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Analysis of Elementary Students' ICT Literacy and their Self-Evaluation According to their Residential Environments

SeungJin Lee[1*], JaMee Kim[2] and WonGyu Lee[2]

[1]Department of Computer Science Education, Graduate School of Korea University, Seoul, Korea; sungjin@keris.or.kr
[2]Department of Computer Science and Engineering, Korea University, Seoul, Korea; lee@inc.korea.ac.kr

Abstract

With ICT advancement leading to the development of various computing technologies, emphasis is being placed on ICT literacy as an essential ability that students must acquire. To evaluate this, studies have been conducted to verify whether there are any differences in ICT utilisation and abilities between the genders and, if so, to what degree. However, there has not been any verification of the relationship between ICT literacy and the students' surrounding environment nor of their own self-recognition. Accordingly, this study was conducted targeting 1,176 elementary school students in Korea with a goal to analyse differences in students' individual abilities according to their residential environments. The results indicated that there was no difference in ICT literacy levels between genders and that evaluation scores increased as the quality of students' residential environment was higher. Through this study, it was observed that students' ICT literacy levels can vary according to their surrounding environment and that improvedself-recognition can affect students' abilities to use ICT. This study holds significance in that it discovered differences in students' ICT literacy levels according to region, rather than by gender.

Keywords: Ability, Computing Classification System: H. 3. 6, H. 4. 3, D. 3. 2, Gender, ICT Literacy

1. Introduction

ICT advancement is leading to the evolution from analog technologies to digital convergence, and changes in infrastructure technologies are being realized not only in industries but also every aspect of our lives. Education, which reflects changes in society, must also respond to the changes occurring in society. For example, it is now necessary to have an ability to respond to technology and computing, to have a broad understanding about computational theories of learning and thus prepare for the new society. This refers to the abilities to use ICT for recognising and solving problems, to efficiently process various types of information, and to cooperate with others[22]. The OECD (Organization for Economic Cooperation and Development) and the U.S. Dept. of Education have emphasized 'ICT literacy' as being a key competency to be included in the future competency development projects of "DeSeCo" (defining and selecting key competencies) and for the "P21" (Partnership for 21st Century Skills) initiative that has been implemented during the past ten years (OECD, 21st Century Partnership). This indicates the

* *Author for correspondence*

keen need for ICT literacy in today's society. In line with this overall trend, the OECD is scheduled to change the PISA (Programme for International Student Assessment) conducted every three years to being a computer based test and also to supplement it with items for measuring ICT.

The IEA (International Association for the Evaluation of Educational Achievement) has recently completed a framework for ICILS (International Computer and Information Literacy Study), which is conducted every four years to compare students' computer and information utilisation abilities across the world, and thus conducted the first ICILS in 2013[20]. Successful use of ICT enables flexible utilisation of a greater amount of information in educational systems[27], and thus can lead to providing various educational opportunities to learners. This means that education in today's knowledge and information society where ICT is continuously changing must play a role in developing students' ICT literacy[12]. However, it has been found that Korean students' ICT literacy has been deteriorating. For example, according to the 2012 PISA result, Korean students' ranking in digital reading assessment fell from 1st in 2009 to 2nd in 2012. In addition, as a result of measuring national ICT literacy levels, the number of students in the insufficient to basic level was found to have increased and the number of students in the medium to excellent level was found to have decreased[23].

There have been several studies on ICT literacy conducted on both the international and national levels by the OECD[34], ETS[2,3,11,28]. Korea is now conducting annual studies on ICT literacy measurement by defining three content components and six ability components based on the studies conducted by the OECD in 2003, ETS in 2006, ACER in 2010, and KERIS from 2007 to 2013. As for content components, the phased content system of the 2005 Elementary and Middle School ICT Education Guidelines was introduced (2005, Korean Ministry of Science and Technology and Education).The configuration of ability components is similar to that of the 2006 ETS.

Korea's ICT literacy test tools are based on Internet and computer utilisation abilities needed in everyday life and the school educational curriculum. In ICT literacy tests, which have been conducted since 2007, female students displayed a higher accomplishment than males. In general, female and male students display different propensities with regard to ICT use. Results of a study on differences in computer and Internet use by gender[29,31,9,17] and a study comparing ICT literacy according to gender[26,46]. ACER[1] focused on the fact that there are differences between the two genders. Vekiri & Chronaki[43] paid attention to the fact that the higher ICT literacy displayed by female students was attributable to the differences in propensity of ICT use between genders. According to their study, female students' higher ICT literacy resulted from the fact that male students mainly use computers and the Internet for playing games, while female students use them for a wider variety of purposes ranging from document preparation, graphic arts and personal communication. In addition, it reported that self-recognition can be an important element. That is, differences by gender can arise from environmental or recognition factors rather than individuals' abilities[6,7,42]. Therefore, this study was aimed at analysing differences in students' ICT literacy and self-recognition evaluation according to regional environments within each gender group.

The concept of ICT literacy and related studies is discussed in Chapter 2; the study method is described in Chapter 3 with results presented in Chapter 4. Chapter 5 wraps up the study with a conclusion based on the overall results.

2. Theoretical Background

2.1 What is ICT Literacy?

When it comes to ICT literacy, one can chose from a number of definitions. These can be divided into a definition of ICT literacy as an ability required of learners to function in the 21st century and a definition that focuses on the usefulness of ICT literacy. First, the definition from the perspective of ability is as of the following. JaMee et al.[18] defined it by quoting the definition of KERIS (Korea Education Research and Information Service).

ICT literacy is the ability to recognise a problem, to explore and collect necessary information, to critically analyse information based on the collected data, to manage and use information efficiently, to create new information for a purpose, and to communicate with others with information using ICT[22].

KERIS[23] defined ICT literacy as an 'ability to search, collect, analyse, create and manage information using ICT tools to recognise and solve problems based on an understanding of information science and technology, information ethics needed in everyday life as well as to share information with others, and an ability to effectively communicate with others'.

The definition according to ACER (Australian Council for Educational Research), which supervises Australia's national ICT literacy assessment program, is as follows:

ICT literacy is the ability of individuals to use ICT appropriately to access, manage, integrate and evaluate information, develop new understandings, and communicate with others in order to participate effectively in society[32].

Based on the above definition, ACER conducted a national level ICT literacy evaluation known as the (Australian) National Assessment Program-ICT Literacy[18].

Second, from the perspective of ICT literacy usefulness, the ETS accepts the ICT literacy definition of the International ICT Literacy Panel[18], which is that ICT literacy is the ability to use digital technology, communication tools and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society[16]).

ICT literacy is the ability to use digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society[16].

As such, ICT literacy refers to abilities of various aspects rather than an ability to do only one thing using a computer or Internet.

2.2 Gender and ICT Literacy

Computers have pervaded all aspects of life to a degree that even individuals who hold a reticent attitude toward computers and who do not think that they could be competent at using a computer simply cannot avoid using computers anymore[29].

Males and females both trust that computers had a positive impact on society and that computers are useful tools. However, females have been reported to express a significantly more cautious attitude towards ICT than males. For example, they are more concerned that their lives might be overly controlled or usurped by computers and that undesirable side effects might occur[4,45], Gender differences concerning the use of computers have also been well documented in the last two decades[5,8,10,24,25,30,37-39]. Middendorf[31] found in a survey among students in Germany that the mean duration of computer use was about 14 hours a week out of which 7.6 hours were study-related. Males spent about 5 more hours per week at a computer than females. This was found to be due to them using computers more extensively for personal purposes (as opposed to school assignments and study-related purposes) and the pursuit of self-generated - as opposed to assigned - tasks. Margarete Imhof[29] concluded that female students used computers more strictly for task-oriented and study-related purposes whereas males enjoyed exploring the computers for a variety of other purposes besides studying. Studies which investigated specific uses of the Internet in more detail suggest a continued tendency for females to email more often than males on the one hand, while on the other hand, males tended to search the Internet more intensely than females[9,17] and to utilise different sites compared to females[44].

ICT literacy levels vary considerably according to students' individual variables[15,21]. A common finding from most ICT literacy studies is that female students' ICT literacy is higher than that of males. This trend is consistently observed in students of elementary, middle and high schools (KyeongSung et al, 2011; Soonkeum et al, 2008[40];. The environment of ICT utilisation, which affects students' ICT literacy, has been analysed and the data are being used in various countries to form policies for improving the ICT literacy of their students (OECD)[35,36]. Since the publication of 2009 PISA data, a number of studies have been conducted abroad about Korean students' outstanding achievements. These studies closely analyse the impact of students' ICT utilisation abilities, ICT education in schools, and the educational environment on ICT literacy scores rather than focusing on students' ICT literacy scores alone[11,36]. The result of analysing middle and high school students' data from the 2009 PISA using a hierarchical linear model indicates that students' ICT literacy is determined by their individual characteristics rather than the characteristics of each school[19]. Heemskerk et al.[13] argued the necessity to take into consideration students' different characteristics,

cultures, propensities and gender in order to ensure effective computer use. Therefore, in relation to computer and Internet use by gender, it is necessary to verify the factors affecting ICT literacy through a focused study.

3. Method

The following are the ICT literacy evaluation tools and sampling and evaluation procedures needed to analyse elementary school students' ICT literacy.

3.1 ICT Literacy Evaluation Tools

ICT literacy, as previously mentioned, is a concept that comprehensively includes both cognitive and non-cognitive attributes necessary for solving general information-related problems in an information society[22]. In other words, ICT literacy includes not only knowledge about information processing, digital technology, communication tools and network use, but also technologies, abilities and attitudes concerning ICT, such as ethical and legal recognition of information use. The test tools of this study consist of three components, 'computer & network,' 'information processing' and 'information society & ethics.' These test tools have been verified of their appropriateness and reliability through a national level Table 1.

3.2 Sampling

To analyse elementary students' ICT literacy, this study used the three-stage sampling technique described below. First, for regional classification, students' residential areas were divided into 'major cities', 'small & medium cities', and 'rural townships'. Second, schools were selected considering the income levels of each region. Third, one class each was selected from grades 4, 5 and 6 in the selected schools.

The total number of students that participated in this study was 1,176. By gender, 689 were male and 487 female. By region, 499 students were from major cities, 372 from small & medium cities, and 305 from rural townships. As for community operating experience, students were asked to personally record their experiences on a questionnaire that was provided with test tools from which it was found that 507 students had experience with community operation while 606 did not. This test was conducted from November 12 to November 23, 2012.

Table 1. Test tools

Evaluation method	Test contents	Components	Details
Questionnaire evaluation	Ability evaluation	Content components	Computer & network, information processing, information society & ethics
Self-evaluation	Computer	Hardware	1)Ability to install or use hardware
		Software	2)Ability to use various software & ability to program
	Internet	Basic Use	1)Ability to use the Internet as necessary in everyday life
		General Use	2)Ability to use e-mail and video contents & ability to use all aspects relating to security or copyrights
ICT environment		Excellent - Major cities Medium - Small & medium cities Insufficient - Rural townships	

3.3 Testing

As for Internet conditions in schools participating in the test, the schools were equipped sufficiently for conducting a test on a single class. In Korea, approximately 95% or more of schools have computer practice rooms. Therefore, environmental objectivity can be maintained[18]. As for the test time, it was set for 40 minutes considering the time of each class in elementary schools. The main test for ICT literacy was conducted using an Internet-based test system. To ensure fairness, the evaluation was automatically ended after 40-minutes.

4. Analysis of the Evaluation Results

To analyse the ICT literacy of male and female students, the students were tested in terms of ability evaluation

and self-evaluation, then the results were analysed. The following are the results of the analysis according to environmental and utilisation characteristics.

4.1 ICT Literacy Comparison by Gender

Table 2 Shows the results of ICT literacy ability evaluation by gender and students' self-evaluation concerning ICT utilisation. By component, female students scored higher than male students by 1.7 points in information processing excluding the 'computer & network' category, and by 0.8 points in the 'information society & ethics' category. However, there were no statistical differences.

Table 2. Average abilities by ICT literacy components according to gender (questionnaire evaluation)

Classification		Male	Female	t
		M(SD)	M(SD)	
Ability Evaluation	Information Processing	57.79	59.44	1.033
	Computer & Network	59.78	59.23	.374
	Information Society & Ethics	52.13	52.99	.476
Self-Evaluation	Hardware	2.77	3.34	8.079***
	Software	2.79	3.13	5.175***
	Basic Use	2.46	2.88	5.031***
	General Use	2.47	2.63	2.532*

The results of the self-evaluation indicated that female students' recognition was higher for hardware use by 0.6 points, and there were statistical differences between genders ($p<.05$). For abilities of software use, basic abilities to install Microsoft Office™ and general ICT abilities, female students' self-evaluation produced higher scores than male students by 0.4, 0.4 and 0.2 points respectively, and there were statistical differences between genders ($p<.05$).

4.2 Comparison of Male Students' ICT Literacy by Region

Table 3 Shows the comparison of ICT literacy of male students by region. As can be seen, the scores for 'information processing' were, perhaps not surprisingly, in the order of major cities having the highest score (61.23) followed by small & medium cities (56.31) followed by rural townships (53.51). For the 'computer & network' category, the scores were also in the same order of major cities (62.57), small & medium cities (57.70) followed by rural townships (57.21). Lastly, for 'information society & ethics', the scores were also in the order of major cities (54.79), small & medium cities (50.09) and rural townships (49.73). Male students in major cities recorded the highest scores followed by those in small & medium cities. Students in rural townships displayed the lowest ICT literacy levels.

Table 3. Comparison of male students' ICT literacy & self-evaluation by region

Classification		Major cities	Small & medium cities	Rural town ships	F-value (post-hoc)
		M (SD)	M (SD)	M (SD)	
Ability Evaluation	Information Processing	61.23 (24.31)	56.31 (26.26)	53.51 (25.51)	5.910** (1,3)
	Computer & Network	62.57 (22.78)	57.70 (23.31)	57.21 (25.61)	3.983** (1,3)
	Information Society & Ethics	54.79 (28.43)	50.09 (25.90)	49.73 (28.42)	2.650
Self-Evaluation	Hardware	2.57 (1.06)	2.99 (1.05)	2.89 (1.12)	10.508*** (1,2) (1,3)
	Software	2.42 (.90)	3.18 (1.02)	2.99 (1.03)	41.455*** (1,2), (1,3)
	Basic Use	2.24 (1.20)	2.71 (1.35)	2.56 (1.26)	9.352*** (1,2), (1,3)
	General Use	2.14 (.92)	2.73 (1.08)	2.75 (1.02)	31.690*** (1,2), (1,3)

As for self-evaluation, scores for hardware ability were, interestingly, in the order of small & medium cities (2.99), rural townships (2.89) and major cities (2.57); scores for software ability were in the order of small & medium cities (3.18), rural townships (2.99) and major cities (2.42); scores for basic ability were in the order of small & medium cities (2.71), rural townships (2.56) and major cities (2.24); and scores for the ability to use were in the order of rural townships (2.75), small & medium cities (2.73) and major cities (2.14). Thus male students in

rural townships displayed the highest scores overall and there were statistical differences by region (p<.05).

4.3 Comparison of Female Students' ICT Literacy by Region

Table 4 Shows the results of the ICT literacy ability test and self-evaluation of female students by region. For ability evaluation, scores for 'information processing' were in the order of major cities (61.23), rural townships (59.55) and small & medium cities (58.01). For 'computer & network', scores were in the order of major cities (67.29), rural townships (60.44) and small & medium cities (58.65). For 'information society & ethics', scores were found to be in the order of major cities (63.98), rural townships (52.36) and small & medium cities (51.84). As such, female students in major cities displayed higher abilities in all areas and there were statistical differences by region (p<.05).

Table 4. Comparison of female students' ICT literacy & self-evaluation by region

Classification		Major cities	Small & medium cities	Rural town ships	F-value (post-hoc)
		M (SD)	M (SD)	M (SD)	
Ability Evaluation	Information Processing	68.13 (21.50)	58.01 (23.94)	59.55 (21.80))	10.430*** (1,2), (1,3)
	Computer & Network	67.20 (19.91)	58.65 (20.06)	60.44 (20.39)	9.047*** (1,2), (1,3)
	Information Society & Ethics	63.98 (28.13)	51.84 (28.65)	52.36 (27.78)	10.270*** (1,2), (1,3)
Self-Evaluation	Hardware	3.01 (1.07)	3.48 (1.05)	3.17 (1.00)	9.522*** (1,2), (2,3)
	Software	2.66 (.92)	3.26 (1.01)	3.00 (.90)	18.563*** (1,2), (1,3)
	Basic Use	2.50 (1.31)	3.04 (1.37)	2.59 (1.32)	8.448*** (1,2), (2,3)
	General Use	2.16 (.91)	2.75 (.97)	2.54 (1.00)	17.939*** (1,2), (1,3)

As for self-evaluation, recognition of students in small & medium cities was the highest and statistical differences were also observed (p<.05).

4.4 Analysis of Correlation between ICT Literacy and Self-Evaluation

Table 5 Shows the results of students' self-evaluation and the ICT literacy test for each gender group. In the case of male students, their recognition of general ICT use was highly correlated with information processing with regards to ability evaluation (.348). In other words, the results can be interpreted that students who recognise that they are using ICT well have higher test scores for 'information processing'. In addition, this is also highly relevant with 'computer & network' (.345) and 'information society & ethics' (.250). As for female students, their recognition in relation to general use was found to have high relevance with 'information processing' (.416), 'computer & network' (.421) and 'information society & ethics' (.310).

Table 5. Correlation between ICT literacy and self-recognition evaluation according to gender

Self-Evaluation		Ability Evaluation		
		Information processing	Computer & network	Information society & ethics
Male	Hardware	.163**	.178**	.070
	Software	.223**	.237**	.136**
	Basic Use	.200**	.235**	.157**
	General Use	.348**	.345**	.250**
Female	Hardware	.235**	.254**	.148**
	Software	.300**	.292**	.186**
	Basic Use	.258**	.270**	.220**
	General Use	.416**	.421**	.310**

**p<.01 *p<.05

5. Discussion and Conclusion

In the burgeoning knowledge and information society where ICT is changing paradigms in all aspects of life, ICT literacy is one of the important requirements for people constituting society[14]. Therefore, this study analysed the differences in students' abilities according to their gender and also according to their environment. In addition, it analysed students' self-evaluation about ICT utilisation and the relationship between students' self-evaluation and their actual abilities.

The results of analysis are as of the following. First, there were no differences in students' ICT literacy levels by gender. This is different from the results of previous studies that report that female students generally have higher abilities.

Second, in terms of recognition of self-evaluation by gender, female students displayed higher levels of

recognition. In other words, female students were found to evaluate themselves more positively than male students.

Third, in terms of analysing male students according to their environments, those living in major cities scored higher in ability evaluation, while those in small & medium cities or rural townships scored higher in self-recognition. As for female students, those in major cities also scored higher in ability evaluation. However, female students in small & medium cities scored the highest in self-recognition. In other words, while female students in small & medium cities or rural townships produced higher scores in self-recognition, those living in major cities where information level is relatively higher produced higher scores in ability evaluation. This result indicates that, as educational information levels in each school are higher than those of educational offices in major cities (51) and of educational offices in small and medium size cities and rural towns (49)[18] and information levels by region are also higher in cities (101.4) than in rural towns (83.1), the regional ICT education and utilisation environment is not an irrelevant factor effecting students' ICT literacy levels.

Fourth, as a result of analysing the correlation between self-recognition and ability evaluation, both male and female students produced higher scores in ability evaluation when they recognise that they are utilizing ICT frequently and successfully in everyday life. That is, the correlation between recognition of general use and evaluation score was high. ICT literacy refers to an ability to understand problems occurring in everyday life and to search, analyse, manage and communicate with data to solve such problems. Therefore, it would be natural for students recognising that they are using ICT successfully in everyday life to produce higher scores in evaluation. However, although everyone is under the same educational conditions as a result of the compulsory education system, it was found that the differences in individual students' evaluations and abilities are closely related with their surrounding environment.

Rather than focusing on gender differences only, this study verified that students' environmental factors had relevance with their ICT literacy levels. In particular, it discovered the possibility that students' test scores increase as their self-recognition levels become higher. For students in lower school years, it will be possible to increase their abilities by providing them with a sense of confidence. In other words, the results of this study suggest that ICT use is not a negative for students and that it is necessary to continuously strengthen the positive effects of ICT on students according to their gender.

6. References

1. ACER. National assessment program information and communication technology literacy 2005 years 6 & 10: an assessment domain for ICT literacy. Australia: MCEETYA; 2007.
2. ACER. National Assessment Program - ICT Literacy Years 6 & 10 Report. Australia: MCEECDYA; 2010.
3. Aypay A. Information and Communication Technology (ICT) Usage and Achievement of Turkish Students in PISA 2006. TOJET. 2010; 9(2):116–24.
4. Broos A. Gender and information and Communication technologies (ICT) anxiety: male self-assurance and female hesitarion. Cyber Psych and Behav. 2005; 8:21–31.
5. Brosnan M, Lee W. A cross-cultural comparison of gender differences in computer attitudes and anxieties: the United Kingdom and Hong Kong. Comput Hum Behav. 1998; 14(4):559–77.
6. Busch T. Gender differences in self-efficacy and attitudes toward computers. J Educ Comput Res. 1995; 12(2):147–58.
7. Carter L. Why students with an apparent aptitude for computer science don't choose to major in computer science. ACM SIGCSE Bulletin. Proceedings of the 37th SIGCSE technical symposium on Computer science education SIGCSE '06; 2006 Mar 3–5; Houston, USA. p. 27–31.
8. Comber C, Colley A, Hargreaves DJ, Dorn L. The effects of age, gender and computer experience upon computer attitudes. Educ Res. 1997; 39(2):123–34.
9. Durndell A, Haag Z. Computer self-efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. Comput Hum Behav. 2002; 18:521–35.
10. Durndell A, Macleod H, Siann G. A survey of attitudes to knowledge about and experience of computers. Comput Educ. 1987; 11(3):167–75.
11. ETS Information and Communication Technology (ICT) literacy: integration and assessment in higher education. System, Cybern and Inform. 2006; 5(4):50–5.
12. Giavrimis P, Ekaterini N. Primary school pupils' ICT Literacy in northern aegean. MJSS. 2012; 3(1):21–31.
13. Heemskerk I, Brink A, Volman M, Dam G. Inclusiveness and ICT in education: a focus on gender, ethnicity and social class. J Comput Assist Learn. 2004; 21:1–16.
14. Kim H, Kim H, Jung S. A Development of ICT literacy testing tool: K-12. Korea Educ & Res Inform Serv 2011.
15. Park HJ, Kim HS. Analysis of learner characteristics according to patterns of computer use in PISA 2006 Korean data. J of Educ Eval. 2009; 22(1):171–94.
16. International ICT Literacy Panel. Digital Transformation: A Framework for ICT Literacy. International ICT Literacy Panel; 2002.
17. Jackson LA, Ervin KS, Gardner PD, Schmitt N. Gender and

the internet: women communicating and men searching. Sex roles. 2001; 44(5–6):363–79.
18. JaMee K, WonGyu L. Meanings of criteria and norms: analyses and comparisons of ICT literacy competencies of middle school students. Comput Educ. 2013; 64(4): 81-94.
19. Yang JH. Effects of high school ICT activities on students' digital literacy in Korea. J of Educ Tech. 2012; 28(2):347–69.
20. Julian F, Wolfram S, John A. International computer and information literacy study: assessment framework. International Association for the Evaluation of Educational Achievement (IEA); 2013.
21. Kennedy GE, Judd TS, Churchward A, Gray K. First year students' experiences with technology: are they really digital natives. Aust J Educ Tech. 2008; 24(1):108–22.
22. KERIS. 2011 Assessing Student's ICT literacy at a National Level. Korea Education & Research Information Service; 2011.
23. KERIS. 2013 Study of measurement of ICT level for K-12. Korea Education & Research Information Service; 2013.
24. Kirkpatrick H, Cuban L. Should we be worried what the research says about gender differences in access, use, attitudes and achievement with computers. Educ Tech. 1998 Jul–Aug; 38(4):56–61.
25. Kirkup G. Gender issues and learning technologies. Br J Educ Tech. 1995; 26(3):218–9.
26. Kim KS, Lee SY, Jun WC, Kim HS, Kwak HS, Kim JH, Seo JH. Measuring ICT literacy of primary and junior high school students in South Korea. The Korean Soc for the Study of Elemen Educ. 2011; 22(3):195–211.
27. Machin S, McNally S, Silva O. New technologies in schools: is there a payoff. Econ J. 2007; 117(522):1145–67.
28. Magdalena C, Preiss DD, San ME, Jara I, Hinostroza JE, Valenzuela S, Cortes F, Nussbaum M. Assessment of 21st century ICT skills in Chile: test design and results from high school level students. Comput Educ. 2012; 59:1042–53.
29. Imhof M, Vollmeyer R, Beierlein C. Computer use and the gender gap: the issue of access, use, motivation and performance. Comput Educ. 2007; 23(6):2823–37.
30. Meredith A, Helen J, Woodcock L. Women can do I.T. - but why don't they. Conference Proceeding: Winds of change - women and culture of universities. Sydney, Australia: University of Technology; 1998. p. 762–6.
31. Middendorf E. Computernutzung und neue medien im studium [Computer use and new media in higher education]. Bonn: Bundesministerium fur Bildung und Forschung; 2002.
32. Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA). National Assessment Program - ICT literacy years 6 and 10 report. Carlton: Curriculum Corporation; 2007.
33. Ministry of Education & Human Resources Development. A guide of ICT education for K-12. Ministry of Education & Human Resources Development; 2005.
34. OECD. Feasibililty study for the PISA ICT literacy assessment: report to network A. Paris: OECD; 2003.
35. OECD. PISA 2009 Results: learning to learn: student engagement, strategies and practices.3. Paris: 2010.
36. OECD. PISA 2009 Results: students on line: digital technologies and performance.6. Paris: 2011.
37. Scragg G, Smith J, Geneseo S. A study of barriers to women in undergraduate computer science. SIGSCE 98; Atlanta, GA, USA. 1998. p. 82–6.
38. Shashaani L. Gender-based differences in attitudes toward computers. Comput Educ. 1993; 20:169–81.
39. Shashaani L. Gender differences in computer attitudes and usage among college students. J Educ Comput Res. 1997; 16(1):37–51.
40. Suh SS, Min KS, Hwang KH, Jang YJ, Kim HS. developing and Validating ICT Literacy Test for Elementary School Students. J Educ Tech. 2009; 25(3):193–220.
41. Baek SG, Kim D Il, Kim MR, Kim HS. The Development of standardized ICT literacy assessment for secondary school student. Korea Education & Research Information Service; 2008.
42. Turkle S, Papert S. Epistemological pluralism: styles and voices within the computer culture. J of Women in Cult and Soc. 1990; 16(1):128–57.
43. Vekiri I, Chronaki, A. Gender issues in technology use: perceived social support, computer self-efficacy and value beliefs and computer use beyond school. Comput Educ. 2008; 51:1392–404.
44. Wasserman I, Richmond-Abbott M. Gender and the internet: causes of variations in access, level and scope of use. Soc Sci Q. 2005; 86:252–70.
45. Whitley BE. Gender differences in Computer - related attitudes: it depends on what you ask. Comput Hum Behav. 1996; 12:275–89.
46. Lee WG, Kim YG, Kim HC, Suh SS, Jun WC, Han SK, Kim YA, Kim HS, Chang SJ. A development of ICT literacy testing tool: K-12. Korea Education & Research Information Service; 2007.