

# Analysis of Concept Map about ICT Education of Early Childhood Teachers

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## Abstract

**Background/Objectives:** The purpose of this study was to use a concept map analysis about ICT education for early childhood teachers and tries to look into knowledge and structure about ICT education.

**Methods/Statistical analysis:** The subject of this study was randomly collected 50 early childhood teachers working in kindergartens located in Busan, Gyeongsangnam province. The conceptual diagrams drawn up by the early childhood teachers were analyzed to find out the numbers of superordinate concepts, the number of content elements, characteristics, hierarchy and density.

**Findings:** First, as for the content of education for happiness, superordinate concepts appeared 354 times in the conceptual diagrams of the early childhood teachers, and there were 21 superordinate concepts overall in their diagrams. Second, early childhood teachers had more knowledge of 'computer education' of ICT education. Third, density of individual concept map of early childhood teachers appears in range from 1.00 to 8.60, and average density appeared 3.34. In addition, since average of group about density appeared higher than average of subordinate group and there was significant difference statistically, difference among individual teachers were appeared big in density of concept.

**Improvements/Applications:** This study suggests possibility and direction about ICT education by executing analysis of concept map about ICT education for early childhood teachers, and has meaning about providing practical material about possibility of ICT education.

**Keywords:** ICT education, Concept map analysis, Early childhood teacher, Early childhood education

## 1. Introduction

ICT is a compound word using IT(Information Technology) and CT(Communication Technology), which means the every method collecting, producing, preserving, delivering, and utilizing information by using information and communication technology [1]. Thus, ICT is the concept including sharable information and communication through various media widely. However, it is true that computer is at the center, which includes both online and offline use of computer. Even though ICT education activity to children through computer is limited, computer based education suggest new level of possibility.

Chadwick pointed out that even though new media is expected to solve many educational problems especially for using media material issue, it is not getting out of the chaos of purpose and method [2]. Among them, it is concerned that though computer is expected the most by people, method may lead purpose unless it reflects initiative, emotion, and thinking process. So, media material shall be used as a medium for effective learning, but it is not supposed to be working as educational purpose and the method must not be the purpose.

So, understanding about concept and recognition about ICT of early childhood teachers that actually operates ICT education for infants in infant education field is very important. Understanding about ICT education of early childhood teachers will largely influence on infant teaching contents and method, and it will play

an important role for infant's value formation. Swaminathan & Wright said that three years old infant may take an interest and participate in interaction with computer, it is reported that proper computer software is partially useful for promoting social and cognitive development of infant [3]. Also, research that proper use of computer helps to raise debating ability, creativity, problem solving ability, flexible thinking Earle suggests positive aspect of ICT education [4].

As teacher's knowledge for teaching activity became important, researchers design many methods to measure knowledge contents and structure that teachers have; the method that is used relatively more among approach methods that approach to personal knowledge structure is the concept map analytic technique [5]. When people try to learn a special topic called the concept map, indication about learner's conceptual understanding is explained through relationship between concepts [6-7]. According to Hong & Lee, since the concept map is showing what is understood in graphical type as it is, it helps to figure out the concept that is wrongly understood, the core concept that is included in particular learning task, and meaningful relationship between those concepts [8]. Also, it is a useful method to explore teachers' knowledge, focusing on how to structure and develop their pedagogical content knowledge within their teaching practices. Recently, concept mapping have been greatly concerned as a core method to analyze teachers' conceptual understandings of learning and teaching, in accordance with the necessity of teachers' knowledge to improve their professional development [9]. Like this, the reason why cognitive conceptualization of early childhood

teacher's knowledge behind their behaviors is highlighted in teacher education is that the understanding about what contents of specialized knowledge system of teachers and how to form this specialized knowledge system can provide key components supporting effective teacher professional development [10].

Thus, this study uses a concept map analysis about ICT education for early childhood teachers and tries to look into their knowledge and structure about ICT education. Through this, it will figure out teacher's knowledge that is base to determine ICT educational contents for young children, as well as to develop effective ICT education programs for teachers. It also helps to decide teaching-learning direction of teacher education as it figures out wrong-understood concepts by teachers. It further enables education administrators to develop educational resources to facilitate ICT-supported teaching and learning. To this end, we set research questions as follows.

First, how is the concept contents about ICT education of early childhood teachers appeared on concept map?

Second, how is the knowledge level of concept about ICT education of early childhood teachers appeared on concept map?

## 2. Materials and Methods

### 2.1. Research Subject

The subject of this study was randomly collected 50 early childhood teachers working in kindergartens located in Busan, Gyeongsangnam province. About general characteristic of early childhood teachers who participated in writing concept map, average age was about 29.5 years-old, and educational career was about 5 years and 8 months.

### 2.2. Research Process

#### 2.2.1. Preliminary Research

For figuring out validity, problem, and the time required, we randomly collect 5 early childhood teachers from June 1st 2016 to June 3rd 2016 and progress preliminary research. Through preliminary research, we let early childhood teachers and day-care center teachers write about personal thought and knowledge about 'ICT education' in concept map, and find out hierarchy and structure of contents and level of knowledge about 'ICT education', and reviewed about pre-explanation time and actual required time to write, execute method, and difficulties in process.

### 2.2.2. Main Research

Writing concept map in main research was executed in subgroup interview or personal interview personally from June 6th 2016 to July 1st 2016. After researcher delivered explanation and writing method of concept map, early childhood teachers and day-care teachers wrote about 'ICT education'. Required time to write concept map for research subject in main research was about 1 hour on average.

### 2.3. Material Analysis

Material analysis was executed based on the advanced study related to concept map [7] [11] based analysis of [9]. Component of concept map consists of hierarchy concept and subordinate concept. For sorting concept appeared on personal concept map, we sorted concepts with three infant education specialists and repetitively reviewed in order to increase credibility. The concept map written by early childhood teachers was analyzed in aspect of number, characteristic, hierarchy, and density in accordance of the number of hierarchy and content element by using concept map analysis method designed by [7]. For checking this kind of result, we checked average, standard deviation, frequency, and percentage by using SPSS 23.0.

#### 2.3.1. Knowledge Analysis about ICT Education

For figuring out how knowledge of early childhood teachers and day-care center teachers about ICT education is, we analyzed contents of superordinate concept and subordinate concept and frequency by contents. The concept map written by early childhood teachers was analyzed in aspect of number, characteristic, hierarchy, and density in accordance of the number of hierarchy and content element.

#### 2.3.2. Analysis of Knowledge Level about ICT Education of Early Childhood Teachers

For figuring out knowledge level appeared on ICT education concept map, we analyzed characteristic of superordinate concept (the number of subordinate concept included in a superordinate concept, hierarchy, characteristic score) and calculated the density. For characteristic of superordinate concept, we arranged everything according to analysis result of sorting 10 superordinate concept appeared as the most frequency on concept map of early childhood teachers and day-care center teachers according to contents element of ICT education, and recorded frequency of use by category. The example of density calculation is as following [table 1].

**Table 1:** Example of density calculation

| Division   | concept map           |                    |
|--|-----------------------|--------------------|
|  | A: computer education | B: smart education |
| superordinate concept                            |                       |                    |
| number of the first level superordinate concept  | 1                     | 1                  |
| number of the second level superordinate concept | 2                     | 2                  |
| number of the third level superordinate concept  | 2                     | 3                  |

density:  $11(\text{number of total concept}) \div 6(\text{number of column}) = 1.83$

superordinate concept : 'computer education' characteristic score of (A):  $5(\text{number of concept of A}) \div 11(\text{total number of concept}) = 0.45$

'smart education' characteristic score of (B):  $6(\text{number of concept of B}) \div 11(\text{total number of concept}) = 0.55$

$\rightarrow A+B = 0.45 + 0.55 = 1$

## 3. Results

### 3.1. Concept Map Contents about ICT Education of Early Childhood Teachers

Superordinate concept is the highest level in hierarchy and connects directly with ICT education, and the concept that early childhood teachers importantly recognize is reflected on

superordinate concept. In contents about ICT education of early childhood teachers, the superordinate concept that early childhood teachers used are as [table 2].

Like we suggested by [table 2], the number of super ordinate concepts that early childhood teachers used at contents about ICT education of early childhood teachers was appeared total 354 times, as a result of categorization with similar concepts, it was deducted with 21 superordinate concept category.

**Table 2:** In concept map about ICT education of early childhood teachers, frequency of superordinate concept

| number       | superordinate concept       | similar concept   | frequency (N) | percentage (%) |
|--------------|-----------------------------|---|---------------|----------------|
| 1            | computer education          | Infant computer education, multi-media education, computer using method                   | 45            | 12.7           |
| 2            | Internet                    | Internet use, internet utilizing, internet education                                      | 40            | 11.3           |
| 3            | smart education             | Smart phone, cell-phone use   | 33            | 9.3            |
| 4            | media education             | media exposure, smart phone addiction, internet addiction, adverse effect, overindulgence | 29            | 8.2            |
| 5            | Information education       | knowledge, education, information use education   | 28            | 7.9            |
| 6            | R-learning                  | Robot based education, I=lobby  | 25            | 7.1            |
| 7            | medium utilizing education  | medium, computer medium, e-book, use of video, teaching material                          | 23            | 6.5            |
| 8            | creativity education        | creativity, imagination, originality  | 20            | 5.6            |
| 9            | game                        | video game  | 19            | 5.4            |
| 10           | difficulties                | limit, difficulties of class application  | 17            | 4.8            |
| 11           | Program                     | PowerPoint, Hangeul, movie maker  | 16            | 4.5            |
| 12           | thinking ability            | intellectual capacity   | 14            | 4.0            |
| 13           | children oriented education | constructivism, interest, game oriented   | 11            | 3.1            |
| 14           | media ethics education      | Information ethics  | 10            | 2.8            |
| 15           | parental education          |   | 8             | 2.3            |
| 16           | integrated education        | integrated approach   | 6             | 1.7            |
| 17           | evaluation                  | infant evaluation   | 4             | 1.1            |
| 18           | computer job                |   | 3             | 0.8            |
| 19           | aesthetic                   |   | 1             | 0.3            |
| 20           | problem-solving ability     |   | 1             | 0.3            |
| 21           | convenience                 |   | 1             | 0.3            |
| <b>Total</b> |                             |   | 354           | 100.0          |

As a result that we looked into specifically, it was appeared in order of 45 times in 'computer education' (12.7%), 40 times in Internet (11.3%), 33 times in 'smart education' (9.3%), 29 times in 'media addiction' (6.5%), 20 times in 'creativity education' (5.6%), 19 times in 'game' (5.4%), 17 times in 'difficulties' (4.0%), 16times in 'program' (4.5%), 14 times in thinking ability (4.0%), 11 times in children oriented education (3.1%), 10 times in 'media ethic education' (2.8%), 6 times in parental education (1.7%), 6 times in 'integrated education' (1.7%), 4 times in 'evaluation' (1.1%), 3 times in 'computer job' (0.8%), 'aesthetic', 1 time in 'problem-solving ability', 'convenience' (0.3%).

### 3.2. Knowledge Level of Concept Map about ICT Education of Early Childhood Teachers

The result of reviewing characteristic score and number of subordinate concepts included hierarchy of superordinate concepts and superordinate concepts mainly with 10 superordinate concepts that recorded the most frequency among superordinate concepts appeared on concept map of early childhood teachers is as [table 3].

Density means how hierarchical and integral each category is composed, and the result that calculated density about concept map of 50 early childhood teachers is as [table 4].

**Table 3:** Superordinate concept characteristic about ICT education concept map of early childhood teachers

| number | superordinate concept | frequency (%) | number of subordinate concept |                         | hierarchy   |                         | characteristic score |                         |
|--------|-----------------------|---------------|-------------------------------|-------------------------|-------------|-------------------------|----------------------|-------------------------|
|        |                       |               | average (M)                   | standard deviation (SD) | average (M) | standard deviation (SD) | average (M)          | standard deviation (SD) |
| 1      | computer education    | 45(12.7)      | 5.50                          | 2.28                    | 1.88        | 0.66                    | 0.30                 | 0.32                    |
| 2      | internet              | 40(11.3)      | 4.35                          | 1.88                    | 1.80        | 0.54                    | 0.25                 | 0.22                    |
| 3      | smart education       | 33(9.3)       | 3.28                          | 1.25                    | 1.54        | 0.43                    | 0.19                 | 0.11                    |
| 4      | media addiction       | 29(8.2)       | 5.27                          | 2.54                    | 1.96        | 0.64                    | 0.20                 | 0.08                    |
| 5      | information education | 28(7.9)       | 3.48                          | 0.96                    | 1.68        | 0.45                    | 0.15                 | 0.10                    |
| 6      | R-learning            | 25(7.1)       | 3.36                          | 0.89                    | 1.52        | 0.36                    | 0.11                 | 0.09                    |
| 7      | medium use education  | 23(6.5)       | 2.84                          | 1.06                    | 1.05        | 0.28                    | 0.09                 | 0.13                    |
| 8      | creativity education  | 20(5.6)       | 4.58                          | 2.33                    | 1.34        | 0.46                    | 0.10                 | 0.07                    |
| 9      | game                  | 19(5.4)       | 4.05                          | 1.76                    | 1.67        | 0.39                    | 0.06                 | 0.05                    |
| 10     | difficulty            | 17(4.8)       | 3.37                          | 1.20                    | 1.23        | 0.50                    | 0.04                 | 0.08                    |

**Table 4:** Density about ICT education concept map of early childhood teachers

| teacher ID | density |
|------------|---------|------------|---------|------------|---------|------------|---------|------------|---------|
| 1          | 4.56    | 11         | 6.18    | 21         | 1.00    | 31         | 2.84    | 41         | 2.16    |
| 2          | 3.33    | 12         | 2.00    | 22         | 3.70    | 32         | 1.67    | 42         | 1.00    |
| 3          | 1.00    | 13         | 2.62    | 23         | 1.33    | 33         | 1.33    | 43         | 2.10    |
| 4          | 4.50    | 14         | 1.00    | 24         | 4.66    | 34         | 8.60    | 44         | 1.33    |
| 5          | 1.16    | 15         | 3.57    | 25         | 3.70    | 35         | 4.82    | 45         | 2.50    |
| 6          | 5.67    | 16         | 6.50    | 26         | 4.33    | 36         | 5.00    | 46         | 3.57    |
| 7          | 2.50    | 17         | 1.33    | 27         | 8.33    | 37         | 1.00    | 47         | 7.08    |
| 8          | 3.33    | 18         | 3.72    | 28         | 1.62    | 38         | 3.33    | 48         | 6.54    |
| 9          | 1.00    | 19         | 2.07    | 29         | 1.00    | 39         | 4.56    | 49         | 1.33    |
| 10         | 3.84    | 20         | 5.20    | 30         | 2.55    | 40         | 2.88    | 50         | 6.03    |

Like suggestion on [table 4], density of individual concept map of early childhood teachers appeared in range from 1.00 to 8.60, and average density appeared 3.34(SD=2.03). As a result of independent sample t-verification of density average of top 27% group (n=14) and bottom 27% group (n=14) of overall average density, average of superordinate group was appeared higher than average of subordinate group, and it was appeared that there was significant difference statistically ( $t=13.37$ ,  $p<.001$ ).

#### 4. Conclusion

This study aimed to explore the knowledge of early childhood teachers that is base to determine contents of ICT education through concept map. For this, we figured out the number of superordinate concepts, characteristics, the number of subordinate concepts, and the density appeared on concept map written about ICT education contents with 50 early childhood teachers. The summary of the research result is as following.

First, as a result of analysis of superordinate concept appeared on concept map of early childhood teachers about ICT education contents, superordinate concept suggested on concept map was appeared 354 times, and as a result of classification process of similar terms among concepts that infant expressed, it was categorized into 21 categories. The most frequent concept among superordinate concepts that early childhood teachers suggested was appeared in order of 45 times in 'computer education' (12.7%), 'internet', 'smart education', 'media addiction', and 'information education'. Through study result like this, it may be interpreted ICT education may be judged as a connected part with performance at life scene of infants, and knowledge about ICT education is segmented, expended, and gets deeper in accordance of teacher's career.

Also, many similar terms about same concept were suggested in this study, which has same context with study result that early childhood teachers use very various terms but do not have enough unified terms [12]. Houle pointed out subordinate culture that establishes intrinsic terms that have unique respective unique tradition at special occupations for establishing professionalism of early childhood teachers, which comes basis to claim necessity to establish unified terms for ICT education that expands its prospect in pedagogy area [13].

Second, for figuring out knowledge level about ICT education contents of early childhood teachers, we looked into the number of subordinate concept, hierarchy of superordinate concept, and characteristic score included in superordinate concept mainly with 10 superordinate concept that recorded the most frequency among superordinate concept appeared on concept map of early childhood teachers. First, if we look in to number of subordinate concept included in superordinate concept, it appeared that 'computer education' has the most subordinate concept, which may be interpreted as meaningful result that reflects characteristic of early childhood teachers group practically.

Next, hierarchy is seeing how subordinate concept included in superordinate concept is stepped down, so we may realize that the concept about this is expanded, segmented, and has depth the most. So, when we deal with concept about 'media addiction' at ICT education, it is thought that it may be spreaded and expanded to various activities. As we see characteristic score, infant will know 'computer education' appeared in the highest level, which is the biggest portion in overall concept map. Thus, we consider 'computer education' related contents largely on ICT education, and the concept of teachers about this is the most.

As we look into characteristic of superordinate concept appeared on concept map of early childhood teachers, we recognized 'computer education' and 'media addiction' as the most important

contents in ICT education, there are wide contents range, included concept, and it composed systematically and recognized the portion highly. Thus, density in the concept of 'computer education' and 'media addiction' means how hierarchical and synthetical each category is composed, so the density about ICT education appeared the range from 1.00 to 8.60. Thus, it shows grouping and hierarchy are well-made in knowledge structure of teachers are well made in concept about 'computer education' and 'media addiction' Though the range of density is big, since most early childhood teachers are distributed on the range from 1 to 5, it is mostly similar level [9]. These results mean that overall integration level is rather parallel than systematic and hierarchical.

Also, it is parallel to the advanced study result that pointed out that it cannot create significant relevance and cannot organize specific concept in general concept hierarchically [8]. In addition, since average of group about density appeared higher than average of subordinate group and there was significant difference statistically, difference among individual teachers appeared big in density of concept. Thus, various plans should be considered by providing training for ICT education for early childhood teachers, seminar, and others in the future.

This study suggests possibility and direction about ICT education by executing analysis of concept map about ICT education for early childhood teachers, and has meaning about providing practical material about possibility of ICT education. Proposals for expected effect, limitation, and follow-up study based on contents gotten mainly from result of this study and discussion are as following.

First, we confirmed various terms were used about concept like analysis result of superordinate concept and subordinate concept appeared on concept map of early childhood teachers. So, we established professionalism of early childhood teachers, and follow-up study for suggesting united terms for academic naturalization about ICT education is requested.

Second, necessity of constant and systematic teacher training and seminar is suggested. When lacked level of contents and educational and academic approach about knowledge are made, knowledge system about ICT education of early childhood teachers may expand qualitatively and quantitatively.

Third, this study progressed restrictively with randomly collected early childhood teachers who work in infant education institutes located in Busan, Gyeongsangnam-do. For increasing generalization of the study result, collecting more numbers of sample in wider area is required. Thus, in follow-up study, we have to progress the study with more sample numbers in wider area.

Finally, it is necessary to categorize early childhood teachers into two groups including kindergarten teachers and preschool teachers for further study. Additionally, it would be meaningful to verify their conceptual differences.

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