Development RECording Support System Stage Adaptable (DRESS-SA) 
Proposal Based on a Web Service Concept

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ABSTRACT

Recently, the diversification of children’s education is advancing in Japan. Nursery schools are required to provide childcare that adapts to the features of each child’s advancement. Furthermore, nursery school teachers have to keep such documents as development records that assess each child’s development status. However, these documents are written on paper. In this paper, we propose a development recording system called DRESS-SA that computerizes the recording of children’s development. By using digitalized features, DRESS-SA provides growth stages adaptable to each child. By using DRESS-SA, teachers can recognize each child’s development features more accurately and use the records for everyday childcare activities. This paper also proposes an extended version of DRESS-SA as a “web service” on the Internet. DRESS-SA provides APIs through which other clients can use the accumulated data of each nursery’s DRESS-SA. The Web service version of DRESS-SA provides a flexible application development platform for development recording systems.

KEY WORDS

Early childhood education, Nursery schools, ICT, Application system design, Web service

1. Introduction

As Japan’s social environment continues to change, the parenting environment is diversified. As a result, in the field of early childhood education, the diversification of children’s education is increasing. Therefore, nursery schools are required to provide childcare that adapts to the features of each child’s development. Based on the above background, an e-Infant Education NET System has been proposed [1] that supports childcare by: 1) digitizing the documents made by childcare workers; and 2) sharing child development information among participants engaged in childcare.

Nursery schools are required to maintain many childcare documents in which they record obligatory government documents called development records to grasp child development stages. Such conventional development records, however, have a problem: the form is restricted by age.

Consequently, development records have been proposed that can adapt to each child’s growth stages. [2] But it is impossible to achieve dynamic development records that are adaptable to growth stages by paper-based records. Thus, development records must be computerized, and a Development Recording Support System growth Stage Adaptable (DRESS-SA) has been developed as part of the e-Infant Education NET System. By using DRESS-SA, nursery school teachers can make development records that adapt to the growth stages of children and accurately grasp a child’s features. Additionally, accumulated records are expected to offer feedback concerning daily childcare.

If they are computerized, dynamic development records can be made that only share the information inside one nursery. However, our proposed system’s structure cannot implement the cooperation of participants related to more than one nurseries such as governmental agencies, counselors, and doctors. To solve the problem using web service technology, this paper proposes structure through which server communicates with the DRESS-SA of each nursery school. This system structure enables the implementation of an environment that can combine the statistics and tendencies of each school that is set with DRESS-SA.

In the rest of this paper, Section 2 describes the e-Infant Education System, which is the background of this research. DRESS-SA details are given in Section 3. DRESS-SA based on a web service concept is proposed in Section 4. Finally, Section 5 concludes the paper.

2. Background of Research: Summary of e-Infant Education System

In Japan, societal opportunities for women are advancing, and double-income households are also increasing. On the other hand, birthrates are declining, and the number of nuclear families is simultaneously growing. The child
raising environment is changing in various ways. In the field of early childhood education, the education of children is diversified.

Therefore, nursery schools are required to provide childcare that adapts to each child. Also, they have to keep such documents as childcare records, communication notes, guidance plans, child original registers, etc. However, although they expend great effort making a lot of documents, these documents aren’t feedback for everyday childcare. But actually childcare professionals must adequately grasp each child’s growth to adapt to each growth stage.

Based on such a background, an e-Infant Education NET System has been proposed [1] that has the following two features:

1) Digitizes documents made by childcare persons
2) Shares children’s information among childcare participants

The e-Infant Education NET System offers a complete vision that supports childcare with the two points (Figure 1).

As part of the e-Infant Education NET System, digital communication notes between teachers and parents and conference tools between childcare persons and counselors have been developed [1] [3] [4].

Additionally, mandatory government documents for monitoring the stages of the growth of nursery school children are called “development records.” Since they record each child’s growth, such extremely important information is the core of the e-Infant Education NET System. Consequently, we propose to digitalize development records [4]. Development records, which support a system adaptable to advancement stages that can adequately grasp the features of child growth, have been proposed [5]. This scheme is called Development Recording Support System - Stage Adaptable (DRESS-SA). The details of development records and DRESS-SA are described in the next section.

Although DRESS-SA closely cooperates with the conventional systems described above, real information sharing in a larger range is possible, which the e-Infant Education NET System can achieve.

3. Outline of DRESS-SA

3.1 Development Records

A development record is written at every nursery school to grasp the degree of child growth child by child. It is constructed from many advancement-inspection items. Each item is checked by the teacher in charge of the child. These items are determined for each school year; for example, middle class children use a development record format for five-year olds that is divided into five categories: health, human relations, environment, language, and expression. Each is divided into subcategories that have advancement-inspection items.

Part of the development record is shown in Figure 2.

1) **No standardization:** The format and evaluation standards vary among nursery schools in Japan. Thus, if a child moves from one nursery school to another, the old records may have little or no meaning at the new school. They also can’t be used statistical analysis to grasp children’s tendencies in larger ranges, such as region and prefecture levels.

2) **Items locked into age:** The advancement-inspection items are determined for each school year. If the highest score is selected at the start of a school year, the teacher cannot read any developmental process from the constant item value for that year, even if the item is evaluated every month. Naturally a difference

![Figure 1 e-Infant Education NET system](image1)

![Figure 2 Part of a Conventional Development Record](image2)
Advancement and inspection items are called "knowledge." In the advancement field and age. This structure of items was divided into eight stages by subcategories that have 392 advancement-inspection language, and expression; each was divided into 32 into five categories: health, human relations, environment, standardized development recording items were classified into five major fields, and each child’s development is fundamentally uneven from field to field. Thus, it is unreasonable to evaluate using fixed items into ages.

3) Few frequency of check: Conventional records are written two or three times a school year: May, Oct., and Feb. (Fig. 2). Thus scores are input a few months after the child’s actual advancement achievements. Furthermore, teachers cannot refer to changes in the scores for daily guidance. Consequently, conventional records are reduced to mere “government reports” that cannot be feedback into daily nursery operations.

To resolve these problems, the authors modified the conventional developmental record and proposed DRESS-SA to adapt to stages of child growth. The details are described in the following section.

3.2 Development Record Corresponding to Children’s Growth and DRESS-SA Proposal

The authors adopted the following approaches to resolve the above problems.

For the first problem, standardized development recording items were generated, and evaluation criteria that included greater objectivity were introduced for possible use in every nursery school. The new standardized development recording items were classified into five categories: health, human relations, environment, language, and expression; each was divided into 32 subcategories that have 392 advancement-inspection items. These items were divided into eight stages by advancement field and age. This structure of advancement-inspection items is called “knowledge.”

We addressed the second problem by proposing knowledge that is not determined by age and that can be adapted to each child’s growth stage [2]. The concept of “Viewpoint” was introduced under each subcategory of the above standardized knowledge, and the items are connected by viewpoint between each stage. Figure 3 shows part of the relation between some items for three- and four-year-olds. By connections between stages, record makers can freely move up/down the stage of specific field items and combine them as adapted to actual growth regardless of the child’s school age. In other words, dynamic development records can be personalized for each child. Fig. 4 shows part of a four-year-old child’s combination sample that uses the items between three and five years old. (The black framed parts are his/her evaluated items) For this child, the items of “play” evaluate a younger stage (three-year-old) because the development of this field is slower, and part of the “society” item evaluates an older stage (five-year-old).

However, since the development recording items change dynamically with every record for each child, it is extremely difficult for conventional paper-based methods to actualize them. To adapt to dynamic development records, the structure of “knowledge” must be expressed by program logic. Therefore it is absolutely essential to computerize the data of the development records not only to share the information but also to create development records adaptable to growth stages.

Finally, for the third problem, the authors proposed increasing recordkeeping frequency from two or three times a school year to once a month so that the data of child growth stages can be obtained more closely to real time. Such frequent records means that DRESS-SA possesses a lot of information on each child. As a result, it becomes possible to suggest future childcare plans for each child from the system side. Thus, since teachers are writing more than mere government reports with feedback of past records for daily childcare, the computerization of development records is desirable.

<table>
<thead>
<tr>
<th>Viewpoint</th>
<th>Item Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>Eats meal and snack pleasantly</td>
</tr>
<tr>
<td></td>
<td>Eats pleasantly with friends</td>
</tr>
<tr>
<td></td>
<td>Eats with interest in the relation between the body</td>
</tr>
<tr>
<td>Society</td>
<td>Makes distinction between his/her own, others' and shared things</td>
</tr>
<tr>
<td></td>
<td>Treats familiar things carefully</td>
</tr>
<tr>
<td></td>
<td>Puts away his/her things</td>
</tr>
<tr>
<td></td>
<td>Puts things away</td>
</tr>
<tr>
<td>Play</td>
<td>Plays in imitators of the elder child</td>
</tr>
<tr>
<td></td>
<td>Plays with older children actively</td>
</tr>
<tr>
<td></td>
<td>Cultivates relations with older children and has regard and</td>
</tr>
</tbody>
</table>
Based on the above solution, the authors developed DRESS-SA that has three features: 1) It can be set up in any kind of nursery school; 2) Advancement-inspection items are adaptable to the growth stages of each child; 3) Past records can be fed back to nurseries everyday. In the following section, the implementation process of DRESS-SA is described.

3.3 DRESS-SA Prototype

We developed DRESS-SA to create development records that are adaptable to growth stages. DRESS-SA offers the following functions:

1) Input of development record scores
2) Browsing of past development records
3) Visualization of each child’s growth process and tendencies
4) Calculation of statistics in class and the entire school

The most fundamental function of DRESS-SA is the first one because the other functions cannot be realized without it. In fact, this system’s core accumulates the development records of all children registered in the nursery school. Therefore, when implementing the system, we first designed a database schema (Figure 5).

Figure 5 Part of Database Schema of DRESS-SA

As described in the previous section, development records made on DRESS-SA must dynamically adapt to the growth stages of each child. A conventional Relational Database Management System (RDBMS) has mechanisms in which one record has fixed some attributes and one table has many records. Basically RDBMS describes much data in tabular form. But DRESS-SA dynamically changes attributes with each record. Thus, the schema of DRESS-SA must be complicated.

First, the hierarchy structure of knowledge is expressed with each table: five categories, subcategories, viewpoints, and advancement-inspection items. For adapting to the realization of the relation between items, a viewpoint table is added to a column indicating items of the next/previous stage. In doing this, a mechanism to adapt growth stages can be achieved on the schema level. In addition, tables of system user relations, data of individual children, evaluation scores for every item, and so on are added. Next, the DRESS-SA interface was developed. DRESS-SA is a web-based server and client system, so system users can access DRESS-SA by using web browsers. DRESS-SA, developed by Ruby on Rails, is a framework that raises development efficiency and maintenance of web-applications based on Ruby [6]. By using this framework, application development is advanced by division into logic and design. Figure 6 shows one DRESS-SA user interface that input evaluation scores for each inspection item.

Figure 6 User Interface of input Screen

4. Web Service of DRESS-SA

4.1 Current DRESS-SA Problems

By implementation of DRESS-SA, as described in Section 3.3, it became possible for nursery schools to maintain development records to adapt to the growth stages of each child. Furthermore, because standardized knowledge, as described in Section 3.2, is introduced to the system, DRESS-SA can be made available at various kinds of nursery schools. However, there is a significant problem. The current DRESS-SA is a closed system for use in only one nursery school. In fact, even if DRESS-SA is introduced into a great number of schools, the
information stored in each school cannot be made put together in the larger range than one school.

Fundamentally the ultimate objective of the e-Infant Education NET System (including DRESS-SA) was to share childcare information among all participants concerned with childcare. But the structure of the current DRESS-SA fails to achieve that objective. At the same time, needs exist from people concerned with childcare. Such participants as local governments, public-sector parenting support, doctors, counselors, and researchers in charge of many nurseries want to know the statistics for all schools and their tendencies under their jurisdiction. Counselors also need an environment in which they can freely browse through all the development records of the children under their care. Some nursery schools have requests to customize DRESS-SA to some degree because forms of organization and childcare school policies vary by school.

Based on the above problem and the needs of system users, the current DRESS-SA must be flexibly extended to combine the data of many schools. The following section describes a solution.

4.2 Proposal Implementation of DRESS-SA Based Web Service Approach

There are two approaches in which DRESS-SA can combine the data of many schools.

One approach actualizes this function by extending the DRESS-SA database schema shown in Figure 5 and by storing all the data of all children and the development records of all nursery schools using the system in a database. Conventional DRESS-SA has adapted this method [5], whose advantages include comparatively easy maintenance because it is constructed by one application. However, the DRESS-SA database schema is already quite complicated for realizing characteristics that can make records dynamically adaptable to the growth stage of each child, as described in Section 3.3. Additionally, as described in the previous section, some schools request a degree of system customization. For example, they request slight changes in the knowledge such as the addition of unique advancement-inspection items and omitting particular standardized items. That is, not only advancement-inspection items change dynamically child by child with time but also the knowledge itself, which is used as evaluation standards, changes dynamically from school to school. In the same way, such organization forms as the establishment of appointments differ in every nursery school. Therefore, we concluded that it is extremely difficult to implement the above mechanism by only extending one database server.

Consequently, the authors propose another approach. By adopting a structure based on a web service concept, it becomes possible to combine the data of many schools without changing the design proposed in Section 3.3. Web service is focused technology through which some web servers/clients or web servers cooperate. It seems to work nearly as one application through the Internet. The details of the proposed structure are described in the following.

First, the database schema of the new DRESS-SA remains the current DRESS-SA. In fact, the system corresponds to only one school at the database schema level, and one DRESS-SA web server is set up per school. In doing so, corresponding to system customization school by school becomes easy. However, it is impossible to implement such needs: browsing child data to extend over many nursery schools for analysis and tendencies of the accumulated data.

Another web server is set up for statistics and analysis, allowing communication with the current DRESS-SAs used at each school through the Internet, so it is possible to gather the accumulated data. Such communication between applications can be implemented by using web service technology. Figure 7 shows the whole image of DRESS-SA based on the web service concept.

The advantages of this structure are described below.

- **Improvement of security side**: Because database servers of one school only store their own children’s records, the records of other schools can never be browsed. Thus, it is easy to prevent browsing of personal information by “wrong” system users.
- **Reduction of number of records**: The distribution of databases by the school reduces the quantity of development records, leading to improvements of response time.
- **Distribution of functions**: Because servers of accumulating data and statistics are set up separately,
each server can concentrate on one function. Thus the whole system can distribute the load.

- **High extendibility:** Because the data are distributed in a form that is easy to use by SOAP protocols, simple reusing of the data from other childcare systems is expected.

When implementing a DRESS-SA web service, we defined APIs on the client side that can list the children in each school and their records for a span. Then a server side interface was implemented, which made communication possible between applications. The development environment adopted Ruby, which is identical to DRESS-SA. The server side was developed by Action Web Service (AWS), which supports the server side of SOAP and XML-RPC protocols on Ruby on Rails applications. The client side adopted SOAP4R, which is a Ruby’s library that corresponds to AP protocols.

### 5. Conclusion and Future Issues

This paper described the development of DRESS-SA as a support tool for nursery school teachers. Our proposed system has three features: 1) It can be set up in any nursery school; 2) Advancement-inspection items are adaptable to the growth stages of each child; 3) Past records can be feedback daily to the nursery.

However, the system structure of the above developed system can not implement the cooperation of participants related to many nurseries such as governmental agencies, counselors, and doctors.

Therefore, an extended structure of DRESS-SA was proposed in this paper. We solved the above problem by adopting a structure based on a web service concept and implemented an API provision that reuses the accumulated data of each nursery’s DRESS-SA with another application and the communication structure between applications. This proposed system structure has four merits: 1) Improvement of security side; 2) Reduction of the number of records; 3) Distribution of functions; and 4) High extendibility. As a result, it became possible for not only the staff inside one nursery but also outside participants to share development records and get statistics and tendencies of all nursery schools using DRESS-SA.

Hereafter, the cooperation of another childcare system will be examined, and an environment that can share childcare information better will be developed.

### References


