

# An ethnographic investigation of the learning of a teacher-as-local-expert in the first phase of introducing computers into an elementary school

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## ABSTRACT

This paper reports consequences of our design project to support an elementary school to introduce computer-based education into it. In the project, support-team came from outside of the school helped a teacher to be a local expert in the school. Participatory observation and close examination of conversation among project participants reveals that (1) The teacher acquired computer skills and appeared as a computer expert in the school, (2) The teacher failed to be a local expert who helps his/her colleagues to acquire computer skills and use computers in their class activities, (3) Supporters from outside of the school served as good instructors for the teacher. They effectively supported the teacher to be a computer expert, however, they could not fully support the teacher to be a local expert in the school community.

## Keywords

sustainability design of educational environment, learning to be a local expert, support by outsiders

## INTRODUCTION

The authors have been observing what is going on in an elementary school which was at the first phase of introducing computers into it while we were serving as sup-

porters. The range of support covered designing computer classroom layout, selecting equipment, providing curriculum materials, and assisting teachers to acquire computer skills and to manage computer-based classroom activities. In this report, in particular, we examine learning of one teacher who was appointed to be a local-expert of computer education by the school management, and discuss how should support for a teacher-as-local-expert of computer education be arranged.

We believe that supporting for design of computer-based learning environment in school should focus on its sustainability. There are many excellent experimental projects to design computer-based learning environment in school, however some of these projects are lack of historical perspective of design. That is, they do not focus on how to sustain the environment after the projects end, or after the researchers leave the field. Our interest resides in how to arrange sustainability of the environment in its designing process. Designing for sustainability includes: (1) continuous adjustment of the school organization for long-term maintenance of the environment. From the view point of Activity theory (Engestrom 1987), the adjustment involves creating new divisions of labor, rules, and community in the school, (2) continuous development or revision of the environment. With sustainability design, the environment is embedded in the historical reproduction and development cycle of the school.

One promising strategy for sustainability design is fostering a local expert in the school, we believe. We define a local experts a technologically empowered member of the school community who can (1) administrate computer room, (2) design curriculum for computer-based learning, and manage

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the computer-based classroom activities, and (3) help the other teachers to learn computers and to utilize computers in their class.

Some researches suggest effectiveness of local experts. For example, Gantt et al. (1992) argue, in their research on learning in organization, that the role of a local expert is important in arranging a CAD (computer aided designing) system to be effectively used in the organization. We consider that a local expert can be a center of "sustainability design" for two reasons: (1) a local expert can work as a mediator in the designing process because he/she knows well about computer technology on the one hand, he/she well knows about the organization into which the environment is going to be embedded, and more importantly, they are legitimate member of the school community and thus have the power to change rules or divisions of labor of the organization on the other hand, (2) a local expert, unlike researchers and designers who will leave the field sooner or later, is rooted in the field and is a part of its historical trajectory. This enables him/her to continuously adjust the environment.

One major way to help fostering local-expert would be, as we adopted for our own project, collaborative design by teachers and a support-team from outside of the school because many schools in the very first phase of introducing computers have no expert in it. This is a kind of participatory design (Ehn 1988) in which people from two different cultures, i. e., teachers and researchers, collaborate and may generate new plane of mutual understanding in the design process.

In this paper, based on our design project, we demonstrate how the teacher, who was appointed to be a local expert, learnt, and then discuss problem and limitation of the collaborative design.

#### FIELDWORK AND ANALYSIS

Fieldwork was carried out in an elementary school into which computers were newly introduced. The school opened a computer room in April 1997, and a computer club was founded (in this school, students have to join at least one club, and they have club meeting basically once a week). Computer club activities were the very first step of computer utilization in this school. Two young male teachers TM and TH were assigned to look after the computer club. TM was also appointed as a local expert; that is, he was expected to enhance his computer-related skills and to help his colleagues to use computers for instruction. We carried out participant observation while working as "supporters" who helped TM to plan and manage the computer club activities. The fieldwork ran from April 1997 to March 1999. The support-team consisted of employees of a computer manufacturer, and undergraduate/graduate students of education. In addition to recording what we saw and thought onto our fieldnotes, we videotaped the club activities and his conversations with the supporters after each club meeting.

This paper focuses on the first year of the fieldwork to exam-

ine the first phase of TM's learning as a local expert and outcome of the collaborative design. In our analysis we mainly rely on recorded conversation between TM and the supporters. We believe that in detail examination of lived conversation is one of the best way to know how people learn since conversation is the field on which people visualize their competence and thus constitute the fact of learning through local interaction. Of course, we utilize fieldnote descriptions to complement our analysis.

#### LEARNING TO BE A LOCAL EXPERT

Learning to be a local expert, we consider, involves the following two aspects which are interpenetrated each other: improvement of computer skills, and establishment of one's status as a local expert in the school community. In the following sections, we examine these two aspects of learning.

The following notation is used for the transcriptions: <XXX> shows a record of action; (XXX) shows an unclear utterance; ((XXX)) shows comments by the authors; = shows continuation of an utterance; # shows simultaneous speaking; : shows prolonged sound; and hhh shows aspirations. In the transcripts, the name of the speaker is indicated by initials. Suffixes indicate the persons' status: T for teacher, C for computer company employee, G for graduate student, and U for undergraduate student.

#### Improvement of computer skills

TM's improvement in computer skill and knowledge of computer technologies is examined in this section. TM did not have any prior experience operating computers before this project. TM was not able to operate even the in March. However, we observed his acquisition of basic computer skills in May. In the following conversation, he talks about his learning.

#### Fragment 1: May 7th (first club gathering)

((In the computer room))

TM-T[01]: <puts his hand on a CRT monitor> I operate it, but I don't know much about how it works. I have eagerly tinkered with it=

YG-G[02]: yeah.

TM-T[03]: = Even using the mouse was a new experience for me.

YG-G[04]: ah::

TM-T[05]: The PC you set up in the staff room was useful; the card game software turned out to be very useful.

SU-C[06]: That's good.

SU-C[07]: Oh::, the game helped you practice using the mouse.

TM-T[08]: Yes, exactly.

SU-C[09]: Well, I actually thought the PC would not be used and would be abandoned, but I'm happy I was wrong.

The juxtaposition of the utterances "Even using the mouse

was a new experience for me”[03] and “I have eagerly tinkered it” [01] shows his improvement in computer skills, since the former statement highlights TM’s previous inability to even use the mouse, and at the same time shows his present level of skill, and hence progress in learning.

At the end of the first semester (In Japan, we have three semesters: the first semester starts April and ends July, the second September to December, and the third January to March), his computer skill was so improved that he tried to import picture data from the digital camera. The following fragment tells us how TM was computer literate at the beginning of July

**Fragment 2: July 2nd (7th club gathering)**

TM-T[01]: I’m sure that any Windows program can be terminated by clicking this x-mark. See.  
<clicks the close box>

SM-U[02]: I see.

((skip))

TM-T[03]: Clicking an x-mark always makes the software stop. It’s a rule of Windows.

SM-U[04]: Yes, I see.

**Fragment 3: July 2nd (7th club gathering)**

SM-U[01]: Can we input text here?

TM-T[02]: Yes, I think so, but we need( )

In fragment 2, TM is teaching SM, one of the supporters who actually had better computer skills than TM, how to use the Windows operating system. In fragment 3, SM asks him about one of functions of the software used in his class. These fragments suggest that TM has improved his computer skills.

Despite improvement in computer skills we still observed, in the first semester, his misconception about computer systems and lack of vocabulary to talk about computers technically. The following fragment is an example of his misconception.

**Fragment 4: June 11th (5th club gathering)**

TM-T[01]: Is computer so unstable?

SU-C[02]: What are you talking about?

TM-T[03]: Students report that they had the trouble when they just hit the return key.

((skip))

TM-T[04]: I asked the sales rep if it is robust. I asked whether it could withstand rough operation by kids, and he assured me it could, but that’s wrong.

In this fragment, TM is talking about the problem he had in the club activity, the problem was that the application program he used in his classroom froze when students hit equal key. As the last line of this fragment tells, TM confuses robustness of hardware and that of software. This kind of misconception gradually disappeared as the following fragments suggest.

**Fragment 5: September 10 (8th club gathering)**

TM-T[01]: He:::y, it’s awful.

( ) [02]: hh.

TM-T[03]: What is the source of this trouble? Is it a hardware problem ((pointing to the computer)), or is it a bug in the software?

**Fragment 6: September 17 (9th club gathering)**

TM-T[01]: Why? The server is expected to have some problems.

YG-G[02]: I don’t think so.

TM-T[03]: Well, I guess that the source of this trouble is a lack of server capacity. Don’t you think so?

YG-G[04]: I think the server has enough power.

TM-T[05]: Do you really think so?

SM-U[06]: hhh.

TM-T[07]: The server may not be able to process every job at the same time.

Fragment 5 shows that TM, at least at this point of time, understands the basic structure of computer system, i. e., hardware and software, and exploits this framework to see and talk about the trouble he has. In Fragment 6, TM views the server’s ability as the cause of the trouble he had (the trouble was really due to server’s memory capacity) . What is important here is that TM talks about the trouble in terms of technology. This “engineer’s talk” is enabled by TM’s acquisition of technical vocabulary and his understanding of mechanism of computers.

The data shown in this section indicate TM’s transition from novice to expert.

**Establishment of status as a local expert**

In this section, we analyze how he talked about himself and his colleagues in conversation between TM and the supporters. In other words, how TM displayed his identity in relation to the others is examined. We believe this investigation would elucidate one aspect of TM’s learning as local expert because his understanding on his role in the school and his speciality is indicated socially through the identity display. Of course, we recognize an unavoidable limitation of this investigation, i. e., the display is carried out in the very relation between TM and the supporters. This means we need to be very careful in treating what we discern in the conversation. We have to continuously remind ourselves that the identity display is indigenous to the interaction between TM and the supporters, and to avoid over generalization.

**I use a computer frequently just because I’m in charge of the computer club: May 7th (1st club gathering)**

Fragment 1 in the previous section shows that TM has been spending much time in studying computers. It suggests that he has positive attitude toward using computers. In the next fragment, however, he is displaying himself differently.

**Fragment 7**

YG-G[01]: Are the other teachers also using computers heavily, or just you right now?  
 TM-T[02]: I use a computer frequently just because I'm in charge of the computer club.  
 SU-C[03]: Oh, you actually hate it?  
 TM-T[04]: Well, no, I don't hate it, but  
 YG-G[05]: # It's time consuming, right?  
 TM-T[06]: # Yes, it is time consuming.  
 YG-T[07]: How about TH ((the other teacher running the club))? Do you talk often?  
 TM-T[08]: We talked just once when we confirmed how to save files.

YG's question [01] asks if the other teachers use computers as eagerly as TM does. TM answers "I use a computer frequently just because I'm in charge of the computer club" [02]. This answer implies that TM is the only person who spends much time with computers. Interestingly, the answer is made by mentioning his role as "computer club teacher". In other words, he answers the question by visualizing a boundary between TM who spend much time on computer-related tasks and the other teachers who spend less time, and accounts the source of the boundary in term of the role given by organization of the school, i.e., "computer club teacher". "Just because" [02] in the statement suggests the role is its only account. One possible interpretation for this is that this utterance allows TM to report the fact that he is the only person who uses computers frequently while avoiding separation from the other teachers. Explaining the difference in terms of the formal division of labor implies that without being forced by the management he would not use computers so often, and he would thus be in the same situation as the other teachers. Explaining his present situation in terms of organizational decision could obscure TM's intention or motivation to be enthusiastic about computers, and he could avoid total separation from the other teachers.

TM's statement [02] further implies that TM in reality dislikes using computers. Consequently SU asks if he really does hate computers [03]. TM answers "Well, no, I don't hate it" [04], but at the same time he expresses reservation by adding a "but". The reason for this reservation is revealed by the conversation subsequent to the answer [05]-[06], where TM mentions disadvantage of being in charge of the computer club in the conversation. What TM tries to achieve through this conversation is to express his positive attitude towards computers while shifting the focus of the talk about his situation (his situation concerning computers) from individual preference, i.e., 'like or dislike it?', to the division of labor imposed by the organization, i.e., 'being in charge of the computer club or not?'. This shift consequently reveals TM as 'an ordinary teacher who just happens to have been appointed to be a computer club teacher', and thus one who belongs to the same group as the other teachers, at the same time one who does not belong to the supporter group.

#### **They are just toying with it: June 4th (4th club gathering)**

Two months have passed since this school opened the computer room, and one month since the computer club started. Teachers other than TM have also gradually become interested in trying to use a computer, but they are in the very introductory phase of learning. In fragment 8, TM talks about his colleague teachers' learning.

#### **Fragment 8**

((SM and SU are talking about the card game software))  
 SU-C[01]: Is this? <Clicks on the icon of "Solitaire"((a card game software))>  
 SM-U[02]: Yes. That's it.  
 SU-C[03]: It's Solitaire.  
 SM-U[04]: I was asked how to play it, but I couldn't explain.  
 SU-C[05]: Like this<operates>  
 TM-T[06]: They have learned how to click the mouse by playing this game hhhh.  
 SU-C[07]: # They learned how to click hhhh.  
 SM-U[08]:# hhhh.  
 ((A few minuets later))  
 SU-C[09]: The PCs here ((in the computer room)) are the latest model.  
 TM-T[10]: I know. But, the one in the staff room=  
 SU-C[11]: =Miserable hhhhh.  
 TM-T[12]: They are just toying with it.  
 SU-C[13]: Oh, it's terrible.  
 TM-T[14]: Well, the good news in this disaster is that they learned how to click through it.  
 SU-C[15]: Yeah, that's right.

Noteworthy in this conversation is TM's statement: "They have learned how to click the mouse by playing this game". This is not a simple report about the fact. This statement indicates that TM has legitimacy to talk about the others teachers' computer-related learning. More interestingly, the identity display is done by editing his own learning history. On May 7th, TM reported that he himself had learned how to click the mouse by playing the card game software (see fragment 1), but in this conversation TM tries to exclude himself from the people who had learned the skill with the statement: "they". After TM's utterance, they sneered together. This sneering labels the other teachers' learning as puerile, and thus mutually confirms TM's status as an advanced computer user together with the supporters, and his relative superiority over the other teachers in terms of computer skills.

In exchange [09]-[15], SU and TM talk about the other teachers' learning to click again. TM belittles their learning by statements [12] and [14] where he mentions the other teachers' learning as a side effect of unproductive and undesirable use of the computer. Through this conversation, boundary

between TM and the other teachers in terms of computer skills is visualized mutually.

**They don't even know how to turn on the server: July 2nd (7th club gathering)**

He was able to operate computers without difficulty for his purpose at the end of the first semester. We observed that some teachers other than TM also had improved their computer skills and tried to use computers in their classroom activities, although their computer skills were at introductory level. In the next fragment, TM is talking about the teachers who used the computer room.

**Fragment 9**

YG-G[01]: It seems that the difference between you and the others has become quite conspicuous.

TM-T[02]: They don't even know how to turn on the server.

UT-G[03]: hhhhh.

TM-T[04]: It's ridiculous.

((skip))

TM-T[05]: There are some teachers who use this room ((the computer room)) for their class activities.

YG-G[06]: Yes.

TM-T[07]: They left this room without shutting down the machines.

YG-G[08]: Didn't they shut down?

TM-T[09]: No, never.

SM-U[10]: They are too dependent on you, right? Did they ask you to shut down for them?

TM-T[11]: No, they didn't ask me to, but, I had to do it anyway.

In this fragment, TM and YG are mutually confirming TM's superiority to the other teachers by talking about their novicehood. The fact that they tried to use computers ([05]-[06]) implies some progress in them. However, in this fragment, the progress is hidden by talking about their defects: they do not know how to turn on the server; they left computer room without shutting down the computers, and thus novicehood of these teachers is reassured. Interestingly, their novicehood is marked by reporting consequentiality between their lack of computer skills and their irresponsibility in managing computer room. In this conversation, TM displays himself as a 'person who can administrate the computer room' as well as a 'computer expert'.

**He is not interested in teaching: September 24th (10th club gathering)**

In the second semester, some teachers have started to use computers for documentation and data processing. One teacher decided to use a multimedia authoring software in her reading the class and started preparation for it. One young teacher bought his own computer for private use and got the Internet access. Some showed interest in computers, however, few teachers are willing to utilize computers for class

activities.

In the following fragment, TM is talking about TD's attitude toward computers. TD is a younger colleague of TM.

**Fragment 10**

SM-U[01]: Do other teachers come here ((the computer room))?

TM-T[02]: Huh?

SM-U[03]: Are you the only one who comes here?

TM-T[04]: Yes.

SM-U[05]: O:h

TM-T[06]: Well, a 3rd grade teacher ((TD)) came, but he was marking students' test papers here.

SM-U[07]: Why don't you invite him to learn about computers?

TM-T[08]: His morale is rock-bottom.

((skip))

SM-U[09]: Well, isn't he interested in computers? He seems to be young enough to be, but=

TM-T[10]: = I tell you what, he bought a PC.

UT-G[11]: Did he?

TM-T[12]: He bought it for private use=

SM-U[13]: But, he is not...

TM-T[14]: =and I guess he is accessing the Internet at home.

SM-U[15]: O:::h

UT-G[16]: O::h

((3 seconds elapse))

SM-U[17]: Then, I presume he is not interested in teaching the kids with a computer.

TM-T[18]: That's right.

In this fragment, TM reports TD's low morale: "His morale is rock-bottom". In line [09]-[18], negotiation on the meaning of 'morale' is carried out. SM's statement [09] can be considered as display of her own interpretation of TD's lack of morale. She apparently views lack of morale as lack of interest in computers. TM's response to SM's statement is reporting that TD bought his own personal computer [10][12], and that he is now accessing the Internet [14]. Embedded in this sequence, TM's response provides evidence against SM's interpretation, since buying his own computer and connecting to the Internet implies strong interest in computers. Consequently, SM's utterance [17] initiated by "then" can be heard as a correction to her previous interpretation. The new interpretation is that TD is not interested in using computers for educational purpose. TM agrees with this [18].

In this exchange, boundary between TM and TD is visualized by referring differed attitude toward compute-based education. TM's current status, or his understanding on himself, as 'a teacher who is in charge of computer-based education' is observable through this exchange.

**He bought them just because he could afford them: September 24th (10th club gathering)**

At the beginning of the second semester, this school installed some additional computers into its science room for the purpose of facilitating computer-based education in science learning. This was decided by YM, a vice principle. In the following fragment, TM and the supporters are talking about YM's decision.

#### **Fragment 11**

SM-U[01]: Do you and YM discuss computer-based education?

TM-T[02]: He has no interest.

SM-U[03]: O::h, but YM said he decided to buy additional computers.

TM-T[04]: Oh, he bought them just because he could afford them.

SM-U[05]: hhhh.

((skip))

TM-T[06]: He just wanted to complete the budget plan.

UT-G[07]: So, he did not really intend to enhance computer-based education.

TM-T[08]: Absolutely not.

In [01], SM is asking if TM and YM discuss computer-based education, and TM answers 'No' [02]. SM expresses her surprise at TM's answer. We can discern from this exchange that the source of her surprise resides in the fact that TM treat YM, who decided to buy additional PCs for science education, as one who has no interest in computer-based education. Her expression of surprise shows that SM views 'buying additional computers' as an evidence for 'being interested in computer-based education'. TM's next utterance [04] can be seen as correction to SM's understanding. That is, the statement distinguishes 'to buy computers to facilitate computer-based education' from 'to buy computers', and excludes YM's decision from the former.

We can see in this fragment TM's display of his legitimacy to preemptively judge the other teachers' interest in computer education of this school. Through this display, TM as a 'key person of computer-based education in this school' become observable.

#### **DISCUSSION ON LEARNING OF TM**

Data shown in section 3.1 indicate TM's transition from novice to expert. In our fieldnotes, it is also reported that TM apparently acquired computer skills and became a computer expert. Analysis of TM's identity display reveals that: In early May, TM tried to avoid showing difference between him and his colleague teachers, however he started to indicate the difference as time goes by; the difference was visualized in terms of computer skills at first, then ability to administrate computer room, and then motivation for computer-based education. This result implies his development as a local expert. Observed shift in the way in which TM displayed the difference between TM and the other teachers implies change in his understanding on being a local expert, that is, from expert in computers to expert in computer-based

education.

We are sure TM learned, however observation still suggests that the learning can not be considered as full success. As we discussed previously, learning to be a local expert involves to be a leader who helps the colleague teachers to learn computers and to utilize computers in their class. This aspect of learning did not saliently appear. Observed was the fact that TM was not very eager to support the others teachers' learning of computers or to diffuse computer-based activities through the school. Rather, TM seemed to be considering the realm of computers as his personal empire and trying to exclude the other teachers from his territory. This tendency can be detected in TM's statements analyzed in section 3.2. There is one interesting characteristic of TM's remarks about the other teachers. In his remarks, improvement of his colleagues is always described accompanied with degrading and exclusion.

Specifically, TM labeled the other teachers' learning to click as a side effect of 'toying with computers' (fragment 8); he upbraided the other teachers who tried to use computer room for class activities for not knowing how to operate the server and thus for not behaving responsibly(fragment 9); he asserted that TD had no interest in educational use of computer despite his strong interest in computers(fragment 10); and he degraded YM's decision to buy new computers to enhance science education(fragment 11). Given that there are many other ways for displaying one's identity than the way TM took, it can be considered that exclusion of the other teachers from the realm of computers was an integral part of his learning.

One possible reason for that would be the very fact that TM was the first person who had to learn about computers. If he had had a more-experienced peer in the school when he started his learning, he could have consulted that person for help, and most importantly, he could have envisioned his future life as a local expert by overlapping the present situation of that person with his own future. However, in reality he did not have such a role model, and thus he could only visualize his learning in relation to his colleagues who were always his followers. In this situation, his learning oriented not to a future-looking activity, but to the upholding of the boundary between himself and his followers to keep his present status. This was because, without the perspective of learning, the followers' attainment of the same skills as his would directly mean loss of status for him, that is, failure of his learning.

The other reason for that would be the fact that being a computer expert was TM's only formally endorsed speciality. Before he was appointed to be a 'computer teacher', his formal speciality had been in science education. TM's nomination as a 'computer teacher' was accompanied by his removal from his original speciality in order to facilitate his development as a computer expert. This way of appointment caused his first priority to become keeping superiority to the

other teachers, i.e., always being top in the school. In this situation, followers who were continuously approaching his level of skill may have been seen as a threat to his status.

#### DISCUSSION ON COLLABORATIVE DESIGN

In this section, consequences of our collaborative design project in which the support team came from outside of the school supported TM's learning, is examined to clarify its merit and demerit.

TM apparently acquired computer skills and became a computer expert through the project. The supporters, who behaved like an experienced colleague, surely contributed to this learning process. The contribution can be divided into the following three aspects:

a) Providing information and instruction: The supporters provided TM with technical information and helped him to acquire both knowledge on computer systems and skills for operation. The following excerpts show how the supporters worked: "Mr. TM, do you have anything unclear about computer?"; "O.K., We will make a short note that tells you how to save files, and so on, and send you by fax. So please notify what you'd like to know".

b) *Showing experts' viewpoints*: The supporter, who were more advanced computer users at least in comparison with TM, demonstrated how a computer expert behaves. That is, they used technical vocabulary to talk about computer related events and they relied upon "experts' common sense" to see phenomenon on the screen. For example, in the following statements made by the supporters display experts' ways of behaving and bearing toward computer technologies: "We, professional users, save files anytime"; "If you would like to avoid 'freeze', you must simplify system configurations."

c) *Visualizing improvement*: In the conversation between TM and the supporters, TM's learning/improvement in computer skills is visualized. For example, when TM reported that he used one of advanced functions of an application software, one of the supporters said; "You know what I do not still know", and in the same kind of situation; "Great, you have mastered everything". By followed by these statements(see also fragment 9), TM's external actions are constituted as evidences of learning. In other words, the fact of his learning is marked by these statements for both TM and the supporters.

Contribution of the support-team to TM's improvement in computer skills is apparent. However, the support method seems not to be perfect when it comes to supporting TM's learning as a local expert. Learning to be a local expert in the school involves more complex social coordination than learning to be a computer expert. Learning to be a local expert involves creating a new formally and informally accepted

'status', role in the school community. In this sense, supporting to learn to be a local expert is a social design process that involved community reconfiguration. In other words, helping TM to anchor his learning about computers into the school community in which his professional life is being shaped was required as an integral part of supporting. Observation tells that the support-team could not fully cover the aspect. There are three reasons for that, we presume:

(1) the supporters were unable to provide learning perspective to be a local expert, especially to be a leader, in the school community because the supporters were not legitimate members of the community. This is related to the previously discussed problem of lack of a role model for TM in the school. The supporters could not substitute for an advanced colleague because they were outsiders.

(2) TM and the supporters mutually confined topic for discussion/support to technological issues. Therefore, their collaborative activities did not penetrate into the school community. It was unable to affect productive activities of the community, i. e., education. Thus, learning of TM was isolated from the school community. This confinement was also based on the fact that the supporters were not legitimate members of the community of teachers. In short, the supporters did not have legitimacy to talk about educational matters and to give TM an advice on his way of instruction. They could have claimed the legitimacy in interaction and won sanction, however, in reality the supporters and TM were mutually confirming that the legitimacy was attributed to TM exclusively. The following fragment shows how they achieved the asymmetry.

#### fragment 12

(( TM allowed students to play a hockey game in his class. After the class, SU and TM is talking about freed PC's during the class activities))

SU-C[01]: ((skip))I think you may have them play the game, but at least I recommend you to tell the kids how to shout down the game.

TM-M[02]: Today is the last day I allow them to play the game.

SU-C[03]: Yeah, that's a right decision. Gaming is dumb hhhh

In this fragment, we can observe SU's contradiction in attitude to the game [1][3]. Confirmed mutually through this exchange would be SU's legitimacy to give technical advice as well as his lack of legitimacy to affect instructional decision, and thus TM's privilege to manage the class activities. On this agreed asymmetry, the field on which technological matters were exclusively discussed was created.

(3) The supporters monopolized TM's learning. There was no one in the school community who intervened in TM's learning. Through intimate and closed relationship between TM and the supporters, his learning was encapsulated in an iso-

lated milieu in which TM and the supporters collaboratively shape and visualize TM's learning. This encapsulation would uproot TM's learning from the school community.

#### **CONCLUSION: IMPLICATIONS FOR DESIGN**

In this paper we focus on the first year of our design project and examine consequences of our design project. The analysis of the process of TM's learning and contribution of the supporters to TM's learning provides the following implications for supporting learning of teacher-as-local-expert.

*Fact:* Lack of a role model in the school community impeded TM's learning as a local expert in the community.

*Implication:* One solution to this problem is to organize local experts from many different schools into an inter-school community. Network technology can provide the medium for forming such a community, since it can transcend both spatial and time barriers. By participating in such a community, a teacher could discuss problems and exchange information with other 'computer teachers' of varying levels of skill/knowledge. This would facilitate learning to be a local expert. Moreover, in this community, learners would encounter more-experienced peers who could act as role models providing a perspective for their learning (see, Lave & Wenger 1991). Having a perspective on learning would make their learning future-oriented. It should be noted that the final goal of this support should not be acquiring membership of the inter-school community, but to become a local expert within the local school community. Therefore, it is necessary to provide support for the transition between the two communities, i.e., the newly established community of teachers as local experts and their respective home-communities. This support should include institutional reconfiguration that allows learning in the inter-school community to be treated as valuable to the home-community and to have significant consequences to the productive activities of the community and their learning trajectories within the school.

*Fact:* Making TM dedicated to 'computer' impeded his learning as a leader.

*Implication:* We presume that the lack of incentives for taking the role of a local expert in this school is the source of this problem. Ideally, the learning process of a local expert should proceed from the phase of acquiring computer skills towards the phase of directing and supporting the other teachers in using computers. To support this shift, it is essential to provide incentives, e.g., to make new rules whereby taking a leadership role in computer utilization for education is taken into consideration for promotion and to foster a community

culture in which taking such a role is publicly respected.

*Fact:* The supporters from outside of the school surely contributed TM's learning to be a computer expert.

*Implication:* We need to design social foundation on which collaboration between school and extra-school supporters, i. e., people from universities, research institutes, and companies, can be supported. For example, re-designing rules of organizations (schools, universities, companies) to enable acceptance or offering supporters, and creating demand/supply lists of support which can be access by public are needed. Network technology, which resolves time and space constraint, would be useful to involve people from various regions and background.

*Fact:* TM and the supporters formed a shard plane which was separated from the school community in which TM's learning should be embedded.

*Implication:* One way to cope with this problem is to link learning in the supporter-teacher community with learning in the school community in which a teacher is a legitimate member. This linkage would be formed by having a regular-basis meeting in which the progress and problems of the computer education in the school are discussed by all staff teachers, a principal, and supporters; and organizing in-house learning programs for computer literacy and computer education taught by the local expert. Another way is to recognize that this is an intrinsic problem of collaborative design, and to incorporate work of reflecting the design process from the standpoint of referential reflexivity (Pollner 1991) into our design project as an imperative part.

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