Abstract

The paradigm of online education has been changing recently as seen with the emergence of Massive Open Online Courses (MOOC) and Open Educational Resources (OER). Accordingly, this study conducted a Delphi analysis with experts to identify which factors deserve consideration when designing online educational systems for early childhood teachers. In the Delphi analysis, two areas, Usability Assurance (UA) and Technical Assurance (TA), were analyzed with seven and six elements identified for each area respectively. This study suggests system elements for ensuring the success of an online education system. It will also be meaningful for identifying further elements supporting the operation of such a system.

Keywords: E-learning, Online system, Technical Assurance, Usability

1. Introduction

The paradigm of online is shifting in the Web 2.0 era being characterized by participation and openness. As the demands for e-learning are increasing, the need to develop and provide quality contents and services is increasing as well, and reinforcement of quality management for accommodating the diverse needs is also required. Also, the expansion of KOCW is the outcome of the spreading of the OER (Open Educational Resource) movement and its drive to provide college lectures to more people. Accordingly, to meet the increased demands, it seems essential to standardize the various contents and systems that are currently produced in an ad hoc manner.

Developments in ICT are now driving the demand for ICT applications for early childhood education and many also suggest that online tools be developed to bolster education programs to enhance the expertise of teachers. It is expected that online tools to further advance education programs for teachers will also help early childhood teachers learn and teach more effectively. That is because online education systems can help early childhood teachers become better users of ICT and contribute to promoting their online community activities. Iram & John underscored that proficiency of using computers, peripheral devices and software programs constitutes a very significant element of the skill sets of early childhood teachers and they should be allowed to access and utilize a variety of information. Online information access should also expedite collaboration among early childhood teachers. Communities where groups can utilize OER together are also effective tools for individuals as they develop teaching materials and collaborate with each other. They can use the systems to support colleagues in remote locations by interacting with them on specific topics and helping them solve problems. Collaboration also enables individuals to contribute to groups beyond the limit of their personal capability. Hence, it is necessary to assist early childhood teachers in designing appropriate online learning initiatives and organizing collaborative wcommunities for learning.

This study originated from the need to meet the demands for learner-oriented system design in online learning. In other words, the quality certification for online learning systems used to be a quality management proposition focused on the supplier (provider). The purpose of this study is to understand what aspects of online learning for early childhood teachers must be taken into consideration when the technical domain of supplier-oriented quality management is combined with that of quality...
management reflecting the needs of consumers (users)\textsuperscript{5-6}. As described above, the purpose of this study is to consider the practical aspects of advanced learner-oriented e-learning systems that are newly required due to the advancement of ICT and changes in the social learning environment, that is, to clarify what needs to be taken into consideration in the learner-oriented system design that is newly required as ICT advances and the social learning environment changes.

2. Theoretical Background

A learner-oriented online education system for early childhood teachers needs to be approached from the perspective of OER. Not to mention its altruistic contribution to the public good, OER delivers both organizational and individual users such benefits as cost saving, better accessibility, and user-centric services as it can be reused and shared\textsuperscript{7,8}. OER offers benefits to both users and publishers, improving accessibility of educational resources for many who rely primarily on online platforms\textsuperscript{9}. It is necessary to configure online education programs for early childhood teachers to double as a forum of information sharing for them rather than focusing on stereotyped contents. In other words, in supporting online education, OER can reduce the costs required for developing educational resources and contents and mitigate uncertainty over copyrights for teaching-learning materials used by early childhood teachers.

OER systems for early childhood teachers need to provide a collaboration model for their use and development to bolster peer-support and knowledge-sharing activities as well as supporting community activities through which learners can improve their potential for more effective learning\textsuperscript{9,10}. By utilizing OER, organizations educating early childhood teachers can reduce their content development costs, improve the quality of the content, build new relationships and promote themselves, all while further strengthening cooperative ties with other entities through better communication\textsuperscript{7,8,11}. Access to learning programs and opportunities for education will be expanded for early childhood teachers\textsuperscript{12} and collaboration among many people will be enabled through open source software, open data and news, and other educational contents\textsuperscript{8,13}. In other words, educational systems for early childhood teachers should be configured from the perspective of OER and designed in consideration of how to support early childhood teachers and encourage collaboration among them.

Meanwhile, JISC/Higher Education Academy presented a more detailed approach to utilizing OER, depending on specific user groups and their roles, suggesting that instructors and faculty members can share feedback with colleagues and build new relationships. In other words, sharing of data among organizations will be facilitated and contents retrieval and use will be expedited in terms of management\textsuperscript{14}. As explained above, although there may be slight differences in utilization pattern, depending on user groups and their roles, quite a lot of positive aspects exist in that OER can increase learning opportunities, reduce costs, improve reputation, bolster support and interaction among peers, support community activities, reduce content infringing on copyrights, and enhance the quality of learning content.

3. Research Method

To clarify what needs to be taken into consideration to design a learner-oriented online learning system, this study analyzed the contents of existing quality management systems and examined experts’ opinions.

This study attempted to use the 2-stage Delphi technique and propose what needs to be considered in learner-oriented systems from the viewpoint of system quality management.

This study used the quasi-Delphi method to extract the items that must be considered in existing online learning systems. The definitions of terms used in each area were presented, and a 5-point Likert scale was used to get opinions on how relevant the areas are in the online learning system. Another 5-point Likert scale was used to get opinions on the necessity of the areas. In Stage-2, based on the experts’ opinions on the relevance and necessity of each of the areas, shown in Stage-1 and functional definitions, a 5-step Delphi checklist was used.

3.1 Delphi use

To identify the components of the online learning system for early childhood teachers, this study collected the opinions of the same experts in both Stage-1 and 2, and tried to derive an agreement. In principle, in consideration of experts’ divergent perceptions, the open forecasting Delphi method must be used to collect the diverse opinions. As it is necessary to participate in this study after understanding its special purpose, however, this study completed the basic framework of the research based on existing related studies before the first Delphi
was conducted. The areas that can be used as the basic framework and their definitions were presented, and the relevance and necessity of the presented areas were discussed. For the following reasons, the Delphi technique was used in Stage-1 and 2 to develop a system framework for supporting online education of early childhood teachers from the perspective of OER.

First, current system or content quality certification programs employ different evaluation criteria in consideration of the characteristics of different projects. In addition, elements of standardization to be considered for each project are not clearly defined. Therefore, it was necessary to analyze standardization and quality control areas in existing projects and identify such areas as are usable for all projects in an integrated fashion.

Second, in areas where a complete and precise theoretical system is not available, the Delphi technique relying on expert judgment for forecasting can provide a more accurate theoretical system. Accordingly, this study analyzed the characteristics of quality control and standardization employed in improving online education and employed the Delphi technique to consolidate the expert opinions and thereby maintain the quantity of analyzed data or reliability of judgment.

### 3.2 Subject of Research

The Delphi analysis was conducted in two stages: in Stage-1, a quasi-open Delphi technique was used; in Stage-2, a checklist-based Delphi technique was used. Critical to the Delphi technique used in this study was organizing the expert panel to be studied. This study considered the following elements for organizing the expert panel and selecting subjects of research for stages 1 and 2 respectively.

First, the level of expertise was given significant consideration in organizing the expert panel. This study organized a quality evaluation panel staffed with experts of OER or quality control who had sufficient understanding of e-learning. Then, experts who had extensive understanding and the knowledge required for the broad spectrum of online education were selected. In addition, an expert group was formed based on their availability of time and willingness to participate in the study.

Second, the expert panel was designed to enable various expert groups to participate in system or e-learning quality control. As the perspective of OER had to be considered, this study encouraged experts with various backgrounds to participate rather than focusing only on specific areas.

### 3.3 Research Tools

Because of the needs for understanding the specific purpose of this study, a basic framework was built by drawing on existing OER, contents and system quality control details before Stage-1 of the Delphi technique was conducted. Areas that could be used for the basic framework were identified and defined. Then, the relevance and necessity of the identified areas were discussed. In addition, this study presented the following operational definitions to enable the expert panel to understand the applicable areas (see Table1).

The Stage-1 Delphi questionnaire was reviewed in advance by four experts who had similar qualifications to that of research participants, modified with feedback from two OER experts and three quality control experts, and then sent by e-mail to the expert group. A 5-point Likert scale was used for evaluating the relevance and necessity of corresponding areas. The scale presented was: 1. Completely Unnecessary 2. Hardly Necessary 3. Average 4 Necessary 5.Highly Necessary. The same scale was applied to the relevance.

### 3.4 Data Analysis

As this study was intended to develop a framework based on the proper considerations to apply towards online education of early childhood teachers, the focus was placed on the relevance of applicable contents. Therefore, in the Stage-2 Delphi analysis, the average from the Stage-1 analysis results was presented and the 5-point Likert scale was employed in Stage-2 to further clarify the relevance of the applicable area. The results of Stage-1 were described in a feedback format and used for deriving agreement among the groups. A 5-point scale was used for evaluating the relevance of each evaluation area and the necessity was classified by M/O.

#### Table 1. UA and TA Definition

| Area                      | Definition |
|---------------------------|------------|
| UA (Usability Assurance)  | Area where users need to make evaluation in relation to learning from the users’ perspective. Therefore, UA engages not only evaluators but also users in the evaluation. |
| TA (Technical Assurance)  | Area, including the contents, for minimizing errors in executing the contents corresponding to the system. |
The Stage-2 Delphi analysis calculated the average of each question. Applicable areas were selected on the following bases:

First, evaluation items whose average values were 4.0 or above, indicating ‘Relevant,’ were adopted. As this indicates that in terms of consideration of quartile deviation, only items in the top 75 percentile or above were considered. Thus, areas were adopted in accordance with highly strict criteria.

Second, necessity was classified by M/O. As M/O was based on the necessity of corresponding area and 18 experts participated, a modified CVR (Content Validity Ratio) was used. The content validity ratio was calculated as the ratio of qualified consensus of criticality to the criterion. CVR was calculated using the following equation (Law she, 1975).

\[ CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} \]  
(Equ 1)

*n*: Number of respondents who answered ‘Important,’ or ‘Very Important’

*N*: Total number of respondents (number of experts)

Considering that content validity is recognized when CVR is at least .49 when the total number of respondents is 18 persons, this study chose necessity ‘M’ to be at least 9 as that number corresponds to .49 of the 18 persons in the study choosing ‘M’.

### 4. Results

Table 2 Illustrates the Stage-1 Delphi results for identifying key elements when designing an online educational system for early childhood teachers.

In the Stage-1 Delphi analysis, the TA area had a higher average ‘Integrity’ of 4.84 than other evaluation areas in terms of relevance, and the highest average of 4.95 in terms of necessity. Hence, it was found that the experts recognized that the area of integrity evaluation was the most necessary and relevant evaluation area for developing a framework for an online system for educating early childhood teachers. Next, the ‘Learning Efficiency’ evaluation area of the UA area scored an average of 4.68 for both relevance and necessity. In the TA area, ‘Integrity’ for judging whether the contents work without any error had the highest level of relevance (4.84), followed by ‘e-portfolio’ (4.47) and ‘Question & Test Interoperability’ (4.37). ‘Integrity’ also had the highest level of necessity (4.95), followed by ‘metadata’ and ‘e-portfolio’ (4.37 respectively).

Stage-2 was conducted on the basis of Stage-1 results. First, Stage-1 Delphi results for corresponding evaluation areas were presented and the experts were asked to describe relevance yet again.

Second, the experts were asked to determine whether the applicable evaluation area was essentially required or optionally needed in terms of necessity.

Table 3 shows the results of the relevance and necessity for each evaluation area. In the Stage-2 Delphi analysis for relevance, the ‘Integrity’ of the TA area was found to be most relevant with an average of 4.89. Next was the ‘Learning Efficiency’ of the UA area with an average of 4.67. The ‘Learning Satisfaction’ of the UA area, however, was the lowest with an average of 3.78 (see Table 3).

A Likert scale was not used for analyzing necessity but the analysis was based on whether each element was Mandatory or Optional, as the basis for necessity had already been confirmed in the Stage-1 Delphi analysis. In the analysis, as 8 respondents chose ‘M’ and 10 chose ‘O’ for ‘Learning Satisfaction’ which failed to meet the criteria for relevance in this study, ‘Learning Satisfaction’ was
classified as Optional in terms of necessity. In addition, ‘Learning Communication’ was classified as Optional as 9 respondents chose ‘M’ and as many experts chose ‘O’.

5. Conclusion

This study intended to identify which elements deserve consideration when designing online educational systems for early childhood teachers. Hence, online educational system design elements were derived from experts.

The analysis identified seven elements for UA (Usability Assurance) and six for the TA (Technical Assurance). The elements of TA were Metadata, e-Portfolio, General Web Service Specifications, Learning Tools Interoperability, Question & Test Interoperability and integrity. Both necessity and relevance were found to be high for learning efficiency and learning accessibility in the UA area. Integrity for assuring effort-free contents delivery by system (TA area) was found to be high both in terms of relevance and necessity. In other words, it was found that the integrity of online learning must be emphasized. This study identified elements to be considered when designing online learning systems to ensure their success. However, as system support alone cannot guarantee success in learning, subsequent studies need to focus on how to support learners. This study carries significance in that it was inspired by interest in online education for early childhood teachers and concluded by identifying the key elements of system support that had not been considered in the past.

6. References

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Table 3. Stage-2 Delphi Results

| Area   | Element                     | Relevance | Necessity |
|--------|-----------------------------|-----------|-----------|
|        |                             | M         | O         |
| UA     | Learning plan               | 4.29      | 15        | 3         |
|        | Learning efficiency         | 4.67      | 17        | 1         |
|        | Learning convenience        | 4.44      | 15        | 3         |
|        | Learning satisfaction       | 3.78      | 8         | 10        |
|        | Learning product            | 4.39      | 15        | 3         |
|        | Learning accessibility      | 4.56      | 18        | 0         |
|        | Learning communication      | 4         | 9         | 9         |
| TA     | Metadata                    | 4.28      | 14        | 4         |
|        | e-Portfolio                 | 4.44      | 13        | 5         |
|        | General Web Service Specification | 4.28 | 12  | 6 |
|        | Learning Tools Interoperability | 4.17 | 11  | 7 |
|        | Question & Test Interoperability | 4.28 | 11  | 7 |
|        | Integrity                   | 4.89      | 16        | 0         |