

Analysis of Early Childhood Teachers' Level of ICT Competency

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Abstract

As new Information Communication Technologies (ICT) become available, school teachers and early childhood teachers need to make sure they keep their technology knowledge and skills up to date. This study was conducted on 433 early childhood teachers to diagnose of their level of ICT competency. The cut score for judging the achievement of ICT competencies were set by experts, and early childhood teachers' achievement was measured and assessed based on them. According to the results of this study, the achievement level of early childhood teachers' ICT in education was around 85% of the cut score, which was the lowest level in the ability area. Based on the analyses of the correlations between ICT areas, high ability was correlated to frequent utilization. This result implies that the construction of infrastructure does not necessarily ensure an increase in the total ICT in the education index value. When early childhood teachers had a high ability to use ICT in education they used ICT for their profession more frequently and felt a higher satisfaction with using ICT in education.

Keywords: Competency, Criteria, Early Childhood Teacher, ICT

1. Introduction

In a knowledge-based information society, knowledge and ICT skills are very important because ICT is used in searching for and analyzing information, acquiring necessary knowledge and producing new knowledge using the information and knowledge. The ability to use a computer, software and peripheral devices is an integral part of the professional role of early childhood teachers and contributes to enhancing their work efficiency¹. However, many early childhood teachers are not yet capable in using the computer systems². In 1995, universities and colleges began to offer the courses related to computer education for young children to prepare students enrolled in early childhood education programs for improving their knowledge and skills in ICT². In 2005, the Ministry of Education of Korea reported the gradually

improving conditions for ICT use in education based on the fact that over 90% of kindergartens across the nation had a computer center in every classroom and that the government's provision of hardware and software solutions to schools increased every year³. Despite continued efforts to improve the level of ICT use in education, studies focused on the relationship between prior experience with ICT and teacher characteristics^{4,5}.

In general, there have been measurements of Information Communication Technology (ICT) levels for teachers, students and parents but not for early childhood teachers⁶. Because early childhood teachers are educating preschoolers, teaching means to educate pedagogically meaningful content and nurture students' potentials through close interaction⁷. Here, the definition of education encompasses changes in discernment through transferring knowledge and behavior. Therefore, early

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childhood teachers can help preschoolers broaden their mind and way of looking at matters and achieve their full potential.

Preschoolers are the future members of the knowledge society that will possess highly developed ICT. This requires them to have ICT-related knowledge and skills. In order for preschoolers to acquire these skills, teachers need to have at least the basic abilities to use ICT in education. Therefore, this study was conducted to measure how well early childhood teachers are prepared for raise future members of the knowledge society.

2. Literature Review

2.1 Early Childhood Education and ICT

Cyber education has been emphasized as a supplement and even a substitute to formal education not only in South Korea but in other countries including Australia and the United States. For example, although Australia started ICT in education as a supplement of formal education, it has been developed as a measure for enlarging educational choice for primary school students and for supporting personalized learning for meeting individuals' needs. Also, the United States implemented cyber education using ICT to provide students flexible educational services freeing them of limitations of time, space and even the pace of learning. Cyber learning is also conceived as one of the ways to fill the varying educational needs of young students. In this regard, a cyber institution was authorized which implies that education using ICT can substitute formal education⁸. In sum, functions of ICT in education can vary from being a substitute for conventional education to being a supplement for it.

2.2 Measurement of Early Childhood Teachers' ICT Competency

So far several countries have presented criteria to measure and assess teachers' ability to use ICT in education. In the US, the International Society for Technology in Education (ISTE) developed the National Educational Technology Standards for Teachers (NETS). Of the three categories of 'A Sound Understanding of Technology Operations and Concepts', 'Productivity and Professional Practice' and 'Application of Technology into the Classroom' issued in 1997, the category of 'Application of Technology into the Classroom' was reinforced, and a new category,

'Social, Ethical, Legal and Human Issues', was added⁹⁻¹¹. In England, the British Educational Communication and Technology Agency (BECTA), which is responsible for promoting the effective use of ICT in education, developed the self-review framework for teachers and schools to evaluate and assess their ICT use in education. Teachers can evaluate and assess their use of ICT in education using the tools offered by BECTA, and school headmasters can offer ICT-assisted courses and evaluate and assess the school management information system¹².

In Korea, the Korea Research and Information Service (KERIS) developed the ICT Skill Standards for Teachers (ISST) in 2001 and presented the national standards for ICT literacy competencies needed by K-12 teachers. The aim of the national standards was to provide the basic tools that could enable teachers to know about their competency level and improve it on their own in order to meet the standards. The standards also provided supervision guidelines for education offices of cities and provinces. Efforts were made to reflect the ICT skills in the context of broader teacher competencies when the standards were developed, but most skills covered in the ISST were related to information processing, rather than to the problem solving skills frequently used by teachers for their teaching¹³.

The ICT competency standards for teachers inspired researchers to measure ICT competency. Studies found that participation in an ICT education program resulted in improved ICT competency^{5,14} yet it is difficult to say that improved ICT competency effects a positive influence on the use of ICT because of inconsistent research results^{15,16}. Some studies found a correlative relationship between the high level of ICT competency and the more active use of ICT in teaching and learning¹⁰, but some did not find the relationship between the level of ICT competency and the use of ICT in teaching and learning^{15,16}. There is also a study that found the effects of teachers' educational beliefs on the level of ICT use in lessons¹⁴. Although teachers' level of ICT competency is not directly related to teaching and learning, it is true that teachers at a higher level of ICT competency are more effective at using ICT than teachers at a lower level.

3. Methodology

3.1 Sampling

To measure early childhood teachers' ICT in education

level, this study randomly sampled 433 early childhood teachers in all regions of South Korea. A typical sample of teachers was obtained through two stages:

In Stage-1, regions were sampled and stratified into 3 groups (large, medium and small) based on their size, i.e. major cities, small and medium cities, and eups/myeons that have different learning and living conditions.

In Stage-2, the aim of the study was explained to teachers working in kindergartens or daycare centers in the sampled regions, and interviews were conducted with the teachers who wanted to participate. The reason for not using a web-based survey was to have the teachers who have difficulty accessing ICT participate in the study. For the area of accessibility including the elements of Internet accessibility and computer use, a questionnaire was used to draw objective answers from the subjects by having them write down their answers on the questionnaire.

The participants consisted of 198 bachelors and higher degree holders, 132 associated degree holders, and 103 daycare teachers.

3.2 Methods for Setting the Criteria and Calculating the Weightings

The ICT competency level needed by early childhood teachers was measured based on the indicators used in diagnosing the ICT competency level. The aim was to set the criteria for the ICT competency level suggested by experts. This study used the Jaeger and Angoff methods for setting the criteria¹⁷⁻¹⁹.

After the criteria were set, the weights were set by the 12 experts who participated in the study. The weighted amount was 100 percent, so a percentage weight was given to scores of respective indicators. The weights of indicators determined by the 12 experts for ICT indicators of elements of areas are as shown in Table 1.

3.3 Index Analysis Coefficient

Indexes of early childhood teachers' ICT in education were calculated by using the following procedure:

First, the total ICT in education index value was calculated.

- Total ICT in education index value: Total of weighted averages of indexes for areas
- Equation

$$\sum_{i=1}^n W_i * X_i \quad W: \text{각 영역별 가중치,} \\ X: \text{각 영역별 지수 분석 값, } n: \text{영역 수(4)}$$

W: Weight for respective areas,

X: Index for respective areas, n: No. of areas (4)

Second, the respective indexes were calculated for 'accessibility', 'ability', 'utilization' and 'satisfaction' which are composed of the ICT indexes.

- Index for each ICT area: Total of weighted averages of indexes for elements of areas
- Components and weight (100) of an area: Accessibility (17%), ability (36%), utilization (34%), and satisfaction (13%) - The index of each area is the score converted into a 0-100 scale.
- Equation for respective areas

$$\sum_{i=1}^n W_i * X_i \quad W: \text{영역을 구성하는 요소별 가중치,} \\ X: \text{각 영역의 요소별 분석 값, } n: \text{요소 수(4)}$$

W: Weight for respective elements of an area

X: Index for respective elements of an area, n: No. of elements (4)

4. Findings

4.1 Cut Scores for ICT Competency Needed by Early Childhood Teachers

For this study, experts set the cut scores for achievement levels of ICT competences. That is, this study established national criteria that can be used to judge the levels of ICT users' competencies. The cut scores for achievement levels of ICT competencies of early childhood teachers are shown in Table 2.

The cut score set by experts for the total 'ICT in Education Index' value for early childhood teachers' was 85.79. The cut score for accessibility was the highest at 96.72, while the cut score for ability was the lowest at 84.38. Experts judged that early childhood teachers could effectively integrate ICT into their teaching and learning when their ICT competency level reached around 85.

The cut score was 100 for 'availability of IT' and 'recency of the operating system' that are indicators of the accessibility element. On the other hand, the cut score for 'educational use of computer or Internet' was 70.58, which was lower than the cut scores for other indicators.

Table 1. Weights of indicators of ICT level.

| Area | Element | Indicator | Weight |
|---------------|--------------------------------------|--|--------|
| Accessibility | Ownership of devices | Ownership of IT devices | 4 |
| | Accessibility ownership of devices | Ownership of devices for wireless connection to the Internet | 2 |
| | Availability of IT | Availability of computer | 4 |
| | availability of IT | Availability of the Internet | 4 |
| | Recency of the Operating System | Recency of the Operating System | 3 |
| Ability | Hardware literacy | Computer connection and use | 4 |
| | Ability hardware literacy | Computer management ability | 4 |
| Ability | Software literacy | Use of application programs | 8 |
| | Ability software literacy | Use of educational programs | 6 |
| Ability | Internet literacy | Basic ability | 2 |
| | Ability internet literacy | General use of the Internet | 2 |
| | Ability internet literacy | Blocking harmful content on the Internet | 2 |
| | Ability internet literacy | IT ethics | 1 |
| | Ability internet literacy | Response to adverse effects | 1 |
| | Self-development | Self-development | 6 |
| Utilization | Quantitative utilization | General Use | 4 |
| | utilization quantitative utilization | Educational Use | 7 |
| utilization | Qualitative utilization | Searching for teaching and learning information | 7 |
| | utilization qualitative utilization | Manufacturing | 7 |
| | utilization qualitative utilization | Use (sharing, utilization) | 6 |
| | utilization qualitative utilization | General application | 3 |
| Satisfaction | Satisfaction | Teaching/learning aspect | 6 |
| | satisfaction satisfaction | Communication aspect | 3 |
| | satisfaction satisfaction | Policy aspect | 4 |
| | Total | | 100% |

Table 2. “Total ICT in Education Index” criteria values for early childhood teachers

| | Total ICT in Education Indexes | | | | |
|----------|--------------------------------|--------------------------|--------------------|---------------------------------|--------------------|
| Criteria | 85.79 | | | | |
| | Accessibility Index | Accessibility Element | | | |
| | accessibility index | Ownership of devices | Availability of IT | Recency of the Operating System | |
| Criteria | 96.72 | 93.11 | 99.32 | 100 | |
| | Ability Index | Ability Element | | | |
| | ability index | Hardware Literacy | Software Literacy | Internet Literacy | Self-Development |
| Criteria | 84.38 | 79.40 | 82.35 | 88.93 | 88.78 |
| | Utilization Index | Utilization Element | | | Satisfaction Index |
| | utilization index | Quantitative Utilization | | Qualitative Utilization | satisfaction index |
| Criteria | 84.57 | 72.97 | | 90.47 | 85.58 |

Table 3. Early Childhood Teachers’ level of ICT in education

| Group | Total ICT in Education Index Value (out of 100) |
|------------------------------|---|
| Bachelor’s degree and higher | 75.605 |
| Associate degree | 73.345 |
| Daycare teacher | 72.293 |

Table 4. Early Childhood Teachers’ Level of ICT in Education in Sub-Domains

| Group | Accessibility | Ability | Utilization | Satisfaction |
|------------------------------|---------------|---------|-------------|--------------|
| Bachelor’s degree and higher | 95.43 | 74.48 | 70.52 | 73.98 |
| Associate degree | 95.78 | 67.86 | 67.20 | 66.15 |
| Daycare teacher | 95.75 | 68.04 | 64.84 | 64.54 |

4.2 Early Childhood Teachers' Level of ICT Competency

The scale for the 'ICT in Education Index' ranged from 0 to 100 and the total index was calculated based on the sub-domains of 'Access', 'Ability', 'Use' and 'Satisfaction'. The total 'ICT in Education Index' value for the level of early childhood teachers' ICT competency is shown in Table 3.

In this study, perhaps not surprisingly, teachers holding a bachelor's degree or higher scored the highest with a score of 75.605. And as can be seen, associate degree holders and daycare teachers scored 73.345 and 72.293, respectively.

Based on the cut score (85.79) set by experts for early childhood teachers' level of ICT in education, the achievement ratio of the group with a bachelor's degree or higher was 88.13%, followed by the group with an associate degree (85.49%) and the group of daycare teachers (84.27). The achievement level of early childhood teachers' ICT in education was around 85% of the cut score set by experts.

Early childhood teachers' level of ICT in education in sub-domains is shown in Table 4:

For accessibility, associate degree holders show the highest value of 95.78 while in the other areas of ability, use and satisfaction, bachelor's and higher degree holders scored the highest.

4.3 Correlation between the 'Total ICT in Education Indexes' and Respective Areas

The correlation between the 'Total ICT in Education Indexes' and respective areas was analyzed and the results showed that they ('Total ICT in Education Indexes') were correlated with ability (0.901), utilization (0.837) and satisfaction (0.704). These results can be interpreted that the total ICT in education index increases as ability improves) see Table 5.

For the correlation between elements, the two that showed the highest correlation were utilization and ability with a score of .585, followed by utilization and satisfaction with .555. According to this result, utilization increases as ability improves, with satisfaction growing as utilization increases. Early childhood teachers' ease of accessibility does not ensure an increase in the 'Total ICT in Education Indexes', nor an improvement of satisfaction with ICT. The following Table 6 shows the 'Total ICT in Education Indexes' correlation with respective elements that were measured to assess early childhood teachers' ICT in education.

Qualitative utilization showed the highest correlation with the 'Total ICT in Education Indexes' with a score of .860, which means that an increase in early childhood teachers' qualitative utilization improves the 'Total ICT in Education Indexes'. However, quantitative utilization

Table 5. Correlation between the Total ICT in education indexes and respective areas (Unit : r<Pearson correlation coefficient >)

| | Total ICT in Education Indexes | Accessibility | Ability | Utilization |
|---------------|--------------------------------|---------------|----------|-------------|
| Accessibility | 0.366*** | | | |
| Ability | 0.901*** | 0.219*** | | |
| Utilization | 0.837*** | 0.191*** | 0.585*** | |
| Satisfaction | 0.704*** | 0.138*** | 0.533*** | 0.555*** |

ns : non-significance, * p<0.05, ** p<0.01, *** p<0.001

Table 6. Correlation between ICT area and element
(Unit : r<Pearson correlation coefficient >)

| Area Element | | Total ICT in Education Indexes | Accessibility | Ability | Utilization | Satisfaction |
|---------------|---------------------------------|--------------------------------|---------------|----------|-------------|--------------|
| Accessibility | Ownership of devices | 0.277*** | 0.762*** | 0.164*** | 0.145*** | 0.101*** |
| Access | Availability of IT | 0.184*** | 0.721*** | 0.066* | 0.081** | 0.053ns |
| Access | Recency of the operating system | 0.272*** | 0.297*** | 0.241*** | 0.175*** | 0.160*** |
| Ability | Hardware literacy | 0.748*** | 0.199*** | 0.840*** | 0.466*** | 0.445*** |
| Ability | Software literacy | 0.835*** | 0.178*** | 0.906*** | 0.576*** | 0.512*** |
| Ability | Internet literacy | 0.830*** | 0.210*** | 0.855*** | 0.598*** | 0.556*** |
| Ability | Self-development | 0.380*** | 0.086** | 0.495*** | 0.174*** | 0.165*** |
| Utilization | Quantitative utilization | 0.209*** | -0.017ns | 0.000ns | 0.515*** | 0.065* |
| Use | Qualitative utilization | 0.860*** | 0.235*** | 0.684*** | 0.879*** | 0.611*** |
| Satisfaction | Satisfaction (Element) | 0.704*** | 0.138*** | 0.533*** | 0.555*** | 1.000 |

ns : non-significance, * p≤0.05, ** p≤0.01, *** p≤0.001

showed a correlation of .209, which implies that teachers' frequent use of ICT, does not guarantee an improvement of ICT competency. Software literacy showed the second highest correlation with a score of .835, followed by Internet literacy at .830.

The 'Total ICT in Education Indexes' showed low correlations with elements of 'access' compared to other areas. The correlations were: .277 with ownership of devices, .184 with availability of IT, and .272 with recency of the operating system. Early childhood teachers could have high accessibility to web information thanks to the build-out of Internet infrastructure, but their accessibility showed a low correlation with the 'Total ICT in Education Indexes'. This low relationship shows that good accessibility does not ensure the development of ICT competency.

The ability area has a correlation of .684 with qualitative utilization of the utilization area, which implies that early childhood teachers with better ability have greater qualitative utilization of educational information. The utilization area has a correlation of .555 with the satisfaction element.

5. Conclusion

The availability of new technologies in the field of ICT has contributed to diversifying teaching and learning methods and contents, and thus the use of ICT has acted to support, replace or supplement teaching and learning methods in various school settings. For the role of schools in fostering competent human resources, the level of ICT

in education can be seen as an important indicator of national competitiveness. For this reason, this study was conducted to find early childhood teachers' level of ICT competency

The criteria, representing the achievement levels needed by teachers, were set to diagnose early childhood teachers' level of ICT competency and to suggest what efforts should be made to improve the level of ICT competency based on correlations between areas. A number of 433 early childhood teachers participated in this study.

According to the results, the achievement level of early childhood teachers' ICT in education was around 85% of the cut score set by experts. They showed the lowest level in the area of ability. Based on correlations between areas, teachers at the higher levels used ICT more frequently. Satisfaction grew as the frequency of ICT increased. Interestingly, emplacement of infrastructure did not ensure an increase in the level of overall ICT competencies, and satisfaction with ICT grew when teachers could use ICT properly for their purposes based on their ability. The significance of this study lies in that it diagnosed the level of ICT in education among early childhood teachers who are educating preschoolers.

6. References

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