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A Study on Correlation Analysis between Emotional Intelligence and Programming Ability☆

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ABSTRACT

Programming ability becomes an essential ability for elementary and secondary school students as well as computer science major students in modern information society. Thus, improving programming ability has long been a research project for computer scientists and teachers in IT areas.

There have been many research works for improving programming ability in various ways. At first glance, emotional intelligence is generally known as humanistic intelligence, and nothing to do with computer areas. In the recent works, emotional intelligence has a correlation with various subjects.

The purpose of this paper is to analyze correlation between emotional intelligence and programing ability. For this purpose, extensive survey works are carried out and statistical results are analyzed. Based on statistical analysis, it is concluded that there is a correlation between emotional intelligence and programming ability.

☞ keyword : Emotional Intelligence, Programing Ability, Logical Thinking Ability, Correlation

1. Introduction

The software industry is superior to other manufacturing industries in terms of added value and employment effects. In other words, it is possible to create high added value with a low initial investment cost, and once the product is prevailed in the market, the consumers who use it are under so call “lock effect” that can use the product continuously[1].

In this sense, software industry becomes a key industry in most developed and developing countries. Naturally, raising software manpower is a great concern in most countries. However, raising high-skilled software manpower takes usually long-term and complicated task. Thus, how to raise software manpower efficiently in the short term is very important issue to improve national competitiveness in a country.

Most developed countries try to train such a high-skilled manpower by public education. In Korea, ICT(Information and Communication Technology) education has been initiated in 2000[2]. With several reforms, ICT education is changed into software education in 2015[3]. Accordingly, educational purposes are also changed. The purpose of ICT education is to let every student become a user. On the other hand, under software education, the purpose is changed to let every student become a maker. As a maker, one can make a program by programming for his or her own.

Software education becomes a mandatory course in 2018. The essence of software education is categorized into three areas, algorithm education, programming education, and information and communication ethics, respectively. Among three areas, programming education is a core area in the light of educational purpose of software education.

In the literature, teaching and also improving programming ability has been a great concern for teachers in IT education. Especially, teaching programming ability for no programming-experienced students is a hot issue[4]. In the literature, it is known that logical thinking ability is correlated with programming ability.

An emotional intelligence is historically known as humanistic intelligence. However, in recent works, emotional intelligence is adopted in IT education[5,6]. Emotional intelligence is defined as “the capability of individuals to recognize their own emotions and those of others, discern between different feelings and label them appropriately, use emotional

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information to guide thinking and behavior, and manage and/or adjust emotions to adapt to environments or achieve one's goal(s)"[7].

It is known that Emotional intelligence can affect study ability. According to work in [8], emotional intelligence influences learners' ability to perform tasks or self-directed learning. Also, the emotional control of emotional intelligence shows that there is a mutually beneficial relationship between learners' self-directed learning and emotional intelligence.

The purpose of this paper is to investigate correlation between emotional intelligence and programming ability. For this purpose, we select some elementary school students and test the correlation works.

2. Related Works

2.1 Emotional Intelligence

In [9], five components of emotional intelligence(EI) are introduced as follows. First, self-awareness is defined as "the ability to recognize and understand your moods, emotions, and drives, as well as their effect on others". Second, self-regulation is defined as "the ability to control or redirect disruptive impulses and moods, and the propensity to suspend judgment". Third, motivation is defined as "a passion to work for reasons that go beyond money or status, and propensity to pursue goals with energy and persistence". Fourth, empathy is defined as "the ability to understand the emotional makeup of other people, and skill in treating people according to their emotional reactions". Finally, social skill is defined as "proficiency in managing relationships and building networks, and an ability to find common ground and build rapport". Also, hallmarks of each component are described as in the following Table 1.

Table 1. The Five Components of EI

Component	Hallmarks
Self-Awareness	- Self-confidence - Realistic self-assessment - Self-deprecating sense of humor
Self-Regulation	- Trustworthiness and integrity - Comfort with ambiguity - Openness to change
Motivation	- Strong drive to achieve - Optimism, even in the face of failure - Organizational commitment
Empathy	- Expertise in building and retaining talent - Cross-cultural sensitivity - Service to clients and customers
Social Skill	- Effectiveness in leading change - Persuasiveness - Expertise in building and leading teams

In the literature, there are some studies on how emotional intelligence has been used in elementary education. In [10], the relationship among emotional intelligence, academic self-efficacy, and creative tendency of elementary school students is investigated. In this study, it was concluded that emotional thinking stimulation, emotional input, and emotional utilization factors influenced creativity in turn.

2.2 Effects of Programming Education

In [11], effects of programming education are presented as follows.

First, students can improve mathematical geometric concepts and principles through programming education. Second, by programming education, problem solving, problem finding ability and problem management skills can be improved. Third, students can enhance programming and logical reasoning by programming education. Fourth, programming education can help students create cognitive types. Finally, students can have enthusiasm and perseverance by programming education.

3. Correlation Analysis between Emotional Intelligence and Programming Ability

3.1 Test Tool

In order to investigate correlation between emotional intelligence and programming ability, test paper developed in [12] is adopted and applied to the 6th grade elementary school students. The test paper consists of five factors: emotion recognition (self-awareness, recognition of others' emotions), emotional expression, emotional engagement, emotional regulation (self-control of emotions, control of others' emotions) and emotional utilization. The test is composed of 20 ques-

tions(4 questions for each factor).

In order to test programming ability, logical thinking ability and creative thinking ability were selected as substitute of programming ability for no-programming experienced students[13].

3.2 Correlation Analysis Procedures

For correlation analysis, 59 students were selected from four classes among the 6th grade elementary school students in Seoul, Korea. From April 4, 2016 to April 8, 2016, the questionnaire was conducted for 5 days. The data was analyzed by IBM SPSS Statistics Version 22.

We investigated correlation among emotional intelligence(emotion recognition, emotional expression, empathy, emotion regulation, emotional utilization), logical thinking ability (preservation logic, proportional logic, variable control, correlative logic, probability logic, matrix logic), creative thinking ability(fluency, originality, and flexibility), respectively. The mean and standard deviation of each variable were analyzed to test the general trends of the collected data. The results of descriptive statistics of the study subjects are shown in Table 2.

Table 2. Descriptive Statistics

	N	Min	Max	Avg.	S.D.
A	59	34	306	158.14	65.777
B	59	14	42	25.68	6.598
C	59	16	54	41.88	8.088

A: Creative Thinking Ability

B: Logical Thinking Ability

C: Emotional Intelligence

The Pearson correlation coefficients are shown in Table 3. It is shown that emotional intelligence has a significant correlation with creative thinking ability (r = .257, p <.05) and no correlation with logical thinking ability. These results imply that the higher the emotional intelligence, the higher the creative thinking power.

The emotional perception of emotional intelligence was correlated with the fluency of creative thinking power (r = .292, p <.05), and emotional utilization of emotional intelligence was correlated with fluency, R (R = .261, p <.05), originality

Table 3. Correlation Analysis Results

		A	B	C
A	Pearson Correlation Coefficient	1		
	Significance Level(both sides)			
B	Pearson Correlation Coefficient	.382**	1	
	Significance Level(both sides)	.003		
C	Pearson Correlation Coefficient	.257*	.121	1
	Significance Level(both sides)	.049	.360	
** p<.01, * p<.05				

A: Point of Creative Thinking Ability

B: Point of Logical Thinking Ability

C: Point of Emotional Intelligence

(r = .305, p <.05), and flexibility (r = .377, p <.01) of creative thinking ability. This result can be interpreted as follows. That is, the higher the ability of learners to quickly recognize their own and others' emotions, the higher the fluency of creative thinking ability. Also, the higher the ability of learners to endure difficulties and strive for their accomplishments, the more flexible and originality of creative thinking can be interpreted. The correlation between creative thinking ability and emotional intelligence sub-factors is shown in Table 4.

The probability logic of logical thinking ability was correlated with the emotional recognition (r = .266, p <.05), empathy (r=.348, p<.05), and emotion regulation (r=.373, p<.05) of emotional intelligence, respectively.The probabilistic logic is the ability to find out the probability of a particular event occurring from an accidental event. On the other hand, the emotional utilization of emotional intelligence shows a meaningful correlation with the proportional logic of logical thinking ability (r=.308, p<.05).The proportional logic means the ability to understand quantitative rules based on the principle that the ratio is the same in both ratios. The correlation between logical thinking ability and emotional intelligence sub-factors is shown in Table 5.

Table 4. Correlation between Emotional Intelligence and Creative Thinking Ability

		A	B	C	D	E	F	G	H
A	Pearson Correlation Coefficient	1							
	Significance Level(Both Sides)								
B	Pearson Correlation Coefficient	.312*	1						
	Significance Level(Both Sides)	.016							
C	Pearson Correlation Coefficient	.377**	.049	1					
	Significance Level(both sides)	.003	.711						
D	Pearson Correlation Coefficient	.395**	.227	.576**	1				
	Significance Level(both sides)	.002	.084	.000					
E	Pearson Correlation Coefficient	.251	.105	.313*	.443**	1			
	Significance Level(both sides)	.055	.429	.016	.000				
F	Pearson Correlation Coefficient	.292*	.050	.198	.207	.261*	1		
	Significance Level(both sides)	.025	.709	.133	.116	.046			
G	Pearson Correlation Coefficient	.252	.009	.220	.149	.305*	.935**	1	
	Significance Level(both sides)	.055	.949	.094	.259	.019	.000		
H	Pearson Correlation Coefficient	.210	-.074	.151	.199	.377**	.785**	.752**	
	Significance Level(Both Sides)	.111	.576	.255	.130	.003	.000	.000	
** p<.01, * p<.05									

A: Emotion Recognition, B: Emotional Expression, C: Empathy, D: Emotion Regulation, E: Emotional Utilization, F: Fluency, G: Originality, H: Flexibility

Table 5. Correlation between Emotional Intelligence and Logical Thinking Ability

		A	B	C	D	E	F	G	H	I	J	K
A	Pearson correlation Coefficient	1										
	Significance Level(Both Sides)											
B	Pearson correlation Coefficient	.312*	1									
	Significance Level(Both Sides)	.016										
C	Pearson correlation Coefficient	.377**	.049	1								
	Significance Level(Both Sides)	.003	.711									
D	Pearson correlation Coefficient	.395**	.227	.576**	1							
	Significance Level(Both Sides)	.002	.084	.000								
E	Pearson correlation Coefficient	.251	.105	.313*	.443**	1						
	Significance Level(Both Sides)	.055	.429	.016	.000							
F	Pearson correlation Coefficient	.155	-.055	.020	.058	-.054	1					
	Significance Level(Both Sides)	.240	.677	.878	.664	.686						
G	Pearson correlation Coefficient	.174	.006	.197	.174	.308*	.206	1				
	Significance Level(Both Sides)	.187	.962	.134	.188	.018	.117					
H	Pearson correlation Coefficient	.116	-.017	.010	-.177	-.107	.347**	.193	1			
	Significance Level(Both Sides)	.380	.899	.942	.180	.420	.007	.143				
I	Pearson correlational Coefficient	.266*	-.072	.348**	.373**	.241	.202	.268*	.267*	1		
	Significance Level(Both Sides)	.042	.589	.007	.004	.066	.125	.040	.041			
J	Pearson correlation Coefficient	-.153	.204	-.041	-.221	-.066	.055	.044	.067	-.061	1	
	Significance Level(Both Sides)	.247	.120	.757	.093	.620	.680	.743	.617	.648		
K	Pearson correlation Coefficient	.074	-.182	.129	.029	.023	.252	.197	.363**	.470**	.000	1
	Significance Level(Both Sides)	.576	.167	.329	.827	.864	.054	.136	.005	.000	1.000	
** p<.01, * p<.05												

A: Emotion Recognition, B: Emotional Expression, C: Empathy, D: Emotion Regulation, E: Emotional Use, F: Preservation Logic, G: Proportional Logic, H: Variable Control, I: Correlative Logic, J: Probability Logic, K: Matrix Logic

4. Conclusions and Further Research Works

Emotional intelligence is a concept that can complement existing cognitive-based education. A learner who has high emotional intelligence recognizes emotions of one and others, understands and empathizes emotions of others, solves problems or affects socially. Emotional intelligence is used in various subjects to enhance study ability in subject. Also, recently emotion itself has been used in various IT areas[14,15,16].

The research motive of this study is that emotional intelligence may help students enhance programming ability. After statistical analysis, we conclude that emotional intelligence is correlated with programming ability. Our research results can be used in various IT education areas including gifted education[17].

We have a plan to extend our research work as follows. We will find other humanistic abilities to enhance programming ability. The possible humanistic ability or intelligence is social intelligence(SQ). It is very interesting to find correlation between social intelligence and programming ability. Also, investigation of correlation between computational thinking power and programming ability is an interesting research subject.

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