24.9	0.7
f. Knowledge that is useful in daily life and that used in science are quite different things	17.0	55.0	26.0	2.0
g. Scientists and professionals should value the knowledge from the general public or ordinary citizens and apply that to their studies.	17.8	60.8	19.0	2.4
h. The general public or ordinary citizens cannot argue with what scientists and professionals say.	4.8	18.4	58.6	18.3
i. Statements by scientists and professionals are too difficult to comprehend.	16.6	53.2	27.3	2.9
j. Statements by scientists and professionals had no effect on my life.	3.6	25.7	59.5	11.3

studies. This finding indicates the possibility of germinating PEST and communications between LK and SK.

3.2 Case Study on Crime-Prevention Activities in Sakai-City

This section discusses an examination into the potentiality of communication between LK and SK using a case study.

The environment around children has recently been changing and serious crimes have been committed against them as victims. Approaches that have defended children against crime have been taken by families, schools, local communities, and NPOs. However, many of these have been conducted individually and experientially, and have not been based on tangible data or scientific methods. Then, it had to be recognized that people who work on this problem introduce scientific findings and methods into the crime-busting measure while receiving the specialists' co-working, in order to solve social problems effectively and continuously. A case is discussed here that was aimed at achieving this goal, i.e., crime-prevention activities in the city of Sakai to protect children.

Framework of Activities

Figure 1 shows the stakeholders who joined in these activities. The main lay subjects were residents of the city of Sakai (Tomioka district) and members of the NPO Sakai hill-front forum. This NPO is an organization that consists of residents of the Tomioka district. The specialists were experts in crime prevention such as police, and engineers who developed an Information and Communication Technology (ICT) system,

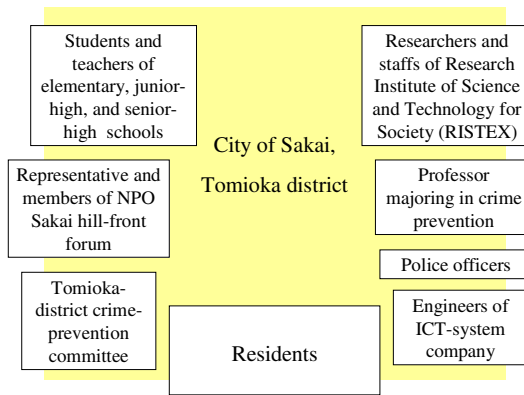


Fig. 1. Stakeholders in crime-prevention activities in Sakai

and university professors who cooperated in these activities. Within this framework, RISTEX (Chap.2.1) also played an important role as it aimed to induce and support the types of innovation that addressed the needs of the public, such as ensuring the safety and security of residents and increasing their quality of life.

The purpose of these activities was to “alleviate residents’ concerns and create a safe regional society in which crimes against children would not be tolerated to construct a new social system.” The three main pillars of the activities to achieve this purpose were the: (1) hardware aspect, i.e., the complimentary use of ICT (confirming the whereabouts of children with a location information system, sharing this information on monitored children through an information sharing system, and providing emergency contact among residents with an information delivery system). The (2) software aspect involved the activities of residents (going on patrols, giving precautionary information at fixed points, and sending out information from FM stations). (3) Collaboration involved the strengthening of regional alliances (e.g., cooperation among organizations such as schools and the police, and activities by young support corps and women’s groups to prevent crime.)

Interviews with Lay Subjects and Specialists

Comments by four stakeholders, as qualitative data, are given here. The interviews were carried out in August, 2008.

Mr. A (a representative of NPO: a lay subject)

“Problems with living have occurred at sites where people live. First, only residents notice these. There are many things that only residents who live in the region understand. Furthermore, problems in our region need to be solved here, because our own children and grandchildren might be future victims of crime. The problems in our community, such as those regarding welfare and education, became evident during our activities to prevent crime. It is possible to solve these through cooperation and collaboration even though individual efforts are minimal. Continuing activities by using individual strengths is important. We, as

residents, and also school teachers, police officers, and ICT engineers, have had numerous discussions to analyze the situation in our community and methods of improving this.”

Mr. B (a patrol member: a lay subject)

“I have been doing these activities for more than two years. I want to repay the kindness the region, where I grew up, has given me. We have continued patrols into the night as well as in the morning, and have found they have had a certain positive effect. I feel the patrols are beneficial. It is good that safety and security have been improved in my community. I am going to continue these activities and I want to enlist an even larger group of patrol members.”

Mr. C (An ICT systems engineer: a specialist)

“I am a professional and specialist in systems development. However, residents know how the ICT system is used in the Tomioka district better than I do, i.e., who to use it with, where to use it at, and when and how to use it. Information literacy also varies according to residents. Although I developed the original specifications for the system, residents express their opinions according to conditions in actual use. I then give them feedback on their opinions, and the residents make additional comments. The system is customized in this way though intercommunication and we have obtained a system that is tailor-made for the Tomioka district.”

Dr. D (A Professor majoring in crime prevention: a specialist)

“The main factor responsible for the success of these activities has been collaboration. Specialists do not one-sidedly offer knowledge, and residents do not continue to experience activities at random. Various subjects with certain strengths cooperated in these activities. Moreover, the devices for group participation operated really well. The effect crime-prevention activities have had in the Tomioka-district has steadily increased. The incidences of bag snatching and loitering have sharply declined. There are not that many regions where crime-prevention activities are continuing as they are here. The methods and techniques we have used can be used as references by other regions.”

Dynamics of Interaction between LK and SK

Further collaboration among not only residents but also specialists such as engineers, police, schools, and crime-prevention researchers was found to have developed using the data obtained from the interviews and the observation of actual activities. Individual subjects in such collaboration send their knowledge through continuous intercommunication.

Figure 2 shows the flows of interactions between LK and SK in the crime-prevention activities in the city of Sakai. Specialists such as engineers and professors develop theories and methods within a scientific framework: however, the society or region moves as a whole. Lay subjects, on the other hand, have experiential perceptions or wisdom. It is the wisdom and experience of residents who live in the region that ties the whole together. Ideas and knowledge are re-designed according to movements within real societies or regions.

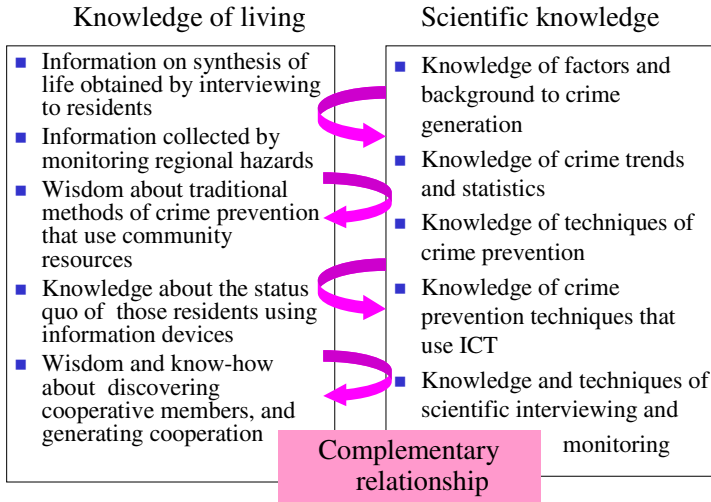


Fig. 2. Interaction between LK and SK in crime prevention activities in Sakai

There are four main factors that enabled communication between LK and SK in Sakai: (1) Lay subjects and specialists alike had a strong sense of consciousness in recognizing themselves as people concerned with the welfare of others. LK demonstrated its enormous influence in raising a strong sense of consciousness about people’s concerns. It was important in communications between LK and SK for lay subjects to participate with a high degree of subjectivity. (2) An appropriate mechanism for further collaboration should be developed. (3) It is crucial to establish trust not only among lay subjects but also between lay subjects and specialists. The veracity of information, the honesty of the sender, and sharing of the same values are needed to generate trust. (4) Not depriving the region of potential problem-solving capabilities is important. Problem solving could not be sustained if specialists merely gave regions equipment or knowledge.

4 Conclusion and Future Work

This paper tried to clarify the uniqueness of LK and SK as well as the significance of communication between them, and to examine the potentiality of and problems with communication between the two kinds of knowledge as chance discovery with some empirical data. Specialists and lay subjects were found to have outstanding knowledge in mutually different contexts even though they had mutual limitations. A questionnaire revealed that although most lay subjects were proud of their own LK, they accepted SK as indispensable and helpful. The case study in the city of Sakai actually demonstrated that the quite real and complicated problem of crime prevention could be solved with the collaboration of lay subjects and specialists using their mutual knowledge on an equal footing.

The conditions under which lay subjects form their views and their methods of communication that depend on attributes such as their age, occupation, and family

structure should be clarified in future work. Cross-cultural studies on communication between LK and SK also have to be conducted. Moreover, significance of “trust” in the double helical model should be examined. It can be argued that the deficit is not just a deficit in knowledge but more a deficit in trust that the necessary procedures are followed correctly.

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