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A Design on Teaching and Learning Method for Creative Talent in the FOURTH INDUSTRIAL REVOLUTION

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Abstract

Purpose; The purpose of this study is to examine the problems of the traditional teaching method, and to clarify how the teaching and learning methods for creative talents is reflected through the design on teaching and learning method for creative talent in the age of artificial intelligence(AI). The design of the creative teaching and learning model proposed in this study is largely classified into two stages, In-class(Offline Practice Learning Steps) and After-class(Post-Class Inquiry and Project-Based Learning). And the mechanism that connects learning states organically rather than independently separate concept, but is analyzed based on a questionnaire evaluation on the concentration and immersion of classes and the understanding of creative teaching and learning methods. And this paper explores that learners who will be at the center of future society have the power to think through concentration and immersion in solving their own difficult problems based on their experience of teaching and learning methods in university education. In this process, creativity is expressed. They will also feel happy with a sense of accomplishment, confidence, and satisfaction while solving difficult problems. This is why problem-based learning is necessary in university education. The teaching and learning method proposed in this study is to induce learners to think freely based on dialogue rather than discussion, and to lead the class by achieving the concentration and immersion in class, thus leading to a sense of achievement. The teaching-learning model, which incorporates elements that can solve problems on their own with convergent and logical thinking, has become an opportunity to reveal the importance of fostering creative talent for the artificial intelligence era.

[Keywords] *Creative Talents, Artificial Intelligence, Teaching and Learning Method, Traditional Teaching Method, Imaginative Creativity*

1. Introduction

Beyond the walls of the Third Industrial Revolution led by computer and Internet-based information society, the era of the Fourth Industrial Revolution, in which virtual and reality converged, and led by the AI society, has arrived. The beginning of the Fourth Industrial Revolution[1] is becoming a world in which not only competition with people who are striving for survival but also competition with machines with artificial intelligence. The development of science and technology, such as information and communication, has clearly progressed to provide a lot of convenience for humans, but on the other hand, it has also accelerated the problem of survival to survive the fierce competition such as the battlefield. Therefore, it is essential for companies that are preparing for the future to anticipate the need of fast-moving consumers and provide them with a competitive advantage by providing them with quality services. The

development of artificial intelligence, led by the Fourth Industrial Revolution, is leading the way to a new level beyond human expectations[2].

Artificial intelligence's judgment and prediction capabilities begin with deep learning. Deep learning, one of artificial neural networks, makes it possible to make judgments and predictions using machine learning methods while repeatedly repeating the process of selectively extracting specific patterns using a large number of big data[3]. Moreover, the development of online to offline(O2O), where online technology connects to the offline market, is connecting consumers easily and rapidly spreading the predictive power of deep learning. More realistically, the age of artificial intelligence has been thought of superintelligence transcending the inherent intelligence of humans as a result of with computers and robots based on big data. In addition, hyper connectivity, where different disciplines are interconnected, is accelerating. For example, the connection of IoT, big data & smart farming is the future of agriculture[4], and also the connection between public transportation and IoT make smart cities. The next step in deep learning is the real revolution of artificial intelligence, which predicts and acts like human sensory functions. For example, three months after the Fourth Industrial Revolution, Google developed AlphaGo, which proved beyond human predictability and proved itself in a battle with humans[5]. In addition, it predicts the surrounding environment and analyzes traffic information closely to drive on its own and prevent accident driving. This is autonomous driving.

The society of reality is becoming another platform that is spreading in all industries, including service systems that are converged online and offline. The artificial intelligence Watson developed by IBM is being implemented in the off-line phase, which is used to predict disease or cancer[6]. It is clear that in the future society, there will be a clear difference between the companies that move AI and those who are aided by AI, and a society in which new judgments and predictions are centered. What talent will companies need in the age of Artificial Intelligence? It is a creative convergence talent.

Future companies are looking for talents who have learned about human empathy, such as identity and relationships, or those who have problem-solving skills[7][8] instead of smart talents with one expertise. These talents can come out through creative convergence education, which will be absolutely advantageous in the age of artificial intelligence. In other words, as future society is expected to be replaced by artificial intelligence, where machines replace people's work, future talent with imaginative creativity that artificial intelligence cannot have is more important.

In general, universities which are higher education institutions, cultivate outstanding talents required by firms, and at the same time, companies that want to possess keen competitiveness are looking for creative talents to plan, develop, and service new products that enrich and facilitate human life. Therefore, it is inevitable for universities to change the paradigm of university education, that is, innovative change in education for future talent[9][10][11].

In the age of artificial intelligence, universities have very little will and effort to develop a variety of programs or contents on how to improve creativity or how to cultivate creative talents, even though future companies want creative talent. The role of cultivating creative convergent future talents should be centered on universities which are higher education institutions. In the age of Artificial Intelligence with a rapid development of computers and the Internet, is there a need for education that memorizes well and receives test scores according to the subjects given by textbooks in an environment full of knowledge and information?

Future university education should not be an injection or memorization education method like the traditional class, but a creative education[12][13] that can develop the ability that cannot be replaced by artificial intelligence or robot. In other words, not a uniform education that

requires the same ability, but creative education is required, that future talent can collect, explore, and analyze a lot of data to de-rive new information based on expertise, and to develop their own ability to think differently from others.

What about a people who are only 0.2% of the world's population, about 22% of all Nobel prizes, and 40% of the billionaires of the United States? Jews. And what are the driving forces that generate a lot of genius in world history? The reason is found in the unique Havruta teaching method[14]. A closer look at Havruta's teaching and learning method is very similar to creativity. This teaching-learning method is an educational method that constantly asks questions and answers to expand thinking and to consider others and to be different from others rather than to compete with others.

Creativity education with the characteristics of coming up with new things should stimulate curiosity about expertise and, through experience, discover new problems on their own and develop the capacity to solve them successfully[15]. Creativity education is the power to think in a word. At the core of creativity education is discussion and dialogue, as mentioned in the Havruta education. In this method of education, the other's opinion, logical thinking, and emotion are very important.

Although creative class can devise various methods, this paper proposes a design of teaching and learning method for developing creative talents in the age of Artificial Intelligence. The distinguishing feature of this study is to develop a sense of accomplishment by allowing learners to concentrate on fun and immersing themselves in a way that learners can freely set subjects and learn around conversations. Learners can maximize the concentration and immersion in the class, leading to a sense of accomplishment, thereby improving problem-solving, logical thinking, and imaginative creativity.

This study is meaningful that it can foster creative human resources who can actively cope with the rapidly developing uncertain society beyond the limitations of passive thinking talent education such as memorization education and the multiple-choice examination in the AI era society. In addition, It is meaningful that it can be organically linked to adjacent fields centering on basic research on the design of teaching methods.

2. Design of Education Model for Proposed Teaching and Learning Method

Communication between instructors and learners or learners is very important in the field of education. The ability to mutual communication with one another is to be able to speak appropriately so that the other person can understand their meaningful messages, to understand and use verb al and non-verbal expression forms, and to understand their writings, meaning the ability to write correctly to listen to other people's opinions. Communication is important because it is built on cooperation, which is a very important ability for learners to prepare for the present and AI era.

For example, auto-driving car, many technologies are required, but the most important requirement is the auto-driving system and human communication. Therefore, learners should focus on developing communication skills in college education in order to under-stand and communicate with each other by sharing and collaborating information and technology in the AI era. Discussion is important in communication, but more important is conversation. In the age of artificial intelligence, conversations can rediscover the depth of others' values by listening to and collaborating with each other, as opposed to the discussions that persuades them to compete with each other and to support the dichotomous arguments that divide their arguments be-tween right and wrong.

The educational model of teaching and learning method proposed in this study focuses on learning the creative thinking ability by listening to the other's words while cooperating with each other by increasing the concentration and immersion of the class rather than the discussion.

Design of education model for proposed teaching and learning method is classified into two stages. In-class(Offline Practice Learning Steps) is shown in <Figure 1>, After-class(Post-Class Inquiry and Project-Based Learning) is shown in <Figure 2>, and The design process of the education model is shown in <Figure 3>, The contents of the education model are as follows.

① In-class(Offline Practice Learning Steps)

In-class classes are organized into theoretical learning and communication learning stages.

First of all, in the theoretical learning stage, the instructor provides video lecture materials to learners using learning tools such as YouTube, band, and smart apps. And Learners faithfully understand lesson while watching the video of the lecture, and write questions about the video content at the same time. At this time, the contents of the question are to list the difficult part of the class or one's own thoughts.

Next when the video is finished watching, the instructor explains to the learners a summary of the video content and supplementation. At this point, the most important step is to answer questions written by the learners, and the instructor should try to minimize the learners' questions by responding sincerely.

Instructors also tests how well they understand what they are learning. They may be several tools for testing, but this study used the play function of Kahoot[8]. Instructor should of course, prepare the contents for the comprehension tests in advance.

In the communication learning phase, as a problem-based phase, the learner expresses what he/she thinks about the learning con-tents in writing, i.e. summarize the learning contents and writes his thoughts in writing. This learning phase will develop into a self-directed learning phase. At this stage, learners can be taught individually or in small groups. In this study, the class was conducted as small groups.

Finally, individual learners or small groups carry out 'group conversations' so that other learners understand what they write. The significance of this 'group conversation' is that other learners can naturally feel the difference with their thoughts and sympathize with each other to expand the learning content, as well as improve logical thinking and mutual communication.

In the traditional teaching method, learners did not have the opportunity to collaborate and communicate with each other in the course of the instructor's transfer of expertise, so there was no voice of learners in the classroom.

The most important thing to nurture creative convergence talent is to teach the class so that learners can lead with motivation and lead in the classroom. Therefore, the education model should be designed in such a way that learners can break the silence of the classroom with concentration and immersion in the class-room.

Figure 1. In-class(Offline practice learning steps).
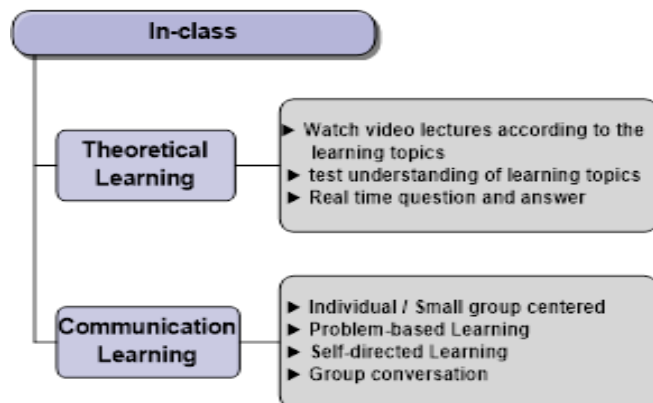
② Post-class Inquiry and Project-Based Learning

In the After-class, classes are divided into inquiry learning and task-based learning stages. In the exploratory learning phase, learners summarize and organize their lessons, produce video themselves and upload them to YouTube. At this stage, you had a good understanding of the class, but you should make your own content after class and include your thoughts. The advantage of this step is that you can learn the videos your own make without time and space restrictions.

Figure 2. After-class(Post-class inquiry and project-based learning).
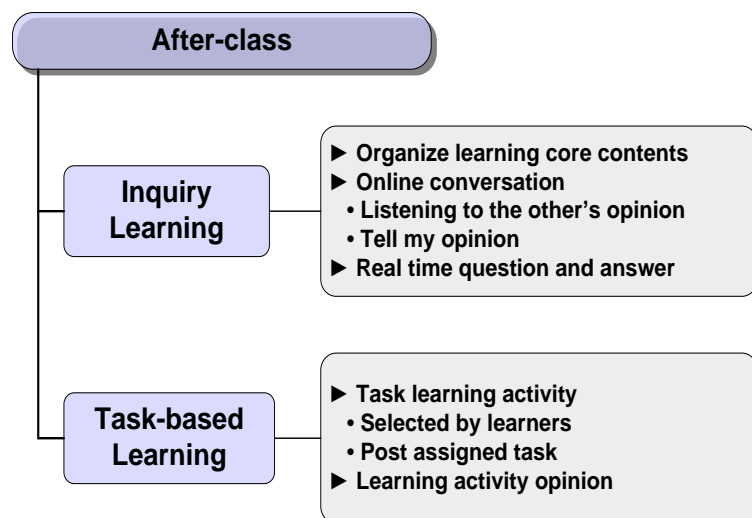
Moreover, the video production method and the YouTube production method can be extended to other subjects and do not need a separate textbook or note-taking. Therefore, you can develop their ability to express your own thoughts in words or in writing, by refer-ring to other learners' ideas. Thus, creative convergence can be increased.

In addition, it is necessary to use 'conversation square' of the band created by instructor to 'com-municate' to understand the other's opinions and to express their thoughts. The most important thing in the class is to express your thoughts actively based on the contents of the class rather than how much you under-stand it, and to improve your thinking ability by talking with other learners.

I think the Jewish Havruta teaching method is a conversational learning method rather than a dis-cussion. The reason why 'conversation' teaching method is required beyond the discussion of 'de-bate', which was mainly dealt with in the age of the third industrial revolution, emphasized 'out-

center' or 'cooperative learning' rather than individual-centered or competitive learning in the age of artificial intelligence.

And in the task activity learning phase, the instructor gives the learners a topic related to the class contents, they freely selects the subjects they are given, writes their intentions logically, produces video and registers it on YouTube. And as learners can examine differences with themselves, their strengths and weaknesses while watching what is registered on YouTube, it is possible to obtain not only thinking but also imaginative creativity.

Finally, the instructor should collect opinions from the learners about "what they liked in this class," "what did they understand and what they thought about it," "the advantages of this class," and "what they hope for this class." It is to use it as a reference for the next class.

The design of teaching and learning method for fostering creative talents proposed in this study is different from the Flipped Learning[16][17] and Project Based Learning (PBL). Flipped-learning is a teaching-learning method centered on online pre-learning and off-line presentations and discussions. And PBL is a teaching-learning method aimed at improving Logical thinking skill by improving problem-solving and collaboration on a problem-based project basis. These teaching and learning methods are innovative in that they complement the shortcomings of traditional teaching methods that convey simple expertise and encourage learners to participate in classes.

However, in the case of Flipped-learning teaching and learning methods, learners may feel burdened when the online lecture is difficult or the video volume is large. Furthermore, if the learner does not study in advance, the discussion class that is conducted offline can be difficult in itself. In addition, the PBL should be continuously connected from elementary school, even before entering university, but the linkage is extremely low considering the domestic environment in which the paper-based examination class is being conducted.

Moreover, instructors who need to perform various tasks besides classes, including various subject classes, are limited to continuous program or content development, and there is room for improvement in that it is not easy for instructors to prepare objective evaluation criteria.
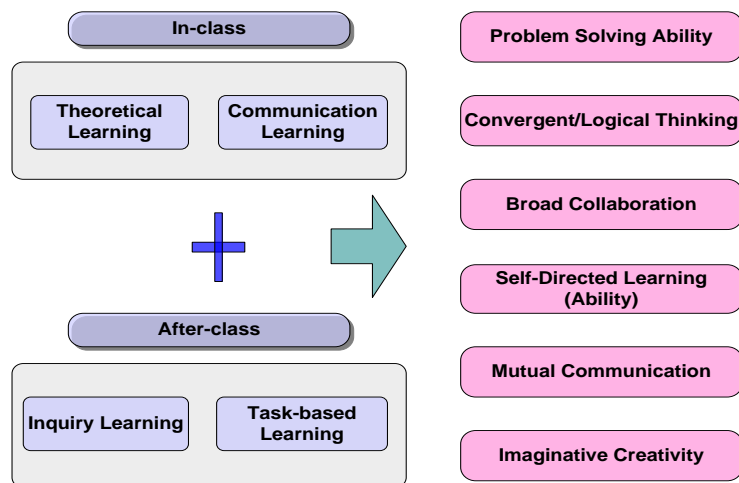
However, the proposed teaching and learning method design has overcome the disadvantages of Flipped-learning and PBL teaching and learning methods. In other words, the proposed teaching-learning method design enhances the understanding of class contents in a short time by allowing the learner to watch videos made by the instructor in the class with the highest concentration of learners. Learners write their own summaries and comments, and then pre-sent them to other learners for easy understanding.

Moreover, this design in not a discussion state, which is the center of Flipped-learning and PBL teaching methods, but a conversation-based learning stage. It is characterized by the ability to broadly understand and think about each other's opinions and various ideas. There-fore, it is possible to increase concentration and commitment to the class.

The future talent emphasizes the importance of creative convergence in the age of artificial intelligence. Then in which direction should universities that have creative convergence talents shift their education paradigm? It should be a noisy classroom rather than a quiet classroom like the Havruta learning method, an education that is thought in memorizing education, an education that emphasizes wisdom rather than knowledge transfer is central, and an education that explores various answers rather than one that teaches one correct answer.

In the future, we need to continuously integrate our knowledge and information, improve our ability to come up with new ideas, communicate with others, and continue to create our own ideas to improve our creative skills. Therefore, universities that nurture future talents should express their ideas in writing and develop into a teaching-learning method that focuses on dialogue rather than discussion.

Figure 3. Educational model design process.

3. Conclusion

This study proposed the design of teaching and learning methods for developing creative human resources in the age of the Artificial Intelligence. As future society demands more creative convergence talents, education that delivers simple expertise should be trans-formed into dialogue-based education. And it should be shifted from teacher-centered education to learner-centered education. In addition, it should be shifted from a competitive learning system to a collaborative learning system.

In the age of artificial intelligence, the ultimate goal of education in universities should be to nurture talent so that those who will lead the future can dream of happiness. For anyone, problems appear and try to be solved in some way or another way. How do you deal with a difficult problem if it is given?

An inexperienced person will likely give up before solving a difficult problem, but an experienced person will develop confidence and challenge. Every time a problem arises, it tries to solve the problem by applying standards and judgments in its own way, which can lead to happiness when solving the fundamental problem with convergence and creative thinking. This is why creative education is so important.

The proposed teaching-learning model was applied only to the 'Intensive English Reading Class', but it is expected to expand the scope of the basic research proposed in this paper to be organically linked to other adjacent fields. In addition, based on the experimental teaching-learning model for this study, it is expected that the preceding research can be conducted in accordance with the domestic educational environment by attempting a technical approach such as developing various programs or contents.

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5. Contribution

5.1. Authors contribution

	Initial name	Contribution
Author	KYD	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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HUMAN & DISASTER: A Study of Prediction on the Species Number and Naturalization Index of Land Naturalized Plants

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Abstract

Foreign plants introduced by overseas exchanges are rapidly transformed into naturalized plants and pose serious threats to biodiversity, including domestic native species. Therefore, this study is based on the flora survey data of 776 map numbers(1200 places) for 12 years from 2006 to 2017, the third to fourth data of the National Natural Environment Survey, the nation's largest basic research project on the natural ecosystem. By analyzing plant species and naturalized plant species and predicting naturalized plant species and naturalization Index, they can be used as basic data to study environmental changes, or they can be used to set various indicators applying naturalized plants and naturalization Index and to set the upper limit of permit for development activities. Therefore, in this study, one-way ANOVA analysis and MANOVA analysis were conducted to determine whether there is a difference in naturalized plant species and naturalization Index by year, region, altitude, population density, GDP, and the ratio of forest to area. There was a correlation between the items such as year, region, altitude, population density, GDP, the ratio of forest to area and the number and naturalization Index of naturalized plants, and the greatest impact on the naturalized plant species and naturalization Index. Curve estimation regression, multiple regression, and dummy variable regression were performed to find out which items are causing the problem. Through this research, it is thought that the naturalization Index predicted by this study can be used for the issue of Permit on Exclusive use of inter-mountain area altitude standard, which is operated under the Act on Planning, and Use of National Territory, and the Mountain Site Management Act. The naturalization Index predicted by this study can be used as basic data for setting the upper limit of Permit on Exclusive use of inter-mountain area, or for studying environmental change, or for setting various indicators.

[Keywords] Naturalized Plants, Naturalization Index, Region, Altitude, Population Density

1. Introduction

The natural ecosystem is composed of biological elements, e.g. animals and plants, and abiotic elements such as topography, soil and climate. However, increases in the number of population and industrial facilities due to urbanization and industrialization have accelerated environmental pollution and climate change[1], reducing biodiversity by degrading and destructing the natural ecosystem. As for the causes decreasing the biodiversity, Ryu Young-jo(2002) identified habitat destruction caused by artificial development and ecosystem degradation[2], whereas Kim Dong-un(2018), Yoon Ik-jun(2013), Jung Soo-young(2014) and Kim Ha-song(2010) pointed at the introduction of foreign organisms[3][4][5][6], Similarly, Lee Hwa-chun(2002) reported that changes and destruction of habitats increased invasion rate of foreign species, which are intentionally or accidentally introduced, and overdevelopment can cause the reduc-

tion in biodiversity[7]. Moreover, Cho Hyun-seok and Cho Kang-hyun(2015) noted that naturalized plants are one of the biggest threats to biodiversity, which not only negatively affect the ecosystem but also cause socioeconomic loss, such as disease transmission and reduction in crop yield[8]. Research on naturalized plants began in the 1960s, and the numbers, areas and directions of the research have been steadily expanding since the 2000s. In particular, the studies of naturalized plants have been concentrated within the field of vascular plant research, and studies that analyze the characteristics of naturalized plants in specific regions or ecological environments of specific naturalized plants have been actively conducted[9]. Among them, the naturalization index, which is used as a method for estimating the degree of human interference or naturalness, is a ratio of naturalized plants devised by Numata and Kotaki(1975)[10] used by many researchers as one of the equations determining environmental indicator. Nevertheless, Numata and Kotaki's(1975) naturalization index has the inconvenience of requiring floristic survey and investigations on naturalized plants[10]. Therefore, this study is based on the flora survey data of 776 leaflets(1200 places) for 12 years from 2006 to 2017, the 3rd to 4th data of the National Natural Environment Survey[11], the largest basic survey project for the natural ecosystem. It is used as a basic data for analyzing environmental species by analyzing plant species and naturalized plant species, predicting naturalized plant species and naturalization index, or used to set various indicators applying naturalized plant species and naturalization index and the upper limit of permission for development activities. We conducted this study in anticipation of becoming a member. This study is based on the flora survey data of 776 map numbers(1200 places) for 12 years from 2006 to 2017, the third to fourth data of the National Natural Environment Survey, the nation's largest basic research project on the natural ecosystem. This study is expected to be useful as fundamental data for studies examining the environmental changes by analyzing plant and naturalized plant species and predicting naturalized plant species and naturalization index or it can be used in setting the upper limit of criteria for setting various indexes and conducting development activities by applying naturalized plants and naturalization Index

2. Methods

2.1. Gathering data

The subjects of this study are 776 map numbers(1,200 places), excluding 48 of the 824 map numbers in Korea, which do not have a list of plants or have not been surveyed as a marine or national park, and the investigation period is 12 years from 2006 and 2017. Among them 2017 had the greatest number of 148 subjects(12.3%), followed by 142(11.8%) in 2014, 120(10.0%) in 2008 and 2010, 117(9.8%) in 2009. 2015 had the least number of 10(0.8%) subjects and 2016 had the second least number of 30(2.5%) subjects.

2.1.1. Data analysis

In this study, one-way ANOVA and multivariate variance analysis(MANOVA) were conducted to understand the differences among the items categorized according to the naturalized plant species and naturalization index by year and altitude. In addition, quadratic regression and multiple regression analysis were performed to examine the correlations. All analyses metioned in this section were carried out by using SPSS Statistics 21 statistics program.

3. Results & Discussion

3.1. Species analysis of naturalized plants

3.1.1. Species analysis by year

The results of MANOVA analysis carried out to find the differences between plant and naturalized plant species by year are shown in <Table 1>. The average number of plant species gradually increased from 162.0 species in 2006 to 179.3 species in 2007, 190.6 species in 2008, 200.9 species in 2009, 209.4 species in 2010 and 223.2 species in 2011, followed by a small decrease to 221.4 species in 2012 and increase to 240.9 species in 2013 and another decrease to 220.5 species in 2014. It indicates that the number of plant species, in general, varies year to year. In fact, the average number of naturalized plant species by year showed increases similar to that of the plant - 6.9 in 2006 to 9.5 in 2007, 11.1 in 2008, 13.0 in 2009, 13.8 in 2010 and 16.2 in 2011 - followed by decreases to 13.4 in 2012 and 12.5 in 2013, increase to 15.4 in 2014 and another decrease to 11.9 in 2015. It shows that the number of naturalized plant species also fluctuates similar to that of the plant. Levene's test of equality of error variance showed that the naturalized plant species were identified as a group through equal variance, and the plant species were also analyzed to belong to the same group with the equal variance of p = 0.364. The test results of year effect on plant and naturalized plant species conducted to examine the effects of year on the species showed F=30.035 and p=0.000 for plant species and F=45.672 and p=0.000 for naturalized plant species, indicating year has effects on the species of plants and naturalized plants.

Table 1. Variance analysis of plant Species and naturalized plant species by year.

		Descriptive statistics			
		Plant Species		Naturalized Plant Species	
Year	Number of Study Sites	Avg. Number of Species	Std. Deviation	Avg. Number of Species	Std. Deviation
2006	85	162.0	70.18	6.9	4.43
2007	110	179.3	93.59	9.5	8.76
2008	120	190.6	90.11	11.1	7.76
2009	117	200.9	81.33	13.0	9.21
2010	120	209.4	77.45	13.8	9.84
2011	113	223.2	82.00	16.2	9.94
2012	105	221.4	81.83	13.4	6.81
2013	100	240.9	82.26	12.5	7.36
2014	142	220.5	72.25	15.4	8.20
2015	10	275.8	108.26	14.9	6.85
2016	30	368.7	84.34	31.1	9.50
2017	148	297.3	86.22	26.7	12.67
Total/Avg	1200	222.2	92.78	14.9	10.67

Note: Levene's test of equality of error variance

Number of Plant Species : F=1.092, df1=11, df2=1188, p=0.364

Number of Naturalized Plant Species: F=10.207, df1=11, df2=1188, p=0.000

3.1.2. Species analysis by altitude

The results of the MANOVA analysis performed to identify the difference between plant and naturalized plant species by altitude are shown in <Table 2>. The average number of plant species was gradually increased from 148.1 at 0-50m to 182.7 at 51-100m and 214.6 at 101-150m and then also gradually decreased to 208.0 species at 151-200m, 203.2 at 201-250m and 191.1 at 251-300m. As the altitude increases, the number of flora species repeatedly increased and

decreased with the largest number of 302.0 species found at 1201-1250m. Similarly, the average number of naturalized plant also fluctuated with altitude, showing 19.4 species at 0-50m decreasing to 16.8 at 51-100m, increasing to 19.3 at 101-150m and 19.8 at 151-200m and decreasing again to 18.8 at 201-250m, 14.8 at 251-300m and 14.3 at 301-305m.

Levene's test of equality of error variance showed that the naturalized plant species were identified as a group through equal variance, and the plant species were also analyzed to belong to the same group with the equal variance of p = 0.504.

The test results of altitude effect on plant and naturalized plant species conducted to examine the effects of altitude on the species showed F=2.923 and p=0.000 for plant species and F=2.779 and p=0.000 for naturalized plant species, indicating that altitude has effects on the species of plants and naturalized plants.

Table 2. Variance analysis of plant species and naturalized plant species by altitude.

Descriptive Statistics					
Year	Number of Study Sites	Plant Species		Naturalized Plant Species	
		Avg. Number of Species	Std. Deviation	Avg. Number of Species	Std. Deviation
0-50	14	148.1	63.31	19.4	11.82
51-100	27	182.7	102.78	16.8	14.00
101-150	54	214.6	112.67	19.3	13.00
151-200	66	208.0	94.27	19.8	13.27
201-250	52	203.2	86.37	18.8	13.45
251-300	50	191.1	79.90	14.8	8.97
301-350	59	196.2	89.37	14.3	10.26
351-400	71	217.2	89.29	16.3	11.04
401-450	62	230.2	71.61	17.5	10.19
451-500	69	211.1	89.39	13.5	10.08
501-550	71	226.2	102.28	16.2	11.89
551-600	82	229.9	87.08	15.1	10.55
601-650	88	210.7	80.81	13.2	9.09
651-700	59	212.8	77.42	12.9	9.77
701-750	46	211.5	84.32	11.3	8.57
751-800	53	256.1	95.34	14.9	10.78
801-850	45	228.1	102.74	12.7	9.36
851-900	38	251.6	89.69	13.8	10.20
901-950	37	220.2	89.68	11.4	7.72
951-1000	29	255.0	98.63	13.3	8.56
1001-1050	16	259.9	92.69	12.5	8.08
1051-1100	19	275.9	94.18	15.5	9.03
1101-1150	17	284.4	94.22	11.6	5.68
1151-1200	26	262.3	114.20	13.2	8.63
1201-1250	14	302.0	100.18	15.1	7.21
1251-1300	15	244.0	84.04	8.0	5.26
1301-1350	6	220.8	79.42	9.0	6.57

1351-1400	6	225.0	73.91	6.2	4.40
1401-1450	3	261.3	50.14	8.3	4.04
1451 or higher	6	219.0	97.39	6.5	6.57
Total/Avg.	1200	222.2	92.78	14.9	10.67

Note: Levene's test of equality of error variance
Number of Plant Species : F=0.975, df1=29, df2=1170, p=0.504
Number of Naturalized Plant Species : F=2.283, df1=29, df2=1170, p=0.000

3.2. Analysis of naturalization index of naturalized plants

3.2.1. Naturalization index analysis by year

The results of One-way ANOVA analysis conducted to examine the differences among different years are as shown in <Table 3>. The F value and significance probability of naturalization index respectively were F=18.532 and p=0.000, indicating that year has no effects on the naturalization index. Naturalization index by year was 4.45% in 2006, 4.90% in 2007, 5.69% in 2008, 6.10% in 2009, 6.18 % in 2010 and 7.22% in 2011, showing a gradual increase. However, it decreased to 6.21% in 2012, 5.15% in 2013, bounced back to 7.12% in 2014 followed by a dip to 5.48% in 2016 and increased again to 8.46% in 2016 and 8.80% in 2017, showing a steady increase except the 4 years between 2012 and 2015.

Table 3. Variance analysis of naturalized plant species by year.

One-way ANOVA analysis					
Division	Sum of squares	df	Mean square	F	Significance probability
Between - group	1945.767	11	176.888	18.532	.000
Within - group	11339.300	1188	9.545		
Total	13285.067	1199			

3.2.2. Naturalization index analysis by altitude

The results of One-way ANOVA analysis conducted to examine the differences among different altitudes are as shown in <Table 4>. The F value and significance probability of naturalization index respectively were F=10.902 and p=0.000, showing a different naturalization index at different altitudes. Naturalization index by altitude was the highest at 0-50m with 12.25% followed by a big drop to 8.40% at 51-100m. As the altitude increased the naturalization index decreased, showing 8.64% at 101-150m and 2.50% at altitude of 1451m and higher. This is equivalent to 4.9 times reduction from 12.25% at 0-50m.

Table 4. Variance analysis of naturalized plant species by altitude.

One-way ANOVA analysis					
Division	Sum of squares	df	Mean square	F	Significance probability
Between - group	2826.283	29	97.458	10.902	.000
Within - group	10458.784	1170	8.939		
Total	13285.067	1199			

3.3. Correlation analysis of naturalized plant species

3.3.1. Correlation analysis between naturalized plant species and year

The results of correlation analysis between naturalized plant species and year are as shown in <Table 5>. The linear regression model and quadratic regression model (secondary model) both were found to be adequate; however, the dependent variables of quadratic regression model did not have a significant influence on the independent variables whereas the dependent variables of linear regression model showed a significant influence on the independent variables. The analysis results can be expressed in the following equation which has R2 value or explanatory power of 22.1%
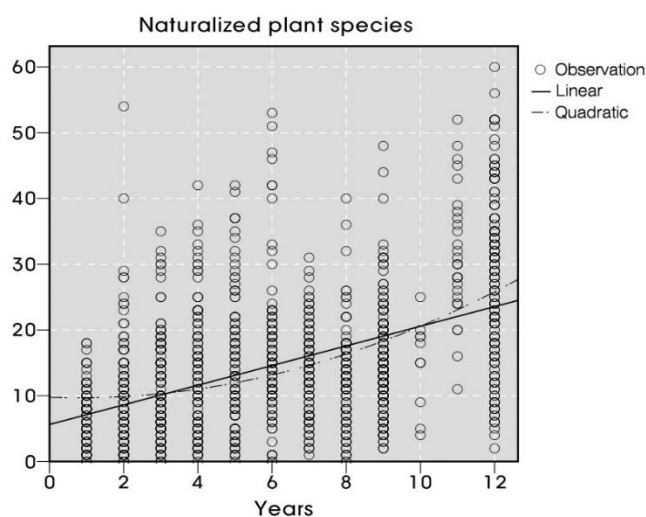
$$y = 5.632 + 1.494x ---------(Eq.)$$

where, y= number of naturalized plant species, x=year

In other words, the relationship between the number of naturalized plant species and year has a positive correlation that increases the number of species every year.

Table 5. Analysis of correlation between naturalized plant species and years.

Model summary and parameter estimates								
Dependent variable : naturalized plant species								
Model summary						Parameter estimate		
Equation	R squared	F	Degree of freedom 1	Degree of freedom 2	Probability of significance	Constant term	b1	b2
Linear	.221	340.176	1	1198	.000	5.632 (.000)	1.494 (.000)	
Quadratic	.239	187.777	2	1197	.000	9.782 (.000)	-.208 (.532)	.129 (.000)

Figure 1. Correlation between the number of naturalized plant species and year.

3.3.2. Correlation analysis between naturalized plant species and altitude

The results of correlation analysis between naturalized plant species and altitude are as shown in <Table 6>. The linear regression model and quadratic regression model(secondary model) both were found to be adequate; however, the dependent variables of quadratic regres-

sion model did not have a significant influence on the independent variables whereas the dependent variables of linear regression model showed a significant influence on the independent variables. The analysis results can be expressed in the following equation which has not too significant R2 value or explanatory power of 3.9%.

$$y = 18.874 - 0.333x \text{ --------(Eq.)}$$

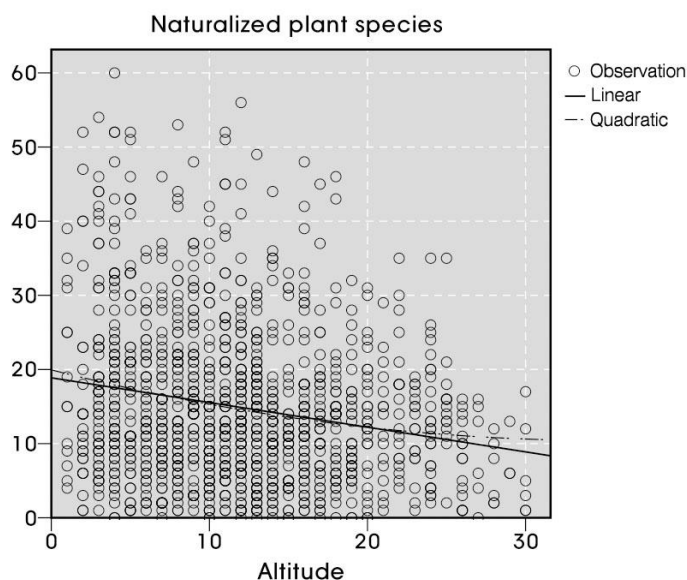where, y=number of naturalized plant species, x=altitude

In other words, the relationship between the number of naturalized plant species and altitude has a negative correlation in which the number of species decreases as the altitude increases.

Table 6. Analysis of correlation between naturalized plant species and altitude.

Model summary and parameter estimates								
Dependent variable : naturalized plant species								
Model summary						Parameter estimate		
Equation	R squared	F	Degree of freedom 1	Degree of freedom 2	Probability of significance	Constant term	b1	b2
Linear	.039	49.246	1	1198	.000	18.874 (.000)	-.333 (.000)	
Quadratic	.041	25.392	2	1197	.000	19.944 (.000)	-.539 (.002)	.008 (.218)
Independent variable = Altitude								

Figure 2. Correlation between the number of naturalized plant species and altitude.

3.3.3. Correlation analysis of naturalized plant through multiple regression analysis

The results of multiple regression analysis on year and altitude are as shown in <Table 7>. The regression model showed statistically significant F=193.509, p=0.000 and the significance probability of the correlation coefficient between year and altitude was also found to be significant. The analysis results can be expressed in the following equation with explanatory power of 24.4%, which is 2.3% higher compared to that of the linear regression model and 20.5% higher than the explanatory power of quadratic regression model.

$$y = 9.009 + 1.445x1 - 0.256x2 \text{ --------(Eq.)}$$

where, y=number of naturalized plant species, $x1$=year, $x2$=altitude

Table 7. Correlation analysis of naturalized plant species through multiple regression analysis on year and altitude.

Independent variable	Unstandardized coefficient(B)	Std. Error	Standardized coefficient	t	Significance probability	R2
(Constant)	9.009	.792		11.379	.000	
Years	1.445	.080	.455	18.013	.000	.244
Altitude	-.256	.042	-.153	-6.058	.000	

Dependent variable : naturalized plant species

Note : F=193.509 p=0.000

Since this study conducted with the subjects of national natural environment survey data collected from mountains and waterside areas where the flora is deemed to be most diverse among the map numbers, the habitat environment was not considered. However, as demonstrated in previous studies, the number of naturalized plant species is can be different with different habitat environment even at the same altitude, and thus the habitat environment should also be taken into account. Therefore, the value of weight accounting for the habitat environment was assigned to developed land 0.7, roadside 0.8 and forest 1.0 and set the following equation by referring to the number of introduced naturalized plant species by habitat location presented by Lee Hyang-ju(2018).

$$y = (9.009 + 1.445x1 - 0.256x2) \times \text{Habitat Type (Weight)--------(Eq.)}$$

where, y=number of naturalized plant species, $x1$=year, $x2$=altitude

Table 8. Weight of naturalized plant species per habitat type considering the habitat environment[9].

Habitat type / Division	Developed land	Roadside	Farmland	Orchard	Forest	Grassland.fallow land	River. lake
Lee Hyang-ju (2018) Number of introduced naturalized plant species	45	53	61	47	65	64	69
Weight value	0.7	0.8	0.9	0.7	1.0	1.0	1.0

Weight value of the number of naturalized plant species for each habitat type

= Number of introduced naturalized plant species for the habitat type ÷ 67(Avg, number of introduced species at forest, river and lake)

3.4. Correlation analysis of naturalization index

3.4.1. Correlation analysis between naturalization index and year

The results of correlation analysis between naturalization index of naturalized plants and year are as shown in <Table 9>. The linear regression model and quadratic regression model(secondary model) both were found to be adequate; however, the dependent variables of quadratic regression model did not have a significant influence on the independent variables whereas the

dependent variables of linear regression model showed a significant influence on the independent variables. The analysis results can be expressed in the following equation which has R2 value or explanatory power of 10.2%.

$$y = 4.422 + 0.317x \text{ ----------(Eq.)}$$
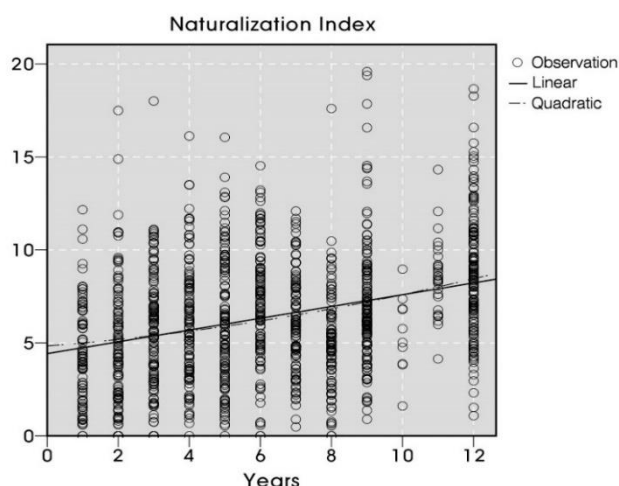
where, y=naturalization index, x=year

In other words, the relationship between the naturalization index and year has a positive correlation in which the number of species increases in each year.

Table 9. Analysis of correlation between naturalization index and years.

Model summary and parameter estimates								
Dependent variable : Naturalization Index								
Model summary						Parameter estimate		
Equation	R squared	F	Degree of freedom 1	Degree of freedom 2	Probability of significance	Constant term	b1	b2
Linear	.102	136.526	1	1198	.000	4.422 (.000)	.317 (.000)	
Quadratic	.104	69.547	2	1197	.000	4.836 (.000)	.147 (.191)	.013 (.121)
Independent variable = years								

Figure 3. Correlation between naturalization index and year.

3.4.2. Correlation analysis between naturalization index and altitude

The results of correlation analysis between naturalization index and altitude are as shown in <Table 10>. The linear regression model and quadratic regression model (secondary model) both were found to be adequate and have dependent variables with a significant influence on the independent variables. The linear regression model analysis results can be expressed in the following equation which has R2 value or explanatory power of 17.6%.

$$y = 9.014 - 0.219x \text{ --------(Eq.)}$$

where, y=naturalization index, x=altitude

The quadratic regression model(secondary model) analysis results can be expressed in below equation with explanatory power of 18.8%, which is 1.2% higher than that of the linear regression model.

$$y = 10.050 - 0.419x1 + 0.007x2 \text{ --------(Eq.)}$$

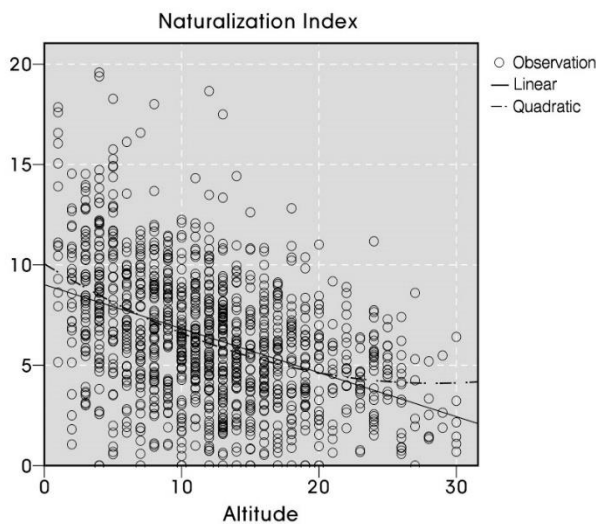where, y=naturalization index, x=altitude

The naturalization index and decreases as the altitude increases to a certain level at which the relationship between the two changes into a positive correlation.

Table 10. Analysis of correlation between naturalization index and altitude.

Model summary and parameter estimates								
Dependent variable : Naturalization Index								
Model summary						Parameter estimate		
Equation	R squared	F	Degree of freedom 1	Degree of freedom 2	Probability of significance	Constant term	b1	b2
Linear	.176	255.696	1	1198	.000	9.014 (.000)	-.219 (.000)	
Quadratic	.188	138.205	2	1197	.000	10.050 (.000)	-.419 (.000)	.007 (.000)
Independent variable = Altitude								

Figure 4. Correlation between naturalization Index and altitude.

3.4.3. Correlation analysis of naturalization index through multiple regression analysis

The results of multiple regression analysis on year and altitude showed a statistically significant F=203.564 and p=0.000 with significant significance probability of the correlation coefficient between year and altitude in quadratic regression model. The analysis results can be expressed in the following equation with R2 value or explanatory power of 25.4%, which is 15.2% higher compared to that of the linear regression model and 6.6% higher than the explanatory power of high-degree quadratic regression model(secondary model).

$$y = 7.116 + 0.278x1 - 0.256x2 \text{ --------(Eq.)}$$

where, y=naturalization index, $x1$=year, $x2$=altitude

Table 11. Correlation analysis of naturalization index through multiple regression analysis on year and altitude.

	Dependent variable : Naturalization Index					
Independent variable	Unstandardized co-efficient(B)	Std. Error	Standardized coefficient	t	Significance probability	R2
(Constant)	7.116	.245		28.994	.000	
Years	.278	.025	.281	11.179	.000	.254
Altitude	-.205	.013	-.391	-15.589	.000	
	F=203.564 p=0.000					

Since this study conducted with the subjects of national natural environment survey data collected from mountains and waterside areas where the flora is deemed to be most diverse among the map numbers, the habitat environment was not considered. However, as demonstrated in previous studies, the number of naturalized plant species is can be different with different habitat environment even at the same altitude, and thus the habitat environment should also be taken into account. Therefore, the value of weight accounting for the habitat environment was assigned to developed land 2.3, roadside 1.8 and forest 1.44, as listed in <Table 12>, and set the following equation by referring to the number of introduced naturalized plant species by habitat location presented by Lee Hyang-ju (2018） .

$$y = (7.116 + 0.278x1 - 0.205x2) \times \text{Habitat type (weight)--------(Eq.)}$$

where, y=naturalization index, $x1$=year, $x2$=altitude

Table 12. Weight of naturalization index per habitat type considering the habitat environment[9].

Habitat type Division	Developed land	Roadside	Farmland	Orchard	Forest	Grass-land. fallow land	River. lake
Lee Hyang-ju (2018) Number of introduced naturalized plant species	18.3	14.1	13.4	12.1	10.8	13.5	16.2
Weight Value	2.3	1.8	1.7	1.5	1.4	1.7	2.0

Weight value of the naturalization index for each habitat type
= Naturalization index for the habitat type ÷ 135(Avg, naturalization index at forest, river and lake) x 1.7

4. Conclusion

This study is based on the flora survey data of 776 map numbers(1200 places) for 12 years from 2006 to 2017, the third to fourth data of the National Natural Environment Survey, the nation's largest basic research project on the natural ecosystem. By analyzing plant species and naturalized plant species and predicting naturalized plant species and naturalization Index, they

can be used as basic data to study environmental changes, or they can be used to set various indicators applying naturalized plants and naturalization Index and to set the upper limit of permit for development activities. The results of this study are summarized as follows.

First, the naturalized plants of 37 families, 140 genera, 234 species, 11 varieties, and 245 classification groups were identified in the 776 map numbers(1200 places), and the result of the difference analysis showed that the naturalized plant species and naturalization Index were year, region, altitude, population density, GDP, and the ratio of forest to area. There were differences among the six items.

Second, in the correlation analysis with naturalized plant species, the relationship with the year has a positive correlation that increases the number of species every year. There was no significant effect on the number of naturalized plant species. The relationship with altitude creates a negative correlation where the number of species decreases as the altitude increases, and the relationship with the population density forms a negative relationship that shows a proportional relationship between two variables up to a certain level and then decreases after that time. The relationship between GDP decreases to a certain level and then increases positively after that time. The relationship with the ratio of forest to area has a negative correlation with the number of species decreasing as the ratio of forest to area increases. Multiple regression analysis on 6 items showed that only year and altitude were significant variables; year increased with slope of 1.445 and altitude decreased with slope of 0.256.

Third, as a result of correlation analysis with naturalization Index, the relationship between naturalization Index and year of naturalized plants form a positive correlation that increases year by year, and the relationship between regions is beyond the level of significance level. There was no significant effect. The relationship with altitude decreases to a certain level and then increases in a positive relationship, and the relationship with population density forms a negative relationship that shows two variables proportional to a certain level and then decreases after that time. The relationship between GDP decreases to a certain level and then increases. After that point, the relationship between GDP forms a negative relationship where the naturalization index decreases as the ratio of forest to area increases. The multiple regression analysis of the six items showed that only the year and the altitude were significant variables, and the year increased with a slope of 0.278 and the altitude decreased with a slope of 0.205.

Fourth, The prediction of the number of naturalized plants was made with y=9.009+1.445x1-0.256x2 made as a result of multiple regression analysis and y=(9.009+1.445x1-0.256x2)×habitat type(y=Naturalized plant species, x1=Years, x2=Altitude) weighted with consideration of the growing land environment. The prediction of naturalization Index was also made with y=7.116+0.278x1-0.205x2, made as a result of multiple regression analysis and y=(7.116+0.278x1-0.205x2)×habitat type(y=Naturalization Index, x1=Years, x2=Altitude) weighted with consideration of the growing land environment.

Unlike the naturalization Index of Numata and Kotaki(1975)[9], which calculate the naturalization Index through a field survey, the naturalization Index of this study can be easily calculated without a plant survey. Therefore, it is thought that the naturalization Index predicted by this study can be used for the issue of Permit on Exclusive use of inter-mountain area altitude standard, which is operated under the Act on Planning, and Use of National Territory, and the Mountain Site Management Act. The naturalization Index predicted by this study can be used as basic data for setting the upper limit of Permit on Exclusive use of inter-mountain area, or for studying environmental change, or for setting various indicators.

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5.4. Conference proceedings

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6. Contribution

6.1. Authors contribution

	Initial name	Contribution
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Corresponding Author*	LWH	-Corresponding ☑ -Play a decisive role in modification ☑
Co-Author	CWK	-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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- A Study on Use Behaviors of Hamjisan Forest Walkway, Korean Institute of Forest Recreation and Welfare, 23(1) (2019).

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International Journal of Human & Disaster

A Study on the HUMAN PSYCHOLOGICAL Stability of Railroad Engineers after an Accident

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Abstract

Trains running through urban railroad sections in large cities are an important means of transportation for many passengers. In 2019, the number of passengers using the Seoul Metropolitan Railway reached 2.9 billion. The drivers are responsible for the safe operation of the numerous passengers repeatedly go two to three minutes apart, looking only at the railroad tracks in the dark underground section. Although the urban railway system is becoming state-of-the-art and accidents are caused by system errors and human error continue, so the train drivers must exert a high level of concentration to prevent accidents. This professional nature has led to considerable job stress for drivers, and the annual subway accident is feared to cause depression, bipolar disorder, obsessive compulsive disorder, and various mental disorders and panic disorder caused by post-traumatic stress disorder. In this paper, while the accident lessons and measures are active in railway operation institutions after the occurrence of various railway accidents, the measures for drivers have been taken away from the very insufficient existing methods and considered the engineer as a special class of high-risk groups, and the application of the psychological stability program of firefighting officials, who are currently high-risk. The meaning and necessity of developing human psychological stability program for railroad engineers were presented by analyzing these.

[Keywords] **Train-Driver, Job Stress, Human-Error, Post-Traumatic Stress, Psychological Stability**

1. Introduction

In 2019, about 8 million urban railroad users in Seoul and 2.9 billion people a year took up 40 percent of the city's transportation share. The safety of the driver who carries passengers at the front line of the railway can be said to be a direct factor responsible for the safe transport of passengers, as an accident on such an urban railroad would result in massive casualties as well as property damage.

The urban railroad system is also called the foot of citizens as it is deeply involved in the lives of citizens to the extent that it determines the daily lives of urban citizens. Accidents on urban railroads have a direct impact on the lives of passengers, and even minor mistakes have resulted in delays and interruptions of trains. In addition, most urban rail users use it as a necessary means of near-field travel rather than long-distance travel, so the economic and time-consuming losses to users in the event of an accident are highly personal and difficult to measure. The timetable for train operations, known to users, is a promise announced to potential customers long before the start of operation, and since customers will decide to move in accordance with this promised time, it is also the responsibility of the city rail operator to have the best respect for the safety and time value of its customers[1].

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The role of the train driver is very important to fulfill these duties, with the special job characteristics of most of them having to maintain the time pressures of working conditions such as underground tunnels, the time pressures of running the promised time, and the tension against unexpected anomalies.

These characteristics face a variety of stress environments at all times, and the resulting physical and mental fatigue directly and indirectly adversely affects safety behavior and human error, thus increasing the likelihood of accidents occurring. And due to the nature of the driver's work, the driver is under latent stress to cope with the ongoing unusual situation, and is deeply linked to the uncertainty of not only the case facing the situation but also the future unusual situation that may occur at any time[2].

An unusual situation is an unusual and unexpected situation always handled by a driver, and there is always anxiety from concerns that an accident may occur in any environment or situation. If the driver fails to take effective action in the event of an unusual situation, and the train is delayed or stopped, or if there is a loss of life, the driver's fear of a disadvantage or injury causes unpredictable stress. In addition to these unpredictable stresses, the unusual situation also affects the driver's cognitive processes and physical responses, especially those who have experienced accidents in the past or experienced child accidents that do not lead to direct accidents in an accident situation, it is believed that the stress from such unusual situations will be aggravated[3].

Among the unusual situations that urban railroad drivers say are the most unpredictable and stressful, and the subway trains are the subway trains. According to the Ministry of Land, Infrastructure and Transport, 47 passengers per year died after jumping into the subway, 35 in 2016 and 33 in 2017 and 17 in 2018 respectively. The number of deaths has been on the decline every year, but the reality is that more than one passenger a month is still throwing himself onto the subway tracks. Most of the subway lines are equipped with screen doors, so it is estimated that the number of accidents caused by jumping into the subway has decreased. The trauma of drivers who have been in a jumping accident is also increasing, and drivers who have experienced a jumping accident or have received information from a fellow engineer can also check an interview article that says their hair stands up and their hearts fluctuate greatly when they pass through a jumping area[4].

As a result, Seoul Transportation Corporation has established a psychological center in charge of the mental health of drivers who have experienced accidents since 2019 to conduct counseling, but the pain of the past remains intact as it excludes drivers who experienced accidents in the past. If the drivers who experienced the accident are left unchecked, the subway will no longer be a workplace but a place of fear.

So In this study, I want to find out about the job characteristics of the driver and identify the type of job that is called the engineer is also a special class that belongs to high-risk groups such as police and firemen. It is worth noting that the Ministry of Public Safety and Security has recently been running a "psychological stabilization program for fire officials" due to internal demands for support measures for mental health disorders such as PTSD, depression and sleep disorders caused by the disastrous field experience of firefighters. In the case of urban railroads, the railroad operator has been indifferent to the psychological stability of the drivers as it has been bent on taking physical measures and coping with the accident.

At times, most of them returned to work without in-depth counseling support, only taking a rest for three to five days at the discretion of their managers. Other newspaper articles reported that the driver who had jumped into the accident suffered from trauma and eventually jumped into the scene of the accident. To prevent these unfortunate incidents from happening any more, we will raise a plan for the operation of a systematic human psychological stabilization program for railroad drivers after the accident as well as a thorough examination of the work environment that drivers are in.

2. Understanding of Urban Railroad Engineers

2.1. Recruitment procedure for urban railroad drivers

Under the current railroad safety law, the enforcement ordinance and the enforcement rules of the same law stipulate that in order to become a railway engineer, he or she is only entitled to take a written test if he or she passes the written test, and only those who pass the written test can obtain a railroad driver's license. In addition, in the course of employment as a driver and job performance, the institution is required to complete regular aptitude tests and physical examinations as well as a certain safety education as prescribed by the law.

Because of the nature of the railway, it is highly probable that a momentary human error will result in a large-scale accident. In the event of an accident, the resulting social impact as well as human and material losses is so great, we will apply strict standards from the process of obtaining a driver's license to minimize the possibility of a safety accident[4].

2.2. Physical examination and aptitude test

Under the Railroad Safety Act, those who want to obtain a license for the operation of a railroad car, which is a necessary process for engaging in the operation of a railroad car, are required to perform train operation tasks safely. Those who wish to obtain a driver's license for a railway vehicle to become a driver must pass a physical examination conducted by the Minister of Land, Infrastructure and Transport to determine whether they are fit to operate a railway vehicle(Article 23 of the Railway Safety Act), which sets standards such as vision and hearing, especially for color-weak or color-blindness, will fail the physical examination.

And it is clearly stipulated in the Enforcement Decree of the Railroad Safety Act that those who wish to obtain a railway vehicle driver's license must pass the aptitude test conducted by the Minister of Land, Infrastructure and Transport(Article 23 of the Railroad Safety Act) that there are largely questions and answers, and there are selective test of their ability, their ability to measure their ability, their ability to respond. In other words, such a physical and aptitude test can be called a system for determining whether a railway driver's license to become a driver has the proper body and aptitude for train operation from the acquisition stage, thus preventing human errors that may occur during train operation in advance and selecting the right person.

Under the Act, those who are already licensed and currently engaged in the operation or control of railroad vehicles, or those who are engaged in the tasks prescribed under the Presidential Decree, are also required to undergo physical and aptitude tests on a regular basis. The Ministry of Land, Infrastructure and Transport stipulates the timing, method, and acceptance criteria of such physical and aptitude tests. If a person who is already engaged in the railway service fails the regular physical and aptitude test standards, the head of the railway authority shall no longer be allowed to engage in such work. This shows that those who want to become drivers or those who are already drivers and are engaged in the operation must maintain their fitness and fitness for the operation through continuous physical and aptitude tests. Noteworthy is that a special inspection can be conducted only on the person concerned if the leader of the agency determines that it is unfit to perform the work smoothly due to a disease or other reasons other than regular aptitude tests, and the compliance of personality is an important item for the special prosecutor. As a person ages, his or her physical condition changes, and external factors can change his or her aptitude. Therefore, the driver himself needs to thoroughly manage himself.

The regular physical examination cycle is two years and the aptitude test cycle is ten years. However, it was judged that due to the perception that train accidents are mainly caused by human error of railway workers, the 10-year regular aptitude test cycle of railway workers was too long, making it difficult to properly manage personnel. Accordingly, the Ministry of Land,

Infrastructure and Transport continuously manages the capability of workers by reducing the frequency of aptitude tests for railway workers who perform safety-related tasks such as operation and control from the last 10 years to five years[5].

2.3. Job characteristics of urban railway operators

In a nutshell, the job characteristics of the drivers of the urban railroads are said to be those that require a high degree of concentration and sincerity Under any circumstances, the driver should seek safe operation of the train, especially since he works in the driver's room, a limited space for the moving train, so he should concentrate on his work while maintaining constant tension.

Therefore, a responsible attitude is required for the crew to faithfully perform a given task with a high degree of concentration under any circumstances. Since the driver works according to the schedule of the train operation, he or she works non-periodic shifts with different commuting hours from day to day and irregular alternation. In addition, the overall operation conditions vary from day to day depending on the trains assigned on the working day, so the work procedures must be followed and implemented as specified by the relevant regulations or instructions. This pattern of service requires a thorough compliance spirit that is well informed of the work schedule in advance and complies with commuting and alternation times, and that during a flight, it is in accordance with the relevant regulations and instructions. In addition, the capacity required for the driver should be the quantity of up-and-coming trade in which he or she can accurately judge the situation and provide emergency measures. This is because the driver should take proper initial actions without being embarrassed when various unusual situations or operational failures occur during the train operation, so the driver must have knowledge of the overall task and the volume of up-and-coming trade for the first step[6].

As the urban railroad driver's operation is highly mentally and physically tired due to the high pressure of safety operation and the characteristics of working alone within a limited space, the schedule and schedule of the train run from early morning to late night are irregular, as well as the frequent fluctuations of sleeping places and short sleep hours caused by night duty. Such heavy work pressure and fatigue of the drivers of the urban railroads may act as a task stress, leading to human error such as causing unstable behavior or causing a safety insensitivity to safety, and misjudging of the initial situation, which could seriously affect the safety of citizens.

Job analysis of railway safety workers has confirmed that the time pressure of the drivers is very high and the probability of human error is high Against this backdrop, it can be inferred that the unusual level of stress among the agencies, which used to be a two-person crew pattern, is very high, depending on the universalization of single operation due to the trend of cost reduction and system automation, the significant civil service provision caused by the rapid speed of railways and the increasing desire of customers for on-time, and the extent or severity of the damage to passengers in the event of errors during accidents and operations.

2.4. Changes in duties according to changes in the railway operating system

The nation's railway operating system is gradually becoming automated and unmanned thanks to the development of high-tech technologies. The ID Dangseon, which already runs on a completely unmanned aerial vehicle, the Busan Kimhae Gyeongjeon Railway, the Incheon Metropolitan Railway Line No. 2, the Yongin Gyeongjeon Railway and the latest Gimpo Gold Line, which opened by the Incheon Metropolitan Rapid Transit Railway, are also operating as non-human.

Such an automatic operation system can also be a fundamental way to eliminate the cause of driver human error. However, the switch to unmanned driving systems across all sections of big cities, including Seoul, will have to be pursued from a long-term perspective, given the number

of customers using the system, the frequency of train operations, the complexity of communication between various functions and the cost of building the system. As the automatic operation system became possible due to the development of technology, a single-person crew with no conductor from the two-person(engineer, conductor) crew was carried out.

All subway operations, except for unattended driving, require a certain part of the role of the driver. When operated as a single crew member, the driver will also be responsible for the duties of the conductor, which were carried out on the existing two-person crew, including monitoring the arrival of trains, opening doors, checking the opening, monitoring the passenger occupancy status, broadcasting passenger guidance, closing the doors, confirming the departure response mark, confirming departure signs, and checking for platform faults. It is believed that the changes in the driver's work caused by the switchover of the one-man crew also affected the cause of the railway accident.

In case of manual operation, the driver's human error may be the main cause, but in the automatic operation system, the system is the main cause and human error occurs in the process of correcting the system error. This suggests that the size of the accident may vary depending on how the driver responds in an unusual situation. In other words, even if the driver does not provide a direct cause in the occurrence of the accident, additional damage is determined by the judgment of one engineer. The future management of driver human error should be more diverse and in-depth as the task shared by the two-member crew has been aggravated by the driver's work and the judgment in unusual circumstances makes it possible to make independent decisions[1].

The extent of damage is beyond imagination if accidents occur due to the same causes in the past as the railway operating system becomes fast and mass-produced. In the past, many railway accidents were caused by single factors, and preemptive repairs were implemented to prevent similar and similar incidents. However, with the introduction of new technologies, accidents are caused by a variety of complex factors, it is difficult to take preemptive action against the current system under individual management. The types of recent accidents account for the majority of human error accidents rather than mechanical ones, and the paradigm for safety management as well as driver human management is changing[7].

While mechanical safety can be improved as machine reliability improves with the development of science and technology, the possibility of an accident can be seen as higher as randomness exists in human interaction and thus puts it in an irregular situation. Even though railway operation is carried out through automation and dehumanization, more accidents are caused by human error, which is believed to be caused by human safety management areas being handled by machines, resulting in fewer caregivers, and the final decision being made by humans.

Therefore, it is necessary to consider changing the duties of one person who will change as the process progresses toward unmanned aerial vehicles. If unmanned, the area affected by one person's judgment will eventually be widened, and if human error occurs, it is likely to cause a wider and more serious accident. Therefore, it is necessary to seek various ways to improve the possibility of human error in consideration of changes in duty[7].

2.5. The effect of job characteristics on drivers

Considering the situation where drivers must stay indoors and in deep underground for a long period of time and work continuously for more than two to three hours for a short period of time, drivers are expected to suffer greatly.

According to the data, which analyzed the work-related difficulties of urban railroad drivers for employees of the Seoul Metropolitan Transit Corporation, drivers generally expected the biggest stress

from the train failure to be the shutdown, but the results of the survey came as a result. They answered that they felt more stress from physiological phenomena or from crew quarters and bedding problems. This means that the drivers have no work to do outside of the flight hours, but have significant meaning in the middle of the intermission. Therefore, drivers feel that the importance of recreation management and the inability to address the most basic physiological phenomenon in humans have been identified as the biggest stressors. While these factors can increase the number of bedclothes at the level of welfare, a solution can be found immediately, for the part of the physiological phenomenon, installing a portable toilet in the driver's room is a complex issue that needs to be considered from the stage of vehicle production design, it is not easy to find a solution. Another problem has been the fact that they were kicked out of their shift and are unable to eat properly, but due to the pressure of work time, they seem to need careful consideration from the operating system, which operates flexibly at the meal time.

In general, there are two main reasons why human error occurs in railways. The first is when the task is complicated or excessive, resulting in arbitrary omission of the process or errors due to tension. The second is when the work is so familiar and repetitive that you miss something to watch out for, and you don't even realize you made an error. The former is mainly due to human error by new employees, the latter to those who are skilled in the service. This is because new employees are not familiar with their jobs and are prone to mistakes because they are unable to perform as planned or because of high mental fatigue, while skilled workers are prone to errors that are overconfident or tactful and unable to proceed as planned.

And also, if a railway accident occurs and no obvious cause, such as mechanical failure, is found, the accident will be closed due to the driver's reasons. This is because it is the easiest and most convenient way to handle accidents. However, if the accident is concluded in this way, it is not possible to find out the fundamental problem of why a person is forced to make an error, and it is highly likely that another type of accident will occur due to human error. Rather than expect systemic safety, such as automated and unmanned railways, more detailed attention and research is needed on conditions and the environment that can reduce human error. This is because it is a very important factor in the driver's mental health care[8].

2.6. Cases of overseas research

In foreign countries, research on Posttraumatic stress disorder(PTSD) of railroad drivers and subway drivers who often experience accidents while driving is active. Norwegian railway drivers with accident experience reported that symptoms of type PTSD were common within hours to days after accident, and drivers with moderate-commercial levels of invasive stress continued to occur in their heads, and in relation to sleep, one-third showed a high acute awakening condition.

A trace of a Swedish subway driver showed that the driver who experienced the accident had more sick leave three weeks and a year after the accident compared to the driver who did not. Also, drivers who experienced accidents involving seriously injured victims were found to have been absent or taken sick longer than those who experienced minor injuries or deaths.

Among the drivers, those with panic disorder experience severe social aftereffects, and tend to regard their physical and mental health as being much higher in medical institutions and worse than the average person. And there are not yet many studies in Korea on panic disorder among urban railway drivers.

Most of the studies on the mental health of the nation's subway drivers are surveys of accident conditions, and few studies on factors that can affect the stress response and mental health of subway drivers based on their accident experience are available. The management of the driver's mental health is critical because the accident experience experienced by the drivers during the train operation not only threatens their mental health but also reduces their work

efficiency, thus threatening the safety of passengers.

In advanced countries, psychological support program Critical Incident Stress Management(CISM), or CISM, has become widely popular as the argument that proper rest and stress management programs are needed for jobs that are vulnerable to disasters or accidents, such as subway drivers and rescue workers who have been deployed to large-scale disaster sites.

However, the nation's situation has been limited to an extemporaneous, unstructured and unprofessional approach in terms of comfort, depending on the personal consideration of the boss. Attention should be paid to the development and dissemination of programs based on the results of the survey, as well as more active surveys.

3. The Human Psychological Stabilization Program of Fire Officers

3.1. Management of fire officers psychological stability program

Posttraumatic Stress Disorder(PTSD) is the total body of a variety of mental and physical symptoms that are seen by people who have experienced shock due to direct or indirect exposure to traumatic or stress events. Trauma Post-traumatic Stress Disorder(PTSD) first started in the study of soldiers who fought in the war, but the scope of traumatic events has been expanded in a variety of ways, including the experience of excessive exposure to such traumatic events as trams, disasters, natural disasters, assaults, robberies, rape, and murder, as well as divorce and death of parents, accidents and domestic violence, child abuse, or the treatment of metamorphoses.

In the preceding study of the factors in the trauma of fire officials, the higher the working period of fire officials, the higher the symptoms of post-traumatic stress disorder(PTSD) also reported that the higher the age and the more working years, the more experienced post-traumatic stress disorder(PTSD).

In the U.S., firefighters who witnessed the deaths are required to receive psychiatric counseling within three days, and PTSD diagnoses of soldiers who have returned from overseas service at hospitals operating directly under state agencies. In addition, there are more than 1,400 hospitals that specialize in treating PTSD and a number of resort-level specialized hospitals that specialize in managing PTSD.

When a firefighter comes back from a disastrous scene, Japan is required to conduct a mandatory inspection and seek counseling from psychiatrists and psychotherapists. Haslam and Mallon(2003) investigated firefighters in the UK and raised the need for in-depth research into the psychological response of firefighters, as well as support at the private level for PTSD mitigation[9].

In Korea, PTSD operates a national healing program for disaster victims, but it is not effective because it not only affects the personal health of firefighters but also the safety of firefighters engaged in firefighting activities. The mental health of firefighters has long been pointed out, but only 14 percent of 213 fire departments, or 30 "visiting psychological counseling centers," where specialists and psychological counselors visit fire departments to conduct preventive health counseling. Discussions on the construction of fire-fighting hospitals, which have been discussed since 2002, have yet to be carried out. In one country, you can specialize in PTSD symptoms.

In addition to securing manpower, a systematic infrastructure for professional hospital operations, PTSD healing facilities such as recreation centers is not well established[10].

However, the firefighting organization is constantly trying to establish programs to overcome the trauma stress disorder of fire officials, and it is also trying to select counselors who are qualified to consult directly among fire officials so that they can become peer counseling. In addition, the Central Fire and Fire Protection School and local fire schools are worth making various thoughts and efforts,

including a one-week course on trauma treatment and a chance to heal firemen suffering from post-traumatic stress[11].

In addition, the organization of police officers has been studying problems related to post-traumatic stress disorder in earnest since 2015 and currently the National Police Agency has been operating a sympathetic healing process for a week, and has been conducting it in Jeju Island since last year with the aim of creating an environment that can be truly healed by being transferred to the headquarters of the National Police Agency. Of course, a week is very limited, but it is meaningful for police officers suffering from post-traumatic stress disorder to create time and opportunity to take care of themselves.

In addition, the company has contracted out outsourcing businesses related to counseling on a yearly basis to establish a system for police officers to be consulted on a regular basis[11].

3.2. Application of firefighting officers psychological stability program to railways officers

As mentioned in the above chapter, police organizations as well as firefighting organizations have already conducted research on post-traumatic stress disorder and are already making efforts to apply it to their members. However, railway organizations are aware of the importance of treatment for post-traumatic stress disorder that can be experienced by railway people, but their efforts to effectively introduce and apply programs on-site can be seen as visibly lacking.

For that reason, it would be one way to manage the contents of the post-traumatic stress-related programs of the firefighting organizations, which are thought, researched, organized and operated first, with educational programs suitable for the railway organization. In addition, counseling programs and counselors operated by fire and police organizations will have to be selected and deployed by the railway organization.

And also, the job training program, the special course for PTSD, which can heal post-traumatic stress, will also be operated as a special course. The reason for doing this is that psychological stability is a very important key to their successful performance of their work for railroad workers who take the initiative for the lives and safety of the people.

Since 7-8 years ago, there has been a shift in social awareness that psychological stability is important for railway people. But there is not enough research staff to do practical research. And the development and research of education programs on how to communicate smoothly with work colleagues or family members that can relieve the post-traumatic stress of individuals who are railways, and psychological management and mediation programs from experts will be needed.

4. Conclusion and Suggestions

The drivers' experience in accidents while operating will not only threaten their mental health but also reduce their work efficiency, leading to accidents caused by human error. Therefore, in order to eliminate the adverse effects of these stresses, we need to understand the psychological reactions and symptoms associated with accidents and develop programs to treat aftereffects such as post-traumatic stress disorder and panic disorder to actively utilize them[12].

Since there are differences in how to cope with the stress caused by drivers at different urban railway operators, it is necessary to carry out a customized program through one-on-one face-to-face consultation, and employees in the accident group will need to pay careful attention to prevent stress and panic disorder.

Also, drivers with accident experience should consider ways to minimize accident prevention and stress, such as creating a job environment where job stress can be overcome on their own by establishing self-diagnosis and supervision systems, and securing flexibility to offset negative experiences

such as accidents and disabilities.

Suggestions for future research focusing on the limitations of this study are as follows.

First, the types of accidents that a driver may experience while in operation vary with machine failure, fire, friction with passengers, delay, and jumping accident, and there may also be differences in the mental aftereffects. Therefore, various questions related to accident types should be presented to distinguish the types of accidents and investigate them in more depth in the future.

Second, proper sampling for generalization is required, taking into account the total number of drivers. In addition, for a more accurate understanding of the mental health problems of drivers, the results of the survey may become more common if a full survey is conducted on those who have experienced accidents or committed suicide.

Third, multidimensional follow-up studies are needed to identify the critical factors that stress conditions develop from PTSD or panic disorders, including various variables such as lifestyle habits or demographic characteristics that affect mental health.

In foreign studies, investigations are conducted from at least several hours to weeks after accidents occur in operation, and long-term follow-up surveys are conducted from one month to one to three years later. Because this study also has the limits of recollection and traversal of the engineer's individual, it is necessary to identify long-term trends from the acute stress reactions that may occur immediately after the accident, and to follow up with appropriate intervention at each time.

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5. Contribution

5.1. Authors contribution

	Initial name	Contribution
Author	PEK	-Set of concepts ☑ -Design ☑ -Getting results ☑ -Analysis ☑ -Make a significant contribution to collection ☑ -Final approval of the paper ☑ -Corresponding ☑ -Play a decisive role in modification ☑ -Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑ -Participants in Drafting and Revising Papers ☑ -Someone who can explain all aspects of the paper ☑

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