A Study on Design and Implementation of a Programming Teaching Model Using Emotional Intelligence

Yesun Bae[1]   Woochun Jun[2]

ABSTRACT

In this paper, we design a programming education model that uses emotional intelligence and apply the model to programming education in elementary school. In our previous work, we found that there is a meaningful correlation between emotional intelligence and programming ability. In this paper, as a follow-up study, we design a programming education model based on a storytelling model and emotional intelligence.

In order to test the performance of the proposed model, we applied our proposed model to the 5th grade elementary school students who have no programming experience. Based on extensive survey work and statistical analysis, we found that the experimental group by the programming education using the emotional intelligence got a statistically significant higher achievement than the comparative group by the traditional programming education. We hope that our model will be helpful in programming education in schools.

☞ keyword : Emotional Intelligence, Programing Education, Digital Storytelling, Software Education, Logical Thinkin

1. Introduction

Software has emerged as a key element in the era of digital-based economy. In the current knowledge and information society, it is aimed to increase the productivity of the industrial society through informatization and digitization. Now software is a center for creating growth, innovation and value of a country. Software is also a deciding factor to the competitiveness of individuals, companies and countries.

However, although the importance of software manpower is increasing, it is not enough to emit excellent software talent. In the software-driven society, there is a need for talented people who are capable of solving problems creatively and effectively by utilizing the principles of computer science. Such talents should be developed and

raised in the country.

In the meanwhile, an ability to make software for himself or herself is required for every citizen. In the most developed countries, the main objective of information education is to let everyone become a maker rather than a simple user using programming.

Programming education is a very essential part of the overall software training to be done in the future. However, existing programming education often leads to learner's cognitive burden. Traditional programming education is based on the cramming method of teaching or project-based method in which students are required to find solutions depending on their ways of thinking and some guidance by teachers. Usually, in order to enhance programming ability of students, logical thinking ability is used in classes. It means that student's programming ability can be improved by nurturing student's logical thinking ability [1]. However, we believe that programming ability can be improved by various factors other than logical thinking ability. It is known that emotional intelligence is a concept that can complement existing cognitive-based education. When a learner with high emotional intelligence recognizes emotions of himself/herself, understands emotions of others, empathizes, solves problems or socially influences, emotion intelligence can be used

correctly [2].

On the other hand, digital storytelling is a short form of digital media production that allows people to share aspects of their story. The media used may include the digital equivalent of film techniques (full-motion video with sound), stills, audio only, or any of the other forms of non-physical media (material that exists only as electronic files as opposed to actual paintings or photographs on paper, sounds stored on tape or disc, movies stored on film) which individuals can use to tell a story or present an idea [3].

In this paper, we develop a programming education model based emotional intelligence and digital storytelling. We apply the proposed model to elementary school students. We investigate that our proposed model is useful to improve students' programming ability comparing to the conventional programming education method.

2. Related Works

2.1 Effects of Emotional Intelligence

According to Mayer's research [4], there are some indicators that emotional intelligence predicts.

First, emotional intelligence can support academic achievement. Some studies show that emotional intelligence predicts school achievement and intellectual problem solving. In Israel, academically superior students showed a higher level of strategic emotion than the average students. Other studies also show that emotions are more relevant when performing academic tasks involving tasks related to emotions [4].

Second, it is a prophecy of deviant behavior. There is a consistent pattern in the study of the relationship between emotional intelligence, deviant behavior, and problem behavior. Emotional intelligence is inversely proportional to abusive behavior, violence, smoking, and drug problems. This relationship also appears when both intelligence and personality were statistically controlled.

Third, emotional intelligence is related with on pro-social and positive behavior. That is, the higher the ability to control emotions, the higher the quality of interaction with friends. The higher the emotional control ability, the more favored friends of the opposite sex and feel that they feel

worthy.

Fourth, there is a correlation with leadership and organizational behavior. The higher the manager's emotion index, the higher the commitment of subordinates to the organization. Sometimes in a relationship between people it is necessary to motivate others. In this case, a person with a high emotional index can present a higher quality vision than others.

Finally, there is a relationship between the development of emotional intelligence and the learning of emotional knowledge. Emotional intelligence is knowledge that is easy to acquire or teach.

2.2 Emotional Intelligence Education

2.2.1 Cognition and Sensibility Fusion Model

A literary reading learning model that combines cognition and emotion in elementary school students' education was developed in [5]. This learning model consists of five stages: Reacting, Understanding, Clarifying, Evaluating, and Making Mine, respectively

In the first step, 'Reacting', it creates an atmosphere to read the works, induces motivation, prepares the responses, and forms a subjective emotional response to the works.

In the second step, 'Understanding', the literary works themselves are analyzed to understand what kind of meaning they are.

In Step 3, 'Clarifying', learners are required to compare the contents or events of a literary work with the lives of the learners or examine them in relation to other literary works with similar contents.

Step 4, 'Evaluating', learners recognize their reactions and the value of the work, as well as the understanding and interpretation of the work. At this stage, learners also consider objective grounds such as 'understanding' and subjective sources such as the 'empathic reaction' of the learner.

In the 5th step, ″Making Mine″, the learner's literary reading process from stage 1 to stage 4 is internalized into the emotional or artistic experiences, so as to be motivated to change oneself emotionally and personally.

2.2.2 Storytelling-based Emotion Education Program

In [6], the direction of the emotional education program through the storytelling is explored. According to [6], the storytelling and the emotional intelligence are highly related to each other as a basic knowledge to implement the emotional education program.

This is because emotion can easily make sense of what they experienced through the story. By educating children with stories, children can memorize for a long time because they can effectively form their own meaning and stimulate their emotions. And when developing emotional education programs through storytelling, these programs enhance students' understanding of themselves, control confused emotions and impulses, and empower empathy.

As a result, personal experiences, peer groups, teacher media, and the emotional environment of schools and local communities should be considered in order to improve academic achievement. Especially, when designing emotional education program through storytelling in the school curriculum, students select key elements to be appropriate to the stage of development of the students and set goals or achievement standards and develop various specific activities.

2.2.3 Emotion Education in Elementary Schools

Emotion education has been used widely in elementary schools as follows.

In [7], relationships among emotional intelligence, academic self-efficacy, and creative personality are investigated. It is argued that emotional intelligence partially predicts creative personality. Also, academic self-efficacy partially mediated between each sub-factor of emotional intelligence and creative personality.

In [8], it is argued that there is a profound relationship among the emotional intelligence, the creativity-humanity education, the STEAM education, the SMART education, and the practical arts education.

In [9], emotion is adopted in social study of elementary schools. It is argued that social studies using emotion focused on video materials stimulate student's emotion, lead positive and active participation in class.

3. Development of Programming Education Model Using Emotional Intelligence

3.1 Development Direction of the Model

In our previous research work in [10], it is concluded that emotional intelligence is correlated with programming ability. The purpose of developing programming education model using emotional intelligence is to introduce emotional education so that learners can improve programming ability more effectively. In this paper, a programming education model with emotional education contents is developed in the following direction.

First, the proposed model in this study is to select the contents suitable for the emotional education and the programming education among the contents taught in the school, and to take a new reconstruction form. Programming education itself can be a subject, but when combined with the contents of other subjects, it becomes enriched in terms of contents and enables the learner-centered lessons.

Second, when extracting the content elements of emotion education based programming education model, subordinate factors having correlation between emotional intelligence and computational thinking ability can be organized together. Among the elements of emotional intelligence, emotional perception and emotional utilization factors are used to correlate with the subordinate factors of creative thinking and logical thinking.

Third, when the programming is taught using the proposed model, both of the emotional education and the programming education should be used at the same time.

3.2 Development Process of the Model

The process of model development is as follows.

First, subjects suitable for emotional education and programming education are selected at elementary school curriculum. In addition, the curriculum of the selected subject is analyzed and the learning contents suitable for application of programming education model using emotional intelligence are summarized.

Second, based on the contents of emotional education and programming education, we extract elements of emotional education and programming education applicable to elementary school students. After confirming that the extracted elements can be taught in elementary school students' developmental stage, the applicable factors in the model to be developed are finally selected.

Third, we develop a programming education model that utilizes emotional intelligence by selecting educational methods or models that can naturally converge emotional education and programming education.

In addition, we find a common model that is used in emotional education and also used in programming education, and places learning contents, emotional education, and programming education elements in the selected courses. It is possible to make a model that can be practiced considering the applicability in actual education field and has a context suitable for class flow.

3.3 The Proposed Model

The developed programming education model using emotional intelligence consists of five steps: programming study goal selection, story selection, story production, work sharing and reaction formation, reaction sharing and evaluation.

The first step "programming study goal selection" consists mainly of teacher activities. The teacher selects the programming study goals that he/she wants to achieve through the activity. At this time, the teacher needs to consider the level of the learner, the software curriculum, and the connection with other subjects. At this stage, the element of emotional education needs elements such as self-synchronization by using emotion.

In the second "story selection" stage, a story is selected to achieve the study goals selected in the previous step. A teacher can choose a story that has element of emotional education. The story that includes programming can be made by selecting contents among the contents in subjects such as Korean language, social study, and morality. Students can create a story by selecting a topic from the contents of study in other subjects. The elements of emotional education used at this stage are self-synchronization through emotional utilization and flexible planning. Programming elements

include understanding algorithms, reconstructing problems to use computers, solving open problems.

The third step is to analyze the story selected as the "story production" stage. In this stage, students design the algorithm to express the story, and express the story by programming. Students can modify and complement the output to produce a simple but finished work. At this stage, a student recognizes the feelings of himself/herself and others, and expresses the emotion in the story. At this stage, programming education elements are used most often. The algorithm is used to develop a procedural storyline, to abstract complex figures and events, and to use sequence, iteration, and selection commands.

The fourth step is the "work sharing and reaction formation" phase. At this stage, students announce their work and listen to their friends' announcements and form responses. Emotional recognition ability to recognize other people's emotions, emotional understanding to understand other people's emotions, emotional control ability to express straightforward expressions are required. Programming education elements require computational thinking skills such as understanding the input/output process of software, confidence in problem solving, and communication ability.

The final step is "reaction sharing and evaluation". At this stage, students will share and present the responses they have formed in the previous steps, and evaluate their work and reactions. Emotional regulation to express in a mild manner is required as emotional education element, and the ability to understand the effects of software on life is required as a programming education element.

The following Table 1 shows the overall description of the proposed model using emotional intelligence depending on roles of teacher and student.

(Table 1) The Outline of the Proposed Model

Step Number	Step Name	Step Function
1	Programming Study Goal Selection	- Teacher: selects the programming study goals that students want to achieve through the activity - Students: prepare the study and understand their study objective

Step Number	Step Name	Step Function
2	Story Selection	- Teacher: chooses a story that has element of emotional education - Students: can create a story by selecting a topic from the contents in other subjects
3	Story Production	- Teacher: monitors and guides students while they are designing the algorithm to express the story, and expressing the story by programming - Students: can modify and complement the output to produce a simple but finished work
4	Work Sharing and Reaction Formation	- Teacher: observes students' problem solving and communication skills - Students: announce their works and listen to their friends' announcements and form responses.
5	Reaction Sharing & Evaluation	- Teacher: evaluates students' reaction and works - Students: share and present the responses they have formed in the previous steps, and evaluate their work and reactions

4. Application and Verification of the Programming Education Model Using Emotional Intelligence

4.1 Research Hypothesis

The purpose of this study is to propose a programming education model using emotional intelligence and to test the effectiveness of the proposed model. The independent variable of this study is "a programming education model using emotional intelligence" and the dependent variable is "programming study achievement". In order to test the effect of independent variable on dependent variable, the following research hypotheses were established.

Research hypothesis: Programming education using emotional intelligence in elementary schools will have a significant effect on programming study achievement.

4.2 Research Procedure

The purpose of this study is to examine whether there is a meaningful difference between programming study achievement in the group with the teaching method using the emotional intelligence and the group with the traditional method. After ensuring homogeneity, the experiment group conducts the programming lesson based on the programming education model using emotional intelligence, and the comparative group conducts the lesson in the traditional class. In order to control the variables due to the physical environment difference, both groups equalize the programming language, study place, and guidance teacher.

After the instruction, the students were surveyed to evaluate the achievement of the programming study by the evaluation criteria based on the actual achievement level of 2015 software education curriculum.

The following Table 2 shows experiment design of this research.

(Table 2) Research Design

G1	O1	X1	O2
G2	O3	X2	O4

G1: Experimental group
G2: Comparative group
O1, O3: Pre-examination (logical thinking, creative thinking)
X1: Programming education using emotional intelligence
X2: Traditional programming education class
O2, O4: Post-test (programming study achievement)

4.3 Research Method

We examine whether the emotional intelligence programming education model developed for the improvement of programming study achievement is more effective than the traditional programming education method. For this purpose, the experimental group is provided with an opportunity to

implement the process of analyzing, designing, and completing the story within the story structure which can recognize and express the emotion

On the other hand, the comparative group conducted a traditional programming education method adopting teacher's explanation and demonstration followed by student practice. The experimental period was planned to be 8 hours from June 1, 2016 to June 28, 2 hours per week.

4.4 Research Results

We checked whether the two groups were homogeneous group. The results of logical thinking and creative thinking are shown in Table 3.

(Table 3) Pre-test Results

Test	Class	N	AVG	S.D.	t	p
A	E	22	22.23	4.163	.641	.525
	C	23	21.39	4.560		
B	E	22	44.18	15.525	-.231	.818
	C	23	45.04	8.678		

* p < .05
A: Logical Thinking Ability
B: Creative Thinking Ability
E: Experimental Group
C: Comparative Group
N: Number of Students
AVG: Average
S.D.: Standard Deviation

As a result of the pre-test for logical thinking, the average of the experimental group was 22.23, which was 0.84 higher than the average of 21.39 in the comparative group, but not statistically significant (p <.05). In the creative thinking ability, the mean of the experimental group was slightly lower than the comparative group, but not statistically significant (p <.05). Therefore, experiment group and comparative group can be regarded as homogeneous group for logical thinking ability and creative thinking ability.

After the pre-test, we used emotional intelligence programming education model and traditional method in class for 8 class hours during 4 weeks for experimental group and comparative group. After the instruction, we

performed the programming study achievement test between the two groups. The results of the t-test for post-test on the achievement of programming study are shown in Table 4.

(Table 4) Results of Post-test for Programming Ability

Class	N	AVG	S.D.	t	P
E	22	60.8	3.13	.382	.036
C	23	57.8	4.57		

* p < .05
E: Experimental Group
C: Comparative Group
N: Number of Students
AVG: Average
S.D.: Standard Deviation

As a result of the post-test on programming study achievement, the average of the experimental group was 60.3 points, which was higher than the average of the comparative group of 57.8 points, showing a statistically significant difference (p <.05). It is concluded that the programming education model using emotional intelligence positively affects the improvement of programming study achievement than the traditional programming education method.

4.5 Analysis of Research Results

When the emotional intelligence is used for learning, the learner recognizes the feelings of himself/herself and others, expresses his/her emotions, empathizes with others' feelings, adjusts his emotions, endures difficulties. The combination of active emotional activities with programming has led to an improvement in programming study achievement as follows.

First, after the basic study such as the concept of algorithms and the use of block-based programming tools, the selection of stories and storyboard production activities immediately lowers the burden of programming study and gives the expectation that learners will make their own works by programming activities. On the other hand, traditional programming study gives tendency to deal with programming in a passive manner because it is the way to complete the predefined coding.

Second, in the process of presenting his work in front of his friends and sharing his impressions of his works with his comments, not only the achievement of programming study but also the improvement of emotional intelligence was achieved. Because the programming works according to the storyboards that student made are different for each student, they are able to analyze the programming works by various comments of others. In this process, problem solving abilities of students are improved and at the same time computational thinking ability is also improved.

5. Conclusions and Further Research Works

Emotional intelligence has been used in various education fields. However, emotional intelligence has not been used in science areas since emotional intelligence is known to have a relationship with humanities. Recently, some research works show that emotional intelligence can be used in science and computer areas.

In this paper, a programming education model using emotional intelligence and storytelling model is developed. In order to test the effectiveness of the proposed model, we apply the programming education model to elementary 5th graders over 8 class hours of 4 weeks. After thorough statistical analysis, the proposed model was found to be effective in improving programming study achievement compared with the traditional method of programming education. Using the proposed model, students can improve study motivation by reducing the burden of programming and maintain interest by the process of planning, producing, and presenting their own work. .

Further research issue are as follows. First of all, we need to find other factors that improve programming ability of students such as writing ability. Second, it is necessary to develop programming education curriculum linked with other subjects. It means that programming education can be done in other subjects as well as computer class.

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◖ 저 자 소 개 ◗

배 예 선(Yesun Bae)
1997년 이화여자대학교 교육공학과 졸업(학사)
2006년 서울교육대학교 컴퓨터교육과 졸업(학사)
2016년 서울교육대학교 교육전문대학원 컴퓨터교육과 졸업(석사)
2011년~현재 서울북성초등학교 교사
관심분야 : 초등컴퓨터교육, 장애인정보화교육, 정보통신윤리
E-mail: yesun75@hanmail.net

전 우 천(Woochun Jun)
1985년 서강대학교 전산학 학사
1987년 서강대학교 대학원 전산학 석사
1997년 미국 University of Oklahoma 전산학 박사
1998년~현재 서울교육대학교 컴퓨터교육학과 교수
관심분야 : 정보영재, 장애인정보화교육, 정보통신윤리교육
E-mail: wocjun@snue.ac.kr