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THE CORRELATION ANALYSIS BETWEEN KOREAN MIDDLE SCHOOL STUDENTS' EMOTIONAL LEVEL AND FRIENDSHIP IN SCIENCE LEARNING

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ABSTRACT

This study aimed to find out the correlation between emotional levels and friendship in science learning. The participants in this study were 30 third-grade students at a girls' middle school in a Korean metropolitan city. For nine months, their science classes were conducted by one teacher in charge of science class and five students were organized into a group. The science learning emotional test tool consisted of 35 questions on the rating scale of 5 phases and the peer nomination method was adopted for the friendship survey in science learning. The test was conducted during the last hour of science class. In the results of analyzing students' science learning emotion levels, students showed high average scores in three emotional elements of positive science learning (joy, satisfaction, and interest), showing overall positive feelings about science learning. After analyzing friendship among the students, the connection between students was analyzed to be close to 1 and none of the students were isolated. Two out of 30 students were given ninth appointment from peers and formed a central axis in the classroom network. On the other hand, two students in the class were not chosen by other students and only pointed out helpful colleagues in science learning. After analyzing the correlation between the emotional level and friendship in science learning based on these two studies, it was analyzed that there was a strong static correlation between two variables. Therefore, since the bond between emotion and friendship in science learning is closely related, there is a need for science learning to take into account the interrelationship between two variables.

Keywords: emotional levels; friendship; science learning; classroom network

INTRODUCTION

It is well known that emphasizing only the cognitive characteristics loses interest in science and leads to adverse consequences for continuous science learning (Chiang & Liu, 2014; Park, 2015). Therefore, in science learning, it is considered important to put efforts to improve the emotional characteristics as well as the cognitive aspect.

It was reported that science learning which emphasized emotional characteristics helped learners to remember long term memories and affected the effectiveness of continuous learning (Ainley et al., 2005; Krapp, 2005). A study by Thagard (2009) suggested that scientists had various emotional experiences during their research and that these emotional experiences were an opportunity for continuous research and new challenges, and further affected the positive responses of all lives. So emotions are a psychological state in the complex interaction between subjective and objective factors and serve as a force that motivates people to achieve their goals (Fu, 2015).

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Patrick et al. (1993) thought the importance of motivation and emotions were considered a deciding factor in learning. Vazquez & Manssero (2007) said that positive emotions tended to prefer learning and stimulated enthusiasm and confidence in learning while negative emotions seriously limited learning abilities. Therefore, a teacher who ignores the emotional aspects of learning can restrict students from changing concepts (Duit et al., 2008). While studies related to emotions in science learning was conducted to analyze students' emotions in each area of biology, physics, earth science, and chemistry (Borachero et al., 2011; Brigido et al., 2013), the relevance of emotions as a medium for activation in science learning process was rarely considered (Jeong et al., 2016).

In a rapidly evolving science field, there was a lot of work for scientists in various fields to work together to solve the problem by synthetically using scientific knowledge and research activities (Yeo & Park, 2005). Therefore, forming an interactive friendship based on active relationships and consideration with colleagues is one of the important virtues that a person should possess as a science researcher. In particular, science education should foster scientific knowledge and ethical awareness as well as active consideration for others with smooth communication (Park, 2015). In particular, because science learning emotion means the idea that students have about what can happen in a science learning situation, identifying learners' characteristics is an important clue to the composition of effective science learning programs and is important to determine success or failure of science education (Ahn & Choi, 2017). In this context, a direction change in science education is needed, which allows them to have a balanced learning experience that reflects students' intellectual aspect and emotions.

Meanwhile, children have friendships in schools, which lead to a basic environmental experience that increases sociality and creates a sense of belonging or responsibility (Jeong, 2007). In other words, students learn the importance of social ties through interaction between groups in schools. Thus, friendship in school life has an important influence on the emotional development of students (You, 2011). However, they indeed did not pay much attention to the friendship that children had in science learning.

In Korea, there has also been active research to understand the emotions of science learning (Ahn & Choi, 2017; Kim & Kim, 2013), but in science learning, the correlation between emotion and friendship was not analyzed. However, since there is a report that emotions can change through personal growth and social experience (Van Kleef, 2009; Zhou & Chen, 2009). Besides, Ogurlu et al. (2018) argued that learning emotion had a close connection with friends, implying that the correlation between these two variables was analyzed. The correlation between emotion and friendship in science learning is expected to be significant in science education. Above all, it is expected to provide a direction for more advanced science education in Korea, where group activities are the mainstay in science learning. Especially, as a method of investigating how important each member of a community is and even the pattern of variables building a community, social network analysis receives more favorable responses recently. However, it is difficult to find researches that have analyzed emotion and friendship, which affect students' learning activities, through social network analysis (Doran et al., 2011; Volet et al., 2019).

In this study, social network analysis method was used to find out friendship in science learning. Social network analysis is a method of interpreting individuals' relationships through a network created by connecting relationships between individuals through networks (Knoke & Yang, 2008). Social network analysis methods have the advantage of being able to pinpoint problems such as group bullying in schools through questionnaires (Jeong, 2007). Even Aini et al. (2019) saw that network analysis is helpful for teachers to understand students. Especially, science activities in the classroom reflect social network format. Therefore, in this study, the level of emotion in science learning to middle school students in Korea is analyzed, and the purpose of the study is to find out the correlation between emotion and friendship after analyzing friendship using social network analysis method.

For this study, the research has established some concrete research problems. They are, how are the emotional levels of middle school students in science learning?; how is the friendship of middle school students in science learning?; and how are correlations between emotional levels and friendship of middle school students in science learning?

METHODS

Research Object

In this study, the participants were 30 third-graders of girls' middle schools in a metropolitan city of Korea. These research objects for this study were students from the same class,

randomly selected, at a middle school, which might represent typical school environments in large cities and adopted the standard curriculum of Korea. In Korea, an ordinary class at middle school consists of 30 students on average. Their usual science classes are heterogeneous groups with five people in a group and are taught as group activities. The group is newly organized for each activity and works five to six times with the same student for at least one year. Korea starts a new semester every March, and a class of new students is organized and is given science classes together for one year. When this study began, the participants had taken science classes together for nine months. A science teacher who guided them was the homeroom teacher of the students in this study who has 13 years of teaching experience.

Science Class Method

In this study, the science class was conducted by the homeroom teacher who was in charge of the science class. In Korea, each class has a homeroom teacher who will teach his or her university major to his students. In Korea, the middle school science class takes 45 minutes per 1 teaching period and the science class has 3 teaching periods per week. The contents of science class were conducted according to the contents of the third-grade science course of middle school in Korea. Science classes were taught in classrooms and science rooms depending on the topic of learning.

The science class in this study was conducted based on the composition of the Korean science textbook. First, the learning objectives problem situations; second, group-by-group inquiry activities; next, general discussions on the research results; the last, scientific phenomena and concepts organizing. In the stage of presenting the problem situation of the learning goal, the teacher grasps the point of the learning goal in advance and presents an example of the problem situations in daily life. This example leads us to understand why inquiry activities are needed to solve problems.

In the group inquiry activity stage, five people design and perform an inquiry related to their design to solve the problem. At this stage, the teacher advises groups who find it difficult to progress but do not participate in inquiry activities directly. In the general discussion stage for inquiry results, the conclusions calculated by the group are summarized and compared with each other throughout the class, and the errors are given as an opportunity to be corrected through the whole class discussion. In the stage of science phenomena and concept organizing, students are guided by the teacher to organize the science phenomena and concepts derived from the previous activities, students summarize in their notes while grasping the science phenomena and concepts introduced in science textbooks.

Testing and Analysis Methods

Emotional Level Test in Science Learning

The science learning emotion test tool developed by Kim & Kim (2013) was used to determine the level of emotion in science learning for middle school students, and some of the terms were modified to meet the purpose of this study. To confirm that there were no errors in the process of modifying some of the terms of the questionnaire, the facial validity test was examined by three middle school science teachers and also the validity of the sentence structure in examination questions was confirmed by conducting a preliminary inspection on 27 students in the third grade of middle school other than the research subject. This test tool consists of three positive elements of science learning emotion (four questions of joy, three questions of satisfaction, six questions of interest) and six elements of negative science learning emotional elements (three questions of boredom, four questions of shame, four questions of dissatisfaction, five questions of anger, three questions of anxiety, and three questions of annoyance). This test tool was conducted in the second period of exploratory factor analysis, and it was confirmed that the conformity of the research model and the final model were valid tools through the construct validity verification.

The question format consists of the five-step rating scale: five points for 'very much like that', four points for 'somewhat like that', three points for 'neutral', two points for 'not much like that' and one point for 'not at all like that'. The total confidence coefficient of this test tool in this study was .833, and the representative items for each sub-part are shown in Table 1. The emotional level test in science learning was conducted under the supervision of a science teacher for 25 minutes at the last class of the third grade of middle school, and the average and standard deviations were obtained by the respective technical statistics for each science learning emotional element and through this, the ranking of each element was analyzed.

Among the elements of negative science learning emotion, the 'discontent' and 'anger' mean that the term itself has for negative terms, but 'very much like that' means that the desire to

learn science is full because it's a view of having a lot of opportunities in science activities and wanting to be immersed in it. On the other hand, the "boredom" element is that the subject of science learning is not interesting or the subject is boring, and the "shame" element is a point of view that is ashamed, unnamed, or afraid of mistakes when it fails to achieve good results by focusing on the results of science activities. The "anxiety" factor is the feeling during the experiment process, which is an anxiety about the experiment itself, and the "annoyance" factor is the point of annoyance about the preparation and doing of science activities. These four negative factors are calculated as reverse coding at the time of analysis because of the lower the score, the more self-directed confidence and more active participation in science learning.

Table 1. Emotional Level Testing Tools Representative Question in Science Learning (Kim & Kim, some modifications to the 2013 development question)

Elements	Question Examples
Joy	I enjoy participating in science research.
Satisfaction	I feel satisfied when I learn new things through inquiry.
Interest	I am interested in the science inquiry that I participate in.
Boredom	It is boring when I learn science content that is not related to me.
Shame	I am ashamed when I make a mistake in the course of science inquiry.
Dissatisfaction	I'd like to speak in science class, but I get a complaint when I'm not given the opportunity.
Anger	I am angry when my friends make a noise and interrupt the science inquiry.
Anxiety	I am anxious because I'm going to break up the lab tool or spill the lab material, so it's hard to explore.
Annoyance	I am annoyed if there are many quests to be made.

Examining Friendship and Analyzing

To investigate the friendship in middle school students' science learning, peer nomination, a method of measuring sociability, was used. The peer nomination method is the sociality measurement method proposed by Moreno (1953), that utilizes the most basic test tool for selecting colleagues based on the given criteria NGQ (Name Generator Questions: a questionnaire designed to identify and complete the member's name in each instruction).

The questions asked to middle school students explained the purpose of the survey (an analysis of friendship in science learning) and were organized to answer up to five people, taking into account the number of groups to accurately understand the directions, "Who would it be helpful to explore or discuss within science learning?" It was required to write down all five friends if possible, and students who did not write down all five friends were also included in the analysis items. The test was conducted for about 10 minutes at the last class of the middle school science, and it was conducted under the supervision of the teacher so that they would not discuss each other or look at the written contents of each other, as it was a test from a personal perspective on a friend. The analysis allowed each student to be randomly numbered instead of his or her name so that his or her personal information could not be exposed. All the students were informed that their survey responses would be kept confidential. As all the class members had to participate in this survey before social network analysis, the researcher made sure that they left school early or were absent from school on the survey day, and surveyed explaining the purpose and method of this survey to them.

Since the peer nomination did not consider the ranking of the named friends, no weights were given according to the order of the peer nomination. Besides, to find out the views of the most frequently cited students, the reasons for their designation with colleagues were to be described in terms of science learning, and it was conducted to approach the relationship between students' emotions and friendship in depth by adding interviews of science teachers who directly observed the students' science learning status. The interview with the science teacher was held in an open interview format for about 30 minutes during the process of receiving the friendship test sheets from the researcher's laboratory.

The social network analysis of the fellowship utilized NetMiner for Friendship Program developed by Cyram to analyze class relationship indicators (total number of students, number of students selected alone, number of students isolated, relationship density, the average number of friends, connection diagrams), friendship status (the most chosen student, the single selected student, the isolated student), friend group status, friendship map, and popularity map.

The friendship map takes the form of a typical social network and has an interactive pattern that links class members to each other according to peer nomination. The friendship map

is linked with an arrow from the designating student to the named student, and the point (small circle) in the friendship map means the student, and when the named student is more nominated, the arrow was more concentrated, and the size of the dots is larger.

Meanwhile, a simple correlation analysis was conducted using SPSS ver. 24 to find the two variables of the relationship between the level of emotion and friendship in science learning.

RESULTS AND DISCUSSION

The Results of Emotional Level Analysis in Science Learning

The analysis of emotional levels in science learning (Table 2) shows a high average of positive learning emotional factors. In particular, when the average of positive emotional factors was over 3.5, the students in the study were generally positive about science learning.

Table 2. Results Analysis by Sub-factor of Emotional Level in Science Learning

	Sub-factor	Average	Standard Deviation	Rank (Average Score Criterion)
Positive science learning emotion	Joy	3.53	1.38	2
	Satisfaction	3.50	1.19	3
	Interest	3.76	1.56	1
Negative science learning emotion	Boredom	2.66	1.29	8
	Shame	2.63	1.09	9
	Dissatisfaction	3.13	1.25	5
	Anger	3.33	1.37	4
	Anxiety	2.90	1.56	6
	Annoyance	2.70	1.26	7
Total		3.13	.93	

Positive emotion in science learning is usually emphasized in Korean science classes, and especially in Korea's science curriculum, as the educational goal is to educate students to learn science knowledge and inquiry methods happily, it can be interpreted positively that the factors involved are ranked at the top. Prachagool & Nuangchalerm (2019) said that when learners realize the worth of scientific products and have positive convictions, it will be helpful to them in actually inquiring into science. Negative emotion in science learning is ranked at a lower level because it relates to difficulties with learning science in a personal emotional aspect and is closely related to learners' styles.

However, negative emotions do not mean that they show a negative attitude toward science. As shown in the representative questions of each element in Table 1, 'complaints' and 'anger' can be interpreted as a style that is more active in science learning as the score is higher. In this study, the average score of 'anger' and 'discomfort' factors was high among the negative factors.

Science learned under negative emotional conditions is rarely helpful to students or adults (Straub, 2009). Sanchez-Martin et al. (2018) saw that dealing with emotions in learning not only helps to achieve immediate academic achievement but also helps to maintain a good mental attitude that needs to be dealt with a temporary failure in the future.

Therefore, it is necessary to regularly check emotional levels in science learning to come up with measures to improve emotional levels. In this context, Wu & Huang (2007) reported that students who took student-centered classes rather than teacher-centered classes had better emotional levels and showed more interaction in emotional learning participation and discussion groups. Therefore, if the student-centered inquiry activities, which are characteristic of science subjects, are continuously carried out, it is likely that the emotion about science learning will be improved more than other subjects. Tomas et al. (2016) saw those inquiry activities with socio-scientific issues were necessary to induce students to have positive feelings in science learning. Even Kim (2018) argued that cooperative learning would promote interactions among female middle school students and increase intimacy with their friends. As inquiry activities in science learning are effective in increasing the emotional level of middle school students, all the science teachers should keep it in mind that it is their role to enhance such inquiry activities.

Results of Friendship Analysis in Science Learning

The results of analyzing the peer relationship index of the class are are as shown in Table 3. The study found that two students in the class

were not chosen by other students and that none of them were isolated students who had no relationship with the other students at all. The density of the relationship is 0 if there is no relationship at all in the class, and is 1 if students have a relationship with each other.

Table 3. Index of Class Friendship

Index	Total Student Nmber	Number of Students Selected Alone	Number of Students Isolated	Relationship Density	Average Number of Friends	Connection Diagram
Value	30	2	0	0.136	3.933	0.869

The study found that the relationship density of the class was low at 0.136. This can be seen as a result that students can nominate up to five people, but most students picked three to four.

In this regard, the average number of friends students had was 3.933. The degree of connection that all students in the class are connected without being isolated appears to be between 0 and 1 which means that 1 is they are all connected, and the class in this study was high at 0.869. In other words, this class can be interpreted as maintaining some stability without isolated students.

Based on the results of a specific study of friendship as shown in Table 4, the top 10 percent of the students who were most-nominated by other students were four. They were nominated by nine (30 percent) and seven (23.3 percent). On the other hand, two students were not nominated by other students. Group 1 is a group of members who are fully connected. Although two students are not nominated, and even if only one group is fully connected, it can be seen that the connection is high because the class is highly connected. Also, these results can be viewed as a result of the frequent reorganization of groups during science inquiry activities.

Table 4. Current Status of Friendship

Index	The Most Frequently Nominated Student (The Number of Being Nominated)	A Student Not Picked Up by Other Students	Group (Members are more than Three and All Fully Connected)
Value	S9 (9), S18 (9), S13 (7), S15 (7)	S5, S10	1 (S4, S19, S29)

Figure 1 is the whole friendship map of this class, and it is visually confirmed that S9 and S18 are the central axis and received the most naming from other students. On the other hand, it is confirmed that S5 and S10 are distributed in outer areas of network and means not to receive the nomination but only pick up other colleagues.

These students, in particular, are less likely to be a loner because they nominate other peers (those who are interested in others) due to the nature of the peer nomination, but it is highly likely that they do not actively participate in the science group activities and may not help members of the group when they are not picked up by other students.

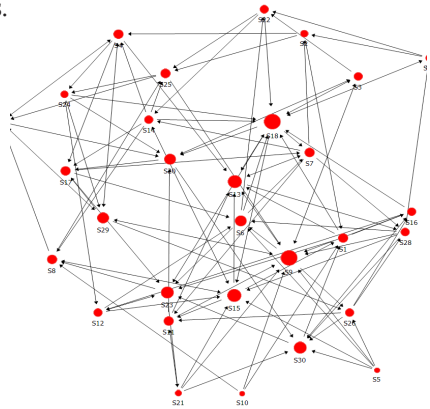

Figure 1. Friendship Map

Figure 2 is a map of popularity among class members, and it can be visually confirmed that the most popular S18 and S9 are centered, and S13 and S15 are located around it. In addition, S5 which are not picked up, and S10 which are distributed outside are confirmed to be less popular.

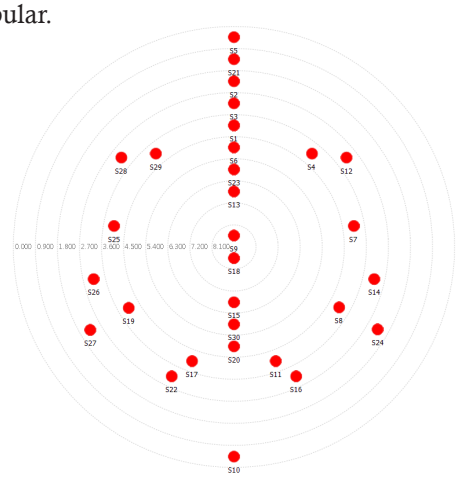

Figure 2. Popularity Map

Children who are branded as non-popular children in friendship are hard to escape from the bridle of non-popular children, and consequent-

ly, the possibility of intervention programs to improve peer relations in non-popular children is also lowered (Choi, 2012). On the other hand, popular children have typical characteristics that they always want to do something with their peer group and keep long-lasting relations. In particular, Cozoline (2013) noted a high incidence rate of bullying in the social transition period such as entering a middle school when the ranking of control is readjusted.

Marginalized students are not active in science learning and more likely to dislike science, so it needs to identify their friendship in advance and prepare solutions. In particular, appropriate measures should be taken since science subjects often perform through group activities rather than individual activities. Meanwhile, concerning this solution, Kim (2018) proposed the application of the STAD cooperative learning model, and it was analyzed that fully connected form increased as a network type as a result of applying this model to science class.

Results of Correlation Analysis between Emotional Level and Friendship in Science Learning

Analysis of the correlation between the emotion level in science learning and friendship (the number of nominations) showed that the correlation coefficient is .874 and the significant level .01 is significant and form a strong static correlation (Table 5). Therefore, the higher the level of emotion in science learning, the better the friendship in science learning.

Compared to each student's actual emotion level in science learning and the friendship (the number of nominating), S9 which were most frequently picked up and S18 emotion scores are 5.0 and 4.56 are found to be close to perfect. On the other hand, the emotional scores of S5 and S10, which are not nominated, are analyzed at the lowest level of 1.89 and 2.000. Therefore, when a student receives a lot of nomination, it is rated that he has a higher emotional level about science learning.

Table 5. Correlation Analysis between Emotional Level and Friendship Variables in Science Learning

Students	Number of Being Nominated	Emotional Level in Science Learning	Students	Number of Being Nominated	Emotional Level in Science Learning
S1	4	3.44	S16	3	2.89
S2	2	1.89	S17	4	3.89
S3	3	2.67	S18	9	4.56
S4	4	3.00	S19	4	3.22
S5	0	1.89	S20	5	3.67
S6	5	3.44	S21	1	2.00
S7	4	3.67	S22	3	2.11
S8	4	3.78	S23	6	4.11
S9	9	5.00	S24	2	1.67
S10	0	2.00	S25	4	3.33
S11	4	3.67	S26	3	2.11
S12	3	3.00	S27	2	1.44
S13	7	4.22	S28	3	3.56
S14	3	2.56	S29	4	3.33
S15	7	4.56	S30	6	3.22

Pearson Correlation coefficient: .874; significance probability, p-value: .000; n=30

In general, the students' narrative assessment about those who received a lot of nomination showed that they always enjoy their inquiry activities, prepare their activities in advance, have an active attitude toward presenting and writing a study paper with friends, and are not angry when the experiment is ruined (Table 6). The science teacher in charge also said that they are not afraid of making mistakes in science research and actively plan their inquiry and act as leaders in the group. As a result of this interview, it was confirmed that the higher the emotion about science learning, the more actively involved in scientific research, and thus supported by fellow students.

These results can be interpreted in parallel with Cozoline (2013) view that a stable emotional level increases strong group identity in interactive group activities. It can also be interpreted in the same context as the results studied by Yeo and Park (2005) that the more students perceive that they are receiving more recognition from their colleagues in friendship, the more positive they have about learning with self-esteem. Even Laine et al. (2020) argued that when students are en-

couraged to express their opinions before their friends, it leads to a positive emotional atmosphere towards learning (pleasure of learning, satisfaction with learning and interest in learning, etc.).

When students form a good friendship in their learning activities, they become confident and improve their learning skills and challenge problem solving more actively in their curriculum activities (Jeong & Lee, 2013; Lee et al., 2015). Therefore, if the level of academic achievement of students has been considered first in the science education so far, the emotional aspects affecting group activities in science learning should be considered further in the future (Han & Noh, 2002).

In the present inquiry-centered science class, the issue of 'Loner' has come up as a hindrance to inquiry activities. Therefore, it is necessary to enhance science learning in the affective aspect. Particularly, it seems necessary to develop and apply new science class programs that can enhance students' friendship. Such new programs should focus on problem-solving strategies through cooperation most of all, not expository instructions from teachers. It is because students tend to show more interest in their problem-solving process through cooperation than inquiry activities unilaterally suggested by teachers, and in the process, they come to show consideration for one another in the same group. It is also a good way of increasing their emotional levels through science learning.

Table 6. Emotional Characteristics of Highly Nominated Students (Results of Interview with a Teacher and Sudents)

Students	The Reasons Students Pointed Out	Teacher Interview Contents
S9	Hard sciences are also interesting.	She is active in unexpected search situations.
	When the experiment is ruined, she is not be angry and attempts it again.	She is very good at hearing the teacher's explanation before the experiment.
	When a friend announces, she listens to the end of the presentation.	She takes good care of friends.
	She does not bother with the arrangements after inquiry activities.	
S18	She always accepts happily what he learned through inquiry.	She enjoys participating in the search.
	She gets excited whenever science activity goes well.	She is satisfied with her own planned inquiry activities.
	She prepares necessary supplies for activities in advance.	She is not afraid of failure in the experiment.
S13	When friends argue that they will experiment with each other, they act as mediators.	She is not afraid of mistakes in the experiment.
	When friends argue with each other for their experiment, he acts as mediators.	Even if it's not interesting, he hears it through.
	She helps students who are not familiar with the inquiry.	She tries to relate science to himself.
	She makes excellent presentation of results.	
	He is trustworthy.	
S15	She knows the exact use of materials in the laboratory.	She always is comfortable with science activities.
	She helps when you have a friend who can't fill out a study sheet.	She plays the role of a leader when she is active with friends.
	She focuses on cases where things go wrong.	She is interested in science a lot.

CONCLUSION

This study aims to analyze the correlation between emotion level and friend relationship in science learning through social network analysis of middle school students in Korea. Achieving this goal seeks to gain implications on how to consider emotions in science learning.

Analysis of the emotional level in middle school students' science learning showed a high average score in 'interest', 'joy', and 'satisfaction' which are positive science learning emotional factors. These results were interpreted as positive results that match the educational goals of Korea's science curriculum.

Negative science learning emotions such as 'dissatisfaction' and 'anger' were found to be more than three points than other factors, so this suggests that middle school students in this study wanted to actively participate in science learning and concentrate on science inquiry. An analysis of friendship in the study found that there was a high correlation connection of nearly 1, and no students were isolated.

However, there were two students chosen alone, so the teacher had to consider the dangers of two students being alone. Also, two out of 30 students received ninth naming from their peers, and the other two students received seventh naming from their peers and formed a central axis in the class network. On the other hand, students who were not appointed by their peers seemed to need the attention of their colleagues around them because they were distributed outside the network. After analyzing the results of the statements about the reasons the students appointed with the characteristics of these networks, the four most-cited students turned out to be those who actively participated as leaders in science inquiry activities, helped their friends, and were not afraid of failure in an inquiry.

The science teacher in charge also said that they are very active in science inquiry activities, listening to the teacher's explanation and that they are very interested in science and liked their friends. The analysis of the correlation between emotion level and friendship in science learning shows that there is a strong static correlation between two variables, so it is highly likely that the emotional enhancement of science learning will form a cooperative friendship in science inquiry activities, and since smooth friendship is a fundamental factor in science inquiry activities, it can be expected to lead to positive learning through science. Above all, the science curriculum in Korea emphasizes the importance of cooperation in science inquiry by conducting inquiry activities as group cooperation learning, so the results of this study suggest that it is a way to develop various cooperative learning programs to raise the level of emotion in science learning. In subsequent studies, it is necessary to examine the effects of various inquiry methodical approaches on science learning emotions in a way that can improve the emotional level of science learning and on the social network. This should confirm a new science learning approach must combine emotional learning methods with knowledge-based learning methods.

In this study, the friendship formed in school science learning for about 9 months is checked one time, but to understand the change of friendship, it is necessary to carry out several tests in the long term and to carry out a long-term project on how it affects friendship according to emotional changes in science learning.

However, the class organization in Korea is made in early March every year and lasts for a year. Because every grade goes up, new classes are organized and the members are different, this is expected to act as a limitation for research.

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