DOI10.17939/hushss2019.63.1.004

A Study of the Effect of Individuals' Orientation, Digital Literacy and Communication on Self-Efficacy: Targeting Students in the Computational Thinking Class†

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Abstract

This study seeks to verify the effect of individuals' orientation of students in the computational thinking class, digital literacy and communication on self-efficacy. Also, it wants to ascertain whether digital literacy has improved communication, and whether digital literacy and communication have improved self-efficacy. For this purpose five factors were developed: two types of individual orientation (extrovert or introvert), digital literacy, communication, and self-efficacy. A survey of 31 items was administered to 180 students in the computational thinking class. Analysis was based on results of 166 questionnaires. The study indicated that extroverts improved digital literacy and communication skill, while introverts improved digital literacy through class. In addition, communication skill improved digital literacy, and self-efficacy was improved by digital literacy. But self-efficacy was not improved by communication ability. Through improved digital literacy, they could distinguish whether others are good or not, after which they could produce trust and start to share and deliver information to others. Finally, improved digital literacy resulted in self-efficacy. Digital literacy and communication skill are core competencies to the undergraduate students in this smart era. This study suggests how education programs in computational thinking can be created for undergraduate students to improve digital literacy and communication skill.

Keywords: *Individuals' orientation, Extroverts, Introverts, Digital literacy, Computer-mediated communication, Self-efficacy*

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†This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea(NRF-2019S1A5C2A04082721).

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Received: January 7, 2020, Revised: February 4, 2020, Accepted: February 5, 2020

디지털 리터러시 및 커뮤니케이션능력이 자기효능감에 미치는 영향에 관한 연구

고윤정

<국문요약>

이 연구는 컴퓨터적사고 과목을 수강하는 학생들의 개인성향에 따라 이 수업을 통해 디지털 리터러시와 컴퓨터를 매개로한 커뮤니케이션능력이 향상되는지 분석하는 것이다. 또한 디지털 리터러시 및 컴퓨터 매개 커뮤니케이션 능력향상을 통해 자기효능감을 향상시킬 수 있는지 밝혀내는 것이다. 이를 위하여 선행연구 고찰과 관련 전공교수로부터 내용타당성검증을 받고, 개인성향, 디지털 리터러시, 컴퓨터 매개 커뮤니케이션, 자기효능감의 다섯개 항목을 개발하였다. 컴퓨터적사고 과목을 수강하고 있는 학생들 247명을 대상으로 설문조사를 실시하였으며, 이 중 166부를 분석에 이용하였다. 연구결과 컴퓨적사고 과목을 수강하는 학생들은 개인성향에 상관없이 디지털 리터러시가 모두 향상되었음이 확인되었고, 자기효능감 또한 향상된 것으로 나타났다. 특히 외향성이 높은 학생들은 디지털 리터러시와 커뮤니케이션능력이 모두 향상된 것으로 나타났으나, 내향성이 높은 학생들은 디지털 리터러시는 향상된 반면, 커뮤니케이션 능력이 향상되지 않은 것으로 밝혀졌다. 또한 향상된 디지털 리터러시로 인하여 궁극적으로 자기효능감을 향상시키는 것으로 나타났다. 컴퓨터적사고 과목을 수강한 학생들은 컴퓨터 활용능력을 바탕으로 실제 디지털 정보들을 이용하여 문제를 해결하고 통합하며 비판적으로 수용하는 등의 능력을 함양하는 디지털 리터러시가 향상됨으로써, 향후 문제해결에 대한 자신감을 가질 수 있다는 것을 알 수 있다. 디지털 리터러시와 컴퓨터를 매개로 한 커뮤니케이션 능력은 미래를 이끌어갈 인재들이 갖추어야 하는 핵심역량 중 하나이다. 이 연구를 기반으로 이러한 능력을 배양할 수 있는 프로그램을 제공할 수 있는 교육환경이 조성되어야 한다는 것을 시사한다.

주제어: 개인성향(외향형, 내향형), 디지털 리터러시, 컴퓨터 매개 커뮤니케이션, 자기효능감

I. Introduction

In the 4th Industrial Revolution, we require new technology convergence ability from a knowledge-based information society to a hyper-connected society in which convergence will include the Internet of Things (IOT) and Artificial Intelligence (AI). Online communication and interaction have been actively taking place based on SNS (Social Network System) or applications, so it is natural that we are aware of a trend incorporating a variety of ways to reproduce, share, and diffuse knowledge. At this point, digital literacy is support to read, understand, and integrate these trends from a critical perspective. Young people in particular do not accept documented information but require digital information; digital literacy is crucial for them.

ICT (Information Communication Technology) literacy or digital literacy has been proposed as the core competency in much research about society in the future, with a focus on providing information, media and technology application ability in the learning framework of 21th century (Battele for Kids 2019). In the Deseco project (OECD 2005) interactive tools as language or technology helped shape the conceptual framework of the core competency In this way, digital literacy has become a crucial stepping stone of life through technological tools of acquiring knowledge.

While many previous studies have analyzed the concept of digital literacy and established its importance, insufficient attention has been paid to whether undergraduate students have a core competency of digital literacy to prepare them for the future. Existing studies on the measurement of ICT and digital literacy (Nam and Ahn 2016; Gwon and Hyun 2014; Baek et al 2009; Lee 2007; Seo 2003) concentrated on the application of information communication technology and the collection, analysis, and processing of information. Even though theory and application about digital literacy have shown progress (Gwon and Kim 2011; Oh 2006; Seo 2003; Yoo 2001), a continuing focus on the conceptual level has limited our ability to specify the required level of implementation. We therefore need to reconceptualize and develop a measurement of digital literacy that reflects the demands of society on future human resources. After that we can begin to produce supporting educational programs that could give students' self-esteem and satisfaction. Beginning with this study, educative supporting programs need to be created for undergraduate students to improve communication ability, digital literacy and self-satisfaction expected in this society.

II. Literature Review

IIa. Individuals' orientation

Even though personality is one of the most often cited factors to explain individual differences, every researcher has different opinions about the subject. From one perspective, personality is a unique, stable, and constant internal psychological orientation that distinguishes each individual. From another, though, it represents the mental activities in constant interaction with the outside world. In other words, personality is composed of various parts, and its contents are often shared with other people (Lee 1989).

One common approach to personality is therefore through personality types, notably the distinction between extroverts, with an outward orientation showing interest in others and willingness to interact with them, and introverts, with an inward-looking focus (Jung 2014). Also, extroverts had a self-understanding and judgement about outside people or things.

Moreover, they had wide a range of personal relationship, and had an active part in outside. On the other hand, introverts were judged things based on their mind, and became thinking-oriented (Lee 2013)

IIb. Computer-mediated Communication

When faced with a problem, many people try to use their own information to solve it. Information narrows the area of uncertainty when individuals decide how to act in a specific situation. Contexts in which people access information tend to be situations unintended by them or recognizable as serving their needs. The expansion of communication channels opens new ways to acquire and apply information in a number of dimensions, including the intended (active), unintended (passive), selective, receptive, and spread. Specifically, Kim and Grunig (1997) proposed six dimensions of communication activities in evaluating and revising situations. First, the information selection would serve to evaluate and select useful degree of solving a problem by its value and relevance to specific information. Second, the information permitted would tend to accept all content relevant to the issue. Third, the information forwarded would spontaneously deliver other information with a related goal and intention. Fourth, information sharing would offer information in response to others' requests. Fifth, information seeking would focus on an intentional search to acquire information about a specific issue. Sixth, information attending would acquire information by chance without a specific intention.

IIc. Digital Literacy

Digital literacy is part of a broad expansion of literacy from its original core meaning of reading and writing skills to encompass other forms of communication in a series of adjectives added to it, so that we now have visual literacy, television literacy, computer literacy, multi-media literacy, information literacy, information communication literacy, media literacy, and digital literacy. Digital literacy was needed to collect, apply, analyze, and produce information for appearing new media, and integrated literacy ability was needed to understand and apply integrated various types of information with distributing and sharing various types of information (Ahn 2013). Gilster (1997) explained that digital literacy was an integrated concept of computer literacy, multi-media literacy, information literacy, information communication literacy, media literacy. For him the term meant more than the manipulative skills to use computers, but also involved critical thinking to evaluate properly the value of information as managing thoughts (cf. Gilster 1997; Seo 2003; Yoo 2001).

IId. Self-efficacy

Self-efficacy, a repositioning of social learning theory by Bandura (1977), involves the feedback between successful accomplishment of some activity and belief in one's own ability. According to Bandura, self-efficacy was the strongest factor influencing human activity as the mediation between inherent skill and real performance. He found three dimensions of level, generality, and strength in self-efficacy: self-confidence, self-regulated efficacy, and preference of task difficulty (Bandura 1977). In addition, researchers have identified a dimension of social self-efficacy applying it in a social context (Hong et al. 2008).

Schunk (1981) argued that self-efficacy was judgement about one's own ability to perform a given activity that included vague, unexpected situations often involving elements

of tension. Wood and Locke (1987) defined it as an individual assumption about one's own ability to perform a series of detailed activities relevant to a situation. Owen and Froman (1988) viewed self-efficacy as a belief related to self-confidence for good results from successful performance of an action, specifically as to the ability to accomplish a specific action. Hwang and Choi (2003) described self-efficacy as one of most influential psychological factors for selecting and following through on actions. It provided motivation for a task performance, a cognitive resource, and a judgement on ability leading to a belief in one's access to skills to shape physical, intellectual, and emotional resources for success. As a result, self-efficacy influenced more actions as it increases with experience validating individuals' confidence in themselves as capable and skilled.

III. Methodology

III-a. Research Questions

This study seeks answers to the following research problems:

- Research Problem 1. Have extroverts and introverts in the computational thinking class had impacts that positively influenced digital literacy?
- Research Problem 2. Have extroverts and introverts in the computational thinking class positively influenced computer-mediated communication?
- Research Problem 3. Has digital literacy positively influenced computer-mediated communication?
- Research Problem 4. Have digital literacy and computer-mediated communication positively influenced self-efficacy?

To inspect impacts, first, we verified contents validity through literature review and interview to three major professor. Second, we developed there were six items of individuals' orientation distinguished with extroverts and introverts. Third, we implemented exploratory factor analysis composed of six items for digital literacy and five items for computer-mediated communication. Forth, we drawn five factors and 31 items composed research model, and we inspected reliability and validity of that. In the last, we used AMOS 25 for the structural verification of research model.

III-b. Participants

The study targeted students in the computational thinking class in H University. Participants were 180 students in a computational thinking class that was mostly composed of freshman because the class was a requirement for freshmen. They were administered a survey composed of six items related to extroversion, five to introversion, six to digital literacy, five to communication, and eight to self-efficacy. Fourteen responses were discarded as frivolous. The remaining 166 responses were analyzed in terms of sex, grade, and age. There were 142 women, 124 men, 108 freshmen, 29 sophomores, 27 juniors, and 2 seniors.

III-c. Analysis

First, the 166 valid responses were to a survey was composed of a seven-point Likert scale. Second, reliability was verified by Cronbach's α test, and convergent validity and

concentration validity was identified through factor analysis. Correlation of five factors was proved. Third, regression test verified the causal relation among factors. Finally, goodness fit of structural equation model was verified using Amos 25.

IV. Findings

Table 1. Reliability and Validity

Variables		Factor load	Cronbach'α
Extrovert	EV2	.789	.836
	EV4	.814	
	EV5	.546	
	EV6	.796	
Introvert	IV2	.782	.665
	IV4	.827	
	IV6	.508	
Digital literacy	DL1	.865	.958
	DL2	.865	
	DL3	.904	
	DL4	.907	
	DL5	.913	
	DL6	.866	
Communication	COM2	.580	.917
	COM4	.596	
	COM6	.524	
Self-efficacy	SE1	.770	.932
	SE2	.834	
	SE3	.864	
	SE4	.747	
	SE5	.777	
	SE6	.782	
	SE7	.785	
	SE8	.773	

*p<.05

IV-a. Reliability and Validity

Per Table 1, Cronbach's α was used to verify reliability. Analysis identified reliability among the five factors between .665~.952. Validity was analyzed by principal component

analysis and varimax rotation, and results was disclosed validity as factors were .508~.913 more than 0.5 (Lee and Lim 2017). Since correlation with potential factors were good as all factors were less than 0.7, convergent validity and discriminatory validity were acquired.

IV-b. Correlation

Table 2 indicates the correlation of extrovert and introvert types among respondents, digital literacy, computer-mediated communication, and self-efficacy in the proposed model.

Table 2. Correlation

Variables	Extrovert	Introvert	Digital Literacy	Communication	Self-efficacy
	r(*p*)	r(*p*)	r(*p*)	r(*p*)	r(*p*)
Extrovert	1				
Introvert	.162 (.037)				
Digital literacy	.195 (.012)	.129 (.098)			
Communica-tion	.223 (004)	.114 (.145)	.545 (.000)		
Self-efficacy	.535 (.000)	.098 (.220)	.306 (.000)	.266 (.001)	1

IV-c. Structural Equation Model Test

This study used previous research and pre-inspection to produce five factors (two personality types, extrovert or introvert; digital literacy, computer-mediated communication, and self-efficacy) through responses to 31 items. Results of a structural equation model were verified using Amos 25. As shown in Table 3, goodness of fit indexes of proposed model were identified TLI = .927, CFI = .937, RMSEA = .070. They all satisfied standard value, the factor load was consistently over .70, and correlation of potential factors remained below .70. As a result, convergence validity and discriminatory validity were proved.

Table 3. Structural Equation Model

Division	NPAR	df	CMIN(χ^2)	NC (CMIN/DF)	TLI	CFI	RMSEA	
							LO90	HI90
Proposed Model	61	239	433.030	1.812	.927	.937	.070	
							.060	.081
Criteria					>.90	>.90	<.10	

Extroverted students in the computational thinking class improved digital literacy and communication skill, while introverted students only improved digital literacy. Moreover, self-efficacy was improved by digital literacy, but self-efficacy did not improve with increased communication skill.

V. Conclusion

This study sought to verify the effect of individuals' orientation of students in the computational thinking class, digital literacy and communication on self-efficacy. Also, it was to identify whether digital literacy improved communication, and digital literacy and communication improved self-efficacy. For this study, we developed five factors and thirty one items through literature review. There were five factors composed of type of extrovert and introvert, digital literacy, communication and self-efficacy.

Results of this study led to the following conclusions:

First, digital literacy and computer-mediated communication skill are crucial in the digital information era. At this point of time, analysis of the sources and constraints of these skills in an empirical test of current undergraduates is crucial because they represent the group with the greatest need for digital information.

Second, there were noticeable differences among students with regard to digital literacy and communication skill based on personality type. Extroverts communicated with other people freely based on improved computer application skill, and were interested in communication activity itself, from which they derived self-esteem. Moreover they showed increased self-confidence for solving problems that led them to accept and integrate digital information critically, using their computer application skills. This result coincided with the existing literature associating extroverts with communication skills (Ahn and Heo 2014; Costa 1992) On the other hand, introverts positively influenced digital literacy based on increased computer application ability, but did not improve computer-mediated communication skill due to an unwillingness to communicate and share information with others in spite of the online environment.

Third, digital literacy improved communication skills. Since its skill was to search, accept critically, and integrate digital information using the computer, improving digital literacy was able to increase the natural computer-mediated communication skill. Because young people were accustomed to the online environment, they could communicate with other people more quickly and easily. Moreover, as their digital literacy improved, they could distinguish whether others were good at it or not, which led to increased trust and more information-sharing.

Fourth, self-efficacy of undergraduate students improved by digital literacy, regardless of their personality. It meant that they felt self-satisfaction, as their ability was increased to integrate and accept digital information through the computational thinking class. Through this process, even though they were in trouble, they could solve problems without difficulty.

Fifth, although undergraduate students improved computer-mediated communication skills, they did not improve in self-efficacy. It meant that communication skill and self-efficacy are not related. Therefore, other means were needed to increase self-efficacy, as teachers needed more active and positive communication with students. This can be compared to the results of Nelissen and Selm (2002), in which, after many organizational changes, members did not communicate with others, and their self-esteem decreased. Constant external motivation became necessary; even if they communicated with others in their organization, self-satisfaction was not improved.

Sixth, this study validated that education programs as computational thinking experiencing practically computer application ability had to be created for students to improve digital literacy, communication skill and self-efficacy.

There were several limitations of the study and thus need to provide suggestions for future studies:

First, its results as to improved digital literacy, computer-mediated communication skill, and self-efficacy might not apply to students outside in the computational thinking class represented in the survey sample.

Second, instead of extroverts and introverts, personality could be distinguish as MBTI, open-minded, optimist, and so on. It is necessary to verify how influence they on digital literacy and communication skill and self-efficacy through future study.

Third, we need to identify the precise characteristics of the computational thinking class that might show benefits in the future. For example, are they more up-to-date in general, more field adaptable, and more focused in applying themselves?

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