

A SUPPORT SYSTEM FOR EARLY CHILDHOOD EDUCATION: E-INFANT EDUCATION NET SYSTEM

Keijiro SASADA
Information System Laboratory
Graduate School of Doshisha University
Kyotanabe, Kyoto, JAPAN
email: k-sasada@ishss10.doshisha.ac.jp

Kimio SHINTANI
Early Childhood Education
Tokiwakai College
Hirano-ku, Osaka, JAPAN

Hirohide HAGA and Shigeo KANEDA
Information System Laboratory
Graduate School of Doshisha University
Kyotanabe, Kyoto, JAPAN
email: skaneda@mail.doshisha.ac.jp

ABSTRACT

Information and communication technology has rapidly spread throughout society, including the non-technical market. This includes the many application systems that have been developed for the field of early childhood education. However, the users of the conventional systems are parents, not nurses/teachers; the workload of nurse/teachers is already too high for them to input and maintain child data in the conventional systems. To resolve the problems, in this paper we propose a new application system, the *e-Infant Education NET System*, as a way to support nurses/teachers and to improve the quality of infant education. The system includes the following features: 1) parenting support; 2) sharing of child information among parents, kindergartens/nursery schools, support centers for parenting, the local government, and medical agencies; and 3) tracking of each child's developmental stages. Also, *Digital Communication Note*, which include *Knowledge Templates*, are proposed and implemented as a core sub-system of the e-Infant Education NET System. The Digital Communication Note accumulate child information, improve parenting efficiency, and maintain child-care quality at a high level. Experimental on-the-spot evaluation confirmed that the system can be effectively adapted to nursery schools.

KEY WORDS

Early childhood education, Child care, Groupware, Mobile phone, Knowledge, Template

1 Introduction

In the field of early childhood education, many information services for parents have been developed as information and communication technology has spread throughout different types of market [2]. Those services include, for example, a Web baby-book service that displays a child's image on a mobile phone, and a delivery service for moving-images/messages from kindergartens/nursery-schools. In the modern child-care market, information services are very attractive, since many young parents have mobile phones and access to the Internet in their daily lives. However, the conventional service mentioned above is not practical from the viewpoint of the nurses/teachers;

the conventional parent-oriented systems bring nothing but extra work for teachers and nurses to record and maintain data on child activity.

On the other hand, kindergartens and nursery schools are required to create parenting support community at the behest of new governmental policy. In recent years, many problems have occurred in the field of infant education in Japan, such as an increase in juvenile crime, a decline in academic ability, a lowering in the age of truancy, child neglect, and child abuse. To solve these problems kindergartens/nursery schools, support centers for parenting, local governments, and medical agencies need to cooperate with each other.

Against the above background, this paper proposes a new system that we call the *e-Infant Education NET System*, shown in Figure 1. The e-Infant Education NET System has three main features: 1) parenting support; 2) a system to encourage information-sharing among parents, a kindergarten/nursery-school, a support center for parenting, the local government, and a medical agency; and 3) tracking of the developmental stages of each child.

We conducted field research (hearing) which involved consulting teachers/nurses in a kindergarten and a nursery school before developing the new system from the perspective of child-care workers. Findings from the hearings revealed that the key to the success of this kind of system is a streamlined procedure for making each child's *Activity Record*. This record includes *Communication Notes*, the *Master Child Record*, an *Activity Report*, and a *Nurturing Plan*, which are produced from computerized recordings.

Based on the research, we developed *Digital Communication Note*, which includes *Knowledge Templates*, as the core sub-system of the e-Infant Education NET System. The Digital Communication Note improve efficiency in the performance of on-the-spot parenting. Particularly, *Knowledge Templates*, produced based on the knowledge of veteran nurses/teachers, make the recording of children's activities easier by utilizing several data by adopting XML. Furthermore, we conducted a field experiment and analyzed the comments made after using the system. As a result, we confirmed the effectiveness of the e-Infant Education NET System.

The remainder of the paper is as follows. In Section 2, we describe background of our research, and in Section 3,

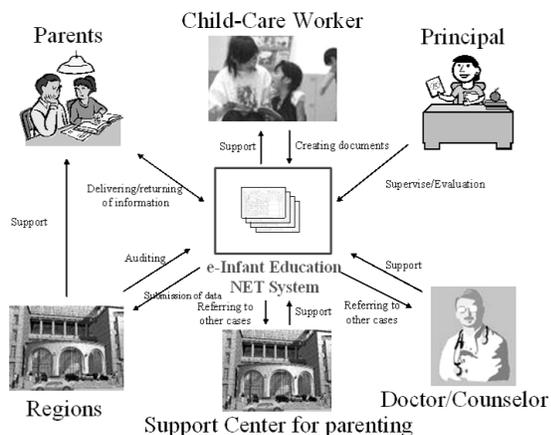


Figure 1. Overall view of e-Infant Education NET System

we analyze the comments made by the teachers regarding their jobs in the child-care facility. In Section 4, we propose and summarize our system, then evaluate it in Section 5. Section 6 contains the conclusion.

2 Background of Research

2.1 Kindergartens and Nursery Schools in Japan

In Japan, kindergartens are education facilities based on the Japanese School Education Law, and educate preschool children from ages three to six for four hours a day and more than 39 weeks a year. Kindergartens also conduct education based on the standard Instruction Procedure by the Ministry of Education, Culture, Sports, Science and Technology [4]. The results of the School Basic Survey in 2003 shows that in Japan, the total number of students in kindergartens is 1,760,442 and the total number of facilities of kindergarten is 14,174 [6]. The number of children in kindergartens is tending to decrease slowly. As a result, the Ministry of Education, Culture, Sports, Science and Technology provided a one form of deregulation: extended (long-time) child-care and acceptance of children less than three years old.

On the other hand, nursery schools are child welfare institutions based on the Japanese Child Welfare Law, which educate preschool children, from ages zero to six, for a maximum of 11 hours a day [1]. Nursery schools also conduct education based on the Education Guidelines for nursery schools by the Health, Labour and Welfare Ministry [3]. In addition, extended child care is often conducted from early morning until late evening outside regular hours. A survey on nursery schools by the Health, Labour and Welfare Ministry on April 4, 2003 states that the total number of students in nursery schools is 1,920,591, and that the total number of nursery schools 22,355 [7]. The number of children in nursery schools has been climbing due to the

Data		Weather	Time for pickup
22 病院予定の通園乗務車			
12月19日 全曜日		天気 (晴)	お迎えの時刻 (17時30分)
園の連絡	From Parents	At home	
<健康状態> 良い・普通・悪い <昨夜の寝寝時刻> 21時50分頃 <起床時刻> 7時10分頃 <朝食の様子> 良く・普通・食べない <排便> 時 便の状態 (分類)		【家庭での様子】 しばらくお預けのあいだ、お預けが 苦痛に感じているのか、お預け (お預け) がお預けのあいだ、お預け 苦痛に感じているのか、お預けが 苦痛に感じているのか、お預けが 苦痛に感じているのか、お預けが	
家庭への連絡	To Parents	At school	
<おやつ (午前)> 良く・普通・食べない <昼食> 良く食べた・普通・食べない <おやつ (午後)> 良く・普通・食べない おひるね 12時30分から 12時30分まで 排便 便の状態 (分類) <健康状態> 良く・普通・悪い		【園での様子】 今はいつもの元気で、お預けが 苦痛に感じているのか、お預けが 苦痛に感じているのか、お預けが 苦痛に感じているのか、お預けが 苦痛に感じているのか、お預けが	

Figure 2. Communication Note (for a two-year-old)

Ministry's policy of reducing the number of children waiting to enter pre-school.

Kindergartens and nursery schools need to develop a competitive difference from the above situation in the following ways:

- 1) Improvement of the child care itself;
- 2) Diversification of child-care services;
- 3) Quality control of child-care through disclosure or independent observers.

About 1), IT (Information Technology) support is irrelevant; this point is related to the essence of child care. However, there is potential for IT growth in 2) and 3). The existing services mentioned in Section 1 are examples.

2.2 Documents in Childhood Education

In kindergartens and nursery schools, many documents are created to record each child's activity [1]. In this paper, the generic name *Activity Record* is given to the documents. A child-care worker (teachers in a kindergarten and nurses in a nursery school) bears a great burden in drawing up the Activity Record. Activity Record is constructed from *Communication Note*, *Master Child Record*, *Activity Report*, and *Nurturing Plan*. All of them are handwritten. The purpose and outline of the each record is described below.

• Communication Note

This is a note exchanging information between parents and a teacher/nurse. A sample is shown in Figure 2. This report is written every day in nursery schools, with the child's state in the home and at school reported each through this note. It allows parents to convey their concerns and anxieties: how their child acts in school life and whether or not he/she does well in school. The Japanese government requires kindergartens and nursery schools to support the parents in all situations of the children's lives, both at home and at school; they recognize that communication with parents is important for child-care workers.

Figure 3. Master Child Record

Figure 4. Activity Report

• **Master Child Record**

The Master Child Record is required by Japanese law. Figure 3 shows an example of the Master Child Record. In this case, the record is written every three months, and is includes an evaluated score, which is based on how much individuals achieved according to the stage of development in accordance with the Instruction Procedure in kindergartens [4], or the Education Guidelines for Nursery Schools in nursery schools [3]. The goal is to improve the quality of child-care, not to evaluate the child.

• **Activity Report**

The Japanese government requires nursery schools to create and preserve an Activity Report for each child. Figure 4 shows an example of an Activity Report. The Activity Report is filled in every month. The format of this document depends upon the nursery school.

• **Nurturing Plan**

The Nurturing Plan is an indispensable document for child-care workers to conduct daily child care. This

Figure 5. Nurturing Plan (weekly plan)

document is completed by a teacher/nurse. Figure 5 shows an example of the Nurturing Plan for one week. There are many types of this Plan: year, semester, month, week, and day. The format of the Nurturing Plan differs among kindergartens and nursery schools, and making the plan is very hard work for an inexperienced child-care worker.

As shown above, many types of document are required in the early childhood education domain. The Japanese Government introduced an independent appraisal system from 2002 to nursery schools as well as to other social welfare organizations. A similar system for evaluation by observers, including self-evaluation and self-checks for disclosure, has tended to be introduced into kindergartens. The documents are very important for the both assessments.

In the above situation, the Activity Record should have higher quality and the workload to write the documents should be decreased in comparison with the conventional method. Because report writing is a routine task that takes place daily, monthly or yearly, a support system is desirable for efficient document creation. Fortunately, competence with computer equipment is widely spread among teachers/nurses, allowing for the provision of richer network services.

3 Consultation-Based Investigation and Job Analysis

3.1 Job Analysis and Consultation at a Kindergarten

We made observations of child-care activity and listened to five teachers in a kindergarten. Name of school: Ibaragi Takami Kindergarten, attached to Tokiwakai College
 Maximum number of infants: 240
 Number of child-care workers: 11
 Research date: July 7, 2003

- **Job Analysis at Kindergarten**

The results of the observation are as the follows: 1) Teachers found it impossible to take even notes while dealing with children during child-care hours. 2) The documents were written up after the children left. 3) It was difficult to get a clear picture of each child's actions because the class divided into some groups when children ran about.

- **Consulting with Kindergarten Teachers**

On speaking with the teachers, we consider the possibility of informatization in the kindergarten. The opinions from the teachers were as follows: 1) Teachers could easily trace the development stage of each child if the development level were displayed in a graphical format. 2) The concrete computerized approach of the Master Child Record and Nurturing Plan is not yet clarified. 3) Data security is essential: restrict access or internally restricted use. 4) Teachers are forced to spend long hours creating Activity Record.

3.2 Job Analyses and Consultation at Nursery School

We observed child-care activity and spoke with five nurses in a nursery school.

Name of nursery school: Social Welfare Corporation Amanosan Nursery School

Maximum number of children: 90

Number of child-care workers: 15

Research dates: August 7 and 18, 2003

- **Job Analyses at Nursery School**

Nurses in nursery schools work in shifts due to the long hours child-care facilities operate. In addition, there is extended child-care before or after the regular hours. The residence time of children in nursery schools is longer than that in kindergarten, and it includes nap time for children between the ages of zero and three. On the other hand, children aged four to six took naps during July and September only. Just as in kindergartens, it was impossible for nurses to take even notes due to the need to constantly deal with children during non-nap hours. Instead, the documents were created during nap times or after the children had left. Regarding Communication Notes, nurses exchange notes with parents until the children turned three. However, if parents request it, they can even exchange Communication Notes when the children are over the age of four.

- **Consulting with Nurses at Nursery School**

We obtained the following comments while speaking with the nursery school's principal: 1) There is no standard format for the Master Child Record across

the country. 2) The creation of the Master Child Record was somewhat subjective. 3) It is difficult to go through the content of the Nurturing Plan, since the plan is often changed.

In hearing from nurses, we obtained the following opinions: 1) Nurses want to know how each child spends his or her time at home. 2) The evaluated score of the Master Child Record should be unbiased. 3) The ability to trace the developmental stages of children from the Master Child Record would be desirable. 4) It is difficult to communicate with parents. 5) Differences among observations occur in Activity Reports, depended on the child. 6) Inexperienced nurses do not feel insecure because they can ask experienced workers for advice. 7) There is resistance to putting Web cameras in class.

4 e-Infant Education NET System

4.1 The Proposed System

From the comments given above, we reached three conclusions: 1) We should create a wide but close-knit community for child-care, comprising parents, kindergartens and nursery schools, a support center for parenting, the local government, and a medical agency. 2) The community should share information (records of activity and development) about children. 3) We should create a new parenting environment that includes whole societies.

This type of community would be a place where child-care workers and parents could closely cooperate. Were some problem to occur, the principal of the school would join this community. If an issue that defied any attempt at a quick and simple solution occurred, a support center for parenting, the local government, and a medical agency would participate in this community. Consequently, this system could fulfill the role of a platform to support child-care by whole societies.

First of all, the support system must provide an easy way to create the routine documents. Moreover, Activity Record should be created that prevents subjective views of child-care workers. Also, improvements to child-care quality can be introduced by taking statistics for the development of children over the long term from the perspective of psychology, pedagogy and medical science.

According to our consultative investigation and job analysis, the system, *e-Infant Education NET System*, has three important roles to fulfill.

- How to computerize Communication Notes, the Master Child Record, Activity Reports, and Nurturing Plans.
- How to improve the quality and efficiency of child-care worker's jobs.
- How to control and improve the quality of child care.

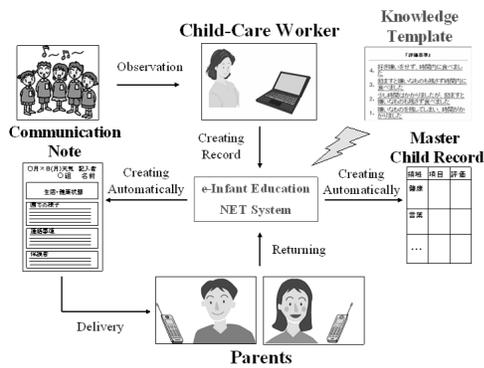


Figure 6. Service Image of Digital Communication Note

The solution to these problems is core information, stored daily in kindergartens and nursery schools and interacted with parents. In this system, we focus on Communication Notes, and develop *Digital Communication Note*, the core sub-system of e-Infant Education NET System.

4.2 Digital Communication Note

Digital Communication Note improves the data input efficiency of creating and equalizing an individual record's quality. Figure 6 shows a service image of Digital Communication Note. Digital Communication Note has five basic functions: 1) Creating Communication Notes in digitalized form; 2) creating a Master Child Record and an Activity Report; 3) delivery of Communication Notes on demand; 4) replies from parents over the Internet; 5) easy reference to activity databases.

Features 1), 3), and 4) are functions of conventional groupware for infant education. Digital Communication Note's two most notable points are that it is possible to create records easily with *Knowledge Templates*, and that multiple Activity Record (Communication Notes, the Master Child Record and the Activity Report) at instantly updated when the child-care worker inputs data. Digital Communication Note's features are described in more detail below.

1) One Data Multi Use

In present kindergartens and nursery schools, Communication Notes, Master Child Records, Activity Reports, and Nurturing Plans are handwritten in parallel. If Activity Record writing were to be computerized in the same manner, the efficiency of the child-care worker's job would likely decrease. Thus, the proposed system generates a Master Child Record and Activity Report automatically, if the Communication Notes are inputted, without any decline in the quality of each child's Activity Record.

2) Knowledge Templates

The *Knowledge Templates* contain the knowledge of veteran nurses/teachers in the proposed system. Fig-

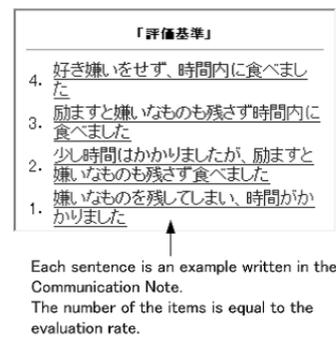


Figure 7. Example of Knowledge Templates

ure 7 is an example of Knowledge Templates. In this example, each sentence number is equal to the level of the development stage. For instance, the first sentence shows that the child eats in a given amount of time and is less than picky about food. This item shows the level in the Maser Child Record for the age of five¹. In this case, the Maser Child Record has four stages of standard evaluation. The average number of sample sentences in Knowledge Templates is about 170 for a five-year-old².

The child-care worker selects an appropriate item and automatically transfers the selected sentence to a description in the Communication Note. The child-care worker can modify the example sentence if required. Furthermore, the level value of the sentence is automatically recorded in the Master Child Record. This mechanism reduces time to create Communication Note and Master Child Record documents.

Conventional handwritten Master Child Records are not unified across kindergartens and nursery schools. Thus, early childhood researchers cannot compare records between two kindergartens or nursery schools. Moreover, researchers face the problem of long-term observation from a fixed viewpoint. The use of Knowledge Templates enables objective evaluation without child-care worker's subjectivity, thereby standardizing the Master Child Record. They also provide a suitable environment for long-term observations from a fixed viewpoint. Thus, the templates lead to an increase in the quality of child-care because any child-care worker can grasp the essence of child observation.

3) Delivery of Communication Notes on Demand

Conventional Communication Notes are paper-based. Through conventional methods, parents cannot see and add comments during the daytime. In contrast,

¹The age of each child is five or six.

²Already, templates are prepared for all children, from zero to five years old. Several-hundred of templates have been written but not evaluated experimentally in the real world, except those for five-year-old children.



Figure 8. Image Delivery on Mobile Phone

the proposed system sends Communication Notes by e-mail to mobile phones, in addition to paper-based notes. This increases parent's awareness.

4) Delivery of Image

The system can deliver photo images to mobile phones. Figure 8 shows an example of image delivery. The talks with child-care workers revealed resistance to putting Web-cameras into the class; this system, however, adopts only photo images. Since attaching an image to an e-mail consumes a high communication charge, this system attaches a URL of the image. Currently, TV images are not delivered, but delivery of animated images will be a feature in the future.

5) Data Format Unification based on XML

This system adopts XML for all data, enabling all data formats to be unified and information to be shared among different documents. There are many problems with young people today, such as growing juvenile crime, a decline in academic ability, a lowering of the age of children refusing to go to school, child neglect, and child abuse. People are increasingly worried about education across our entire society. To accurately follow changes in these problems, there is the need for large amounts of high-quality statistical data about the development stages of children, from the perspectives of psychology and pedagogy. This function will be able to collect various types of data in a unified format if the proposed system is widely accepted in Japan.

4.3 System Block Diagram

Figure 9 shows a schematic block diagram of the proposed system, a Web-based server/client model. The application server employs BayServer to deliver XML contents [5]. BayServer is a freeware and open-source software provided by Yokohama Baykit. With this system, teachers/nurses can create records and check the content, and parents can send a return message for the Communication Notes or send a message concerning the child's absence. In addition, teachers/nurses and parents can access this system to use a Web browser through the Internet. This system also

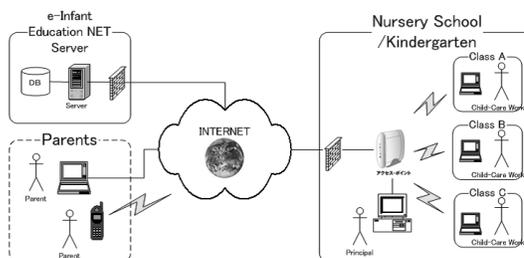


Figure 9. System Block Diagram of the System

氏名: ○○ ○○	クラス: ○○組	記入日: 2004/01/13	記入者: ◇◇ ◇◇
生活・健康状態			
検温	36.1℃ (起床時)、35.5℃ (登園時)		
便通 (自宅)	有		
便の状態	普通便		
便通 (園)	無		
便の状態			
睡眠時間	8.0時間		
食事			
昨日の夕食	ハンバーグ、ポテトサラダ、ご飯、コーンスープ		
朝食	ご飯、味噌汁、玉子焼き、牛乳		
昼食	パン、シチュー		
おやつ	クッキー		
通信			
園での様子	今日の昼食のシチューの中にブロックが入っておりよけて食べていましたが残さず時間内に食べました。		
保護者通信	昨日は、保育園で「どんぐりころころ」歌を歌った話してくれました。楽しそうに話していたので、音楽の授業が好きなのかなと思います。家では、特に変わったこともなくいつも通りでした。		
今日の子供の様子			
			
子供達が帰宅前に先生のお話を聞いている様子です。			

Figure 10. Example of a Communication Note generated by the system

authenticates users and provides a private page for every single person.

4.4 User Interface of the Proposed System

1) Function provided for Parents

The parents access the system via mobile phones and the Internet. The menu items for parents are: (1) Receiving a Communication Note; (2) Response for a Communication Note; and (3) Sending message regarding absence of the child. Figure 10 is an example of a Communication Note generated by the system for Internet access, while Figure 11 is an example for access via mobile phone. Parents receive benefits from this type of Communication Note in the following ways.

- The parents can view various data, the appearance and activity of their child, and the child-care situation at any time.
- The parents can send return-mail and contact the school about their child's absence by mobile phone.

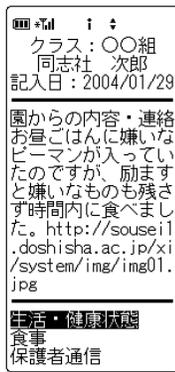


Figure 11. Mobile Phone Version of Communication Note

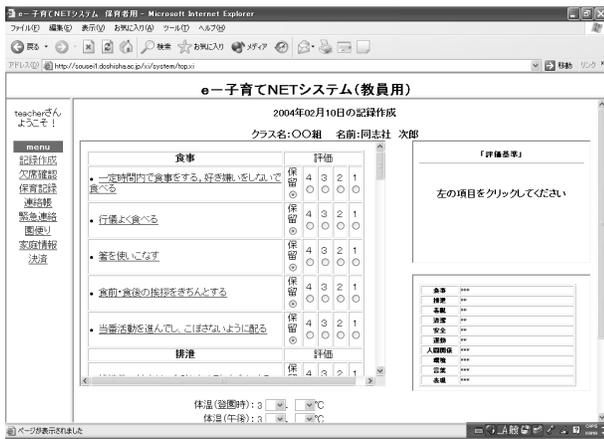


Figure 12. User Interface of Data Input Screen

- The system increases opportunities and consciousness of parenting.

2) Function provided for Teachers/Nurses

Usually teachers/nurses access the system by PC because the screen provided for child-care workers has many input items. The menu for teachers/nurses includes: (1) Data input; (2) Display of Activity Report; (3) Absence checking; (4) Display of Communication Notes; (5) Emergency contacts; (6) Private information; and (7) Display of the Master Child Record. Figure 12 shows a screenshot of the data-input screen. By using this screen, teachers/nurses obtain the following benefits.

- Reduction in time needed for writing records, and efficient data entry.
- Easy item selection for using Knowledge Templates.
- No bias in activity observation among children,
- Possibility to take various statistics from the database.

5 Experimental Evaluation

5.1 Hearing from Child-care Worker On-the-spot

After developing the system, we demonstrated the system and asked teachers/nurses at the two schools for their opinions on it.

• Consultation Results from the Nursery School

The nurses gave favorable reviews of the implemented system, though certain nurses adhered to a policy of creating documents by hands. Another nurse resisted inputting data via a keyboard, but she still wanted this system to be implemented for other tasks. One inexperienced nurse said that Knowledge Templates are convenient for writing Communication Notes, and that there is no trouble in creating Master Child Records. The principal thought that the proposed system improves job efficiency, and that digitalized information is suitable for management disclosure. Finally, the principal give permission to execute this system on-the-spot for real parents.

• Consultation Results from the Kindergarten

The teachers felt a burden from new work because they usually need not create Communication Notes in a kindergarten. Moreover, they sensed a slight discomfort with this system because we had set it up for nursery schools. There were, however, some positive opinions received when, for example the system was used as if it had been set up for a kindergarten. Regarding Communication Note, it is required to add an input/output mechanism for daily, monthly, or any other period input interval for kindergartens. Finally, we felt that this system could be introduced into kindergartens as a complete system for disclosure and job-efficiency improvements.

5.2 Experimental Evaluation On-the-spot

The authors compared the system with handwriting approach. The records for two children were written by hand and by the system for three days respectively. Hearing from the teacher was conducted after the experiment. The results of the evaluation are summarized as follows.

1) Communication Note

There was a quality difference observed between handwriting and the system for the records: a teacher/nurse can write an unbiased record for children by using the system. On the other hand, there were often special comments made about each child in the handwritten reports. Also, there was no writing quality difference observed among children with

the system. We came to the conclusion that the teachers/nurses can write sound and unbiased Communication Notes that would be reflected in future child care.

2) Master Child Record

There was no difference in the number of computer and handwritten entries. However, there was an observed difference in evaluation quality for children in handwritten records. On the other hand, there was no difference in those records created by the system. Finally, we confirmed that handwriting promotes some subjectivity because the teachers/nurses spend different amounts of time with each child.

Strictly speaking, record creation by hand is easier than that by our system when the evaluation item is a highly abstract one, such as the level of human interaction and the child's concentration level. Such abstract items correspond to many situations in the real world. Thus, the Knowledge Templates are highly specialized. However, real-world cases are not equal to the Knowledge Templates; thus, the teacher/nurses cannot select a suitable one. Heavy re-writing of the sample sentence is required in this case, and further research is required to resolve this problem. On the other hand, the system does provide objective observations. Also, long-term observation is available by using the system. This improves the quality of early childhood education.

6 Conclusion

In this paper we proposed the *e-Infant Education NET System* as a new aspect of informatization for early childhood education. We implemented *Digital Communication Note* having *Knowledge Templates*: a core sub-system of e-Infant Education NET System. The possibilities and effectiveness of the system were clarified with a field study at a kindergarten and a nursery school. The system eliminates child-care worker's subjectivity in child observation and increases equalization for child evaluation. The system was highly regarded by teachers/nurses.

The Knowledge Templates, however, require further refinements as was pointed out in the field study. Also, discussion for standardization by infant education professionals is desirable and the further verification of the system is required in parallel on-the-spot.

References

- [1] Japan Private Nursery School Association Website (in Japanese), <http://www.nippo.or.jp/>
- [2] i-kosodate.net Website (in Japanese), <http://www.i-kosodate.net/home.html>
- [3] Tetsuo Ishii, Masaaki Okada, Mayumi Masuda, *Education Guidelines for Nursery Schools* <revised version in 1999> (in Japanese), Floebel-kan Pub., 2000
- [4] Yutaka Oda, Mitsuko Kaminaga, *Explication of Instruction Procedure* (in Japanese), Dai-ichi Hoki, 1999
- [5] Baykit.org Website, <http://www.baykit.org/index.xi>
- [6] Ministry of Education, Culture, Sports, Science and Technology, *The results of a basic school survey in 2003* (in Japanese), http://www.mext.go.jp/b_menu/toukei/001/03080801/index.htm
- [7] Health, Labour and Welfare Ministry: *The results of the condition of nursery schools as of April 4* (in Japanese), 2003, <http://www.mhlw.go.jp/houdou/2003/08/h0819-3.html>