Network-oriented design for learning environment

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1 Introduction

In this paper, we propose the network-oriented design for the learning environment. According to this view, design of ICTs (information and communication technologies) is not confined to design of system itself but comprises an arrangement of a socio-technological network of design and the use of ICTs. Here, we concretely show what the network-oriented design approach is by describing the case of design of ICT accompanied with arrangement of network.

Before proceeding to the details of the network-oriented design, firstly, we review the previous relevant research on learning. Situated learning theory is the most relevant approach to the viewpoint of this paper. This view reformulates learning as part of social practice and, in that sense, it is in great contrast to the traditional formulation of learning as individual’s acquisition of knowledge and skills. Knowledge and skills are not something that resides in an individual, such as a master. Rather, they reside in a CoP (community of practice), as Lave & Wenger (1991) write in the following excerpt.

... mastery resides not in the master but in the organization of the community of practice of which the master is part: The master as the locus of authority (in several senses) is, after all, as much a product of the conventional, centered theory of learning as is the individual learner. Similarly, a decentered view of the master as pedagogue moves the focus of analysis away from teaching and onto the intricate structure of community’s learning resources.

(Lave & Wenger, 1991, p. 94)

Thus from the perspective of situated learning theory, in order to understand learning in a CoP, we must, first of all, clarify what structure of community’s learning resources enables access or hinders access. Second, we must clarify how access to activities and resources is organized. For example, in 1991 version of situated learning theory, learning requires “access to a wide range of ongoing activity, old-timers, and other members of the community; and to information, resources, and opportunities for participation” (Lave & Wenger, 1991, p. 101). According to situated learning theory, learning is regarded in terms of participation in a CoP, and as something that co-occurs with identity formation. Participation in a CoP can be defined as “accessing” ongoing activities and resources that are socially organized and controlled by members of a CoP. This access to activities includes access to artifacts such as machines used in that activity, and access to people who are involved in the activities.

Further, situated learning theory also distinguishes two ways of viewing learning (Lave &
Wenger, 1991, p. 97). One way is from a perspective of a learning curriculum and the other is based on a teaching curriculum. A learning curriculum is a learner-centered view of learning. According to Lave & Wenger, “A learning curriculum is a field of learning resources in everyday practice viewed from the perspective of learners.”

On the other hand, a teaching curriculum consists of items that are supplied by the teaching side in the form of prescriptions about proper practice. It is an external view of what knowing is about. As Sawyer (2004) pointed out, the distinction between a learning curriculum and a teaching curriculum implies different perspectives on what should be prepared for learners. Thus from a teaching curriculum perspective, a teaching method for learners must be designed. That is, for this design for pedagogy, based on a cognitive psychology model, a series of teaching procedures to increase skills and competence needs to be chosen, elaborated, and improved for learners as individuals.

On the other hand, for a learning curriculum, what is needed is a design for the learning environment (Sawyer, 2004). As Wenger (1998) says, “The first requirement of educational design is to offer opportunities for engagement” (p. 271). This design for the learning environment is based on situated learning theory, and it implies designing support resources, social organization, and opportunities for participation in a CoP, resulting in access to practices (Wenger, 1998, pp. 263-277).

As shown above, situated learning theory indicates what aspects one should focus on for designing the learning environment. For example, this theory suggests that it is critical to notice design of access to various resources, social organization in practices and practices themselves. However, what does the situated learning theory suggest how to design the learning environment that includes ICTs? Or who should design the learning environment, in this view? It seems that situated learning theory does not give us suggestions concrete enough for designing the learning environment, although it does provide us with the perspective that the design of ICTs goes beyond the design of a computer system itself.

Actually, when one attempts to design, to introduce, and to use ICTs, one has to consider how a design-and-use community should be organized as Newman (1999) shows in the analysis of sequences of developing a middleware. She describes that a system such as a middleware can be regarded as organizing a network based on actor-network theory.

According to actor-network perspective, system design is not a design of a system itself but constituting alliance among various actors including things or among humans-nonhumans (Latour, 1987). Recently, Callon (2001) pointed out that actors or agencies are not fixed, but are changing dependent on the configuration of humans-nonhumans. According to Callon, the design and use of ICTs invite reconfiguration of hybrid collectives composed of humans-nonhumans, rather than merely satisfying needs of users. In other words, it creates new agencies or transforms existing ones. Here, Callon claims that artifacts such as ICTs are redefined in use, and people become something more than users. This issue is related to reformulation of the distinction between the designer and the user. Thus, actor-network perspective can be utilized as a practical resource to organize a network of design for the learning environment including ICTs.

Previous research on CSCL and CSCW, except for research such as O’day et. al. (1998), that proposed the idea of a network as CSCW and Newman (1999) have not focused well enough to organize a socio-technological network in designing ICTs, although they have often attempted to see practices of users. How about participatory design? In this approach, relatively short-term
sessions and workshops are organized for making users participate in designing ICTs. (Bodker, 1986; Kensing & Bodker, 2001; Kensing & Blomberg, 2001). However, it does not include a perspective on organizing a network as a design of ICTs, either. Further, this approach has not arranged the environment where users themselves engage in the system design. In participatory design, the actual system design is conducted by designers, although designers make attempts to adopt users’ needs. Here, the distinction between the designers and the users is still maintained. In short, previous approaches on system design or design of learning environment do not have a theoretical perspective on organizing a network of design and use. In other words, they do not have a perspective of design as that of a network which is quite different from the traditional view of design as that of things themselves. Thus, actor-network theory sheds light on some aspects that previous approaches have not focused on and that are indispensable for designing the learning environment.

The approach of this paper came from our activity of participating in organizing the open source community called NOTA network. NOTA is a system for the internet which enables one to write letters, and draw pictures and figures directly on a browser as described in detail later. In this NOTA network, the boundary of designers and users is becoming unclear. Some members are engaging in the arrangement of environment where various participants are able to conduct the redesigning of NOTA. This network can be regarded as constituting a learning environment for activities utilizing NOTA and for the design of ICTs. By participating in the NOTA network, we have to reconsider what a system design is, what a design of learning environment is, and the distinction between designers and users. In this context, it seems to us that actor-network theory can be utilized as a practical resource for making our activities of organizing network visible.

The purpose of this paper, first of all, is to follow the formation of NOTA open source network, and to analyze this ongoing organizing of the network as a design of learning environment. Secondly, based on the above, we propose the network-oriented design for learning environment including ICTs, along with utilizing actor network theory.

2 Methodology
2.1 Network-Oriented Design
This research describes formation of NOTA network. In the process of formation of this network, we are not merely an observer but an organizer and a participant. In other words, we are not merely observing this process but attempting to expand this project of design and use of the network of NOTA. By doing so, we are actively involved in the redesign and use of NOTA. Our approach in this project can be called as network oriented design. In a network oriented design, the design of ICTs is not merely design of ICTs themselves but includes organizing a network of design and use of ICTs. Thus, what we mainly focus on for observation is concerning organizing the network of design and use of ICTs.

2.2 The background of the research project
For the past three years, one of the authors, Ueno has been involved in some projects with a citizen’s group in a local community. This group has conducted projects such as a redesign of their own residential area, including a survey of traffic accidents in the area in order to propose reform plans for their traffic environment, and an activity of protection of the environment of parks in the
local area. In these projects, this group has made various kinds of maps based on surveys. Some students in the author’s lab have helped to digitalize these maps and they have participated in some of their projects.

This group has rich connections with various citizens’ groups in their area and other areas in Yokohama City. The main member of this group has introduced various groups and people to the author during projects. Thus, at the beginning, the authors could access a broad range of citizens’ network by participating in projects of this group.

2.3 The network in local communities and people’s method of ethnography

Each citizens’ group are gathered around various themes such as promoting the use of computer technologies for local people and senior persons, protecting local the environment such as parks and rivers, supporting the day-to-day life of foreigners in local areas, and supporting the use of computer networks in public schools. Some members of these groups overlap and some groups often collaboratively organize projects and events. In these projects and events, members of each group meet and become acquainted with each other. Each group has a mailing list and a web site. In mailing lists, some members are on several mailing lists because they belong to several groups.

Some of the members who belong to several groups can be regarded as a knowledge broker. (Wenger, 1991) These people cross group boundaries and transfer knowledge of one group to another. The knowledge includes ways of managing projects, knowledge of web technologies, and knowledge about who has various specialties in areas such as environmental issues, computers, and laws in different groups.

As shown above, people become acquainted with each other, introduce one member to the other, and expand their network through participating in various projects, events, meetings, and parties. People use mailing lists and websites for keeping in touch with each other, and for making announcements about projects and events. Thus, ICTs are indispensable part of these networks.

People’s ways for organizing a network in local communities, and making it visible can be regarded as the snowball method with ICTs. The snowball method is people’s everyday method for networking and this method is part of their organization. In other words, people in local communities do ethnography and make their own network visible before researchers do so. We can access people, activities, their themes, their knowledge, and the network in local communities by utilizing this people’s method for organizing a network and making it visible. In other words, researchers can be regarded as participants in communities, in other words, networking and ethnography can be accomplished by participating in a CoP or even by organizing a network. This view of ethnography came from one of the authors’ ethnographical research (Sawyer, 2004).

3 Fieldwork and Practice
3.1 NOTA network

In the context shown above, we have been exploring a new way of participating in the network in a local area. Previously, our role in local communities was mainly to support computer use for their projects. This was all happening when one of the authors encountered NOTA and introduced it to the citizens’ network in Yokohama city. In terms of NOTA, the author can be regarded as a kind of a knowledge broker.

The introduction of NOTA to the local communities did not only supply new tools for communication but also linked up new groups such as the Kyoto students’ group who developed
NOTA, IT Venture, and students of the author’s lab to this citizens’ network. In this paper, we describe the formation of a new network beyond the range of the citizens’ groups, along with our active involvement in organizing the network.

The descriptions of the Data list on the formation of the NOTA network are below. Field-notes were taken during the meetings and the workshops were recorded by VCR cameras.

a. The meetings for expanding use of NOTA in local communities: the student who mainly developed NOTA, the IT Venture person in charge of NOTA, and some members of the author’s university.
b. Two NOTA workshops and the subsequent parties that were organized by the authors.
c. The meetings for the preparation of establishing the open source community NOTA network: some citizens’ group members, the student who developed NOTA, a student of the author’s lab, a student of another lab, and professors who are the author’s colleagues, and the IT Venture for preparing the open source community NOTA network.
d. The meetings and the preparing of activities for projects utilizing NOTA in local communities such as Tsuzuki Traffic Project and the disaster prevention projects for elementary school children and their parents.
e. The mailing lists and websites for each of the projects, local citizens’ groups, and NOTA network.

The data list shown above is actually embedded in the activities of organizing the NOTA network as network-oriented design. In the following sections, the process of formation of this network and the network as design of learning environment are described. The specific design of learning environment that focuses on the redesign of accessibility to various resources and persons in practices is based on one of the authors’ work. (Sawyer, 200a, 2004b).

3.2 Formation of NOTA network

3.2.1 NOTA

As we have seen previously, NOTA shown in Fig. 1 is a server side program that enables one to write letters, and draw pictures and figures directly on a browser. There is no need to save data. What one creates on NOTA will directly be sent to a server right away and will be saved there. Uploading and creating links can also be done on browsers. Below is NOTA’s bilingual manual site. http://rakusai.org/nota/person/supertaro/html/?page=20040405090301

This system is developed in ActionScript of Flash and Perl. Main actions in a browser and sending of data to a server are developed in Flash, and the management of data is done by
programs written in Perl.

The person who developed this system is Rakusai, a young student in Kyoto. He and his university friends rented a traditional Kyoto style half-business and half-residence building called Machiya. While he was actively involved in various local community activities, he thought of developing this system.

### 3.2.2 Expansion of NOTA network

Previously, the developer of NOTA, Rakusai had a connection with an IT Venture through developing another application for a personal computer. Thus, this IT Venture became in charge of distributing and selling NOTA for Rakusai and his student group. At the beginning, this IT Venture distributed one hundred NOTA accounts for free in a commercial site. However, it was scarcely utilized by users there. According to the person who is in charge of distributing and selling NOTA, almost all of the users who came to the commercial site played once with NOTA and then stopped shortly after. Thus, the management side of this IT Venture regarded NOTA as an unprofitable system and the person who was in charge of distributing and selling NOTA had a difficult time on her business.

December of 2004, one of the authors had a chance to meet with one member of the Kyoto student group at a research meeting in Kyoto. The student demonstrated NOTA there, and the author obtained three NOTA accounts for testing. Soon after the author came back to Yokohama, he introduced NOTA to a citizen who was engaged in distributing and teaching web technologies for Yokohama citizen’s groups. He immediately introduced the information about NOTA on mailing lists of local communities. By this means, some citizens in Yokohama obtained NOTA accounts from one member of the Kyoto student group and from IT Venture. The number of access to each NOTA site reached from one to two thousand within one month. Thus, NOTA has become famous in the local network in Yokohama and many NOTA sites have been opened.

As shown in the previous section, citizens in Yokohama area were forming groups on a variety of themes. These groups were often connected to the author’s university through different kinds of activities even before NOTA was introduced. In this environment, different groups have collaboratively conducted various activities and they had strong need for a tool to make their existence and activities visible to each other and among group members. Because of this situation, citizen groups have been installing various systems such as weblog, wilki, xoops and others on servers and testing them or actually using them for communication within a group and between other groups. This was the climate that NOTA had been introduced to. It was regarded as a tool that could be utilized for various things for the citizen groups.

The student group in Kyoto and IT Venture were watching the NOTA sites of citizen’s groups in Yokohama. A couple of months after NOTA sites were opened in Yokohama, the developer and the IT Venture person contacted some members of the author’s university and we had meetings. In the meetings, the person from IT Venture told us that the one hundred NOTA accounts distributed in the commercial site were scarcely used, and that they were very surprised at the citizens’ active use of NOTA in Yokohama. Further, she said that they would continue distributing NOTA to Yokohama citizen’s groups and the author’s university of free. She expected that the free version would make NOTA well known and it would create a market for the NOTA business.
After the meeting, the author organized NOTA workshop and almost all of the people related to activities utilizing NOTA in Yokohama took part. The developer and the IT Venture person joined as well. In the workshop, the cases of NOTA use in local communities and universities were reported and the possibilities of NOTA and its use were discussed. The IT Venture person also stated that she had a hard time selling NOTA and she expected the active use of NOTA by citizen’s groups made the future of NOTA. The participants in the workshop became the core members of the open source community NOTA network that will be described later.

Regarding the IT Venture, as we have learned from the company, the NOTA project did not seem to be a promising business endeavor. According to the IT Venture person, by the active use in Yokohama citizen groups, the NOTA project was able to survive within the company. Thus, the network of the developer, the IT Venture, the local citizen groups, and the universities concerning NOTA were formed as shown in Fig. 2.

![Fig. 2 Formation of network around NOTA](image)

### 3.2.3 Use of NOTA in various groups

The site of Tsuzuki traffic project is one of the citizen groups’ sites shown in Fig. 1. Before introducing this site, let us take a look at the background of this site. NPO (Non Profit Organization) “I love Tsuzuki” is a citizen group. Their aim is to improve and to protect the local environment and redesign the town they reside in. For example, the group has been investigating and assessing comfortableness of local parks, monitoring illegal disposal of wastes, and surveying traffic conditions. They made maps concerning these activities based on their field survey. Further, “I love Tsuzuki” has been informing citizens about local conditions and urging local government for the improvement of the environment through showing these maps.

At first, this group had been drawing a large map on a piece of paper by hand. At one point, the author’s university started to provide support for digitalizing maps for this group by showing them how to draw maps on computer applications such as Adobe Illustrator. The group members were invited to present their activities in the university classes as well. The connection between the group and the university was made through these exchanges.
In 2003, this group investigated traffic accident in this area. They obtained basic statistical data from the local police office after a persistent negotiation. However, the statistical data only showed how many accidents occurred in certain places, and whether the accidents resulted only in property damage, and/or accidents that resulted in personal injury or death. In other words, the data that came from the police office did not show how the accidents occurred. The group decided to form smaller groups and directly interview local people about traffic accidents. One of the authors cooperated with a group and went to interviews with them.

In this survey, locals, who were near these accident sites, such as convenience store shopkeepers, gas station workers, and firefighters had often witnessed how these accidents occurred. They often understood the structural problems of the roads, and of traffic signals. However, these people did not have a proper route or method to inform such vital data/information. They did not know whom to inform, or what to inform about.

“I love Tsuzuki” created a map using Illustrator based on these interview data, photographs, diagrams and analysis of roads and traffic signals about the frequent accident sites along with the data they obtained from the police. This map shows which sites are more likely to have accidents and the reason why there are many accidents in one view. This map was displayed in the ward office and police department as well as uploaded on a website, and made local residents, the administration, the police and the public work office aware of these problems. Thanks to the presentation of the traffic accident map, and analyzed data to the police and the public work office, tree branches blocking view of the drivers were actually trimmed for better driving conditions.

This project was dormant for a while, but right after the author obtained a NOTA account, he proposed Tsuzuki traffic project to design an environment where many locals could add information on the maps by using NOTA. Thus, Tsuzuki traffic project became active once again. The members obtained new traffic accident statistics from the police and surveyed the points where there were many accidents. After that, new data and the results from the analysis of surveys were written in the maps on NOTA. NPO “I love Tsuzuki” and the labs of the author’s university are currently involved in this project. Moreover, they compiled additional detailed data about dangerous zones around schools gathered by local school PTAs, the data about dangerous areas marked on the map by local taxi drivers, and the map data from a bus company’s internal information about dangerous points.

This project was developed by constructing a network on local traffic problems; meanwhile, writings on NOTA page increased. NOTA was used as an artifact linking up various information and knowledge concerning local traffic condition, and it made mutual access each other of locals easier.

### 3.2.4 Organization of NOTA network

After NOTA was utilized in various ways, in the network, orientation about how to officially organize the open source community became clear. As it was mentioned previously, after the NOTA workshop, the developer and the IT Venture contacted us to create a NOTA portal site to announce the technological information of NOTA, examples of activity utilizing NOTA, and rules for this open source community. Thus, we had several meetings on how to establish the NOTA open source community. In these meetings, it was decided that the portal site would be managed by the developer, the IT Venture, the university labs including the author, and the Yokohama citizen group. Also, it was clarified that we would officially establish the open source community for NOTA called NOTA network as shown in Fig. 3. In the open source community, NOTA programs are distributed for free, the programs can be installed in servers, and source codes are made open. We discussed the rules for the NOTA network based on the rules of Linux community as well. This is how the use of NOTA
spread among the Yokohama citizen’s group, and the NOTA open source community was organized.

Open source communities such as that represented by Linux have arranged a new type of community for system development. At the same time, it has provided a rich learning environment where various resources are arranged for system developers. Open source movement has strong implications for co-construction of the system, and the construction of new socio-technical networks for collaborative learning.

In the case of Linux, however, program specifications are only represented in source codes, making it only accessible to UNIX specialists. Thus, there is no room for non-specialists such as citizens, students or children. On the other hand, the NOTA network was organized as an open resources and the environment is arranged for non-specialists such as citizen group members, teachers, students, and children.

According to the person in charge of NOTA in the IT Venture, they will continue supporting the open source NOTA network. That is, they are expecting that NOTA network will make NOTA much more popular. Thus, the IT Venture and the other members of NOTA network are currently maintaining an alliance.

3.2.5 Redesign NOTA along with organizing the open source community

Along with the formation of NOTA network, it seemed necessary for the participants to arrange the environment that enables re-designing of NOTA on their own. Redesigning of NOTA can be done by writing scripts of Flash plug-ins and rewriting CGI Perl programs. Thus, some sample scripts were written, mainly by graduate and undergraduate students of the author’s University. For example, a graduate student developed a map plug-in. In this plug-in, one can mark points on the map and open a small windows at each point. One can write sentences in the small window. By doing that, users are able to add various kinds of information concerning these points. Further, as shown in the Fig. 4, the map can be represented in multi-layers and various kinds of information can be represented in each layer. These Flash scripts are open to the public, and participants of NOTA network can freely use and redesign them. The idea of multi-layer map came from the NOTA use in

![Fig.3 NOTA network](image-url)
Tsuzuki traffic project. In this sense, the redesigning of NOTA cannot be separated from the actual activities and projects using NOTA. Influenced by the activity of students, the citizen’s groups have started creating new plug-ins.

4 Network oriented design of learning environment

As previously shown, the way people used NOTA was quite different between the users in the commercial site and the citizen’s groups in Yokohama city. It indicates that a user of NOTA is not an individual but a people’s network that is engaged in activities. In other words, utilization of NOTA was accompanied by organizing a network along with planning a project or an activity.

NOTA’s possibilities became visible when it was located in a network that had a theme and an activity. For example, the Tsuzuki traffic project shows that NOTA expanded possibilities of mutual access of various groups regarding traffic information in the local area. Here, the configuration of NOTA and the network arranged by NOP, *I love Tsuzuki*, were designed in an activity utilizing NOTA in the project. Without this kind of network and activity, NOTA may have not been so useful as in the case of users in the commercial site. The use of a system can be regarded as part of the system design and the design of the system is beyond that of the system itself. Specifically, it includes the design of the network, and the activities or formation of alliance under some shared interests.

A similar case is shown by Feenberg (1999). In 1980s’, France Telecom distributed a couple of million terminals called Minitel for free. Minitel was developed for accessing the service of
information on-line. However, some users invented a new use for Minitel, utilizing it for network communication. They started to use Minitel for on-line chat to make friends and sex friends. Thus, users redefined the system from a top-down distribution of information to their system of communication. In this case, “users” became designers by inventing a new way of use.

Callon and Rabeharisoa (1998) also showed the case in which users and designers are one and the same. With Vololona Rabeharisoa, they have studied organizations formed by patients suffering from very serious genetic diseases. They form collectives where researchers, clinicians, patients, and industry collaborate, and which are at the origin of important therapeutic breakthroughs.

Callon (2003), concerning new technologies, pointed out the following.

......... to conceive new technologies, new goods and new services, is not just a question of satisfying needs or demands expressed by well-identified human beings. It is also and mainly shaping new forms of human agencies and consequently constructing new types of collective life. The main challenge for the next couple of years will be to discuss which type of human agencies people want to develop. Or, in other terms, which types of socio-technical arrangements people will design and experiment. (p. 9)

If we look at the agency, called users, as something created from certain hybrid collectives not detached from their configuration, and as something that has the potential of superceding as merely being a user, then our view toward design and use of ICTs will change dramatically. According to this perspective, design and use of ICTs does not mean simply responding to needs and fulfilling demands. Rather, it includes the formation of new agencies and brings about reconfiguration of existing agencies. On the contrary, if one regards users as a fixed agency and design as merely meeting the users’ needs, the possibility of design will be extremely confined.

4.2 Design of learning environment

In the case of NOTA, starting members of NOTA network including the authors have attempted to organize an open source community that is connected with various groups and various uses of NOTA in activities. Organizing this network has conducted reconfiguration of the previous network. This reconfiguration came from organizing the network as an open source community. The open source community made a linkage up to citizen’s groups and new groups, such as the NOTA developer group, the student group of the author’s University, the researcher’s group and the IT Venture.

Regarding the design of the learning environment, organizing this network has arranged at least two layers of environments. First, it arranged a new learning environment for participants in activities where NOTA is utilized such as the Tsuzuki traffic project by increasing possibilities for participants to access each other and to other relevant resources. Second, this network provides an environment that enables participants’ to redesign NOTA. This was made possible by increasing opportunities for participants to access various technological resources such as, the source code of the system, multiple relevant technologies, and various members who have technological and other backgrounds. This second layer as learning environment for redesigning NOTA is accomplished by organizing this network as the open source community. These two layers of the learning environment cannot be separated. This is because ideas of design and redesign come from both organizing activities and in utilizing the system for those activities.
For participants’ redesigning of NOTA, how to organize participants’ access to various technological resources is very critical. For example, it is necessary to arrange the environment that makes designing of plug-ins by Flash scripts easy. Currently, a graduate student and several undergraduate students are engaged in writing some sample scripts such as the multi-layer map as shown in the previous section. The idea of the multi-layer map came from the actual use of NOTA in the Tsuzuki traffic project. It is difficult to write much information on one map on a browser. However, it becomes possible by categorizing information and by dividing it into multi-layers. Depending on the purpose, one can take a look at one layer, two layers or more layers. These kinds of scripts produced by students will be resources for participants not only for using plug-ins but also to design them. The components of the scripts can be recombined for new scripts. Another student of the author’s lab has rewritten CGI programs of side menus and a program for an easy tool to install NOTA on a server. These programs were shown in the NOTA workshop and also uploaded to the NOTA portal site.

While students are designing the learning environment for participants of NOTA network by writing programs, the NOTA network arranges a learning environment for students to design plug-ins and CGI programs. In other words, NOTA network provides these students an orientation for programming through the feedback from participants of NOTA network. Thus, the formation of the NOTA network and students’ participation in it, make these activities of students possible. In other words, NOTA network arranged interests for students.

4.3 Individual participants in the network

The NOTA network rearranged various relations among humans-nonhumans and the design of learning environment. This can be regarded as the reconfiguration of a hybrid collective of humans-nonhumans. If so, what did the reconfiguration bring to individual participants? Let us take a look at the case of the graduate student who developed plug-ins with undergraduate students. While, in the network, participants had access to the knowledge and technologies of the graduate student by his writing of plug-in scripts, the graduate student also had access to various participants such as local citizen’s groups and the students’ group that developed NOTA. The graduate student could obtain some position in the network and by his writing and showing scripts. Further, it is possible to say that NOTA, as a platform, expanded the use of Flash and the possibilities of writing scripts. As a result, the learning environment of this graduate student was designed. This new position or the new way of participation of the graduate students in the network was brought about by the reconfiguration of the network as the open source community mediated by NOTA.

The above case also demonstrates that ways of participation in CoP (community of practice) is not a linear process from a newcomer to an oldtimer. Rather, ways of participation are brought by reconfiguration of networks or by rearrangement of relations to various communities and technologies also as shown in Sawyer (2003). Thus, organizing the NOTA network as the open source community, is oriented to the design of the learning environment for participants by the reconfiguration of networks or hybrid collectives of humans-nonhumans.

This case reminds us of the case of the knowledge broker that Wenger (1990) describes. He introduces a case that is related to the nexus of several trajectories of participation in multiple CoPs (p. 164). Wenger illustrates the role of a broker in a youth peer community by citing Eckert (1989). According to Eckert, in a peer community of juveniles, a knowledge broker is a peripheral existence. However, because of this peripheral position, he has a potential of being an agent who brings about change in the CoP. For example, by the leader and other members being interested in a new trend
brought by this knowledge broker, this knowledge broker in the periphery will become empowered to move toward full participation. At the same time, the leader and the other members now move toward the position of the broker, which was previously a peripheral position. Then an individual such as a knowledge broker could become an agent of change by bridging across CoPs.

This example illustrates that one obtains a certain position (a knowledge broker, in this case) not by participating in a certain CoP, but by participating in several CoPs. Regarding the case of the graduate student in the NOTA network, NOTA as an ICT played the important role of linking up different communities and the student could cross the boundaries of communities through forming a network mediated by NOTA.

4.5 Rearrangement of division of labor in design and use

In the previous approach to system design, the boundary between designers and users has been established. System design has been finally conducted by specialists even though the process of collaborative design with users are partially included in the development of the system. This is true in the case of participatory design. The approach of participatory design does not aim to arrange the environment where users themselves can design a system. Further, it is not oriented toward organizing a network of designers, users, and systems.

However, as shown in the case of NOTA, the boundary of design and use of system is not so clear as institutionalized division of labor defines. Furthermore, in reality, designing ICTs is not confined to just the design of ICT itself. Designing ICTs includes the design and arrangement of a network. The NOTA network is attempting to make ICTs as black box glass boxes by increasing participants’ accessibility to knowledge, technologies and persons, and activities in the network.

A black box is “a device which performs some useful function, but whose internal mechanisms are not available to inspection” (Wenger, 1990, p. 96). Wenger calls the opposite device a “glass box.” What makes a black box a black box is the inaccessibility to its mechanism or content, whereas a glass box is transparent and we can see the mechanism and whatever else is inside. By applying this analogy, according to Wenger, a black box is an artifact whose meaning is not transparent for those who cannot access the activity in which that artifact is utilized. On the other hand, organizing NOTA network as an open source community attempts to make ICTs transparent by increasing the accessibility to various resources and activities, as the result, it is arranging a new kind of learning environment for the design and use of ICTs.

Finally, we must point out the difference between the NOTA network and open source communities such as the Linux community. In the case of the Linux community, the fact that specifications are expressed in source codes indicates that this open source community is actually open only to specialists of the Unix system. Thus, it is impossible for mundane citizens, students, and child to participate in the community. On the contrary, the NOTA network is oriented to open the technologies of use and design to citizens, students, teachers, children and others.

References


