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Measurement of University Students' IT Capabilities

Seung Jin Lee[1], Ja Mee KIM[2] and Won Gyu Lee[3]*

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

Abstract

As the IT industry, which has been a core industry of the nation since the 1990's, has reached the limits of development, this study attempted to measure the IT competency of college students, who are our future leaders, and propose a countermeasure for any shortfalls found. The results show that college students' scores were about 50 points lower than those of office workers. As Test of Practical Competency of IT (hereinafter TOPCIT) is the first and primary IT competency test developed in Korea, it was utilized in various ways.

Keywords: College Students, Competency, IT, Test

1. Introduction

In Korea, the IT industry has been leading the country's economic development since the 1990's as a core industry of the national economy, but it has reached the limits of continuous development as the policy for growth placed too much emphasis on hardware. Continuous investment established the three main IT industries of Korea as world-class industries, but the competitiveness of the software, contents and service industry of Korea remains very weak[1,2]. As the foundation of added value has been shifted from manufacturing to services in modern societies, software, i.e. securing talents, is key to future competitiveness. However, theory-oriented university IT education is weakening the competitiveness of students when it comes to business practice.

Korea depends heavily on IT, as IT products account for 30% of the total export volume and contribute approximately 12% to its GDP[3]. In particular, according to statistics compiled by (National IT Industry Promotion Agen (NIPA hereinafter) (2013) and Korea Institute for Advancement of Technology (KIAT) on the contribution of each industry to exports and GDP for the past three years, the IT industry accounts for 29.9% of total exports and 8.4% of GDP, which indicates that the IT industry contributes 2.6 times and 3.4 times more to national exports than the automotive and shipbuilding industries respectively. Thus, the IT industry makes the biggest contribution to the national economy of Korea[4,5]. Korea Research Institute for Vocational Education & Training (herein after KRIVET) forecasted that given the estimated demand for new IT professionals between 2012 and 2016, 350 IT professionals on annual average or 1,750 in total would be in short during the same period[6].

In corporate recruiting, problem solving skills and the abilities to carry out projects are very important, but there is asymmetric information due to the absence of objective evaluation criteria, and thus corporations are rather passive in recruiting. Currently national qualification and certification systems issue more than 40 IT certificates weekly, but they exist in name only because of their low entry barriers and the excessive number of certificates that have been issued so far[7]. Accordingly, efforts must be made to resolve manpower shortages by improving the quality of university IT education and to reinforce the foundation of growth of new industries[8]. Furthermore, it is necessary to induce the qualitative improvement of college graduates who account for the largest portion of IT academics and IT professionals[9].

*Author for correspondence

It will be necessary to improve the current vicious cycle of university education-jobs-industry competitiveness in the current IT ecosystem and turn it into a virtuous cycle. In particular, it will be necessary to enhance the ability to assess the competencies if IT majors, and foster a healthy IT industry ecosystem by improving IT education in universities. This has been discussed as the major plan of the 'Planning Committee for Improvement of University IT Education' which the government has been operating since 2010, and the Ministry of Knowledge Economy announced it as an official government agenda for its 'University IT Education Improvement Plan' in April 2011. And as a follow-up measure, the National IT Industry Promotion Agency developed an IT competency test for college students and office workers in July 2010. This test is known as TOPCIT.

Now well-established since being launched in 2011, TOPCIT is expected to contribute to improving IT education in universities and bolstering IT industry as well[10]. The purpose of this study was to conduct the TOPCIT competency evaluation test and check the actual IT level of college students.

2. TOPCIT

2.1 Cultivation of IT Talents

IT-related studies and data analysis reports have painted pessimistic pictures of IT education in Korea. In other words, from the perspective of cultivating IT talents, problem-solving skills, project implementation capabilities, etc. are deemed critically important. However, a lack of objective evaluation criteria has lead to a distrust of the competency of IT resources. Not only in Korea but also in other parts of the world, it has been pointed out that slack management of school performance and inflation of course credits hamper discrimination of personal competency[11]. It was suggested in Korea that a kind of 'IT Competency Index' be designed to ensure objective assessment and verification of the IT competency of individuals be adopted to better discern the true qualification of college students majoring in IT-related subjects from the perspective of cultivating IT talent[12]. Such suggestion was inspired by the need to meet corporate demands for talent and to build a growth platform for new industries by bolstering the quality of college IT education.

Such efforts were expected to improve the quality of college graduates accounting for the biggest share of IT professional resources (53.7%) and boost the quality of college IT education[13]. They were also intended to create a virtuous cycle of IT talent cultivation including the development of a foundation for cultivating competent IT talent.

2.2 Concept and Structure of TOPCIT

TOPCIT is a performance-based test for diagnosing and evaluating the core competencies required for IT industry workers and SW developers to successfully conduct business in the real world. The targets and test method are described below Table 1.

The purpose of developing the TOPCIT was, as previously mentioned, to establish standardized objective practical skillset indexes for the IT/SW sector to foster industry and academic manpower that will be able to handle IT/SW convergence and reduce the gap between industries and universities[4].

The following table shows the areas covered in TOPCIT and importance of each area (Table 2).

TOPCIT consists of three areas: the technical area, the business area and the integrated area that combines the first two areas. The technical area is divided into the 'software development ability,' the 'database building and operating capabilities' and the 'ability to understand and utilize networks and security.' The business area is composed of the 'ability to understand the IT business,'

Table 1. Targets and Test Method of TOPCIT

Target	IT/SW majors and people who want to get a job in the IT/SW sector
Test method	CBT (Computer Based Test)
Types of questions	A total of 65 questions per exam (multiple choice, short-answer-type, essay-type, performance-based). Total points: 1,000

Table 2. Areas Covered in TOPCIT and Importance of Each Area

Area	**Definition**		
Technical Area	52%	**Software**	31%
		Database	11%
		Network & Security	11%
Business Area	23%	**IT Business**	8%
		Technical Communication	6%
		Project Management	10%
Integrated Area	26%		

the 'technical communication ability' and the 'ability to manage projects.' It requires business-side capabilities. The integrated area tests the 'ability to comprehensively utilize multiple competencies for solving problems occurring in the field.'

The following Table 3 contains the definitions of the specific competencies covered in each area.

3. Research Method

3.1 Setting up Criteria

This study set up criteria to ensure that the IT competency of college students could be assessed against a set of absolute standards. Criteria for TOPCIT were set up by incorporating expert feedback collected in five interviews. This study also set three standard scores in order to create five levels. Table 4 shows the threshold scores for each level and corresponding definitions.

3.2 Composition of Questions

Questions presented in the first TOPCIT test conducted by NIPA in 2014 were used as assessment tools[14]. There were 65 test questions each screened from various open NIPA-sponsored competitions and preliminary tests. Table 5 shows the framework of the questions.

3.3 Sample Method and Subject

This study sampled subjects to take the TOPCIT from college students willing to participate in the study. TOPCIT was announced in advance on a large scale and college students and corporate employees who applied to take the test within two weeks were sampled. Although the overall tone of this study was focused on college students, the sampling scope was expanded to include corporate employees because: first, it would be difficult to understand accurately the level of corresponding competency if only college students were to be sampled (in other words, the current competency level of college students was to be evaluated by comparing them to corporate employees), and, second, corporate employees were included to encourage broader adoption of TOPCIT. In other words, although TOPCIT was intended to measure the IT competency level of college students, the competency level of corporate employees who actually needed the applicable competencies was also included to help determine the needs for IT talent cultivation.

Table 3. Definitions of Basic Model Areas of TOPCIT

Area		Definition
Technical Area		Basic knowledge and technical area of ICT elements and systems required for analysis and resolution of problems faced by engineers
	Software	Ability to understand the concept and structure of software and system architecture and utilize such understanding in operating, managing, developing, and maintaining on/off-line solutions required for actual business operations
	Database	Ability to understand the concept and structure of databases and utilize such understanding in analyzing, designing, operating, and managing databases, and developing and maintaining related application programs
	Network & Security	Ability to understand the concept and structure of networks, and concepts and methods of security, and utilize such understanding in operating, managing, developing and maintaining related application programs
Business Area		Area of competency for understanding business requirements, utilizing ICT infrastructure and services to plan, execute and manage efficient delivery methods, and thereby create values
	IT Business	Ability to understand the needs for and environment of IT sector management, and business and knowledge required for utilizing business models and solutions to perform given tasks efficiently
	Technical Communication	Ability to analyze problems in the IT sector, and communicate and persuade stakeholders with speech, text and media concerning decision-making process and results
	Project Management	Ability to efficiently manage and implement the scope, schedule, resources, risks and quality of projects delivered in a series of cycles
Integrated Area		Ability to utilize various skill sets comprehensively to solve practical problems

Table 4. Definition of Levels

Level	Definition
Novice type (Need to Learn, Poor) : 0~99	Poor understanding of knowledge and skillset related to technical and business areas
Knowledge type (Understands, Comprehends): 100~399	Understands the knowledge and skillsets related to technical and business areas
Challenge type (Demonstrated Problem Solving Skills, Applied Skills) : 400~699	Able to solve problems by applying knowledge and skillsets related to technical and business areas
Problem-solving type (Proficient Problem Solving Skills, Adoptive) : 700~899	Able to solve problems by adopting knowledge and skillsets related to technical and business areas
Creative convergence type (Creative Problem Solving, Leading) : 900 or over	Able to take initiative in solving problems by adapting knowledge and skillsets related to technical and business areas

Table 5. Test Composition Framework

Classification		Number of questions (Evaluation structure)				Score assignment
		Multiple-choice	Single choice	Descriptive	Performance	
Technical Area	SW					305
	DB					105
	NW/S					105
Business Area	IT biz					75
	TC					55
	PM					95
Integrated area						260
		65 questions				1,000

The TOPCIT was conducted via an IBT in May, 2014. A total of 158 persons took the IBT including 98 college students and 60 corporate employees.

4. Research Results

Table 6. Shows the results of the TOPCIT.

As shown in Table 6, when looking at the total 1,000 point score, students scored 170.5 whereas corporate employees scored about 50 points higher at 223.8 points. In terms of percentages based on the 1,000 point scale, this means that students achieved a score of 17% compared to corporate employees who achieved 22.4%. As for each area, college students achieved a percentage score of 19.4% in the Technical Area, which was higher than the 17.8% of corporate employees, however, corporate employees scored higher in the other areas, 34.9% vs. 21.5% in the Business Area, and 22.4% vs. 17.0% in the Integrated Area.

Table 7 shows the TOPCIT-assessed competency level distribution of test subjects.

When analyzing the competency levels, both students and corporate employees were concentrated mostly in Level 2 with only 0.3% of the students and 1.8% of corporate employees rated to be in Level 3. This indicates that actual IT competencies of both groups are not up to expectations.

Figure 1. Shows The Portfolio Matrix Presented Based on the TOPCIT Results of Students and Employees.

After analyzing the matrix, it was found that the priority for students should be to improve PM competency while for corporate employees it was found that the priority should be to improve DB competency.

Table 6. TOPCIT Test Results

	Total (1,000)		Technical Area (515)		Business Area (225)		Integrated Area (260)	
Students	170.5	(17.0%)	99.8	(19.4%)	48.3	(21.5%)	22.4	(17.0%)
Corporate Employees	223.8	(22.4%)	91.4	(17.8%)	78.4	(34.9%)	53.9	(22.4%)

Table 7. Competency Level Distribution of Test Subjects

	Level 1 (0 ~ 99)	Level 2 (100~399)	Level 3 (400~699)
Students	(19.4%)	(80.3%)	(0.3%)
Corporate Employees	(5.8%)	(92.3%)	(1.8%)

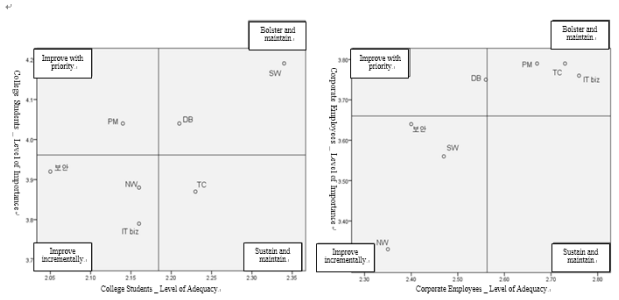

Figure 1. Portfolio Matrix.

5. Conclusion

The purpose of this study was to check the degree to which the IT competencies of college students are inferior to those of office workers, and measure the actual levels of college students. The assessment tool was the TOPCIT, which is a national assessment exam for IT competency developed in Korea. The test results showed that college students were less competent than office workers.

It seems that the TOPCIT can be legitimately used for recruitment purposes, and it may be also linked to a graduation accreditation or engineering education accreditation program. The HR staff of corporations may utilize it when hiring new employees, assigning work to new hires, or hiring interns.

This study carries significance in that it attempted to measure the IT competency of tertiary education beyond the realm of ICT literacy focused on elementary/secondary school students. In other words, if cultivation of IT talents is to be the focus rather than improvement of IT fluency, IT competencies should be assessed at a level comparable to that of the TOPCIT.

6. Acknowledgement

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