Proficiency level and Gender Difference in Computer and Information Literacy

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Abstract

Background/Objectives: As the digital era, the importance of computer and information literacy is increasingly emphasized. The study aims to analyze the achievement characteristics of Korean students based on proficiency level and gender. Methods/Statistical Analysis: We calculated the percent correct of each student groups and the difference between groups to each assessment aspects of ICILS 2013 using Republic of Korea data. Findings: The result showed that there was big differences both in 'Creating information' and 'Sharing information' compared with other aspects between proficiency levels and between genders in Korea. In particular, the highest level (Level 4) showed the big difference in percent correct between gender in 'Creating information' and the lowest level (Below level 1) showed the great difference in 'Sharing information'. Application/Improvements: The results suggest conducting remedial education for Korean students based on proficiency level and gender.

Keywords: Computer and Information Literacy, Gender, Proficiency level, ICILS

1. Introduction

Recently, the ability to live in the 21st century has been highlighted the key competencies. Key competencies are considered as necessary personal and social skills. It may vary depending on the personal circumstances and environment. The educational way to cultivate these competencies has been proposed in numerous studies. In addition, several countries try to enhance students' key competencies in education in order to foster future leaders.

Among the various key competencies related to personal and vocational lives, ‘Computer and Information Literacy (CIL)’ is an essential ability required to survive in digital age1-5. The various researches have been conducted to analyze whether the ICT related contextual factors are affecting the students’ CIL. International Computer and Information Literacy Study (ICILS) 2013 is the first cross-national study to investigate differences among the 8th graders of participating countries in CIL and to analyze ICT-related educational environment2.

Even though CIL is highlighted as a key competency, there was not much case that the CIL of students was investigated in accordance with systematic and detailed assessment framework until now. It is hard to find such studies that directly analyze the CIL difference between the groups based on each assessment factors. ICILS 2013 has been surveyed for the CIL of students, which is based on the systematic assessment framework. But, this study only calculated the average CIL scores and did international comparisons2. Therefore, the analysis of students’ CIL on the group difference needs to be done according to the detailed assessment aspects.

The Republic of Korea has been attentive to such international trends and participated in the ICILS 2013 study. According to the research of International Telecommunication Union (ITU) in 2013, the Republic of Korea has 13.5 percent of digital natives of its total
population which is third place and has topped the ICT Development Index (IDI) in the world. However, Korea shows remarkable differences in achievements by proficiency level and by gender compared with other participating countries in ICILS 2013. In order to make less difference, the differences among the groups need to be more deeply investigated and the content domains need to be identified in order to understand which domains are needed to supplement learning.

Because the computer and information literacy gap between groups is very large in Republic of Korea, it is needed to find ways to narrow the gap. For the purpose of this study, in-depth analysis was conducted on differences in CIL between groups for each assessment aspects of ICILS 2013 using the data of the Republic of Korea. We analyzed the characteristics of Korean students’ CIL achievement more meticulously. Throughout the findings of in-depth studies, teaching and learning methods which are fitted in students’ characteristics could be developed and adapted to students for fostering CIL.

2. Background

2.1 The concept of Computer and Information Literacy

Computer and information literacy is classified as one of the key competencies to raise the equipped citizens in the 21st century. This concept is named with various terms in various studies, and the commonly used terms are ‘Computer literacy’, ‘Information literacy’, ‘Digital literacy’ and ‘ICT literacy’. ‘Computer literacy’ is the ability to use a spreadsheet and a word processor and to search the World Wide Web for information. It was focused primarily on technology based definitions, concepts, and skills, involved some explicit indication of the importance of computers, and an ability to use them, in a social context.

On the other hand, ‘Information literacy’ is the ability to access, evaluate and use information from a variety of sources. Therefore, it is the set of skills and knowledge that allows us to find, evaluate, and use the information we need, as well as to filter out the information we don’t need. From the pedagogical point of view, this concept is concerned with a student’s ability to collect, analyze and utilize information gathered via the use of information technology and to use that information to make effective decisions.

Considering the notions of ‘Computer literacy’ and ‘Information literacy’, these two concepts are associated with each other. For example, ‘Information literacy’ is a concept that has evolved as a result of recent efforts to move technology-based instruction and research to a level above the long-held concepts previously associated with ‘Computer literacy’. All these terms highlight the need to handle technology in the digital age. For the ICILS, notions of ‘Computer literacy’ and ‘Information literacy’ were unified under one term ‘Computer and information literacy (CIL)’. CIL was defined as “Individual’s ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in the community”.

According to the CIL framework of ICILS 2013, students’ CIL consists of two strands and each strand has several aspects (see Table 1). One strand is ‘Collecting and managing information (strand 1)’ which consists of three aspects: Knowing about and understanding computer use, Accessing and evaluating information, and Managing information. And the other strand is ‘Producing and exchanging information (strand 2)’ which consists of four aspects: Transforming information, Creating information, Sharing information, and ‘Using information safely and securely’ (see Table 1). An aspect 1.1 Knowing about and understanding computer use is more related to computer literacy. Except for an aspect 1.1, the other six aspects (1.2~2.4) are more related to information literacy in the CIL framework of ICILS 2013.

| Strand | Aspect |
|--------|--------|
| 1. Collecting and managing information | 1.1 Knowing about and understanding computer use |
| | 1.2 Accessing and evaluating information |
| | 1.3 Managing information |
| 2. Producing and exchanging information | 2.1 Transforming information |
| | 2.2 Creating information |
| | 2.3 Sharing information |
| | 2.4 Using information safely and securely |

2.2 CIL proficiency level and gender difference in ICILS 2013

ICILS targeted 8th graders and collected the data about students’ CIL achievement and ICT-related educational...
context. The main survey of ICILS 2013 was conducted in the year of 2013 and 18 countries were participated. This study reported the international comparative results about student's CIL in 2014. According to the results, the CIL scale score of 8th graders of Republic of Korea was 536 points, which was higher than the ICILS average score of 500 points.

ICILS also analyzed and compared CIL achievement across countries with respect to proficiency levels. The proficiency levels of CIL on ICILS 2013 were set by considering the content of the items and scaled difficulties. These levels have benchmark of 407, 492, 576, and 661 with 85 scale point difference. According to the results, the CIL scale score of 8th graders of Republic of Korea was 536 points, which was higher than the ICILS average score of 500 points.

According to S. Lee, J. M. Kim, and W. G. Lee, students’ ICT literacy levels can be associated to their surrounding environment and that improved self-recognition can affect students’ abilities. Therefore, it is important to analyze students’ characteristics in accordance with proficiency levels.

Table 2 shows the result of calculating the percentage of students by CIL proficiency level among the top 5 countries of ICILS 2013. The percentage of Korean students within the highest proficiency level (Level 4) was the highest (5%) among the 14 participating countries. On the other hand, the percentage of Korean students within lowest proficiency level (Below Level 1) was 9% which is also the highest among top 5 performing countries. But, this is lower percentage than overall ICILS average (17%). These results meant that the achievement gap between Korean students’ proficiency levels might be big, compared to other high achieving countries. Therefore, the CIL components needed to be explored, which appeared to be a large difference between the upper-level students and lower-level students.

A common finding from most CIL related studies is that female students’ literacy is higher than male students. ICILS results also showed that female students’ CIL was higher than male. The scaled score of Korean female students was higher than male students (score point: female 556, male 517). This trend in gender difference (female higher than male students) was shown in the majority of the participating countries; however, Korea showed the largest gap among the participated countries (score point difference: Korea 38, ICILS average 18). CIL achievement of Korean female students ranked the second place after the Czech Republic but male students’ average score was as much high as females’ the lowest among top 5 performing countries. That is the reason why the big gender gap shown in Korea, therefore it is necessary to conduct in-depth research on gender differences.

### 3. Method

#### 3.1 Analytical Framework

In this study, the seven aspects of ICILS 2013 CIL framework were used as the analytical framework. ICILS 2013 framework was separated by two strands and each strand also separated by several aspects (see Table 1). The reason why the strand level was not used for an analytical framework is because it was thought that the strand level has little number of factors (only two) for analyzing characteristics of students’ achievement but also ‘Knowing about and understanding computer use’ aspect involved in the strand 1 has a different attribute with ‘Accessing and evaluation information’ and ‘Managing information’ aspects in the strand 1 as described earlier.

The connection of items and assessment aspects were based on the ICILS 2013 item mapping. The average percent correct of the assessment aspects was calculated by adding the items in those aspects and divided by the number of items. When there are the sub-items and they

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**Table 2. Percentages of students at each proficiency level**

| Country          | Below level 1 (%) | Level 1 (%) | Level 2 (%) | Level 3 (%) | Level 4 (%) |
|------------------|-------------------|-------------|-------------|-------------|-------------|
| Rep. of Korea    | 9                 | 19          | 36          | 30          | 5           |
| Australia        | 5                 | 18          | 42          | 30          | 4           |
| Poland           | 6                 | 20          | 42          | 29          | 4           |
| Czech Republic   | 2                 | 13          | 28          | 34          | 3           |
| Norway           | 5                 | 19          | 46          | 27          | 3           |
| ICILS average    | 17                | 23          | 38          | 21          | 2           |
have different assessment aspects, the average percent correct of each assessment aspects were calculated by including sub-item. The number of ICILS 2013 items & tasks for calculating the average percent correct for each aspect are shown in Table 3, and it depends on each aspects.

### Table 3. Items (Tasks) mapping to ICILS 2013 framework

| Aspect | Number of items (tasks) | Percentages of items (tasks) |
|--------|-------------------------|-------------------------------|
| 1.1    | Knowing about and understanding computer use | 12 | 17.9% |
| 1.2    | Accessing and evaluation information | 9 | 13.4% |
| 1.3    | Managing information | 4 | 6.0% |
| 2.1    | Transforming information | 11 | 16.4% |
| 2.2    | Creating information | 15 | 22.4% |
| 2.3    | Sharing information | 3 | 4.5% |
| 2.4    | Using information safely and securely | 13 | 19.4% |
| Total  | 67 | 100.0% |

### 3.2 Analysis

In order to examine students’ characteristics of CIL, the percent correct of groups by proficiency levels and by gender for each seven aspects of ICILS 2013 framework was calculated, and also a difference between groups was calculated. The percent correct of an aspect was calculated to average of the percent correct of each items included in the aspect. In particular, the highest and the lowest level of ICILS 2013 were used to analyze the characteristics of differences among proficiency levels. In other words, the three levels (level 1-3) were not used in this study. The percent correct of level 4 (L4) at the highest level and below level 1 (BL1) at the lowest level was calculated and differences between proficiency levels was compared to analyze.

### 3.3 Data

The study used existing test data collected during a year of 2013. In Korea, 2,888 8th graders from 150 middle schools were participated in ICILS 2013. The Korean students’ achievement data of ICILS 2013 was used to derive the results of study.

### 4. Results

#### 4.1 CIL difference by proficiency level

Among all the aspects, the level 4 students of Korea has the highest percent correct for 'Knowing about and understanding computer use (90.5%)', and has relatively high percent correct for 'Creating information (88.9%)' and 'Sharing information (87.0%)'. And they have the lowest percent correct for 'Accessing and evaluation information (74.4%)'. The below Level 1 group has the highest percent correct for 'Knowing about and understanding computer use (48.5%)' and is relatively high percent correct for 'Using information safely and securely (41.1%)'. But, they have the lowest percent correct for 'Accessing and evaluation information (3.8%)' and relatively weak for 'Creating information (8.9%)' and 'Sharing information (8.2%)'.

From these results, it was found that both proficiency level groups are commonly weak to manage and evaluate information. In addition, the level 4 group of Korean students has relatively strong for 'Creating information' and 'Sharing information', while a below Level 1 group was relatively weak for these two aspects. In short, these two levels showed mutually opposing trends. According to Table 5, Korean students in below level 1 had the average percent correct of 8.2% for 'Sharing information' which is lower than the ICILS average 9.4%. Only 'Sharing information' aspect was the lower than the ICILS average among all the aspects. According to an analysis of differences by proficiency level, there was a big difference in the understanding of 'Creating information (80.0%p)' and 'Sharing information (78.8%p)' between the highest level and the lowest level and there was the smallest differences in the 'Using information safely and securely'. These results displayed the serious gap of high level and low level on 'Sharing Information' aspect. These result indicated that teaching methods and materials about creating and sharing information skills should be developed suitable for low achieving students of Korea.
4.2 CIL difference by gender

According to the analysis results of Korea for a difference between genders, female students show higher percent correct for all aspects than male students (see Table 6). Female students' percent correct is also higher than male students' at the analysis results of international data and this trend is same as Korea. But the gender differences in the percent correct of all the aspects can be seen that the differences of Korea are bigger than those of International averages. In particular, there was a difference bigger than 10 percent point in 'Creating information (12.1%p)' and 'Sharing information (11.6%p)' between the percent correct of female students and male students. In contrast, the percent correct of gender differences was relatively small in 'Using information safely and securely (1.8%p)'.

A Female students' percent correct for 'Knowing about and understanding computer use' was the highest of all the CIL aspects, and 'Accessing and evaluation information' was the lowest of all the CIL aspects both Korea and International. Also, the male students showed the same results as the female students.

4.3 CIL difference by proficiency level and gender

Table 7 is the analysis results for a difference between level 4 and below Level 1 at each gender groups of Korea. For female groups, only two aspects were shown larger differences of percent correct than male groups, which are 'Creating information' and 'Using information safely and securely'.

Both female and male students had relatively big differences between the highest and the lowest groups for 'Creating information' and 'Sharing information'. It is the same analysis results as entire students of Korea. In particular, the difference of percent correct for female students of Korea between the highest and lowest level about 'Creating information' was shown most dramatically by 79.9%, because of the percent correct of the highest performing group of females high as 89.8%. Also, the difference of male in 'Sharing information' was the largest (80.3%), because of the very low percent correct of the lowest performing group of male students (7.4%, see Table 8).

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**Table 4. Data sources**

|                     | International (ICILS 2013) | Rep. of Korea |
|---------------------|-----------------------------|---------------|
| **Proficiency level** |                             |               |
| Level 4             | 1,310                       | 157           |
| Below Level 1       | 8,442                       | 269           |
| **Gender**          |                             |               |
| Females             | 29,331                      | 1,408         |
| Males               | 30,096                      | 1,480         |
| **Total**           | 59,430                      | 2,888         |

**Table 5. Percent correct by proficiency level**

| Aspect                              | International (ICILS 2013) | Rep. of Korea |
|-------------------------------------|-----------------------------|---------------|
|                                     | L4 (%)                      | BL1 (%)       | Difference (L4-BL1) (%p) | L4 (%) | BL1 (%) | Difference (L4-BL1) (%p) |
| 1.1 Knowing about and understanding computer use | 90.6 | 38.6 | 52.1 | 90.5 | 48.5 | 42.0 |
| 1.2 Accessing and evaluation information | 74.6 | 2.8 | 71.8 | 74.4 | 3.8 | 70.6 |
| 1.3 Managing information            | 82.9 | 14.8 | 68.1 | 79.7 | 18.1 | 61.6 |
| 2.1 Transforming information        | 79.3 | 11.6 | 67.6 | 78.4 | 12.6 | 65.8 |
| 2.2 Creating information            | 85.5 | 8.9 | 76.7 | 88.9 | 8.9 | 80.0 |
| 2.3 Sharing information             | 82.0 | 9.4 | 72.6 | 87.0 | 8.2 | 78.8 |
| 2.4 Using information safely and securely | 79.3 | 30.5 | 48.8 | 80.6 | 41.1 | 39.5 |
| total                               | 82.4 | 18.4 | 64.0 | 83.3 | 22.7 | 60.6 |
The analysis results for a difference between gender by level 4 and below level 1 can see in Table 7. Percent correct differences in proficiency levels of females and males in each aspects was less than 5 percent point. A difference of level 4 gender group was relatively large at ‘Accessing and evaluation information’. A difference in the percent correct between gender groups of below level 1 was the greatest in ‘Sharing information’.

Looking at each aspect in Table 8, the percent correct of male students in level 4 was remarkably higher in ‘Accessing and evaluation information’ than that of female students. The percent correct of female students was a little higher in ‘Creating information’ than that of male students. The percent correct of male students in below level 1 was higher only for a ‘Using information safely and securely’ aspect, and the percent correct of female students was higher in other six aspects.

According to the analysis results of level 4, the total percent correct of males is 83.7% and that of female is 83.3%, a percent correct of male students is somewhat higher than female. On the other hand, for below level 1 group, the total percent correct of females was higher than males. When the highest and the lowest groups are compared the different results between male and female students were displayed.

5. Discussion

For the purpose of examining the gap between students of CIL in depth, several differences were analyzed such as CIL differences based on proficiency levels and gender. While Korean students are comparatively more computer and information literate than the other students participated in ICILS, wide gaps persist among them along proficiency levels.
levels as well as the gender in ICILS 2013. Results of ICILS 2013 data analyzed through the proficiency and the gender are commonly showed that ‘Accessing and evaluation information’ is the most weak aspect for Korean student. In addition, there were relatively large differences both in ‘Creating information’ and ‘Sharing information’ skills between groups. Therefore, for Korean students it is necessary to emphasize assessing, evaluating, creating, and sharing information.

‘Accessing and evaluation information’ defined as the investigative processes that enable a person to find, retrieve, and make judgments about the relevance, integrity, and usefulness of computer-based information. Selecting information from within a website is an example of tasks that provide evidence of a student’s ability to this aspect. Among the published assessment tasks of ICILS 2013, ‘Information completeness’ task is related with this aspect. In order to complete this task, two of the three required pieces of information about the program have been included in the poster. The ability to distinguish the necessary information to oneself is essential to living in the 21st century information society. Nevertheless, students from all ICILS 2013 participating countries showed that the ability to assess and evaluate information is the weakest, especially in Korea were found to be not a high performing female students than male students in the highest-level students. Therefore, this ability should be learned by all students, in particular further educational prescribed should be provided to female in Korea, high level female students appeared to be less competitive than male students.

‘Creating information’ was defined as a person’s ability to use computers to design and generate information products for specified purposes and audiences in ICILS 2013. This aspect includes the ability of using a simple graphics programs, designing and writing a presentation for the purpose of explanation, and using a given set of information to make recommendations in a report that integrates text, data, and graphics. Among the published assessment tasks of ICILS 2013, ‘Text layout and formatting’ task is related with this aspects. ‘Text layout and formatting’ task requires that formatting tools have been used to some degree to show the role of the different test elements. Therefore, ‘Creating information’ is the ability that manipulate and integrate the information which given various formats to make products suitable for the purpose. According to the analysis results in this study, a difference between level 4 and below level 1 for female was larger than male. The female students in the lowest level displayed less competitive in creating information. Therefore, it is necessary to provide the teaching and learning methods that can enhance this ability for female students of below level 1 group.

‘Sharing information’ refers to a person’s understanding of how computers are and can be used, as well as his or her ability to use computers to communicate and exchange information with others in ICILS 2013 framework. The examples of this ability are using software to disseminate information such as attaching a file and email, or creating or modifying information products to suit a specified audience or purpose. Among the published assessment tasks of ICILS 2013, task for ‘Sharing information’ is to measure whether students have the ability to distinguish those who receive and check the e-mail. In order to complete this task, students must check the recipient by using the e-mail address in the reference.

### Table 8. Percent correct by proficiency level and gender

| Aspect   | Level 4 | Below Level 1 |
|----------|---------|---------------|
|          | Females (%) | Males (%) | Females (%) | Males (%) |
| 1.1      | 90.5    | 90.6         | 49.3        | 48.3      |
| 1.2      | 72.9    | 77.3         | 4.5         | 3.6       |
| 1.3      | 79.8    | 79.4         | 19.6        | 17.6      |
| 2.1      | 77.5    | 80.0         | 14.2        | 12.0      |
| 2.2      | 89.8    | 87.1         | 9.9         | 8.5       |
| 2.3      | 86.6    | 87.7         | 10.8        | 7.4       |
| 2.4      | 81.6    | 81.5         | 43.5        | 44.5      |
| total    | 83.3    | 83.7         | 24.1        | 23.0      |
Considering the computer and information literacy in terms of key competencies, the abilities related to the ‘Sharing information’ can be used to collaborate with others in a professional society. According to the analysis results in this study, a difference between level 4 and below Level 1 for male was larger than for female, this is because male in the lowest level would have less competitive skills. Therefore, it is necessary to prepare the plan to foster the ‘Sharing information’ ability of the male in the lowest computer and information literacy level.

6. Conclusions and Implications

Computer and information education in Korea, first introduced as part of occupational training in the early 1970s, has improved and transformed dramatically. Due to the strong government initiative, it is formed a powerful IT infrastructure and providing substantial education for Koreans. As an effort to reduce this difference, that have mentioned throughout the study, the results of this study may be used as a basic data to design and provide customized education for each student group.

While it may be impossible to minimize the gender gap overnight with policy support only, policy measures are still indispensable to narrow down the gap between the literate and the illiterate. The proper goal should be set up to public computer and information education policy on elementary and middle school, should mitigate and eliminate the information gap among students. Korean policymakers now need to identify and analyze all the causes of this widening gap and find tailor-made policy solutions accordingly. This will be the first step to improve the teaching and learning method through the feedback of evaluation results and to improve the CIL of Korean students.

7. References

1. Fraillon J, Schulz W, Ainley J. International Computer and Information Literacy Study: Assessment Framework. IEA: Amsterdam, 2013.
2. Fraillon J, Ainley J, Schulz W, Friedman T, Gebhardt E. Preparing for Life in a Digital Age: The IEA International Computer and Information Literacy Study International Report. Springer: Switzerland, 2014.
3. Hignite H, Margavio T, Margavio G. Information literacy assessment: moving beyond computer literacy. College student Journal. 2009; 43 (3), pp.812-821.
4. Nasah A, Dacosta B, and Kinsell C. The digital literacy debate: an investigation of digital propensity and information and communication technology. Education Tech Research. 2010; 58, pp.531-555.
5. Eisenberg M. Information literacy: Essential skills for the information age. Journal of Library & Information Technology. 2008: 28 (2), pp.39-47.
6. International Telecommunication Union (ITU). Measuring the Information Society. Author; Switzerland, 2013.
7. National Research Council. Being fluent with information technology. National Academy Press: Washington, DC, 1999.
8. Bawden D. Information and digital literacies: a review of concepts. Journal of Documentation, 2001; 57.
9. Doyle C. Information literacy in and information society: a concept for the information age. ERIC Clearinghouse Information & Technology, ED 372763: Syracuse, NY, 1994.
10. Lee S, Kim JM, Lee WG. Analysis of Elementary Students’ ICT Literacy and their Self-Evaluation According to their Residential Environments. Indian Journal of Science and Technology. 2015 Jan; 8(51); pp.81-88.
11. Kim S, Park JH, Jeon K, Kim M, Lee Y. International Computer and Information Literacy Study: ICILS 2013 Report. Korea Institute for Curriculum and Evaluation: Republic of Korea, 2014.
12. Fraillon J, Schulz W, Friedman T, Ainley J, Gebhardt E. ICILS 2013 Technical Report. IEA: Amsterdam, 2015.